Length – Weight Relationship, Condition Factor and Sex Ratio of Clarias gariepinus Juveniles Reared in Concrete Tanks

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Abstract. Concrete tank culture of Clarias gariepinus is one of the most common fish farming systems in Nigeria. There is therefore need to know the growth pattern and condition of this fish in concrete tanks as there has been information on those from the wild and indoor recirculation system tanks. Length-Weight Relationship of C. gariepinus juveniles reared in concrete tanks in Aleluya Farm, Woji, Port Harcourt, Nigeria was studied. The fish samples were sexed, the lengths and weights measured according to standard methods. Temperature, pH, dissolved oxygen (DO) and ammonia (NH3) were determined following standard methods. The “b” value for the males was 7.74 while that of the females was 6.96 and combined sexes 7.87. The regression equation was Log W = 65.78 + 7.87 Log L (r = 0.90). Condition factor ranged between 1.06 (males) and 1.15 (females). The water quality parameters were within the acceptable range for fish production. C. gariepinus juveniles reared in concrete tanks exhibited positive allometric growth and in good condition of health. This growth pattern favours fish farming as it enhances its profitability.

Key words: Growth pattern, wellbeing, culture system, sex, Clarias gariepinus

1. INTRODUCTION

Aquaculture is the application of biological principle to the business of rearing of fish in an artificial enclosure that can retain water. Fish farming has grown strongly as an effective way of generating food and income from dwindling land space, as fish supplies from open water and lagoons continue to fall and human population increases (Adebayo and Adesoji, 2008). This demand and supply gap is bridged by importation at a colossal foreign exchange cost of US $594.4 million approximately 92.75 billion naira (PDF, 2007). To reduce importation of fish, aquaculture has been identified as the next viable solution (Pepple and Ofor, 2011). The world aquaculture (food fish and aquatic plants) has grown significantly during the past half century. From a production of below 1 million tonnes in the 1950’s, production in 2004 was reported to have risen to 59.4 million tonnes, with a value of USD 70.3 billion (FAO, 2006). This represents an average annual increase of 6.9% in quantity and 7.7% in value over reported figures for 2002. In 2007, fish demand has been put at 2.66 million tonnes in Nigeria, while domestic production amounts to a paltry 620,000 metric tonnes, leaving a deficit of 2.04 million tonnes (83.2%) (Pepple and Ofor, 2011).

The African mud catfish, C. gariepinus (Family Clariidae) has also gained widespread recognition as a promising species in aquaculture production (Taiwo, 2008; Lennent et al., 2008). It is an economically important food fish, cultured primarily in freshwater ponds in tropical countries (Balbola and Apat, 2006). C. gariepinus exhibits many qualities which makes it suitable for commercial culture. These include its rapid growth, hardiness, high disease resistance, high yield potential, high fecundity, air-breathing characteristics and good market potentials (Ayinla et al., 1994, Anyanwu et al., 2007). The aforementioned facts necessitate a search for reliable information on the culture of C. gariepinus which is also a very good species for aquaculture.

Length – Weight Relationship (LWR) is useful tool in fish growth pattern or age determination and fishery assessment (Pepple and Ofor, 2011). Beyer (1987) reported that Length – Weight Relationship of fishes are important in fisheries biology because they allow the estimation of the average weight of fish of a given length group by establishing a mathematical relation between the two. When the b-value is less than 3, the fish has a negative allometric growth but when it is greater than 3, it has a positive allometric growth and when it is equal to 3, the fish has isometric growth (Khairenizam and Norma-Rashid, 2002). Information
on fish age data is used for stock composition, age at maturity, life span, mortality, growth and production (Beyer 1987; Bolger and Connolly, 1989; Kulbicki et al., 1993; King, 1996a, Gavcia et al., 1998; Haimovic and Velasco, 2000). The condition factor often referred to as “K” provides information on the wellbeing of a fish and is usually influenced by the fish, sex, season, maturity stage etc. (Anyanwu et al., 2003). Fulton (1902) proposed the use of a mathematical formula for quantifying or estimating the condition of fish as K = 100w/L^3. The role of the condition indices as stated by Stevenson and Woods (2006) is to quantify the health of individuals in a population or to tell whether a population is healthy relative to other populations. When fish of a given length exhibits higher weight it means they are in better condition (Anwa-Udondiah and Pepple, 2011).

Fish farming is a capital intensive venture and it should bring appropriate profit. Concrete tank culture of *C. gariepinus* is one of the commonest outdoor fish culture systems (Akinwole and Faturoti, 2007). There is therefore need to know the growth pattern of this fish in concrete tanks as there has been information on those from the wild and indoor recirculation system tanks. This study examined the growth pattern and condition of the fish stock reared in concrete tanks in Aleluya Fish Farm in Woji, Port Harcourt, Rivers State, Nigeria using Length-Weight Relationship tool.

