

# Length Frequency Relationship of *Sarotherodon melanotheron* in Dominli Lagoon - Ghana

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## Abstract

*Sarotherodon melanotheron* is a commercially important fish species and constitutes about 59% of fish exploited in brackish water systems in Ghana. Biological data on *S. melanotheron* from the Dominli lagoon was explored to determine size distribution of the population and the body and gonad weight of the species by month. The data was analysed to establish the relationship between the length and weight using regression. The modal length of the fish was 11.2cm. The regression analysis showed a negative allometric growth ( $b = 2.6782449$ ) of *S. melanotheron* populations in the lagoon. Thus the fish species were increasing faster in length than body weight.

## Introduction

Black-chinned tilapia, *Sarotherodon melanotheron*, belongs to the family Cichlidae in the order Perciformes. It is native to West Africa from Senegal to Zaire and in its native range, it occurs in brackish coastal lagoons and estuaries (Trewavas 1983). This species is plantivorous feeder, consuming mainly algae, detritus and cyanobacteria but also consume small portions of zooplankton (Kone and Teugels 2003, Ayoadze and Ikuala 2007). They have been introduced to other continents like Asia and America. The cichlids (tilapia) are of high commercial and economic importance to African countries (Abban et al, 2004).

It is one of the major commercially important fish species exploited in brackish water systems in Ghana and constitutes about 59% of fish caught in brackish water systems in Ghana (Welcome, 1972, Blay and Asabere, 1993). The blackchin tilapia fishery provides livelihood to fishers and also serves as cheap source of protein to neighboring communities (Arizi et al, 2014). The biology of this species has been widely studied by different authors. Faunce (2000) in his study on the reproductive biology of *Sarotherodon melanotheron* in impounded mangrove systems in Florida reported the sex ratio of 1:1 for the species. However, in Ghana few studies have researched the *Sarotherodon melanotheron*. Blay (1998) studied the growth and mortality of blackchin tilapia in the Benya lagoon and the Kakum river Estuary in Ghana and reported the length at first sexual maturity to be 5.5cm and 4.6 respectively. Other studies have also looked at the genetics (Abban et al, 2000) and the ecology of the species (Ofori Danson and Kumi, 2006).

Information on relationship between length and weight and other biological parameters of this species of fish in Dominli lagoon is not well studied. Good management of *Sarotherodon melanotheron* necessitates adequate information on its abundance, biology and general population structure. According to King (2007), length-weight relationship and condition factor are important tools for providing basic scientific information to inform management decisions for fish species. According to King (2007), the growth of the fish is said to follow the cube law (Froese, 2006) which is  $W = aL^b$ , where W is the weight of fish, L is its length, a and b are constants.

The growth pattern of fish in a normal population is said to be isometric, when length increases in equal proportions with body weight for constant specific gravity. When  $b = 3$ , the fish is said to grow isometrically indicating a good growth pattern of the fish. On the contrary, when the rate of increase in weight is greater than the rate of increase in length ( $b > 3$ ), the growth is said to be positive allometric. It is negative allometric when the rate of increase in length is greater than the rate of increase in weight ( $b < 3$ ). Hence, I will estimate



Figure 1: *S. melanotheron*

the length-weight relationship of Sarotherodon melanotheron Dominli lagoon in Ghana to understand the well-being of the species.

## 2. Methodology

### 2.1. Study Site

The area of concern is the Dominli Lagoon located between latitudes  $5^{\circ} 1'$ ,  $5^{\circ} 2' N$  and longitudes  $2^{\circ} 44'$ ,  $2^{\circ} 47' W$  at Bonyere in the Jomoro district in Ghana. This lagoon covers a total land area of 465,724.4m<sup>2</sup>. Diverse fish species, crabs, reptiles, molluscs and mangrove is found in this area.

### 2.2. Fish Data

Data on fish specimens collected monthly from October to September 2012 from the Dominli lagoon was used for this analyses. A total of 1046 specimen of fish were bought from commercial fishermen. The fish was identified to the species level using fish identification manual by Dankwa et. al (1999) and Paugy et. al (2003 a, b). The specimens were put on ice and then transported to the laboratory for analysis. At the laboratory, the length was measured to the nearest 0.1cm with a measuring board and the weight to the nearest 0.01g using an electronic weight balance. The sex of each fish was also determined.

