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# Natural diets and length-weight relationship of Brycinus macrolepidotus in lower Ogun River, Akomoje, Ogun state

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**Abstract**
The natural diets and length-weight relationship of Brycinus macrolepidotus in Lower Ogun River, Nigeria was studied. 124 fish samples were collected twice monthly from February-August, 2015 from catches landed by artisanal fishermen using cast nets and long line. The total length and total body weight of all fish captured were measured and then grouped into sizes. Length-weight relationship was determined using the formular $W = aL^b$. Gut contents were determined using the frequency of occurrence and numerical method. Index of fullness was also determined. Result of stomach content suggests omnivorous feed habit as diet were of plant and animal materials. Stomach fullness was higher during the dry season and onset of the rains than at the peak of the rains. Mean total length and weight of specimens varied from 18.19 ± 1.59 cm and 71.21 ± 15.54 g (juveniles), 34.99 ± 2.80 cm and 142.25 ±34.05 g (sub-adults) and 24.45 ± 2.53 cm and 301.46±22.67 g (adults) respectively. Length-weight analyses showed negative allometry for all sizes ($b<3$) and 'r' values 0.8252 to 0.9963. The study contributes to documented facts about the species from water bodies with a view of developing its aquaculture.

**Keywords:** allometry, Length-weight relationship, food items, index of fullness, juveniles, Brycinus macrolepidotus

## 1. Introduction
The True Big-Scale Tetra (Brycinus macrolepidotus) belongs to the family Alestidae of the order Characiformes (Valenciennes, 1850). Brycinus macrolepidotus is easily identified by dark bands or stripes found on their bodies and are more prominent in mature forms. Brycinus species are common in fresh water and water bodies of low salinity, thriving well in both lacustrine and riverine conditions as is typical of most [1]. The species is commonly regarded as an omnivore due to its ability to feed on both plants and animals matter inn its environment. Food habit of fish may vary from month to month due to change in seasons. Several researches have been conducted on various species of the Brycinus genus, they include, studies on the distribution, abundance, growth pattern and dietary habits of Brycinus nurse [2], Length-weight relationships and condition factors of Alestes baremoze, Brycinus nurse and Schilbe intermedius [3], Size, sex and seasonal dynamics in the dietary composition of Brycinus nurse[4],. However, little has been reported on this species in Nigeria water bodies. For fish culture, biological factors that are considered important includes food and feeding habit and the length-weight relationship of the fish as they provide useful information the selection process of culturable species, feed to make available, fish niche and to prevent crowding and overstocking of culture environment. It is virtually impossible to near possible to collate sufficient information on the food and feeding habits of fish species in their natural habitat without studying their gut contents. Studies have revealed that the food and mode of feeding varies between individual fish species, with respect to size, age, life history stage, kinds of food available, season, time of the day and the location in which they are found [5, 6]. The study of the length-weight relationship (LWR) of fish from the wild are vital factors to the fishery industry as it help in predicting the maximum length and time suitable to harvest any fish species. Knowledge of the condition and growth patterns of specific fish is also obtained from the LWR of fish [7]. LWR is important in the calculation of the equation of growth in length into an equation of growth in weight [8]. Despite that the species is of great economic importance

in Nigeria and South West specifically, there is still paucity of information on B. macrolepidotus in Nigeria waters. The present study is aimed to attempt to examine the natural diet and LWR of B. macrolepidotus in Lower Ogun River.

## 2. Materials and Method

### 2.1 Description of the Study Area

Ogun river, with a latitude of 6.63 ($6^0$371 60N) and longitude of 3.45 ($3^0$271 0E) is a forest reserve located in Ogun State, Nigeria, West Africa. The location is situated 6.25 kilometers South West ($234^0$) of the approximate center of Nigeria and 526 kilometers south west ($239^0$) of the capital Abuja, measured with a compass. A 10 square kilometer area around Ogun River has an approximate population of 313439 (0.003134) person per square metre) and an average elevation of 40 metres above sea levels. It discharges into the Lagos lagoon and rises in Oyo state near Shaki at coordinates $8^0$4110N, 302810E and flow through Ogun state, precisely at Abeokuta south west local government area of Ogun State and into Lagos state [9].