### 2. MATERIALS AND METHODS

#### 2.1. Study area

The study was carried out in Aleluya Fish Farm in Woji, Port Harcourt, Rivers State, Nigeria. The farm has 29 concrete (8m x 3m x 1.5m each) and 31 plastic tanks (1000 and 5000 litres capacity) respectively.

#### 2.2. Source water and experimental procedures

Borehole water (ground water) was the source of water. There was a system of continuous flow of freshwater from the borehole source from power supply. A total of three hundred and thirteen (313) *C. gariepinus* juveniles fed to satiation with foreign floating feed (42% protein) were sampled from three of the Alleluya concrete fish tanks for three months (May to July 2010). The fish specimens were randomly removed using scoop net from the tanks; excess water was removed with tissue paper. Body weights were measured to the nearest 0.01 g using a digital weighing scale (Model DT, 302). The total length (TL) and standard length (SL) were taken to the nearest 0.1cm using a measuring board. Sex differentiation was done following method described by Viveen et al. (1986). The length –weight relationship was estimated by using the equation provided by Ricker (1973):

\[ W = aL^b \]

where \( W \) = Weight of fish in grammes (g)

\( L= \) Total length of fish in centimeters (cm), \( a = \) Regression constant or intercept, \( b = \) Regression coefficient or slope. The equation was linearised by a logarithmic transformation into:

\[ \log \text{Weight} = \log a + b \log \text{length} \]

The total length and weight of fish as provided by Pauly (1983) with the equation: \( K = 100w/L^3 \) where \( K = \) condition factor, \( W = \) Mean body weight in grammes (g), \( L = \) Mean total length in centimeters (cm). The linear relationship between the length and weight was also estimated by calculating the correlation coefficient \( (R^2) \). The sex of the fish was determined using visual observation; sex ratio was determined by counting numbers of males and females specimens throughout the experiment.

#### 2.3. Water quality measurements

The temperature and pH of the water in each culture medium was measured in degree Celsius using a mercury – glass thermometer and pH meter (Horiba u – 10 water checker HANNA Model) respectively. Dissolved Oxygen (DO) was determined by the modified Winkler’s method (APHA, 1985). Ammonia was determined using the Phenate method (APHA, 1985).

#### 2.4. Data analyses

Data was subjected to statistical analysis system (SAS) (2003) and Microsoft Excel (2003) for analysis of variance (ANOVA), regression, Pearson correlation coefficient, Chi square test and descriptive statistics. FAO–ICLARM Stock Assessment Tools (FISAT 11) was used for length and weight relationship.

### 3. RESULTS

The monthly length (TL & SL) values indicated that May recorded the lowest TL (22.1 cm) and SL (20.2 cm) while July the highest TL (28.5 cm) and SL (26.1 cm) (Table 1). The monthly weight of the juveniles ranged from 110.50 mg (May) to 240.5 mg (July). The “b” value for the males was 7.74 while that of the females was 6.96 and combined sexes 7.87 (Table 2). The correlation coefficient “r” for males, females and combined sexes were 0.78, 0.86 and 0.90 respectively. The overall mean condition factor ranged between 1.06 and 1.15. The average monthly condition factor (“K”) values were highest in May (1.23, 1.44 and
1.34) and lowest in July (0.97, 0.99 and 0.98) for the males, females and combined sexes (Table 3).

The sex ratio of the fish examined indicated that 40% (126) were males and 60% females (188) giving a sex ratio of 2:3 (Male: Female). Chi square test analysis conducted on sex ratio showed that there was significant difference from the expected 1:1 ratio (Table 4).

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<tr>
<th>Table 1: Monthly length and weight measurements of <em>C. gariepinus</em> juveniles reared in concrete tanks</th>
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<td>Month</td>
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<tr>
<td>May</td>
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<td>June</td>
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<tr>
<th>Table 2: Length–Weight Relationship of <em>C. gariepinus</em> juveniles reared in concrete tank</th>
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<td>Parameter</td>
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<td>Male</td>
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<td>Female</td>
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<td>Combined sexes</td>
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n = number of samples, a = intercept/regression constant, b = the slope/regression coefficient, r = the correlation co-efficient, k = condition factor