### 2.3 Data Analysis

#### 2.3a. Packages

All analyses and plots were done in “R version 3.3.1” using the following packages psych, ggplot2, plyr, bbmle. The data was analysed using both exploratory and regression techniques. Histogram was used to explore the distribution in the length of fish. Additionally Boxplot, which gives graphical representation of the summaries-minimum, lowerquatile, median, upperquatile and maximum, was used to explore the distribution of gonad and body weight of the fish. The regression model was used to establish the relationship between body weight and length of fish.

### 2.3b. Length Weight Relationship

The length-weight model (see equation 1) was linearized by log transformation to obtain equation 2. To establish the relationship between length and weight, we modelled log transformed weight (log W) as the response and log transformed length (log SL) as predictor using simple linear regression.

$$W = aSL^b \quad (1)$$

$$\log W = \log(a) + b\log(SL) \quad (2)$$

Where, **W** = weight of fish specimen (in grammes), **SL** = standard length of fish (in cm), **a** = growth constant; and **b** = exponent of the equation.

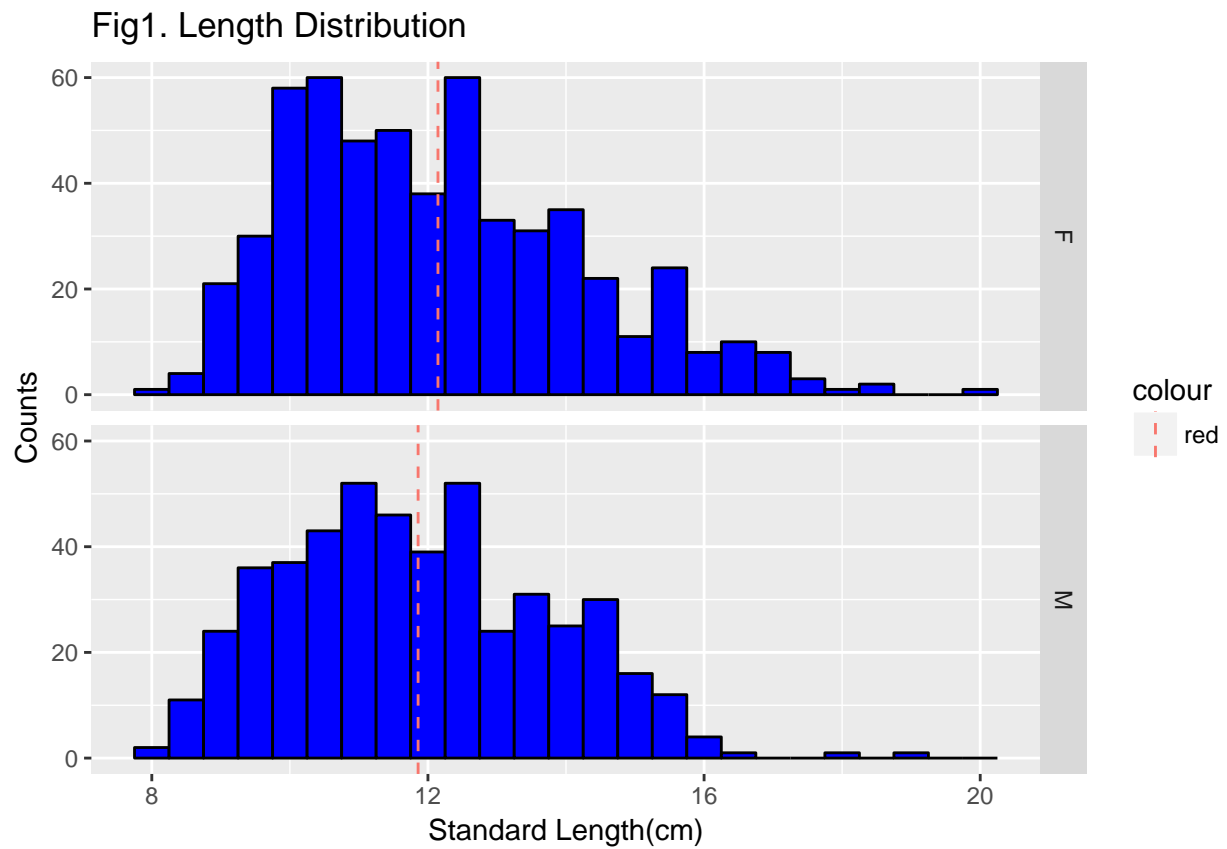
### 2.3c. Gonad Weight of Female and Body weight

