IJABR Vol. 10(2): 32 - 40 (2019)

Original article

COMPARATIVE STUDY OF LENGTH - WEIGHT RELATIONSHIP OF SOME COMMERCIAL FISH SPECIES IN SHIRORO RESERVIOR, NIGER STATE, NIGERIA

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Submitted: November, 2019; Accepted: December, 2019; Published: December, 2019

ABSTRACT

Length-weight relationship is one of the commonly used parameters in fisheries with wider application. The computed values of this relationship are useful for various ecological parameters. Study of the length-weight relationship of four commercial fish species in Shiroro Reservoir, Niger State, Nigeria was carried out between April 2017 and August 2017. Four hundred and six (406) fish samples that comprised 99 *Clarias gariepinus*, 108 *Brycinus nurse*, 99 *Bagrus filamentosus* and 100 *Oreochromis niloticus* were collected for this study. There were variations in the body measurements with *Bagrus filamentosus* as the biggest in size, which differed significantly ($p<0.05$) with the other species. On the overall, the fishes with the exception of *B. nurse* were small in sizes. The parameters "a", "b" and "r" were obtained from the linear regression of the growth equation, $W = aL^b$ when transformed to log length and log weight of fish respectively. The b-values of *C. gariepinus* (1.30), *B. nurse* (1.24), *B. filamentosus* (1.11) and *O. niloticus* (1.41) indicated negative allometric growth pattern; the length and weight of fish did not grow at the same proportion. There was positive relationship between the length and weight parameters of these fishes in the reservoir. Similar study need to be done for the remaining months, other aspects of the biology be studied.

Keywords: - growth parameter, fish species, allometric, Shiroro Reservoir,

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INTRODUCTION

Fish found in freshwaters whether river, stream, floodplain, lake and reservoir comprise 25% of all living vertebrates and this represent 13-15% of the 100,000 freshwater animal species currently known across the world [1]. Fish yield from freshwater is of significant importance because it contribute over 30% of the total fish production with an estimated 60% to the total domestic supply [2]. This need to be sustained from adequate knowledge of biological parameters, which include length-weight relationship.

Length-weight relationship is one of the commonly used parameters in fisheries with wider application. The computed values of this relationship are useful for

various ecological parameters. For instance, it reveal the dimensional variation exhibited by fish as part of adaptations to freshwater habitat. It is important in biological studies of fishes as well as stock assessment. The values obtained are used for predicting the growth parameters and fish mortality rate, which is essential for fish stock assessment [3]. The relationship is also useful to assess the relative well-being of fish.

Clarias gariepinus, *Brycinus nurse*, *Bagrus filamentosus* and *Oreochromis niloticus*are commercial fishes found in Shiroro Reservoir, which are common and constitute bulk of the landings in fishers catch. However, basic knowledge of their length-weight relationship is lacking for the reservoir and this has hindered the evaluation of growth patterns making their management challenging. Therefore, there is need to have adequate knowledge of fish well-being and survival in this reservoir for better management. This study aim to determine the sizes of these fish species, their growth patterns from length-weight relationships, making recommendations for better management of these fish species in Shiroro Reservoir, Niger State, Nigeria.

MATERIALS AND METHODS

Study area

Shiroro Reservoir is located on Longitude 6^{o} 54' E and Latitude 9^{o} 55' N in Niger State. The reservoir was created in May 1984 by damming Kaduna River at Shiroro village. The elevation of the reservoir above sea level is 372 metres. It has an estimated surface area of 312km^{2} and mean depth of 22.4 m. It was purposely constructed for hydro-electric power generation. It is expected that the condition of the reservoir will be favourable for fisheries production.

Fish sampling and identification

Four landing locations on Shiroro Reservoir were chosen and visited for fish sampling from the catches of fishermen. The choice of these locations was based on accessibility to landing sites as well as level of fishing activities. The fishermen catch comprising of *Oreochromis niloticus*, *Clarias gariepinus*, *Bagrus filamentosus* and *Brycinus nurse*, were identified, using manuals by [4] on the basis of their morphometric character.

Fish collection and transportation

Ninety-nine samples each of *Clarias gariepinus* and *Bagrus filamentosus*, one hundred *Oreochromis niloticus* and one hundred and eight *Brycinus nurse* were collected between April, 2017 and August, 2017. These chosen locations were visited twice in a month. Small, medium to large were carefully collected to ensure all sizes available are represented.

Fish samples collected were transported in ice-chest box to the Biology Laboratory, Ibrahim Badamasi Babangida University, Lapai, Niger State where analysis, which included measurements were carried out.

