# LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF CATFISH (*Clarias gariepinus*) FINGERLINGS REARED IN STRUCTURED AND UNSTRUCTURED WATER

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**Abstract:** 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 allows estimation of average weight of the fish of a given length group. The study of length – weight relationship and condition factor of Catfish (*Clarias gariepinus*) fingerlings reared in structured and unstructured water (de – chlorinated tap water) was carried out in the Zoology Laboratory of Nasarawa State University Keffi. Structured water was obtained from Innovative Biotech Limited along Keffi – Abuja road while Unstructured water (de – chlorinated tap water) from the University environment. Length – weight measurements were taken using electronic weighing balance (KERRO Model number: BL 20001), measuring board and centimeter rule. The regression analysis of length – weight relationship of *C. gariepinus* fingerlings were b < 2.835 in structured water and b < 2.512 in unstructured water. The fish in the structured water grew better both in length and weight than those in the unstructured water. However, this result indicated that both structured and unstructured water exhibited negative allometric growth pattern. The values of correlation coefficient (r) were 0.848 in structured water and 0.816 in unstructured water indicating a strong positive relationship between length and weight. The mean value of condition factor (K) was 1.00 in structured water and 0.99 in unstructured water showing that the fish fared well during the period of investigation. There was no significant difference (P > 0.05) in the condition factor of *C. gariepinus* fingerlings reared in both treatments although; fish in the structured water had a better living environment than those in unstructured water.

**Keywords:** Catfish, condition factor (K), Length-weight relationship, structured-unstructured water

## Introduction

The relationship between Length – Weight is important in fishery management for comparative growth studies (Moutopoulos and Stergiou, 2002; Ananias *et al.,* 2014). Haruna and Bichi (2015) reported that length-weight relationship (LWR) provides valuable information on the habitat where the fish lives. Length Weight Relationship of fish is important in fishery biology because they allow the estimation of the average weight of fish of a given length by establishing a mathematical relationship between the two parameters. LWR is particularly important in parameterizing yield equations and in estimation of stock size. The length – weight relationship (LWR) data is used in determining condition factors in which it can measure the change in robustness of fish over time (Schneider *et al.,* 2000, Morrey *et al.,* 2003).

The relationships of length - weight were used in the estimation of condition factor (K) of fish. Condition Factor (K) is used in order to compare the 'Condition' 'Fatness' or wellbeing of fish (Ahmed *et al.,* 2015; Ambily and Nandan, 2017). The condition factor of fish is an indicator of physiological state of the fish in relation to its welfare (Le Cren, 1951; Gokce *et al.,* 2014). 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; Amisah *et al.,* 2016).

The objective of this study is focused on length–weight relationship and condition factor of Catfish (*C. gariepinus*) fingerlings reared in structured and unstructured water.

## Materials and Method

### *Study area*

The research was carried out at the Zoology Laboratory of Nasarawa State University Keffi. This was carried out from March – June, 2018.

### *Source and analysis of water quality parameters*

Structured water which was used for this study was obtained from Innovative Biotech Limited along Keffi – Abuja Road, behind NYSC Orientation Camp Keffi while de-chlorinated tap water (Unstructured water) was from the university environment.

### *Source and acclimatization of catfish (C. gariepinus) fingerlings*

The fish fingerlings were purchased at Sunlight Agro Business Enterprises Auta Balefi, Nasarawa State along Keffi – Abuja Express way and transported to Zoology Laboratory of Nasarawa State University Keffi and acclimatized for two weeks. During the period of acclimatization, the fish fingerlings were fed with commercial formulated feed bought from Giza in Mararaba, Karu LGA of Nasarawa State. Water parameters were monitored (Temperature, pH, DO, BOD and Conductivity). At the end of the acclimatization period of two weeks, the fingerlings were weighed and the values recorded.

### *Research design*

A total number of 60 Catfish (*C. gariepinus*) fingerling stocked in glass aquarium were used for the experiment. There were two (2) treatments with three (3) replicates for each treatment. Feed was given at 3% body weight for ten weeks. The fingerlings were weighed weekly and the feed adjusted to reflect the new body weight. Fecal matter and feed remnant from fish in each of the aquarium were siphoned every morning using a rubber tube and the water volume replaced by addition of fresh water from the reserve to each aquarium.

### *Length-weight measurement*

The length - weight of *C. gariepinus* fingerlings were determined after acclimatization using electronic weighing balance KERRO with Model number (BL20001) and length using measuring board and measuring rule. The length and weight measurements were carried out on weekly basis.

