Original Research Article

Stomach content, length-weight relationship and condition factor of *Tilapia* sp. found in the Sombreiro River across three communities in rivers state, Nigeria

Abstract

Aim: The present study aims to determine the condition factor incomplete of *Tilapia guineensis and Sarotherodon melanotheron* in Sombreiro River across Buguma, Abonnema and Degema communities in Rivers State.

Study design: This study employs fieldwork, laboratory experimental design, statistical analysis and interpretation of data.

Place and duration of study: live fish samples were caught by fishermen in Buguma, Abonnema and Degema communities in Kalabari kingdom of Rivers State, and were conveyed in a rectangular plastic aquarium containing ice blocks and oxygen bags to the department of Applied and Environmental Biology, Rivers State University. The duration of the study lasted for twelve weeks (65days).

Methodology: One hundred and eighty fish samples give their average weights and lengths were identified. The fish samples were weighed using an electronic weighing balance, the total length and length of intestine were measured with a meter rule (cm), color of fish, spines and rays of fish were also observed. Their stomach contents were analyzed viewing under a microscope. The frequency of occurrence method and the numerical method were used for analyzing the food items.

Results: The stomach content analysis indicated that the major food was phytoplankton. The length and weight relationship in the three sampled stations for *T. guineensis and Sarotherodon melanotheron* showed negative allometric growth, (<3). The condition factor for all the fish samples was greater than one. The physicochemical parameters showed that there were significant differences in the various physicochemical parameters across the study stations except for turbidity (P=0.744) and salinity (P=0.922), that showed no significant difference across the study stations.

Conclusion: The length-weight relationship in fishes can be affected by a number of factors including season, habitat, gonad maturity, sex, diet, stomach fullness, health and differences in length ranges of the specimen caught. The exact relationship between length and weight

differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish.

The stomach content analysis of the sampled fishes provided a baseline study of food and feeding habits of Tilapia species in the sampled stations.

Keywords: *Tilapia,* stomach content, Condition factor K, monthly, communities, Sombreiro river

1. INTRODUCTION

Tilapia is a common name derived from the Latin word Thiape, Tswana word for fish [27]. This species of fish are mostly dominant in Middle East and Africa among other regions. Tilapia is a fish from the family Cichlidae, one of the famous and common fish found in the marine and fresh water. Tilapia is a major source of protein for man [20]. Therefore, it is necessary that absolute attention is given to the feeding habit of Tilapia. In Nigeria Tilapia is used to complement the protein source in normal diet (20). According to (22), some Tilapia species feed on a wide range of food organism in their aquatic habitat. (7) reported that the principal food items of Tilapia are diatoms, algal filaments and unidentified organic matter(debris).

Stomach content studies can provide useful information to determine the level of Tilapia in the food web and help to formulate strategies to manage multispecies in the fish farming system. (18) reported that some Tilapia are mostly found in the benthopelagic, potamodromous , freshwater and the brackish environment with a depth of five meters and they feed on mostly benthic-algae and phytoplankton. Also, Tilapia is omnivorous with a tendency to be herbivorous.

However, the feeding rate and body weight decreases as the fish size increase. Small Tilapia rendali consumed significantly more diatom than the larger individual (5). (24) reported that the amount of phytoplankton in the Nile Tilapia stomach content is inversely proportional to the body size. However, the stomach content analysis is a search for variation in food consumed by Tilapia. But food and feeding habit of Tilapia are altered by seasonal change.

2. MATERIALS AND METHODS

The materials used in this study were a rectangular plastic aquarium, dissecting sets, dissecting board, microscope (model), meter rule and a weighing balance (Denver Instrument Germany) TP-512A.

2.1. Study area

The study was carried out at the middle reach of the Sombrero River. The Sombreiro River is located east of the Orashi River and originates from swamps in the Oguta-Ebocha zone. It has its source from the Niger River, runs downwards into the Southern tip of the Niger Delta basin and empties into the Atlantic ocean. The Middle Reach of the Sombriero River is brackish and appears turbid during the raining season. The wet or rainy season occur between March to October with annual rainfall between 2,000 and 3,000mm per year. The dry season lasts from October to February with occasional rainfall [28,29]

2.2 SAMPLE COLLECTIONS

Fish samples of *Tilapia guineensis* and *Sarotherodon melanotheron* were obtained from fishermen across the three sample stations namely Buguma, Abonema and Degema oin Nigeria respectively. The fishermen employed cast and gill nets methods and the live fishes were immediately transferred into a 30 litre rectangular plastic aquarium containing brackish water from the same river, the aquariums were fortified with ice blocks to maintain water temperature and oxygen bags for better aeration and were conveyed to the laboratory of Applied and Environmental Biology of the Rivers State University for analysis.

2.3 Essay conduct One hundred and eighty (180) Tilapia fishes weighing between the range of 21.98g-289.45g with total length ranging between 8cm-28cm for *Tilapia guineensis* and 20.54-250.75g with total length of 9cm-27cm of *Sarotherodon melanotheron* were analyzed. All fishes arrived without mortality to the departmental laboratory where sorting of fish species, as well as measurements, immediately commenced. The fish samples were identified with the aid of keys according to (11) and (19). Morphological characteristics such as the total length (TL) of the fish (from the tip of the snout to the tip of the tail fin) was measured with a meter rule. A number of lateral lines, number of rays and spines, mouth part, color of fish and the bands on the fishes were taken. Denver Instrument Germany TP-512A was used to weigh the fishes. Each fish sample was placed in a clear dissecting board and dissected using a dissecting kit. During the dissection; a mild ventral cut was made on each fish from the anal aperture to the base of the operculum, the body wall was cut open at both sides enabling a thorough exposure of alimentary canals, each stomach was slit open. The content was poured into a Petri dish and observation of the food items was carried out with the aid of a dissecting microscope. The frequency of occurrence method and the numerical methods were used in analyzing the food items.

In the frequency of occurrence method, the stomach contents were examined and the individual food items were sorted and identified. Thereafter, the number of stomachs containing one or more of each food item were recorded and expressed as a percentage of all stomachs containing the food items.

% occurrence of a food item = Total number of stomach with a particular food /Total number of the stomach with food x100

In the numerical method, the number of individual food item in the stomach was sorted and counted. A total of all the food items were recorded and expressed as percentage number of individual food items in the stomach.

% number of a food item = Total number of a particular food item /Total number of all food items x100

The physicochemical parameters were measured both insitu and exsitu. The insitu measurements were done with instruments such as HANNA instrument model HI 8424, and Extech model DO 700. BOD and COD were done exsitu. Water samples were taken with a clean plastic rubber and were immediately transported to the laboratory for analysis.

The condition factor (K) of the fish was calculated according to (9).

$K = W \times 100 / L^3$**2.4 STATISTICAL ANALYSIS**

Data generated were subjected to one-way analysis of variance (ANOVA) with Duncan's Multiple Range Descriptive Test. The results were further analysed using the statistic package for social science (SPSS) VERSION 23. Differences among mean were separated with Turkey HSD at P=0.05.

