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# Food and Feeding Habits of the Cichlidae in Tagwai Reservoir, Niger State, Nigeria

**Ibrahim Baba Usman[1]*, Balogu Dennis Odionyenfe[2] and Yunusa Audu[1]**

[1]Department of Biological Sciences Faculty of Natural Science Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria

[2]Department of Food Science and Technology Faculty of Applied Sciences Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria

**ABSTRACT**

Feeding is one of the most important biological factors in the life of any living organism. Its abundance and variety influence the structure as well as composition of fish populations in the aquatic environment. Food and feeding habit are useful in determining fish population level, since the number of individuals on the population depends on the amount of food available, the composition of such food may also vary depending on fish size, level of maturity, habitat types and environmental condition. Four hundred and seventeen (417) samples comprising of one hundred and eighty-six Sarotherodon galilaeus and two hundred and thirty-one (231) Coptodon zillii were collected on monthly basis for four (4) months (March, 2021 to June, 2021) from the catches of local fishermen operating on Tagwai Reservoir, in Niger State, Nigeria. The fresh samples were transported in ice - chest box to the Biology Department laboratory of Ibrahim Babangida University (IBB), Lapai, Niger State, where analyses were carried out. Eight (8) different types of dietary items that constituted plant and animal materials were found as food in the stomachs of each of S. galilaeus and C. zillii. This included detritus, sand, algae, plant material, nematode, plankton, seed and unidentified material. Plant material was highest (30.30%). Followed by detritus (17.32%), then algae (16.01%), the lowest was nematode and unidentified material each with 2.16%. Feeding intensity of both species of fish was high due to low percentage of empty stomachs recorded during the period of study. 157 stomachs of S. galilaeus out of 186 examined had food while 181 stomachs of C. zillii out of 231 examined had food. S. galilaeus and C. zillii are omnivore and herbivore respectively based on their feeding habits. Diet overlap or similarity showed moderate level of association in diet and less competition for food between the two species. There is need to examine other aspects of biology, such as growth, fecundity, age of these fishes in the reservoir. This study can be used as baseline information for carrying out similar study in other water bodies.

***Corresponding author**

Ibrahim Baba Usman, Department of Biological Sciences Faculty of Natural Science Ibrahim Badamasi Babangida University Lapai, Niger State, Nigeria.

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## Introduction

Feeding is one of the most important biological factors in the life of any living organism. Its abundance and variety influence the structure as well as composition of fish populations in the aquatic environment [1]. Therefore, knowing the natural food of fish helps to identify the tropic relationships present in aquatic ecosystems, identifying food composition, stability and structure of food webs in the ecosystem [2,3].

Food and feeding habit are useful in determining fish population level, since the number of individuals on the population depends on the amount of food available. However, the composition of such food may also vary depending on fish size, level of maturity, habitat types and environmental condition [4]. Analysis of fish diet in the natural habitat enhances the understanding of the abundance, growth, productivity and distribution of organisms [5].

Food consumed by fish is determined through the examination of gut or stomach contents. This is so because the natural habitat offers a great diversity of organisms, which are utilized as food by fish differs both in sizes and kind [6]. The kind of food consumed by fish, which is supported by shape of mouth, type of teeth and length of alimentary tract helps in categorizing fishes into the appropriate feeding regimes or groups as carnivores, herbivores and omnivores.

The family Cichlidae, which is among the commercially important group of fish in Tagwai Reservoir Sarotherodon galileaus and Coptodon zillii as most common, have not being given due attention, in terms of knowing their natural food and changes in dietary preferences as a way to managing these fishes adequately.

Food and feeding habits study has been an important subject of continuous research because it determines the nutritional needs and interaction with other organisms [7]. This forms the basis for development of successful management program in both capture and culture fishes. However, there is no available information on food and feeding habits of these fishes in the reservoir.

Cichlidae is one of the most important families of fish of inland water bodies of Nigeria because of their commercial values.

Two (2) important genera (Sarotherodon and Tilapia) are found in Tagwai Reservoir contributing immensely to the fisheries of the reservoir, which is evident in fishers catch. Therefore, such study gives understanding of fish diet, method of feeding, provide information on grouping of fish based on their food and subsequent culture [8]. The objectives of this study are to determine the food composition, feeding intensity, feeding habits, and, if there is competition for food items among these fishes.

## Materials and Method

### Study Area

Tagwai Reservoir is one of the many fresh water bodies found in Chanchaga Area of Niger State, middle belt of Nigeria. It is located on latitude 9o 34' N and 9o 37' N and longitude 6o 39' E and 9o 44' E. The reservoir has a stretch of 1.8 Km in length and 25m high with a capacity of 28.3 million cubic meters. The activities going on around, and, in the reservoir include domestic, farming and fishing.

### Fish Identification, Sample Collection and Transportation

Samples of S. galilaeus and C. zillii (formerly Tilapia zillii) were identified at landing sites using morphological and meristic features, such as spine and ray counts, color, body form based on guide by [9].