Fish sample measurements

Fish standard length (measured from the tip of the snout to the caudal peduncle), total length (measured from the tip of the snout to the longer portion of the caudal fin) and weight of each fish sample were measured and taken respectively. Measuring board was used to measure the different lengths (cm) and spring or weighing balance to measure weight (gm) depending on the size of fish. These measurements were done on monthly basis and the data kept separately.

Determination of length-weight relationships (LWR)

The data for lengths and weights of these fishes were used to determine the relationship known as growth patterns. The data was first inspected for errors on the course of measurements; 99 samples of *Clarias gariepinus*, 108 of *Brycinus nurse*, 99 of *Bagrus filamentosus* and 100 of *Oreochromis niloticus*.The growth pattern from length-weight relationship of these fish species were determined from the following formula according to [5].

$$W = aL^b$$

This will be transformed into logarithm to obtain a straight line graph with the following equation:

$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

Log length values will be plotted against log weight values to obtain a, b and r.

Where:

W = body weight of fish (g), L = standard body length of fish (cm)

a = intercept, b = growth exponent (This define the growth pattern of fish).

DATA ANALYSIS

Descriptive statistics was used to calculate means, standard deviation, minimum and maximum values of data collected. Data collected was also subjected to analysis of variance (ANOVA) to test for any significant difference at 5% confidence level. Post hoc using Duncan Multiple analysis was used to separate the mean. Linear Regression was carried out to test for any correlation between the parameters.

RESULTS

Table 1 shows the various body measurements of 99 *Clarias gariepinus samples*, 108 *Brycinus nurse* samples, 99 *Bagrus filamentosus* samples and 100 *Oreochromis niloticus* samples in Shiroro Reservoir, Niger State.

There were variations in standard lengths, total lengths and weights measured during the period of study. *Clarias gariepinus* standard length, total length and weight ranged from 7.00 - 16.20 cm ($\overline{X}$= 11.19), 8.10-19.80 cm ($\overline{X}$ = 14.30) and 22.49g-92.00g ($\overline{X}$ = 48.27) respectively. *Brycinus nurse* standard lenght, total length and weight ranged from 4.00- 20.20 cm ($\overline{X}$ = 11.32), 6.20-24.40 ($\overline{X}$ = 14.60) and 17.20g - 99.20g ($\overline{X}$ = 50.43) respectively.

Bagrus filamentosus standard length, total length and weight ranged from 3.80- 20.40cm ($\overline{X}$ = 11.21), 6.90-25.10cm ($\overline{X}$ = 14.46) and 14.50 -302.00 g ($\overline{X}$= 51.10) respectively. *Oreochromis niloticus* standard length, total length and weight ranged from 5.20-16.70cm ($\overline{X}$ = 9.83), 6.90-20.80cm ($\overline{X}$ = 12.95) and 20.10-80.20g ($\overline{X}$ = 40.80) respectively.

There was significant differences ($p<0.05$) in standard lengths, total lengths and weights of the fish species in the river.

Table 1: Body measurements of some commercial fish species in Shiroro Reservoir, Niger State, Nigeria.

Parameter	*Clarias gariepinus*	*Brycinus nurse*	*Bagrus filamentosus*	*Oreochromis niloticus*
No of sample	99	108	99	100
Standard length (cm)				
Minimum-Maximum	7.00-16.20	4.00-20.20	3.80-20.40	5.20-16.70
Mean ± SD	11.19±2.05[b]	11.32±3.14[a]	11.21±3.31[b]	9.83±2.57[c]
Total length (cm)				
Minimum-Maximum	8.10-19.80	6.20-24.40	6.90-25.10	6.90-20.80
Mean ± SD	14.30±2.23[b]	14.60±6.67[a]	14.46±4.10[b]	12.95±3.14[b]
Weight (g)				
Minimum-Maximum	22.40-92.00	17.20-99.20	14.50-302.00	20.10-80.20
Mean ± SD	48.27±16.50[ab]	50.43±20.44[a]	51.10±31.88[a]	40.80±15.49[b]

Values on the column with different superscript are significantly differen

The log length - log weight relationships parameters of *Clarias gariepinus*, *Brycinus nurse*, *Bagrus filamentosus* and *Oreochromis niloticus* were shown and depicted in table 2, figures 1, 2 and 3 respectively. Intercept (a) values for *Clarias gariepinus*, *Micralestes occidentalis*, *Bagrus filamentosus* and *Oreochromis niloticus* were 0.16, 0.24, 0.39 and 0.03 respectively. The b - values of 1.3, 1.24, 1.11 and 1.41 showed negative allometric for *Clarias gariepinus*, *Brycinus nurse*, *Bagrus filamentosus*, *Oreochromis niloticus* respectively. Correlation values (r) of 0.67, 0.83, 0.74 and 0.93 *Brycinus nurse*, *Bagrus filamentosus* and *Oreochromis niloticus* show positive correlation between lengths and weights during the period of study.