3. RESULTS AND DISCUSSION

3.1 Stomach content analysis

Results on the stomach content (Figure 1) shows that in the month of August, station 1, *Tilapia guineensis* and Sarotherodon melanotheron fed more on phytoplankton, than others and then plant materials. In station 2, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on phytoplankton, others and then plant materials. In station 3, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on plant materials, phytoplankton, protozoa and others.

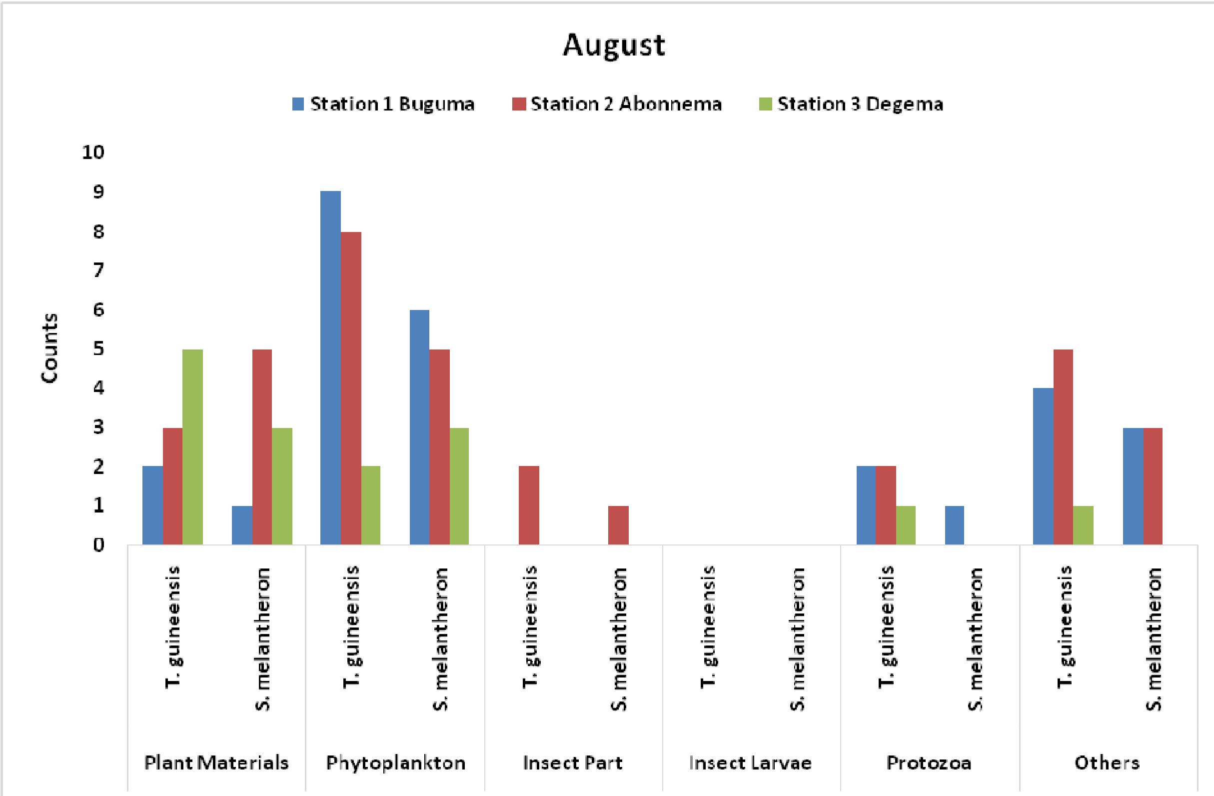

Fig 1: Stomach Content Analysis for August 2018.

In the month of September, station 1, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on others, phytoplankton and plant materials. In station 2, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on plant materials, phytoplankton, others and insect parts. In station 3, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on phytoplankton, others, protozoa and plant materials.

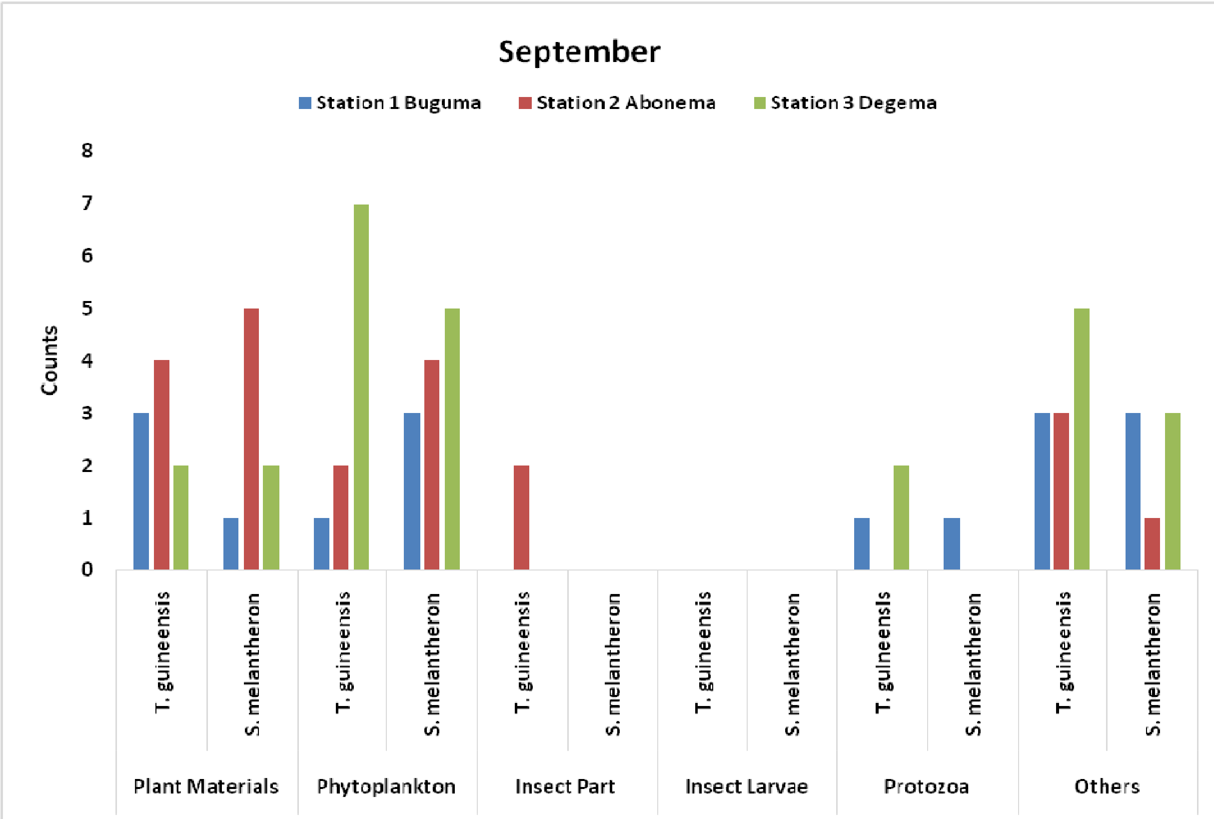

Fig 2: Stomach Content Analysis for September 2018.