### *Percentage weight gain*

This was calculated as the difference between the final and initial weights of fish (final weight of fish – Initial weight of fish);

$$\text{Weight gain} = \frac{final\ weight\,(g) - initial\ weight\,(g)}{initial\ weight\,(g)}\,x\,100$$

***Percentage length gain***

This was calculated as the difference between the final length and initial length of fish;

$$\text{Length gain} = \frac{final\ length(cm) - initial\ length(cm)}{initial\ length(cm)} x100$$

***Length – weight relationship of fish***

The analysis of length-weight data is aimed at describing mathematically the relationship between length and weight to enable conversion of one another. It also measures the radiation from the expected weight for length of individual fish.

$W = al^b$ Le Cren, 1951---------- (1)

**Where:** w = weight of fish in grams; l = length of fish in Centimetre; a = intercept/constant; b = slope /exponent

The above equation (1) and data were transformed into Logarithms before the calculations were made.

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

***Condition factor (K)***

$$K = \frac{W}{L^3} x100$$ Le Cren, 1951 --------- (3)

**Where:** K = Condition factor; W = Weight of fish in grams; $L^3$ = Standard length of fish (cm)

***Statistical analysis***

Data collected were subjected to descriptive statistics using statistical package for social sciences (SPSS) version 20 and Regression analysis were used to compare relationships between weight and length and student T – test to compare weight, length and condition factor (K).

**Results and Discussion**

***Length – weight relationship of catfish (C. gariepinus) fingerlings***

Table 1 depicts the mean weekly weight and length gain of *Clarias gariepinus* while the length – weight relationship of Catfish (*C. gariepinus*) fingerlings from the research experiment is presented in Table 2. The regression analysis proved that Catfish (*C. gariepinus*) fingerlings reared in structured and unstructured water exhibited negative allometric growth pattern. The ‘b’ values were less than 3. The intercept (a) of Catfish (*C. gariepinus*) fingerlings for the period of ten (10) weeks were – 2.858 for unstructured water and – 3.504 in structured water respectively. The values of exponential ‘b’ obtained were 2.512 for unstructured water and 2.835 for structured water while the values of correlation coefficient (r) were 0.816 for unstructured water and 0.848 for structured water. This indicated a strong positive correlation between length and weight.

**Table 1: Mean Weekly Weight and length gain of *Clarias gariepinus***

| Tr | Initials S.E | Experimental period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| UW1 W | 3.3±0.20 | 4.55±0.31 | 6.49±0.47 | 8.69±0.74 | 11.71±1.13 | 16.30±1.72 | 23.17±2.52 | 27.30±3.16 | 37.57±4.50 | 47.66±5.82 | 63.74±7.77 |
| L | 6.88±0.14 | 7.40±0.18 | 9.20±0.21 | 9.20±0.26 | 10.33±0.35 | 11.84±0.50 | 13.43±0.61 | 14.21±0.68 | 16.10±0.85 | 17.29±0.96 | 18.17±0.99 |
| UW2 W | 2.74±0.26 | 3.85±0.44 | 5.55±0.71 | 8.75±1.03 | 13.1±2.01 | 18.43±3.98 | 23.93±4.38 | 26.38±4.66 | 40.04±6.20 | 51.55±7.94 | 70.24±10.31 |
| L | 6.23±0.19 | 6.86±0.29 | 0.17±0.43 | 9.40±0.41 | 10.97±0.66 | 11.97±0.97 | 13.23±0.98 | 14.17±93 | 16.30±0.93 | 17.63±0.99 | 18.72±11.00 |
| UW3 W | 3.33±0.20 | 4.8±0.31 | 6.14±0.59 | 8.23±0.91 | 11.94±1.37 | 16.03±21.17 | 22.82±2.95 | 25.86±320 | 36.36±4.47 | 42.57±6.05 | 62.83±10.21 |
| L | 6.71±0.15 | 7.57±0.16 | 8.37±0.30 | 9.26±0.36 | 10.64±0.47 | 11.32±0.49 | 13.26±0.53 | 14.17±0.50 | 15.99±0.64 | 16.67±0.71 | 18.23±1.22 |
| SW1 W | 3.8±0.39 | 5.26±0.56 | 5.71±0.75 | 8.20±1.06 | 12.24±1.64 | 17.97±255 | 25.22±4.93 | 30.77±5.09 | 48.85±8.72 | 57.84±10.40 | 71.65±13.30 |
| L | 7.10±0.20 | 7.63±0.24 | 8.01±0.32 | 9.08±0.35 | 10.38±0.51 | 12.02±0.63 | 15.97±2.09 | 14.29±0.94 | 16.50±1.05 | 17.94±1.14 | 18.61±1.18 |
| Sw2 W | 2.9±0.26 | 3.60±0.59 | 5.74±0.59 | 8.03±0.91 | 11.04±1.38 | 18.13±1.48 | 30.27±5.16 | 37.37±6.99 | 53.72±10.16 | 68.42±14.05 | 76.67±15.17 |
| L | 6.53±0.21 | 6.87±0.22 | 8.09±0.27 | 9.00±040 | 10.30±0.48 | 11.99±0.33 | 14.63±0.76 | 15.72±0.87 | 17.40±1.04 | 18.88±1.22 | 19.68±1.41 |
| SW3 W | 3.09±0.29 | 3.99±0.35 | 5.43±0.38 | 7.22±0.65 | 9.73±0.96 | 16.32±1.88 | 24.95±3.17 | 32.63±4.63 | 45.33±7.23 | 50.45±12.54 | 78.12±12.59 |
| L | 6.51±0.19 | 7.01±0.20 | 8.07±0.33 | 9.93±0.34 | 9.93±0.34 | 11.55±0.52 | 13.98±0.63 | 15.17±0.73 | 16.87±0.85 | 18.23±0.88 | 19.38±0.85 |