Table 2: Length - weight Parameters of some commercial fish species in Shiroro Reservoir, Niger State, Nigeria.

Parameter	*Clarias gariepinus*	*Brycinus nurse*	*Bagrus filamentosus*	*Oreochromis niloticus*
No	99	108	99	100
a	0.16	0.24	0.39	0.03
b	1.30	1.24	1.11	1.41
r	0.67	0.83	0.74	0.93

No: Number of samples, **a**: Exponent describing the rate of change of weight with length (intercept), **b**: Regression coefficient (slope), **r**: Correlation coefficient

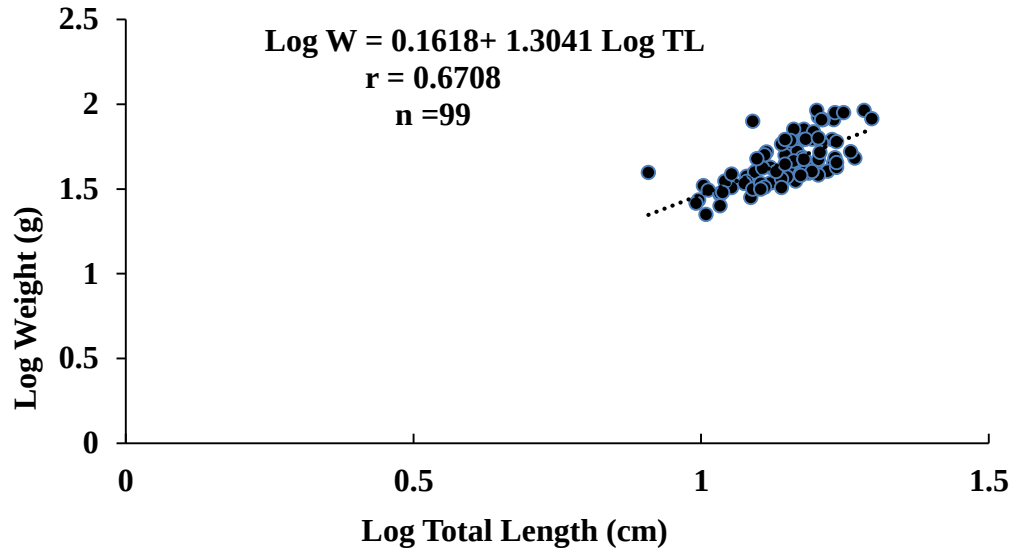

Fig. 1: Log total length -log weight relationship of *Clarias gariepinus* in Shiroro Reservoir, Niger State, Nigeria.

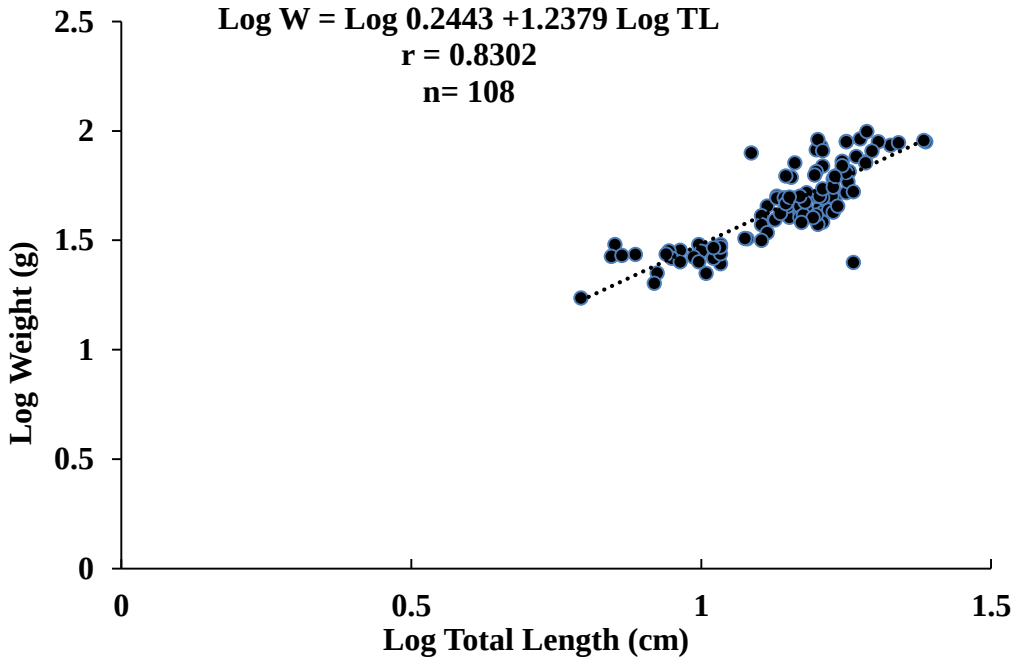

Fig. 2: Log total length-log weight relationship of *Brycinus nurse*in Shiroro Reservoir, Niger State,Nigeria.