Four hundred and seventeen (417) samples comprising of one hundred and eighty-six S. galilaeus and two hundred and thirty-one (231) C. zillii were collected on monthly basis for four (4) months (March, 2021 to June, 2021) from the catches of local fishermen operating on the reservoir.

Different sizes of fresh samples were collected and as soon as this is done, samples were transported in ice - chest box to the Biology Department laboratory of Ibrahim Babangida University (IBB), Lapai, Niger State where analyses were carried out.

### Fish Measurements, Dissection and Preservation

Standard length (cm), total length (cm) and the weight (g) of each fish sample were measured using measuring board and weighing balance respectively [10]. Each fish samples were dissected using a pair of scissors and their stomachs completely removed by carefully detaching them from other internal organs and fatty tissues. Samples that cannot be analyzed immediately were preserved with 5% formalin solution in properly labeled sample bottles.

### Stomach Fullness Classification

Each stomach was examined and scored based on the quantity of food found in it according to the procedures of as follow:
Empty Stomach - 0, Almost Empty Stomach - ¼, Half Full Stomach - ½, Almost Full Stomach - ¾ and Full Stomach – 1
The weight of each stomach was measured in grams (g) using sensitive weighing balance or scale [11].

### Stomach Contents Analyses

Stomach from each fish sample was carefully dissected or cut open and the contents removed and emptied in petri - dish then examined. Where food items stick together, distilled water was used to disperse them. Food items were sorted, identified and counted under the microscope for items that are minute. Those that are macro (visible to the eyes) were sorted, identified, and then counted. Identification of the food items was done using key by Macan (1979). Frequency of occurrence was used to analyze the stomach contents [2].

### Measures of Association or Overlap

This index determines whether two (2) species of fish have similar or different diets. It uses the presence, absence and joint food items to determine any form of competition. This was determined using the following method:
S = 2C/(A+B) ……Adesina and Ikuyeju (2019).
Where:
S = Ranges from 0 - 1.0
A and B = Number of different food items consumed by fishes
C = Number of joint food items consumed by fishes

### Statistical Analyses

The following data, Standard length (cm), total length (cm) and the weight (g) were subjected to descriptive statistics to compute for means, minimum, maximum, standard deviations and percentages. Analysis of variance (ANOVA) was used to test for any significant difference at 95% confidence limit of the data. Microsoft Excel 2010 and Special Package for Social Sciences (SPSS) Version 20 were used as statistical packages.

## Results

The observed food items found in the stomachs of S. galilaeus in Tagwai Reservoir, Niger State is shown in Table 1. There were variations in food compositions of S. galilaeus during the period of study.

Eight (8) different types of items that made up of plant and animal materials constituted the food of the fish. This included plant materials, spirogyra species, copepods, sand particle, detritus, insect part, mollusc and unidentified material. Detritus was highest (27.42%) followed by plant material (24.19%) then spirogyra spp (16.13%) and lowest was copepods (1.61%).

**Table 1: Food Composition of Sarotherodon Galilaeus in Tagwai Reservoir, Niger State, Nigeria**

| Item | No | % |
|---|---|---|
| Plant material | 45 | 24.19 |
| Spirogyra spp | 30 | 16.13 |
| Copepods | 3 | 1.61 |
| Sand particle | 25 | 13.44 |
| Detritus | 51 | 27.42 |
| Insect part | 12 | 6.45 |
| Mollusc | 10 | 5.38 |
| Unidentified material | 10 | 5.38 |
| Total | 186 | 100 |

The observed food items found in the stomachs of C. zilllii in Tagwai Reservoir, Niger State is shown in Table 2. There were variations in food compositions of C. zilllii during the period of study. Eight (8) different types of items that constituted plant and animal materials were found as food of the fish. This included detritus, sand, algae, plant material, nematode, plankton, seed and unidentified material. Plant material was highest (30.30%), followed by detritus (17.32%), then algae (16.01%), and, lowest were nematode and unidentified material each with 2.16%.

**Table 2: Food Composition of Coptodon Zilllii in Tagwai Reservoir, Niger State, Nigeria**

| Item | No | % |
|---|---|---|
| Detritus | 40 | 17.32 |
| Sand | 22 | 9.52 |
| Algae | 37 | 16.01 |
| Plant material | 70 | 30.3 |
| Nematode | 5 | 2.16 |
| Plankton | 39 | 16.89 |
| Seed | 13 | 5.64 |
| Unidentified material | 5 | 2.16 |
| Total | 231 | 100 |

Classification of stomach contents of S. galilaeus based on degree of fullness in Tagwai Reservoir, Niger State throughout the period of study is shown in Table 3. Out of the one hundred and eighty-six (186) stomachs examined, 157 (84.40%) contained food while 29 (15.60%) were empty. Based on degree of fullness, half full stomach was highest (29.60%) followed by almost empty (23.10%) while almost full stomach was the lowest (9.68%).