In the month of October, station 1, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on phytoplankton, others and plant materials. In station 2, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on plant materials, phytoplankton and others. In station 3, *Tilapia guineensis* and *Sarotherodon melanotheron* fed more on phytoplankton, others, protozoa and plant materials.

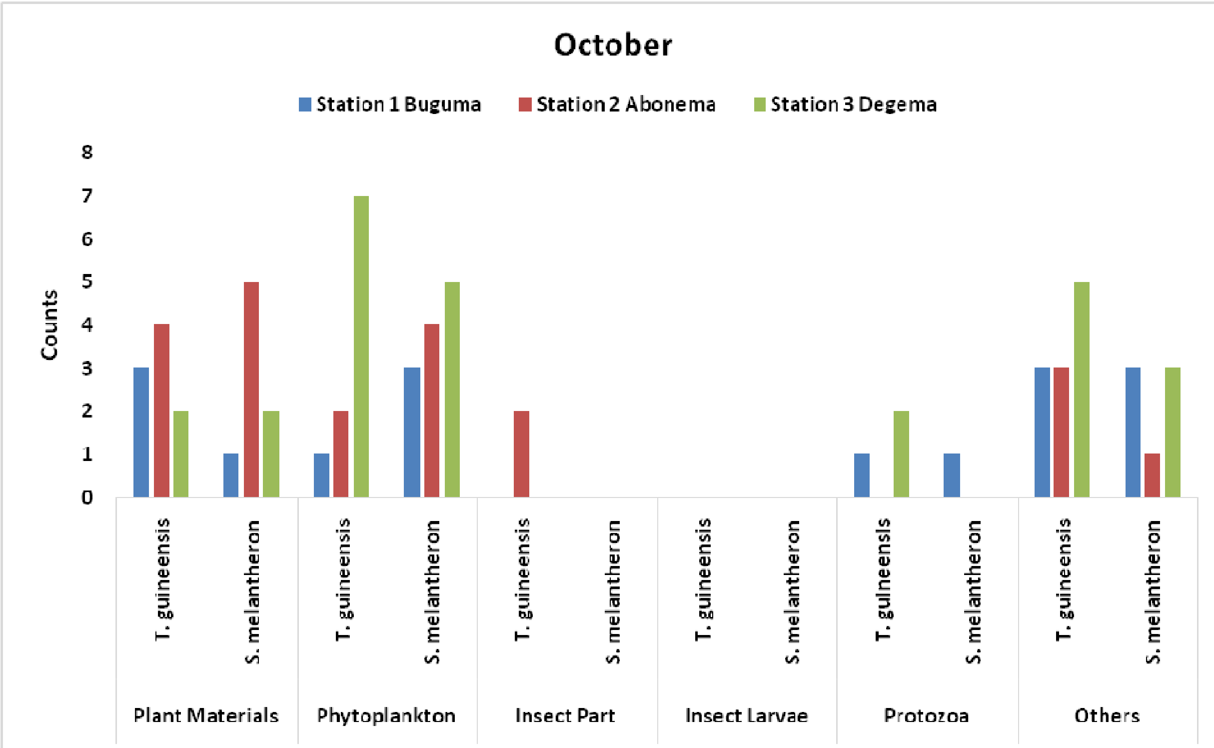

Fig 3: Stomach Content Analysis for October 2018.

3.1 PHYSICO-CHEMICAL PARAMETERS

Physico-chemical parameters are presented in table1. It appears that pH levels showed a narrow range of variation between different stations, with the highest (6.63 ±0.2) mean p^H and the lowest (5.6 ± 0.2). There were however significant differences in pH between the stations (P=0.00146). Temperature levels differed significantly across the stations (P<0.0001) which range from 25.33- 26.7°C. Conductivity in the three stations vary significantly (P=<0.0001) and ranged between 140 µS /cm -416.67 µS /cm.

Table 1: Results of Physiochemical Parameters of the three Sampled Stations.

Parameters	Temperature (°c)	pH	Conductivity (µS/cm3)	Turbidity (NTU)	Salinity	Chemical Oxygen Demand (mg/L)	Biological Oxygen Demand (mg/L)
Station 1	26.7 ± 0.31^{b}	5.6 ± 0.2^{c}	416.67 ± 10^{a}	7.4 ± 2.13^{a}	8.7 ± 5.12^{a}	16.53 ± 0.1^{a}	3.95 ± 0.1^{a}
Station 2	25.33 ± 0.1^{c}	6.2 ± 0.15^{b}	140 ± 7.64^{c}	8.8 ± 1.82^{a}	8.93 ± 3.46^{a}	42.6 ± 0.01^{c}	1.3 ± 0.01^{b}
Station 3	27.3 ± 0.2^{a}	6.63 ± 0.2^{a}	208.33 ± 15.28^{b}	9.5 ± 5.03^{a}	10.07 ± 4.5^{a}	20.57 ± 0.06^{b}	3.94 ± 0.01^{a}
P	< 0.0001	0.00146	< 0.0001	0.744	0.922	< 0.0001	< 0.0001
Significant Difference	Yes	Yes	Yes	No	No	Yes	Yes

Key: (^{abcd}) Superscript of different alphabets along columns shows Mean comparisons that are significantly different.

3.2 CONDITION FACTOR

The condition factor (K) for *Tilapia guineensis* found in Abonnema had a mean and standard deviation of 2.17 ± 0.71, while *Sarotherodon melanotheron* had a mean and standard deviation of 2.37± 0.36. The results showed that the fishes in Abonnema were in a good condition.

The condition factor (K) for *Tilapia guineensis* found in Buguma had a mean and standard deviation of 2.39± 0.4. while *Sarotherodon melanotheron* had a mean and standard deviation of 2.25± 0.52. The results showed that the fishes in Buguma were in a good condition.

The condition factor (K) for *Tilapia guineensis* found in Degema had a mean and standard deviation of 2.35 ± 0.39, while *Sarotherodon melanotheron* had a mean and standard deviation of 2.27± 0.33. The results showed that the fishes in Degema were in a good condition.

There is no significant difference in the condition factor of the fishes across months and stations as shown in the table below.

Table 2: Anova (Turkey test) Comparisons across months and stations

	Weight	Length	Condition factor K
August	127.49 ± 37.08^{a}	17.11 ± 1.7^{a}	2.58 ± 0.98^{a}
September	80.066 ± 30.34^{b}	14.72 ± 2.37^{b}	2.48 ± 0.73^{a}
October	63.27 ± 27.74^{c}	13.18 ± 2.12^{c}	2.65 ± 0.55^{a}
Pr> F(Model)	< 0.0001	< 0.0001	0.48
Significant Difference	Yes	Yes	No

	Weight	Length	Condition factor K
Station 1	92.61 ± 44.41^{a}	15.33 ± 2.72^{a}	2.41 ± 0.49^{a}
Station 2	90.81 ± 41.89^{a}	14.86 ± 2.59^{a}	2.73 ± 1.01^{a}
Station 3	87.41 ± 39.75^{a}	14.82 ± 2.57^{a}	2.59 ± 0.71^{a}
Pr> F(Model)	0.79	0.492	0.072
Significant Difference	No	No	No

3.3 Graphical Expression of Weight- Length Relationship

Figure 4-11 is a graphical expression of lenght –weight relationship. This also showed the allometric growth of all different species of sampled fishes across the sampled stations. The empircal values were plotted their respective weight on an arithmethic scale using the Natural logrithm of the length and weight of the fishes.