The body weight of all the fish and gonad weight of females were graphically explored to explain the patterns of spawning using boxplot. The weight of the gonads and body weight were plotted on y-axis and months of catch was on the x-axis

## 3. Results

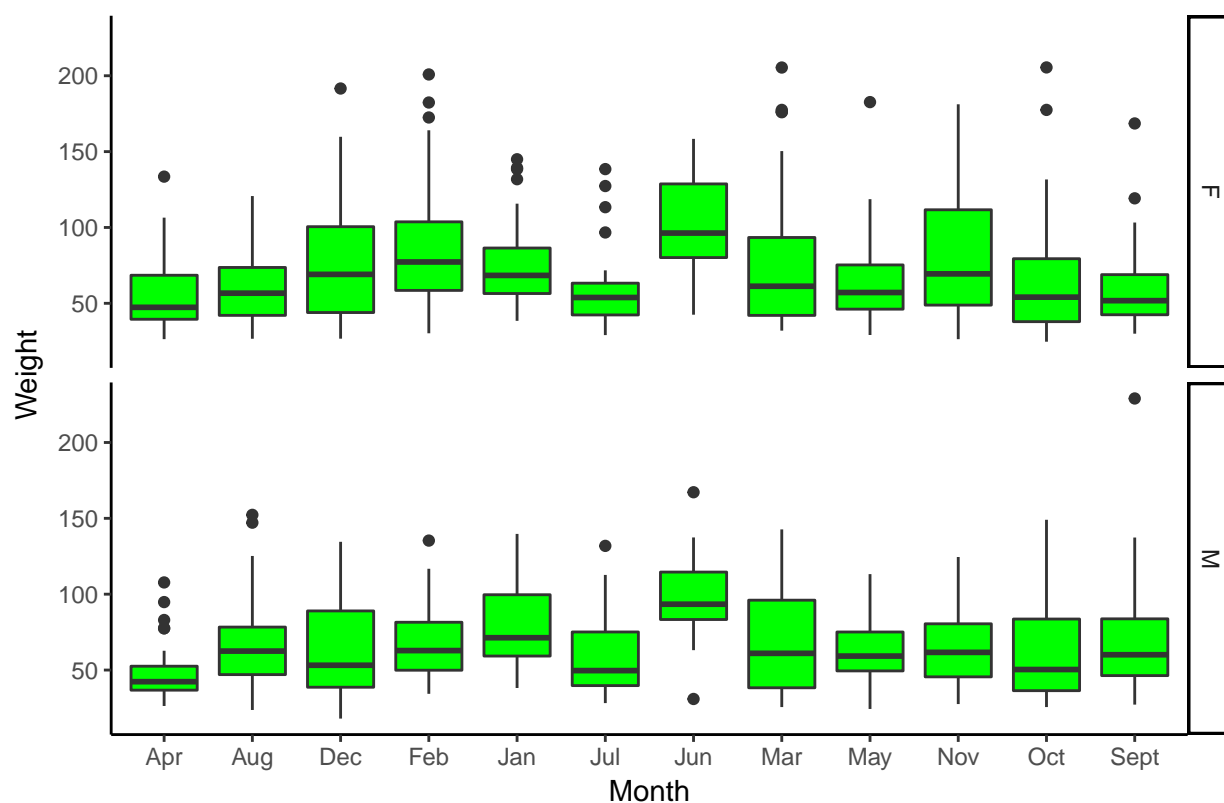
### 3.1. Length Distribution of Tilapia

The distribution plots shows that males are approximately normally distributed and the distribution of females is skewed to the right. The sizes of *Sarotherodon melanotheron* in the Dominli lagoon ranged from 7.9 to 19.8 from a total sample size of 1046 specimens. The modal class was between 10 -10.9cm. The mean standard length of males 11.8574949 was a few centimeters lower than that of females 12.1454383. Sizes of fish above lengths 16cm were mostly Females. Males were few in this size ranges.



### 3.2. Body Weight of fish The lowest median weight was observed in April for both sexes and heighest in June also for both sexes.