**Table 3: Stomach Contents Classification of Sarotherodon Galilaeus Based on Degree of Fullness in Tagwai Reservoir, Niger State, Nigeria**

| Degree of fullness | Number of stomachs | Frequency (%) |
|---|---|---|
| Stomach with food | 157 | 84.40 |
| Stomach without food | 29 | 15.60 |
| Full (1) | 41 | 22.04 |
| Almost full (3/4) | 18 | 9.68 |
| Half full (1/2) | 55 | 29.60 |
| Almost empty (1/4) | 43 | 23.10 |
| Empty (0) | 29 | 15.58 |
| Total | 186 | 100 |

Classification of stomach contents of C. zillii based on degree of fullness in Tagwai Reservoir, Niger State is shown in Table 4. There are differences in the stomach fullness classification during the period of study. Out of the two hundred and thirty-one (231) stomachs examined, 181 (78.35%) contained food while 50 (21.65%) were empty. Based on degree of fullness, half full stomach was highest (29.44%) followed by almost empty (22.51%) while full stomach was the lowest (6.49%).

**Table 4: Stomach Contents Classification of Coptodon Zillii Based on Degree of Fullness in Tagwai Reservoir, Niger State, Nigeria**

| Degree of fullness | Number of stomachs | Frequency (%) |
|---|---|---|
| Stomach with food | 181 | (78.35) |
| Stomach without food | 50 | (21.65) |
| Full (1) | 15 | 6.49 |
| Almost full (3/4) | 46 | 19.91 |
| Half full (1/2) | 68 | 29.44 |
| Almost empty (1/4) | 52 | 22.51 |
| Empty (0) | 50 | 21.65 |
| Total | 231 | 100 |

The measure of association or overlap between the food compositions of S. galilaeus and C. zillii in Tagwai Reservoir, Niger State is shown on Table 5. The number of food items in each fish was categorized as eight (8) while joint or common ones are four (4).

The calculated value was 0.50, which shows some degree of association or similarity in the diet of these fishes.

**Table 5: Measure of Association or Overlap of Food Between Sarotherodon Galilaeus and Coptodon Zillii in Tagwai Reservoir, Niger State, Nigeria**

| Species | No. of different food items (A and B) | Number of joint foods shared by species (C) | Measure of association or overlap (S = 2C/A+B) |
|---|---|---|---|
| S. galilaeus | 8 | 4 | 0.50 |
| C. zillii | 8 | 4 | |

* S values range from 0 - 1.0

**Discussion**

Food is very important in the existence of organisms including fish. The categories of food items ingested by S. galilaeus were between plants and animal materials. This is similar to the findings of [11]. Detritus and plant materials are the most important item and copepod as lowest indicated its less importance in the food of the fish. This supports the findings of that reported detritus as the most important food item but contradicts that of where higher plants was the most important [11-12]. This could be due to availability or absence of these items in the aquatic environment. C. zillii also fed on wide variety of food items ranging from plant to animal materials. Plant material and detritus were important items in the diet of the fish. Nematode and unidentified material are of less importance in the fish diet. The presence of sand or sand particles in the stomachs of S. galilaeus and C. zillii indicated that these species carry out feeding activities at the shallow part of the water body.

The high percentage (84.40%) of stomachs of S. galilaeus with food and low stomachs (15.60%) that are empty indicate the abundance of food during the period of study. Although there was high feeding intensity, almost empty stomach (23.10%), which was highest in terms of fullness, could be due to digestion taken place during and after capture. The high stomach percentage (78.35%) observed in C. zillii also signify availability of food for this species in the reservoir with half full stomachs being highest in terms of fullness. Feeding in tropical water fishes is highly seasonal and changes in factors such as season, food availability and temperature. This could the reasons for such observation.

The abundance or dominance of a food item is very important in categorizing fish based on trophic level. S. galilaeus can be said to be an omnivore because it exploits wide varieties of food items from both plant and animal materials. This is similar to the findings of [13]. C. zillii fed predominantly on plant materials with only nematode as animal material in the food items in the reservoir. Therefore, it can be classified as herbivore. This is similar to the findings of Dadebo et al. (2014), that reported C. zilli as an herbivore, and contrary to the findings of Uneke (2017) that reported C. zillii as an omnivore.

Measure of association or overlap is an important index used to determine if two species of fish have similar or different diets. Once the calculated value is greater than 0.5, the diets of fishes are similar. The calculated value (0.5) indicates that there is moderate level of association in the diet between the two species of fish. There could be less competition for food between these species of fish.

## Conclusion

Eight different food items that ranged between plant and animals materials were found in the stomachs of each of S. galilaeus and C. zillii. Although detritus and plant materials were the dominant items found in stomachs of these fishes, there were differences in other food items. Feeding intensity of both species of fish was high due to low percentage of empty stomachs recorded during the period of study. 157 stomachs of S. galilaeus out of 186 examined had food while 181 stomachs of C. zillii out of 231 examined had food. S. galilaeus and C. zillii are omnivore and herbivore respectively based on their feeding habits. Diet overlap or similarity showed moderate level of association in diet and less competition for food between these species.

There is need to examine other aspects of biology, such as growth, fecundity, age of these fishes in the reservoir. S. galilaeus and C. zillii can be raised in the same environment or culture system. There is need to analyze or determine the nutritional contents of their diets to serve as guide in feed formulation. This study can be used as baseline information for carrying out similar study in other water bodies [14,15].

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