For the Abonnema as shown in Fig 4 & 5, *Tilapia guineensis* had R^2 Value of 0.912 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.26 (b<3), which shows negative allometry indicating that the *Tilapia guineensis* in Abonnema grows faster in length than in weight. *Sarotherodon melanotheron* had R^2 Value of 0.952 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.91 (b<3), which shows negative allometry indicating that the *Sarotherodon melanotheron* in Abonnema grows faster in length than in weight.

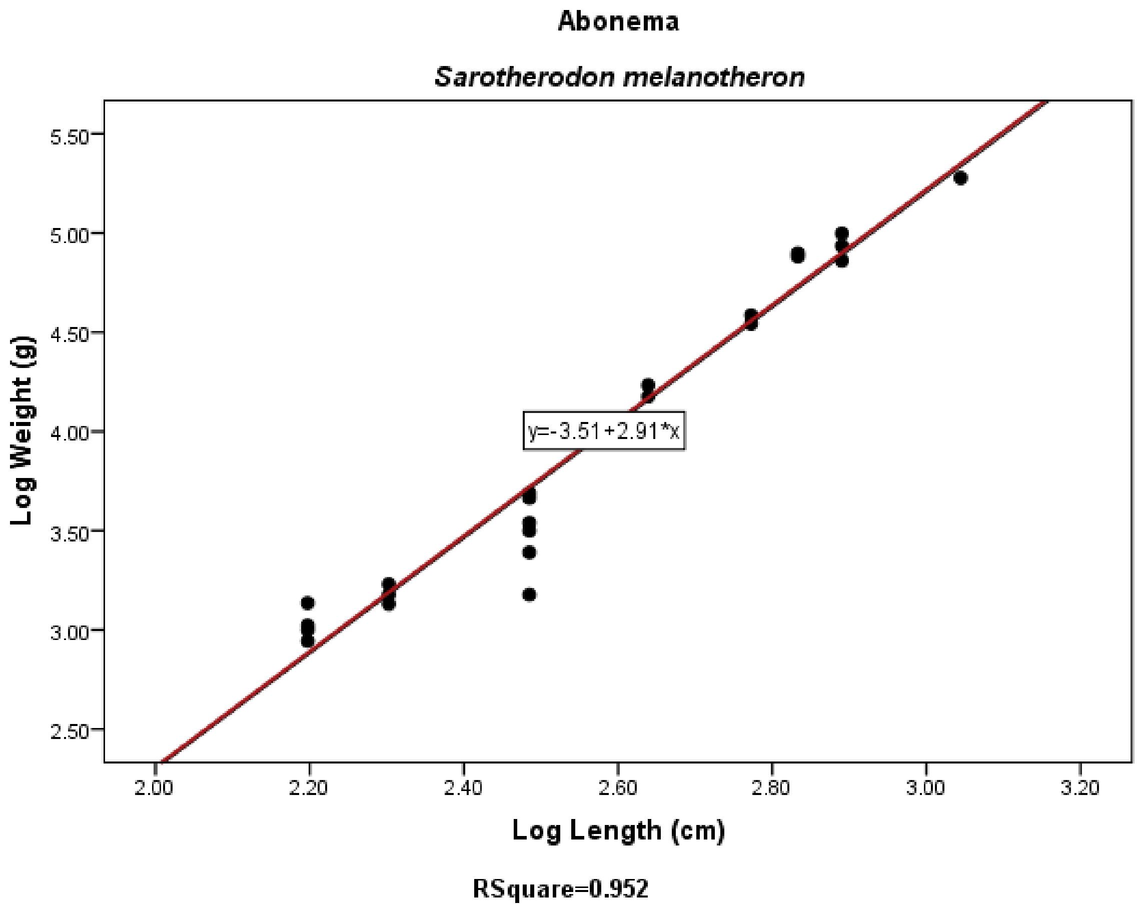

Fig 4: Log Length and Log Weight relationship (Bivariate Fit) of *Sarotherodon melanotheron* in Abonnema.

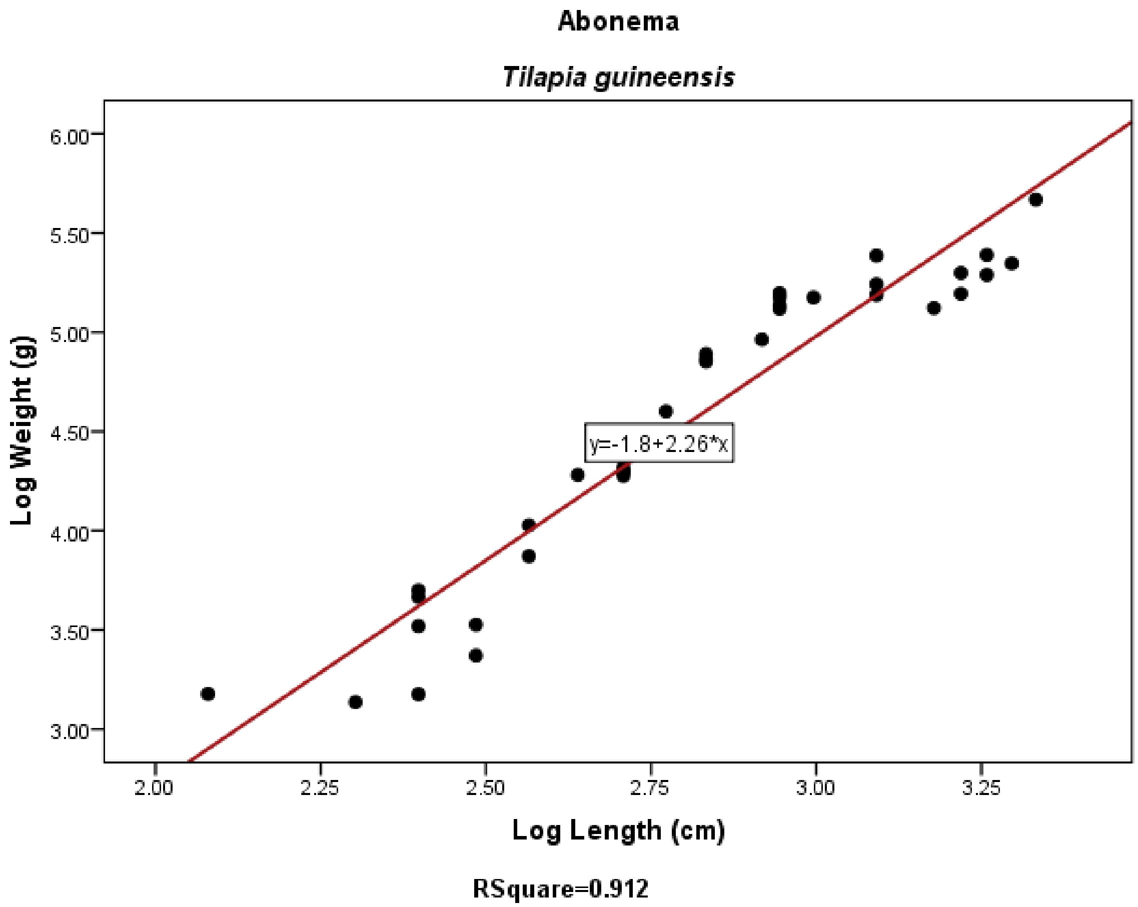

Fig 5: Log Length and Log Weight relationship (Bivariate Fit) of *Tilapia guinessis* in Abonnema.