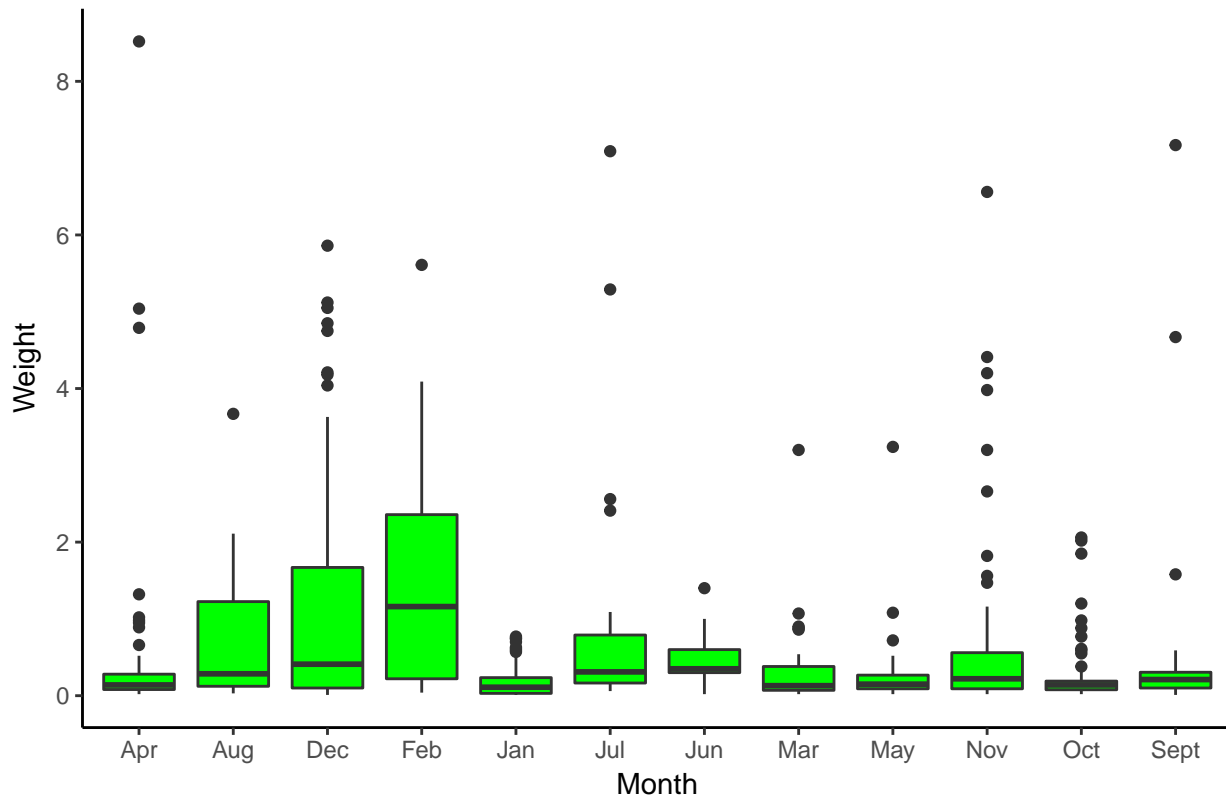
Fig2. Plot of Body Weight by Month



### 3.3 Gonad Weight

Median weight of Ovaries in Females was highest in the month of February. However, weight of ovaries was least in the months of September, October, May and April.