### 2.2 Sampling and measurement

A total of 124 samples of B. macrolepidotus were collected twice monthly for the period of seven months (February - August, 2015) from catches landed by artisanal fishermen using cast nets and long line. The total length and total body weight of all fish captured were measured to the nearest 0.1cm using a fish measuring board and weight up to 0.1g by using a scale sensitive portable battery operated balance (Model No., CT, 1200-S, made in USA) respectively after using tissue to mop off water from the surface of the specimens. Fish samples were then grouped into sizes (juvenile, sub- adult and adult) for analysis.

### 2.3 Length-weight relationship

The LWR of fish was estimated by using the equation:

$$W = aL^b,$$

Where
W = total body weight in grams (g),
L = total length in centimetres (cm),
a = scaling constant
b = allometric growth coefficient.

After logarithmic transformation of this relation (Log a + b log L), parameters 'a' and 'b' were determined via least squares linear regression according to [10]. The value of 'b' gives information on the kind of growth of fish: The growth is isometric if b=3 and the growth is allometric if b≠3 (negative allometric if b<3 and positive allometric if b>3) as described by [11]. Then, body cavities were opened with the help of a simple scissors and entire stomach contents were removed, labelled and preserved in 4% formaldehyde for further laboratory analysis.

### 2.4 Laboratory techniques

General observations were made with a zoom stereo microscope, range 0.7-4.5, X20 wide-field eyepieces and X2 extra objective lenses giving total magnification of X180. Gut contents were thoroughly examined and notes made on organisms present. The contents were observed in sub samples to avoid impediment to viewing caused by quantity of material in whole stomach. Distilled water was added to each sample and then broken down cautiously to reveal whole identifiable organisms. The percentage composition of food items were applied, frequency of occurrence method and numerical methods as in [12] were used in the analysis of the stomach contents to show seasonal variations in food choice, and feeding habit of the fish.

#### 2.4.1 Number method by Hynes [12]

The total numbers of individuals of each food item are given, and are also usually expressed as percentages of the total number of organisms found in all fish examined.

% Number of a food item = Total number of the particular food item x 100 Total number of all food items

#### 2.4.2 Occurrence method Hynes [12]

The number of stomachs in which each item occurs is recorded and expressed as a percentage of the total number of stomachs examined.

% Occurrence of a food item = Total number of stomachs with the particular food item x 100
Total number of stomachs with food

#### 2.4.3 Index of fullness

Fullness index was estimated using the formular

Fullness index = dry weight of stomach contents x 100
Fresh weight of fish

It is usually expressed as parts per 10,000 (%00, or parts per decimile)

## 3. Results

### 3.1 Length-weight relationship

Result of length and weight measurement revealed a total of 33 juvenile, 52 sub-adult and 39 adult fish samples Table 1.

**Table 1:** Data on length and weight

| Fish size | No of specimen | Length groups (cm) | Weight ( g ) | Mean length (cm) | Mean weight ( g) |
|---|---|---|---|---|---|
| Juvenile | 33 | 10-20 | 40-95 | 18.19 ± 1.59 | 71.21 ± 15.54 |
| Sub-Adult | 52 | 21-30 | 92-200 | 34.99 ± 2.80 | 142.25 ±34.05 |
| Adult | 39 | 31-40 | 280-330 | 24.45 ± 2.53 | 301.46±22.67 |

The length to weight relationships of varying sizes of B. macrolepidotus is presented in Figure 1. The regression coefficients 'r', when calculated using the methods of least squares for samples of B. macrolepidotus based on size gave the following equations: LOG W = 0.84+1.52LOGL, LOG W= 0.99+1.6007LOGL, LOG W= .1.37+ LOGL1.4954 for juveniles, sub-adult and adults respectively. Exponential value of the length-weight relationship 'b' was 1.52, 1.60 and 1.49 as observed from the above logarithm equations. Values for all specimens were practically identical indicating negative allometric growth (b<3)