For the Buguma as shown in Fig 6 & 7, *Tilapia guinessis* had R^2 Value of 0.943 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.82 (b<3), which shows negative allometry indicating that the *Tilapia guineensis* in Buguma grows faster in length than in weight. *Sarotherodon melanotheron* had R^2 Value of 0.774 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.58 (b<3), which shows negative allometry indicating that the *Sarotherodon melanotheron* in Buguma grows faster in length than in weight

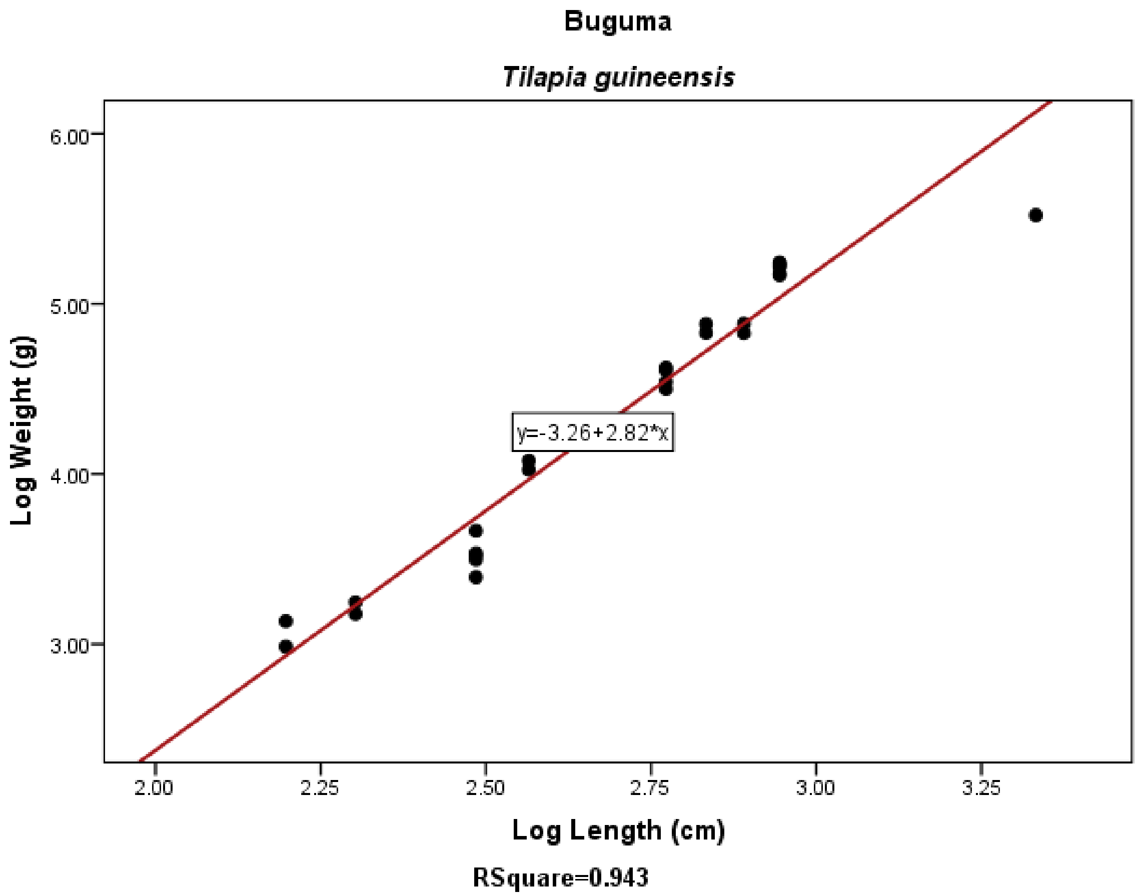

Fig 6: Log Length and Log Weight relationship (Bivariate Fit) of *Tilapia guineensis* in Buguma.

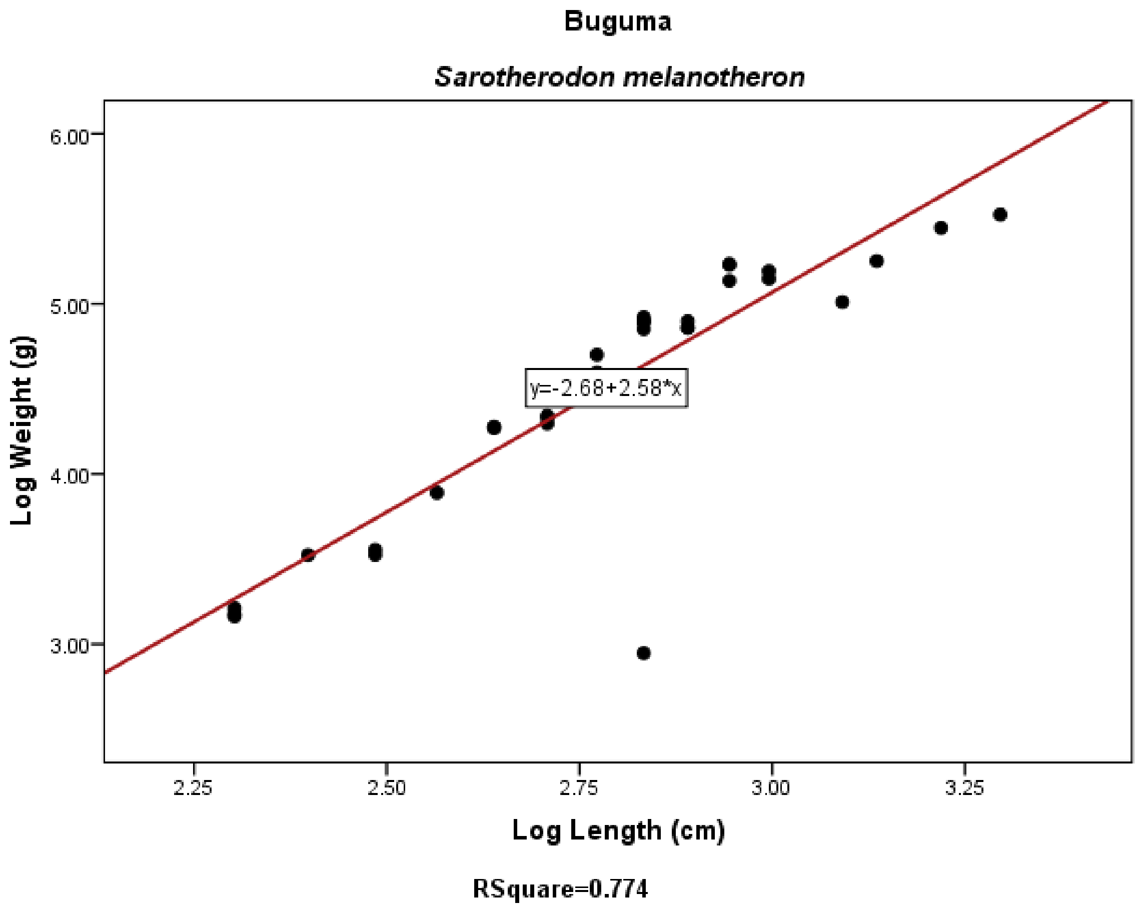

Fig 7: Log Length and Log Weight relationship (Bivariate Fit) of *Sarotherodon melanotheron* in Buguma.