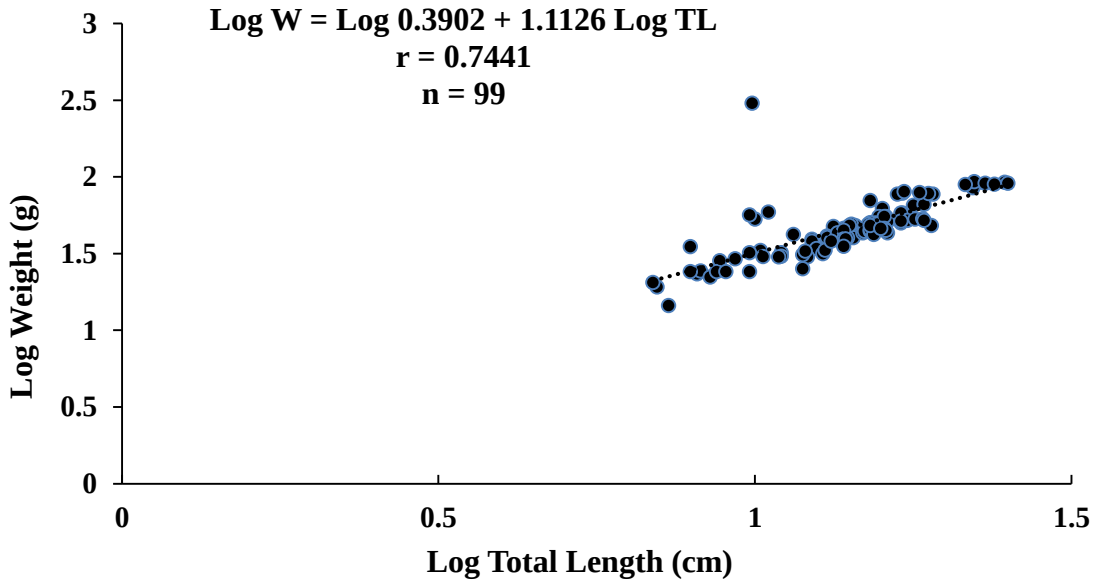

Fig. 3: Log total length-log weight relationship of *Bagrus filamentosus* in Shiroro Reservoir, Niger State, Nigeria.