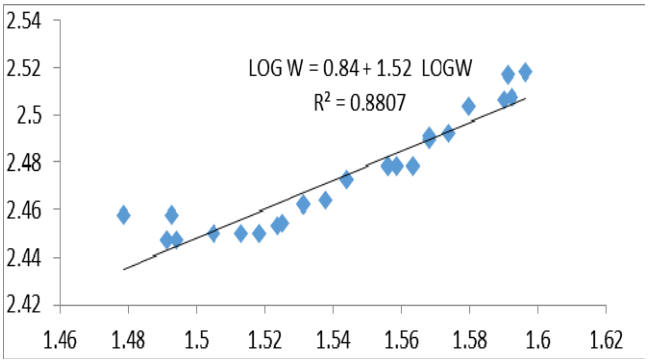


**Fig 1a:** Juvenile fish samples

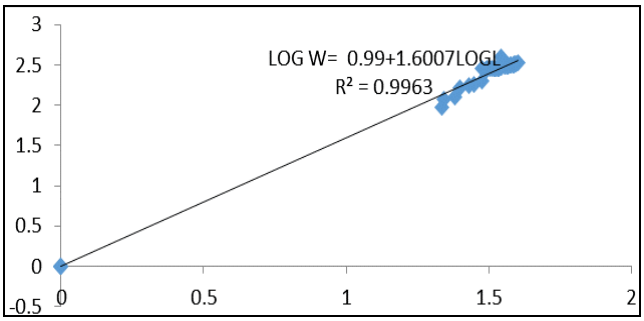


**Fig 1b:** Sub-adult fish sample

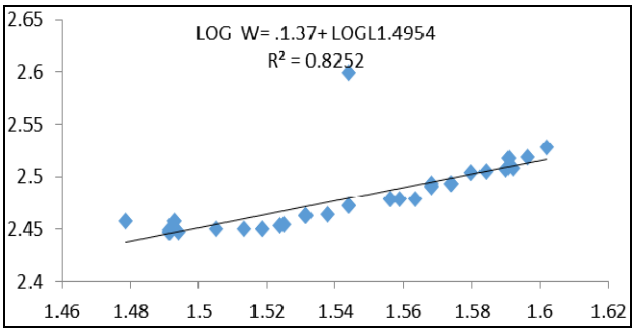


**Fig 1c:** Adult fish samples

**Fig. 1:** Length-weight relationship of different sizes of B. macrolepidotus in the Lower Ogun river

### 3.2 Seasonal feeding intensity

Table 2 and Fig. 2 showed the season and feeding activity of 124 fish samples examined during the study. Index of fullness revealed a higher percentage of fullness in the stomach of B. macrolepidotus in the dry season and onset of the rains than at the peak of the rains.

The maximum number of ¾ full stomachs was observed in wet season in the month of April with 85.79% and the minimum number of ¾ full stomachs was recorded in dry season in the month of March which had 67.05%.

**Table 2:** Season and feeding activity of B. macrolepidotus and fullness index

| Season | Months | Number of fishes dissected | Percentage of Fullness | Percentage of Emptiness | Fullness index |
|---|---|---|---|---|---|
| Dry season | Feb | 24 | 75.25 | 24.75 | 3/4 |
| | Mar | 13 | 67.05 | 32.95 | 3/4 |
| Wet season | Apr | 31 | 85.79 | 14.21 | 3/4 |
| | May | 21 | 79.74 | 20.26 | 3/4 |
| | Jun | 10 | 53.43 | 46.57 | 2/4 |
| | Jul | 07 | 42.73 | 57.27 | 2/4 |
| | Aug | 18 | 44.74 | 55.26 | 2/4 |
| Mean ± Sd | | 124 | 64.10 ± 20.56 | 35.9 ± 16.01 | 3/4 |