For the Degema as shown in Fig 8 & 9, *Tilapia guineensis* had R^2 Value of 0.952 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.62 (b<3), which shows negative allometry indicating that the *Tilapia guineensis* in Degema grows faster in length than in weight. *Sarotherodon melanotheron* had R^2 Value of 0.948 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.88 (b<3), which shows negative allometry indicating that the *Sarotherodon melanotheron* in Degema grows faster in length than in weight.

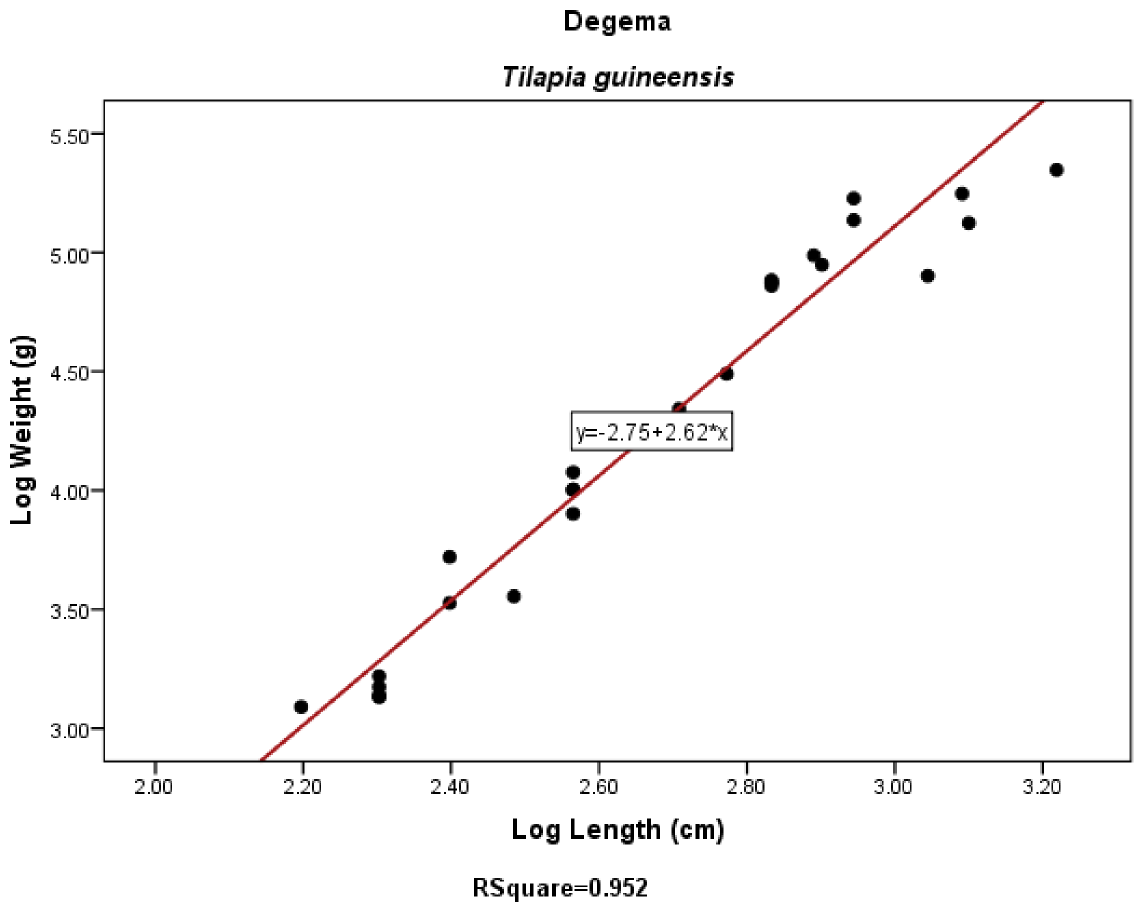

Fig 8: Log Length and Log Weight relationship (Bivariate Fit) of *Tilapia guineensis* in Degema