SW = Structured water, UW = Unstructured water

***Condition factor (K)***

The Mean Condition Factors (k) is presented in Table 3. The Mean Condition Factors for this study showed that Catfish (*Clarias gariepinus*) were in good condition. The condition factor (K) for fish reared were1.00 in structured water and 0.99 in unstructured water, there was no significant difference (P >0.05) in the condition factor of *C. gariepinus* reared in the two treatments aquaria.

**Table 2: Regression analysis of length –weight relationship of catfish (*Clarias gariepinus*) reared in structured and unstructured water**

| Treatments | a | b | r |
|---|---|---|---|
| UW | -2.858 | 2.512 | 0.816 |
| SW | -3.504 | 2.835 | 0.848 |

A = regression intercept, b = Slope/exponent, r = correlation coefficient

**Table 3: The mean Condition Factor (K) of *Clarias gariepinus* reared in structured and unstructured water**

| Treatments | Weight M±SE | Length M±SE | K-value M.SE |
|---|---|---|---|
| UW1 | 21.64±2.28 | 11.84±0.46 | 0.99±0.01 |
| UW2 | 20.93±2.66 | 11.42±0.53 | 0.99±0.02 |
| UW3 | 19.65±1.94 | 11.58±0.40 | 0.99±0.01 |
| SW1 | 24.16±2.68 | 12.15±0.49 | 1.00±0.02 |
| SW2 | 25.46±3.39 | 11.96±0.57 | 1.00±0.01 |
| SW3 | 23.14±3.09 | 11.82±0.55 | 1.00±1.01 |

For a normal fish that maintains its shape as it grows, the ‘b’ value will be (b = 3), which means cube law is obeyed (Le Cren, 1951). However, most of the fish species do not obey cube law as they change their shape throughout their life. It is best assumed that ‘b’ is not equal to 3 for the basis of investigation proposed by Le Cren. If b < 3, it is negative allometric growth, it means the fish becomes thinner or elongated as length increases (King, 1996). In opposite case where ‘b’ is more than 3 (Positive allometric growth pattern), it indicates an increase in height and weight with respect to increase in the length (Hile, 1936, Anderson and Neumann, 1996) while when b = 3 it exhibit Isometric growth pattern i.e fish becomes more robust with increasing length (Bagenal and Tesch, 1978).

Condition factor is a mirror for the equalization of the wellbeing of fish in relation to its abiotic and biotic environment (Ikongbeh *et al.,* 2013). When (K) value is 1, the fish is said to be doing well in terms of growth and wellbeing. When (K) value is less than 1 (K< 1), the fish is said not to do well (Froese, 2006). A high condition factors indicates favourable environmental condition such as habitat and food availability; in contrast, a low condition factor indicates less favorable environmental condition factor (Blackwell *et al., 2*000). Fish weight is considered to be a function of length. Condition factor is useful in comparative measure of fish plumpness for a given length. The result showed the values of Condition Factor (K) structured water were within the range of 1 as suggested by Le Cren (1951) which indicated good condition factor and UW < 1 (0.99) which is less than 1, an indication of poor condition factor.

The value on length – weight relationship obtained in this research proved that Catfish (*C. gariepinus*) in structured water (2.835) and unstructured water (2.512) exhibited negative allometric growth pattern because "b" is less than 3. However, the result is in line with Abdullahi (2002) who recorded b value to be between 2.3 and 3.4 for fish studied in various water bodies; Pauly and Gayanilo (1997) observed b value storage from 2.5 - 3.5 and Samat *et al.* (2008) who adduced that the value of ‘b’ for most temperate and tropical fishes ranged from 2.7 - 3.4.

**Conclusion**

The values of mean length gain and weight obtained were higher in fish reared in SW than in UW while the condition factor value of 1 in fish reared in SW also indicated better wellbeing of the fish. This research has conclusively revealed that fish can do better in SW than in UW in the practice of aquaculture.

**Conflict of Interest**

Authors declare that there is no conflict of interest related to this study.

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