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<th>Table 3: Mean condition factor of <em>C. gariepinus</em> juveniles raised in concrete tanks</th>
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<td>Sex</td>
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<tr>
<td>Male</td>
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<td>Female</td>
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<td>Combined sexes</td>
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<th>Table 4: Chi square test analysis on sex ratio of <em>C. gariepinus</em> reared in concrete tanks</th>
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<tr>
<td>Sex</td>
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<tr>
<td>Male</td>
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<td>Female</td>
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<td>Total</td>
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<th>Table 5: Overall mean values of water quality parameters of water in concrete tanks in Aleluya Farm</th>
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<tr>
<td>Parameter</td>
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<td>Temperature (°)</td>
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<td>pH</td>
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<td>Dissolved oxygen</td>
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<td>Ammonia</td>
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The water temperature in the culture system was 6.75±0.63°C, pH, 7.6±0.17, dissolved oxygen, 9.7±4.3 mg/L and ammonia 2.27±0.01 mg/L (Table 5).

4. DISCUSSION

The differences in weight as observed in this study could be due to individual condition factor which is the wellbeing and degree of fatness of an animal (Pauly, 1983). It could be linked with season as the highest weight of fish was recorded in July which is the peak of rainy season. The “b” value in the males was higher than that of the females. This contrasted Anyanwu et al. (2007) study that reported “b” value of 2.8412 for females, 1.2713 for males and 1.8776 for combined sexes in *C. gariepinus* reared in water recirculating system. This indicated negative allometric growth which is contrary to the present study observation. The “b” values of this study revealed that the *C. gariepinus* juveniles reared in concrete tanks exhibited positive allometric growth. According to Khairenchizam and Norma-Rashid (2002), when the “b” value is less than 3, the fish has a negative allometric growth but when it is greater than 3, it has a positive allometric growth and when it is equal to 3, the fish has isometric growth. The values of “b” obtained in this study is supported by studies by Srisuwantach et al. (1980) that reported “b” value of 3.0857 for combined sexes of cultured *C. batrachus*. *Clarias gariepinus* in the present study had regression equation for the combined sexes which was similar to that of Srisuwantach et al. (1980) of Log W =-2.1692+ 3.0857 Log L for cultured *C. batrachus*. Pepple and Ofor (2011) obtained a positive allometric growth with regression equation for the combined sexes as Log W = -2.1612+ 3.0445 Log L (r= 0.95466) for *Heterobranchus longifilis* reared in earthen ponds in Lagos State. According to Bagenal and Tesch (1978), Koutrakis and Tsiklaris (2003), allometric coefficients “b” may range from 2-4. From length–weight parameters (a, b), fishes are affected by a series of factors such as season, habitat, gonad maturity, sex, diet, stomach fullness, health, preservation techniques and annual differences in
environmental conditions (Bagenal and Tesch, 1978; Froese, 2006). Such differences in "b" values can be ascribed to one or a combination of factors including differences in the number of specimens examined, area and season effects and distinctions in the observed length ranges of the specimens caught, to which duration of sample collection can be added as well (Mouotopoulos and Stregiou, 2002).

The condition factors were relatively higher than the values (0.65-0.70) documented by Anyanwu et al. (2007) for C. gariepinus juveniles reared in water recirculation system and fed at 3% body weight as against 5% weight per day. The present higher K values might be attributed to feeding of the fishes at satiation and indicated that the C. gariepinus juveniles are in good condition of health in the concrete tanks. According to Deekae et al. (2010) several factors affect the condition factor of fishes. They range from feeding, spawning, food nutrient composition and fat accumulation. The variations of condition factor (K) in fish according to King (1995) may be due to food abundance, adaptation to the environment and gonadal development. The overall mean condition factor obtained in this study varied slightly with results from other studies. Fafioye and Oluajo (2005) reported condition factor of 0.79±0.15 for C. gariepinus in Epe Lagoon and Anyanwu et al. (2007) recorded K of 0.654±0.1907 for C. gariepinus reared in water recirculation system. The differences in the K values of the males and females might be attributed to egg development in the females hence increase in the body weight. The values obtained from the study revealed that C. gariepinus juveniles were in good condition. The observed sex ratio in this study is highly desirable for brood stock development and hatchery operation as one male is required to fertilize at least three female. The recorded water quality parameters were within the acceptable range for fish production (Viveen et al., 1985).

5. CONCLUSION

C. gariepinus juveniles cultured in concrete tanks exhibited positive allometric growth. This growth pattern favours fish farming as it enhances its profitability. Weight of fish and not the length determines the selling price of fish as fishes are sold by weight. The fish specimens were in good health condition based on the observed condition factor. The recorded sex ratio favours broodstock development and hatchery development. The observed water quality parameters were within the acceptable range for fish production hence the observed growth pattern and condition factor.

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