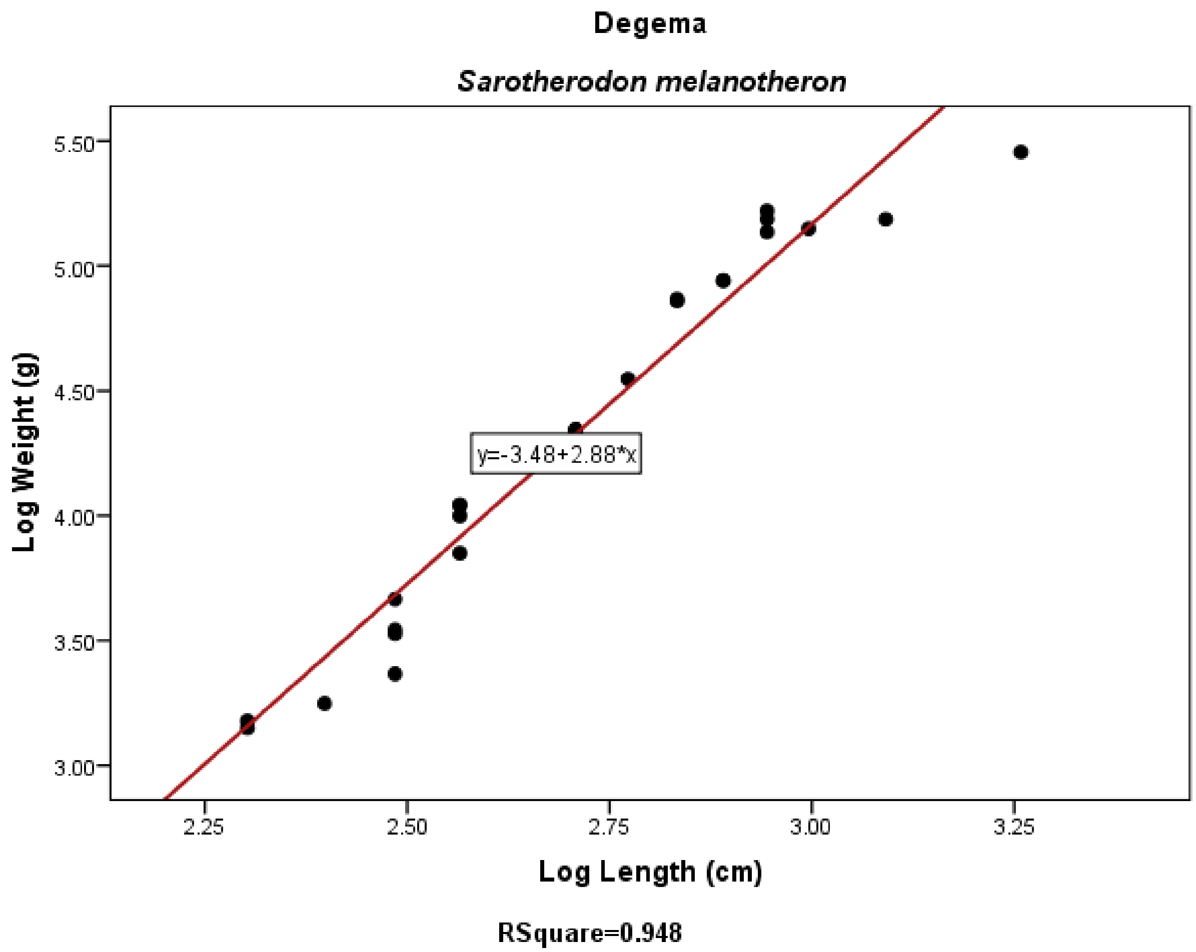

Fig 9: Log Length and Log Weight relationship (Bivariate Fit) of *Sarotherodon melanotheron* in Degema.

The total *Tilapia guineensis* found in all 3 stations as shown in Fig 10 had R^2 Value of 0.927 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.48 (b<3), which shows a negative allometry indicating that the *Tilapia guineensis* in all sampled stations grows faster in length than in weight.

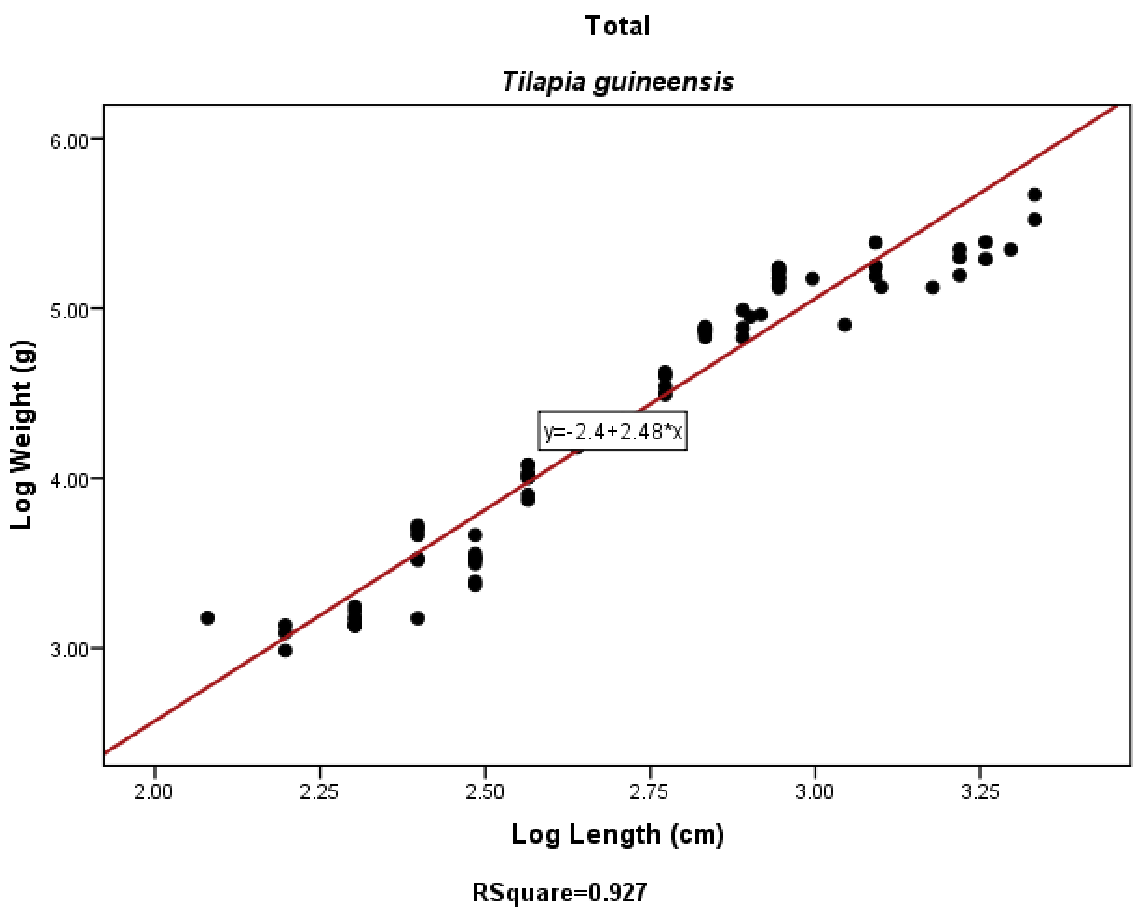

Fig 10: Log Length and Log Weight relationship (Bivariate Fit) of *Tilapia guineensis* sampled in all stations.

The total *Sarotherodon melanotheron* found in all 3 stations as shown in Fig 11 had R^2 Value of 0.891 which shows a strong relationship between the weight and length of the fishes. It also has a b=2.75 (b<3), which shows a negative allometry indicating that the *Sarotherodon melanotheron* in all sampled stations grows faster in length than in weight.