Statistical values are expressed as mean ± standard deviation

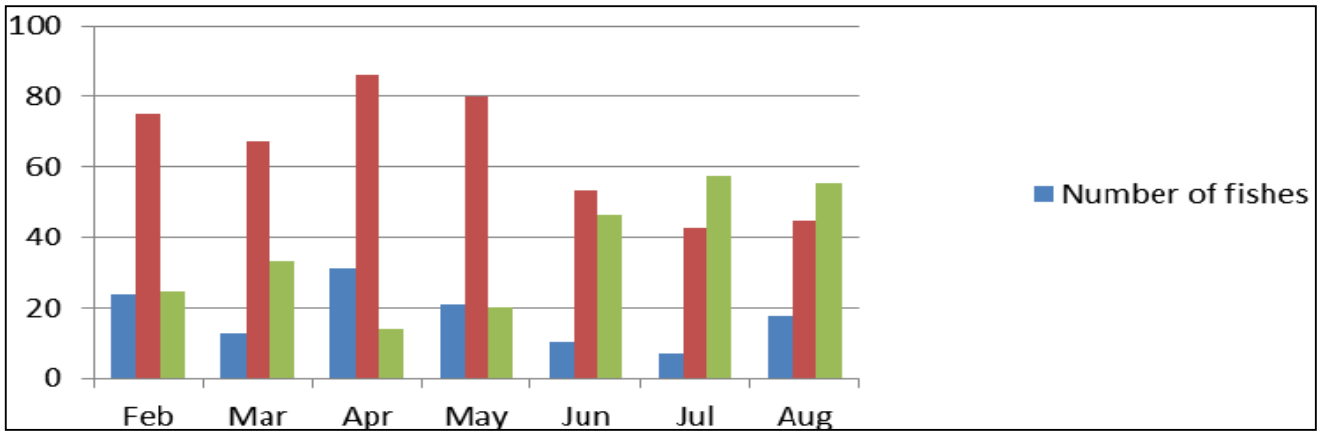


**Fig. 2:** Monthly variation in season and feeding activity of B. macrolepidotus

### 3.3 Summary of food items present in the stomach of B. macrolepidotus

A total of 21 organisms were identified in the stomachs of B. macrolepidotus which comprise rotifers, crustaceans, protozoans, Chlorophyceae, Cyanophyceae, Invertebrates, Diatom, Unidentified Materials and Detritus Table 3. Highest percentage was observed in the protozoan Volvox both in occurrence and in number.

**Table 3:** Summary of food items present in the stomach content of B. macrolepidotus

| Prey categories | Occurrence method | | Numerical method | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Rotifers | | | | |
| Keretella | 82 | 66.13 | 245 | 7.16 |
| Testudinella | 45 | 36.29 | 182 | 5.32 |
| Rotaria | 22 | 17.74 | 32 | 0.93 |
| Crusteceans | | | | |
| Cypridopsis | 24 | 19.35 | 50 | 1.46 |
| Chydomis | 33 | 26.61 | 149 | 4.35 |
| Eurycercus | 58 | 46.77 | 61 | 1.78 |
| Cyclops | 39 | 31.45 | 45 | 1.31 |
| Protozoans | | | | |
| Volvox | 103 | 83.06 | 619 | 18.08 |
| Chlamydomonas | 94 | 75.81 | 333 | 9.73 |
| Loxodes | 44 | 35.48 | 145 | 4.24 |
| Chlorophyceae (Green alga) | | | | |
| Pediastrum | 20 | 16.31 | 110 | 3.21 |
| Scenedesmus | 16 | 12.90 | 11 | 0.32 |
| Cladophora | 34 | 27.42 | 15 | 0.44 |
| Cyanophyceae (blue-green algae) | | | | |
| Anabaena | 50 | 40.32 | 320 | 9.35 |
| Nostoc | 33 | 26.61 | 186 | 5.43 |
| Invertebrates | | | | |
| Food items | | | | |
| Water Spider | 42 | 33.87 | 119 | 3.48 |
| Chironomus | 29 | 23.39 | 84 | 2.45 |
| Diatom | | | | |
| Melosira | 15 | 12.10 | 99 | 2.89 |
| Tabellaria | 09 | 7.26 | 69 | 2.02 |
| Unidentified Materials | 81 | 65.32 | 220 | 6.43 |
| Detritus | 92 | 74.19 | 369 | 10.78 |

### 3.4 Feed items Distribution base on fish size

Table 4 shows the relationship between size of B. macrolepidotus and its feeding habit. The major feed items were all present in the adult sample. Rotifers, green algae and some other feed items were observed to be absent in the juvenile fish samples.