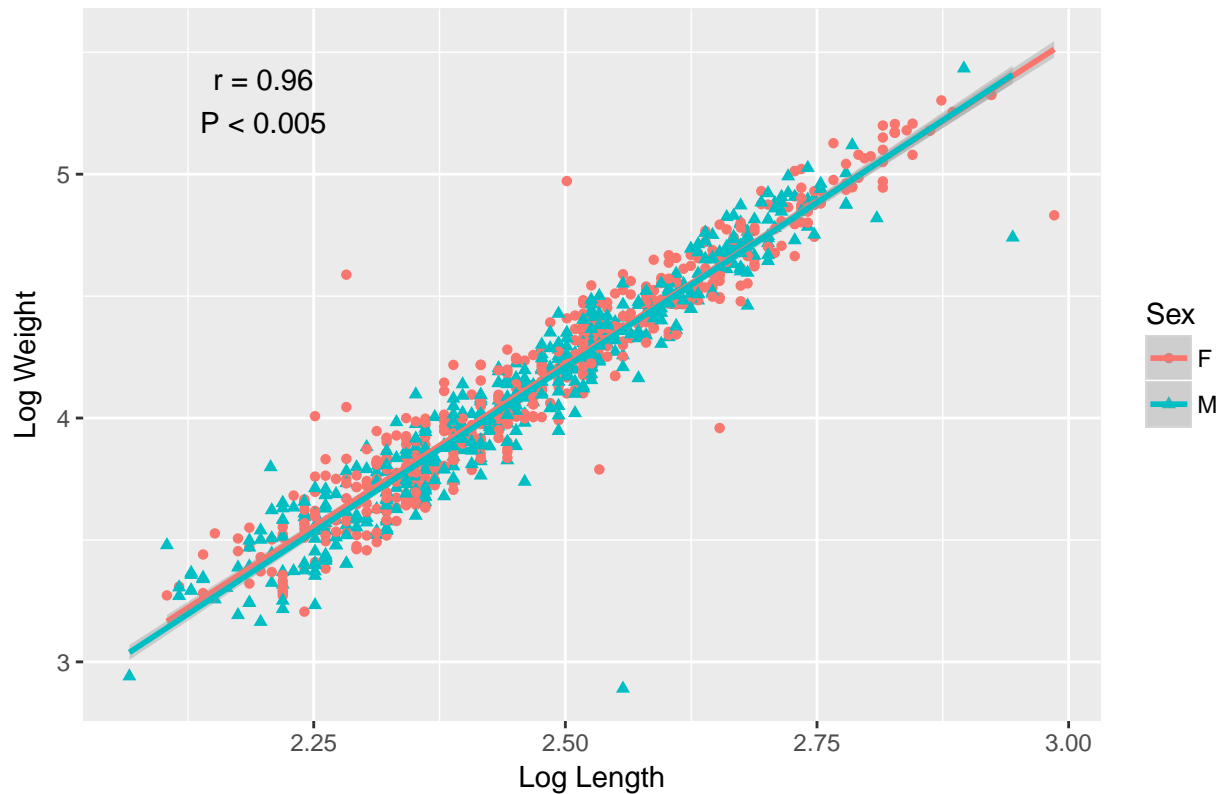
Fig3. Gonad Weight of Females



### 3.4 Length Weight Relationship

The regression analysis indicated that there is a strong relationship between the  $\log(W)$  and  $\log(SL)$ . The correlation coefficient was 0.9211521 and shows that the log transformed weight increases as the log transformed length. The slope was 2.6782449 and indicates that for a unit increase in  $\log(SL)$  of *S. melanotheron* population in the lagoon the weight increased by 2.6782449. The p-value of 0 ( $p < 0.05$ ) shows a significant relationship between the length and weight.

Fig 4. Length Weight Relationship of Blackchin Tilapia



#### 4. Discussion

In data poor regions, Length and weight data are important in fisheries research because they provide basis for fisheries management and stock assessments. The size distribution of blackchin tilapia in the Dominli lagoon were longer than sizes of the same species in other lagoons and estuaries in Ghana like the Benya lagoon and Kakum estuary (Blay, 1998). The relationship between length and weight provides important information in assessing the biology of fish (Abowei and Hart, 2005). It also gives an indication of the conditions in the habitat of a Fish (Pauly, 1993). The growth constant, which is the b-value (hypothetically = 3) in the length weight equation gives an indication of the well being of the fish (Carlande, 1969 and King, 1996). The value of b estimated for *S. melanotheron* population in this study is 2.6782449 and a p-value of 0. This shows the population of *S. melanotheron* grows an allometrically. Thus the rate of increase in length is greater than increase in body weight. Again the p-value indicates a significant relationship between length and weight of the fish. Studies by Agboola and Anetekhia (2008) agrees with the results found in this analysis, however results from Blay (2008) somewhat differ from this study. Regression analysis shows a strong correlation between weight and length of the fish. Blackchin tilapia has an extended spawning season, which peaks in the month of February, that is why the heighest median weight was observed for that month in the boxplots. The extended spawning season is attributed to low fishing pressure and favorable habit condition of the fish. Again, the month with heighest body weight of fish in the population corresponsed to the raining season (June - July) in the area. It is therefore assumed that in this month the fish will have more food and space to enhance growth.

## 5. Conclusion

Size distribution of *S. melanotheron* in Dominli lagoon shows fish in good condition. There was a strong relationship between the length and weight of the fish. The Relationship shows a negative allometric growth of the fish populations in the lagoon

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