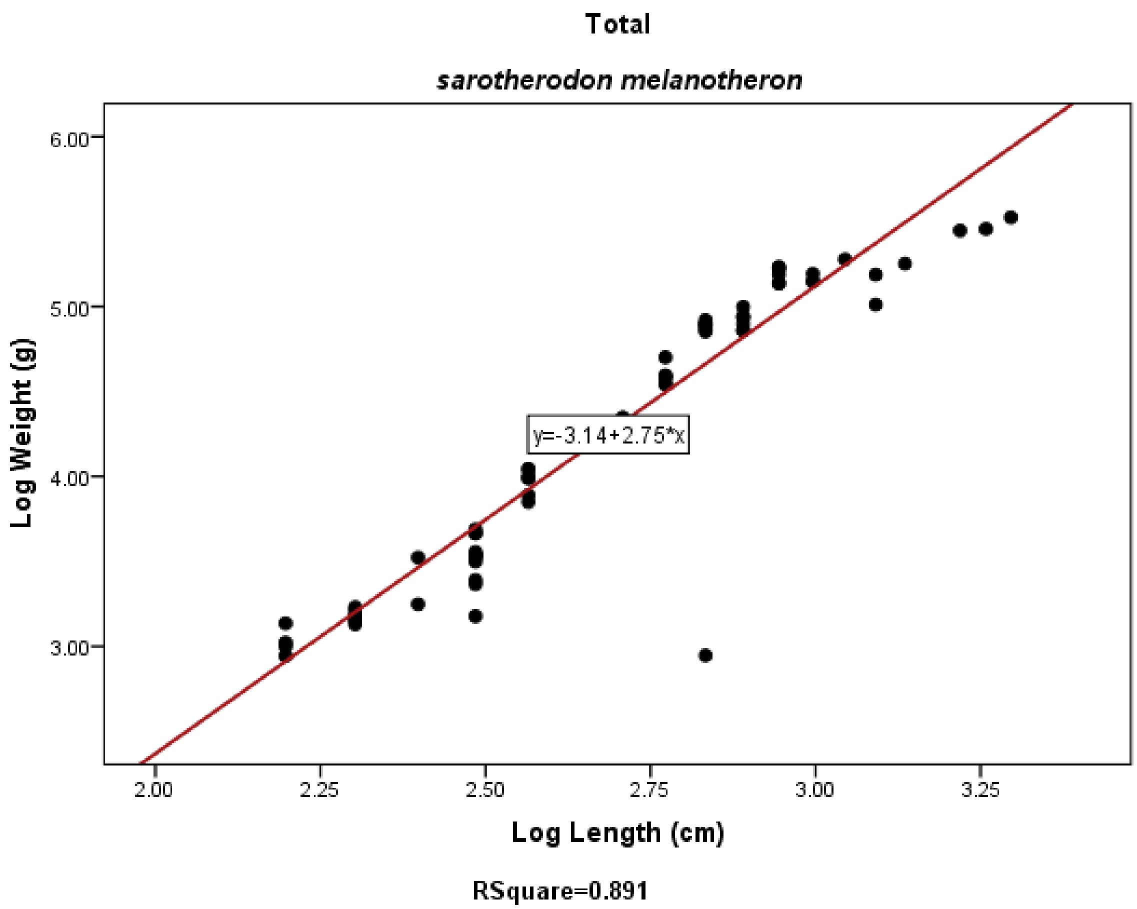

Fig 11: Log Length and Log Weight relationship (Bivariate Fit) of *Sarotherodon melanotheron* sampled in all stations.

4. DISCUSSION

Two Species of Tilapia were identified in this study. They Include *Tilapia guineensis* and *Sarotherodon melanotheron.*

4.1 Stomach Content Analysis

The stomach contents of Tilapia species found in this study across stations were mainly planted compositions ranging from phytoplankton, plants parts, etc. indicate that they were herbivorous. They feed mainly on plant food substances such as phytoplankton, plant parts, leaf parts and some percentages of animal food include insect pupae, insect larva and protozoa. This agrees with (10), (17) and (7) who reported that *Oreochromis niloticus* are obligate herbivores that feed on algal filaments, diatoms and unidentified organic matter. Similarly,(2) reported that the main stomach content of *Synodontis niloticus* is phytoplankton.

(12) and (16) reported that insects and crustaceans comprise a large portion of the diet of *Oreochromis niloticus* and also reported that *O. niloticus* have the ability to feed on either small or bulky particles and can efficiently filter, and utilize a broad range of particle size (13). (21) reported that Blackchin Tilapia feeds primarily on phytoplankton and filamentous algae. The stomach contents of these fish also include granules of mud and sand implying that they suction feed on the bottom of their aquatic habitat.

Tilapia guineensis sampled in all three stations had a mean and standard deviation of 2.29± 0.54 implying that the fishes sampled during the study were in good condition. While Sarotherodon melanotheron sampled in all the three stations had a mean and standard deviation of 2.29± 0.42 implying that the fishes sampled during this study were in a good condition.

4.2 Physico-chemical Parameters.

pH levels showed a narrow range of variation between different stations, with the highest (6.63±0.2) mean p^H and the lowest (5.6 ± 0.2). There were a however significant difference in pH between the stations (P = 0.00146).

Temperature levels differed significantly across the stations (p= < 0.0001), with range from 25.33 to 26.7°C.

Conductivity in three stations vary significantly (P value = < 0.0001) and ranged between 140 µS/cm to 416.67 µS/cm. (6) noted that conductivity values greater than 100 µS/cm were indicative of human activity. According to. (23) , water conductivity of between 150 and 500 µS/cm is ideal for fish culture (23). (26), however, put the desirable range of conductivity for fishponds at between 100 and 2000 µS/cm.

4.3 Length / weight Relationship

The length-weight relationship in fishes can be affected by a number of factors including season, habitat, gonad maturity, sex, diet, stomach fullness, health and preservation techniques, and differences in the length ranges of the specimen caught. The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish. The logarithmic values of length were plotted against their logarithmic respective weight on an arithmetic scale, the smooth curve was obtained. Statistical analysis of LWR showed that the regression coefficients obtained from length-weight relationships (LWR) as presented here was a significant correlation between length and weight.

The results from the study showed a strong relationship between the length and weight of the two Tilapia species sampled across stations as shown in Fig 4 to Fig 11. The average b values were less than 3 for both species which shows that most of the fishes had a negative allometric growth i.e. most of the Tilapia grows faster in length than in weight. It also indicates when b<3, either that the large specimens have changed body shape, i.e., become more elongated, or the small specimens were in better nutritional condition at the time of sampling. These results agree with the studies of (8) and so many other fisheries studies that postulated that there is a strong relationship between the length and the weight of Tilapia species and that generally exhibit a negative allometric growth pattern.

4.4 Condition Factor

The individual fish species condition is determined based on the analysis of length weight data reflecting that the heavier fish at a given length is in better condition (4), hence indicating favourable condition. The Tilapia species found across stations had an average condition factor above two (2). This shows that the fishes are in a favourable condition and agrees with the studies of Puntiuschola, (1), (3) and (15).

Condition sometimes reflects food availability and growth within the weeks prior to sampling. However, the condition is variable and dynamic. Individual fish within the same sample vary considerably, and the average condition of each population varies seasonally and yearly.

The differences were attributed to the effect of eutrophication and pollution on growth and other biological aspects of *Oreochromis niloticus* as suggested by, (14) and, (25), also observed similar results. The study presented the basic information on length-weight relationships and condition factor of *T. mossambica* of study area which would be useful for fishery managers as well as the sustainable management.

5. Conclusion

The stomach contents analysis indicated diverse food sources. The major food source was phytoplankton. Other food samples from plant sources found in the stomach analysis were; leaf plants, plant tissue, etc. The animal sources were insect parts, insect larva, protozoa and others. The stomach content analysis of the sampled fishes provided a baseline study of food and feeding habits of Tilapia species in the sampled stations.

The condition factor for all the fish samples was greater than one. This result is an indication that all the fishes were in a good condition. The condition factor for the sampled fishes in the three sampled stations agreed with the length and weight relationship

The length and weight relationship in the three sampled stations for the *Tilapia guineensis* and *Sarotherodon melanotheron* showed negative allometric growth, i.e. they were all < 3. This is an indication that fishes grow longer in length than in weight. The length-weight relationship in fishes can be affected by a number of factors including season, habitat, gonad maturity, sex, diet, stomach fullness, health and preservation techniques, and differences in the length ranges of the specimen caught. The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish

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