**Table 4:** Percentage of major food items found in the stomach of different sizes of B. macrolepidotus

| Food items | Size of the fish | | |
|---|---|---|---|
| | Juvenile (10-20cm) | Sub-Adult (21-30cm) | Adult (31-40cm) |
| Rotifers (%) | *** | 8.41 | 7.24 |
| Crustaceans (%) | 5.22 | 8.69 | 9.30 |
| Protozoans (%) | 13.60 | 16.28 | 16.67 |
| Green alga | *** | *** | 3.95 |
| Blue-green algae | *** | 4.28 | 6.53 |
| Invertebrates | 5.58 | 2.46 | 3.10 |
| Diatoms | 0.79 | 1.89 | 2.30 |
| Unidentified Materials | 8.26 | 14.11 | 19.38 |
| Detritus | 14.00 | 22.41 | 12.57 |

*** = Did not occur in discrete unit

## 4. Discussion

In the course of the study, B. macrolepidotus captured had maximum length of 40 cm and the minimum length 10 cm thereby splitting the specimen into three sizes of juvenile, sub adult and adult. The total length range recorded of members of The Brycinus family in other water bodies in Africa were 6.5-7.5 cm White Volta River [3], River Jamieson 9.6-26.1 cm [2], 12-23 cm and Asa reservoir [4]. However, larger sizes of B. macrolepidotus were obtained during this study when compared to that of other Brycinus species from other water bodies. This could be attributed to the under exploitation of the species in this body of water. The length exponent 'b' values obtained in this study revealed that the juvenile, sub-adult and adult of the species from the water body expressed allometric growth pattern. Positive allometry growth pattern (b>3) was reported for males and isometric (b=3) growth pattern for immature and females of B. longipinnis in River Jamieson [2], however, this does not corroborate the findings of this research. Also, 'b' values obtained in the study of [3] range between 2.9, 3.45 and 3.07 for the Brycinus species: Alestes baremoze, Schilbe intermedius and Brycinus nurse respectively in the lower reaches of White Volta River. The low values of the length exponential revealed for the species in this study could be due to weight of the species not aligning with the length as the fish grows. However, B. macrolepidotus like other members of this family exhibited a preference for feeding on food items of plant and animal materials and thus it is regarded as an omnivorous feeder [6]. The seasonal variation in the feeding intensity observed in the species is not unexpected. Higher percentage of fullness index obtained in samples during the dry season may be attributed to the concentration of food items in the water body due to reduction in water level. However, highest percentage of fullness was observed during the onset of the rains which could be due to washing of food items that may have gone into hibernation or material that may have been excavated the soil and buried themselves deep into the soil back into the water body by the rains. This species diet composition was of varying food items ranging from plant to animal materials confirming the euryphagous and non-selective feeding habit expressed by other members of the family [2]. This result does not align with the findings of Suseelan and Nair [15] who stated that the species is a scavenger due to the presence of big teleost vertebrae bone in their diet composition. Victor and Brown [16] have reported similar result in their study on B. nurse in Asa reservoir. Other researchers have recorded an overlap in diet of members of this family [17, 18]. Examination of the diet of B. macrolepidotus showed that there was high percentage of volvox and chlamydomonas in their stomach. The fact that volvox (83.06%) and some higher plants were the major food item in the gut of the species in the study area implied that most of the fish species in this water body are omnivores. The food items observed in the stomach of the adult specimen were the major food items such as crustaceans, volvox when compared to the sub-adult and juvenile specimen. This shows that the adult of this species were non-specific feeders but selection could be detected in the stomach of the smaller sizes with absence of algae in their stomach diet composition. Dietary habit relative to size was however qualitatively measured in this study.

## 5. Conclusion

This study has explored the aquatic interactions between the species and its environment in the Ogun River and thus has contributed to knowledge of LWR and natural diet of B. macrolepidotus. Thus, more researches should be carried out on this species to provide sufficient data for management, conservation and culture of the species.

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**Competing Interest**
The authors declared that they had no competing interest.

**Authors' Contribution**
FIA and OSA participated in the design of the study. OSA carried out the experiment and performed the statistical analysis. FIA, AWO, ODO and IAA supervised and coordinated the research. FIA and AMO participated in the discussion and corrected the manuscript. All authors read and approved the final manuscript.

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