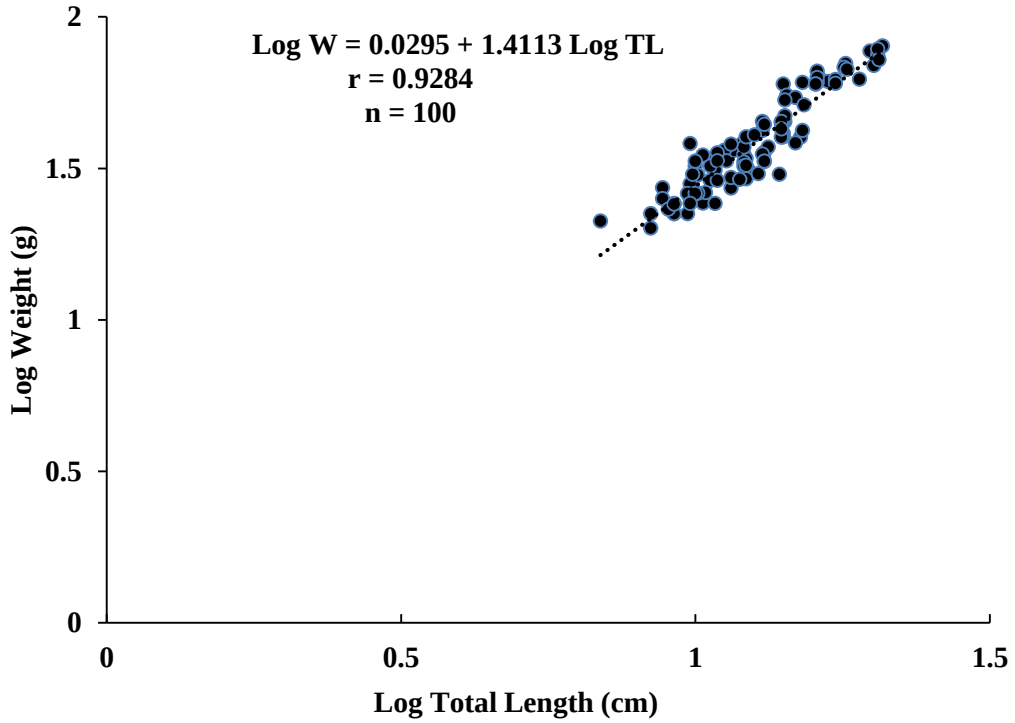

Fig. 4: Log total length-log weight relationship of *Oreochromis niloticus* in Shiroro Reservoir, Niger State,Nigeria.

DISCUSSION

The body measurements of the four commercial fish species varied during the period of study. This indicate the presence of different sizes of *Clarias gariepinus*, *Brycinus nurse*, *Bagrus filamentosus* and *Oreochromis niloticus*. [6] reported mean total length and weight of *O. niloticus* as 10.70cm and 23.89g respectively. [7] did report mean total length and weight of *C. gariepinus* as 15.50cm and 143.00g respectively. In the case of *Brycinus nurse*, [8] did report mean length and weight of 49.94cm and

3.575g respectively. While [9] did report mean standard length and weight of *Bagrus* species as 26.14cm and 388.2g respectively. This show differences in the sizes of these fish species, which also supports the findings of the study. *Brycinus nurse* and *O. niloticus* had the highest and lowest total length respectively while *B. filamentosus* and *O. niloticus* recorded highest and lowest weight respectively. These variations were significantly different ($P<0.05$) during the period of study. This is always a common observation in water bodies where fish species differ in length and weight. In addition, some fish generally are small in size compared with other species as well as the conduciveness of the environment for growth and survival.

Length and weight parameters are very important in the assessment of growth pattern of fish in the aquatic environment. The slope of the graph (b-value) of length-weight parameters determine the growth pattern of the fish species. Once the b-value obtained from regression is equal to 3 then growth is isometric and less than 3 or greater than 3 showed allometric growth. The results obtained from this study showed that these four commercial fish species exhibited allometric growth pattern and to be specific negative allometric growth pattern. This indicates that the lengths of these fish species are not growing at the same proportion with their weights. [10] reported 3.1 and concluded that *O. niloticus* exhibited isometric, which is contrary to the findings of this study. This could be due sizes of the fish, period of study, availability of food, water quality parameter amongst others. [11] Musa *et al.*, (2016) reported b-values of 2.5 and concluded that *O. niloticus* exhibited negative allometric growth pattern. This is in line with the findings of this study, where b-value of 1.41 is less than 3. [12] reported b-value of 2.3 for *C. gariepinus*, which exhibited negative allometric pattern, which is in line with the findings of the study, where b-value of 1.3 was recorded. In the case of Bagrus species, [13] reported b-value of 3.2, which was positive allometric growth and is contrary to the findings of this study. *Brycinus nurse* in this study had b-value of 1.24, which was less than 2.2 reported by [8] although all showed negative allometric growth pattern. 14 reported b-values of range 2.5-3.4 for freshwater fish. All the four species of fish in this study did not fall within this range. These observations could be due to food availability, changes in water quality, spawning period and other environmental factors.

The level of association between the growth parameters of fish is very key in fisheries. It helps to define the extent at which the length has influence on the weight. [13] reported r - values of 0.95 and 0.83 for *O. niloticus* and *Bagrus* species respectively, which were greater than the values for this study. [12] did report r - value of 0.95 for *C. gariepinus,* while [15] did report r - value of 0.93 for *Brycinus nurse*, which was also greater than the values for this study. This level was highest in *O. niloticus*, followed by *Brycinus nurse* and lowest in *C. gariepinus*, although all fish species showed positive relationship between length and weight. Converting these values to percentages, it indicate that length and weight of *O. niloticus* correlate up to 93% followed by *Brycinus nurse* with 83% and lowest in *C. gariepinus* of up to 67%. This could be due to the sizes of fish and stages of development.

CONCLUSION

The four commercial fish species used for this study revealed that *Brycinus nurse* recorded the highest length, while *O. niloticus* recorded the highest weight

that differ significantly ($P<0.05$). The four commercial fish species exhibited negative allometric growth; fish grows slimmer as there is increase of length. There was positive relationship between the length and weight of these fish species in the river.

RECOMMENDATIONS

Similar study should be done for the remaining months in order show seasonal growth pattern, other aspects of the fishes biology need to be studied, as well as the water quality.

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