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Studies on the Food and Feeding Habits, Condition Factors of Tilapia Zilli in Tiga Dam, Kano State, Nigeria

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ABSTRACT

Studies on the biology of Tilapia zillii was carried out for nine months, April – December, 2015. During this period of study, 306 specimens of Tilapia zillii were caught in Tiga Dam. The smallest specimen had a standard length of 7.00cm and a total length of 9.00cm and a weight of 13gm; while the biggest specimen caught had standard length, total length and weight of 52.23cm; 60.1cm; and 300gm respectively. The specimens were concentrated mainly in the shallow inshore regions of the Dam. Feeding activity was intense during the day reaching a peak at noon and this declined towards evening. Food items were sorted into taxonomic categories and the displacement of the group of items in each category is measured in a partially filled graduated cylinder. To obtain meaningful results, superficial water attached to food items were removed before displacement is measured. The fish fed on wide variety of food substances predominantly on the shoreline higher plants, green algae and insect remains.

Keywords: Feeding habits, Food, Condition factors, Tilapia zilli, Dam, Feeding pattern, Food composition.

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1. INTRODUCTION

Fish is a staple article of food which had found favour with man and there are few races today who do not include the valuable protein food in their ordinary diet [21, 27]. In the Northern part of Nigeria, fresh water fishes of which *Tilapia zilli* is one, form the bulk of food protein [3, 24, 35]. The colour of *T. zilli* varies and this is related to the wide area of distribution as observed by Gunther, [20]. There is a distinct blotch in the upper corner of the gill cover with the throat, chest and belly usually light in colour, while the fins are rust coloured [11]. The dorsal fin has a blue black spot. In some males especially, the throat and belly show brilliant blood red colour and transverse bands are distinct at the side of male and female fish.

In Nigeria, artisanal fish production under natural conditions had for generations played a major role in fish production [13, 39]. The first attempt at fish culture in Nigeria was in 1951, at a small experimental station in Lagos, involving various *Tilapia* species. The *Tilapia* culture was not successful and what can be termed

modern pond culture started with the establishment of a pilot fish farm of 20 hectares in panyam (plateau state) for rearing carp [35] *Tilapia* is one of the most widely cultured fish in the world currently, farmed *Tilapia* represents more than 75% of world *Tilapia* production [17] and this contribution has been exponentially growing in recent years [33]*Tilapia* feed on a wide variety of dietary sources, including phytoplankton, zooplanktons, larval fish, and detritus. Adult *tilapia i*s principally herbivorous but readily adapts to complete commercial diets based on plant and animal protein sources [22, 38].

Many *cichlids* living in swallow fresh waters of Africa move in to warm water during the day and return to cooler deeper water at night. Fryer lles, [18] and El-Sherif and El-Feky, [16] reported that the fish family *cichlidae* which includes *Tilapia zilli* has over 2000 species distributed throughout Africa, Israel, Syria, and India.

It is of considerable economic importance to be able to determine the age of a particular fish especially if the fish is of commercial importance as the case of *Tilapia Zilli*. The scales of a fish exhibit a great diversity in shape and size in different fish species. Greenwood, [21] noted that bony fishes including *T. zilli* have regular scale arrangement and with certain limits, both scale size and disposition is constant for any species of fish. William Reed, John Burchard, A.J Hopson, Jonathan Jenness, Ibrahim Yaro, [40] pointed out that the determination of age usually from the rings on the scales had become one of the standard methods in fishery research. However, the observation made by Lowe-McConnell, [32] was that female *Cichlid* in particular showed the most definite scale rings during age determination. Allen Davis and Nelly Isyagi, [8] remarked that *Tilapia* species exhibit stunted growth as a result of rapid reproductive rate.

Nikolsky (1945 and cit hartly, 1948) were of the view that the study of food and feeding habits of a fish will help to understand the qualitative connections between the fish and food organisms. Liem, [31]; Negassa and Getahun, [34] noted that the intra and interspecific difference in feeding of *Cichlid* fishes had resulted to many species feeding on variety of foods. Hutchinson, [26] and earlier found out that fishes on a wide variety of foods but this varieties within species indicating some food selectivity. Azubuike, [4] reported that *T. Zilli* ate anything that comes its way while searching for its preferred food. Fryer and lles, [19] earlier observed that *T. Zilli* was a plant eater and found that *T. Zilli* fed on aquatic macrophytes.

1.1. Justification

Tilapia Zilli is one of the *Cichlid* family found all over Nigeria. The study of its Biology will assist fish farmers in its management strategy for higher productivity in aquaculture. Also, aquatic weed infeststion of dams is a big problem in Nigeria. Several methods of control have been to remove them, which includes:

1. Manual control
2. Chemical control
3. Biological control

Tilapia Zilli is a macrophytic feeder used to control aquatic weeds. It will be of importance to see whether the fish could be used for aquatic weed control in Tiga Dam. *Tilapia Zilli* due to its prolific acts, *Tilapia Zilli* will be of immense advantage as ingredients of fish feeds

1.2. Objectives of the Study

1. Study abundance and distribution of the species in the dam
2. Gives a list of the food items and feeding rhythm

2. MATERIALS AND METHODS

2.1. Tiga Dam

In 1971, the construction of Tiga Dam was started by the Ministry of works and surveys of Kano state Government. Out of this ministry, WRECA-Water Resources and engineering construction Agency was established in 1974, WRECA thus became the actual contractor of Tiga Dam on behalf of Kano state government. The dam has a catchment area of6553km^3 (2,564 sq.ml) of land. Average annual rainfall 1000mm (40 inches) and average annual runoff 1.3x10^{9}m^3. The dam has a volume of 12x10^{6}m^3 at its maximum capacity. The reservoir area is 18,900ha.

Tiga dam is the largest dam in Kano State and its location in the state. The main outlet goes across the road to the Northern part of the State. It firstly supplies water to RuwanKanya Dam before it movies to GarunMallam side. It gives water to eleven (11) night storage reservoir of Kano River Project (Phase 1) under HadejiaJama'are River Basin Development Authority. It goes through Wudil up to the Barage in Auyo. It finally moves beyond Hadejia Local Government. The Dam is very rich in different types of fish.

2.2. Dam Embankment

Tiga Dam is a 48 meters high embankment Dam, situated on the Kano River some 60km south of Kano. The embankment is 6km long and it impounds a large reservoir with a capacity of 1974x10^{6}m^3 (1,600,000 acre feet) which provides a substantial degree of regulation of the flow of the Kano River. The dam has a separate free over-fall spillway located on a saddle on the left bank. The dam is equipped with three outlets.

Two major seasons cover this annually. The dry season extends from November to April while the rainy season is from May to October. Some submerged tress appears sparingly along the periphery southwards of the resservior. Despite the fact that the Dam receives high discharge of water during rainy season, its water does not become turbid because this water does not carry sediments from farmlands and lands of the catchments area. At this particular period, a lot of excess water passes out to the reservoir through the auxiliary spill way.

2.3. Sample Site

The sampling that were employed during this work were:

1. The Head Water – Rock Castle Hotel in shore (A)
2. Nata'alaVillaga – Mid – shore (B)
3. Rurum – Offshore (C)

Tiga Dam is a zoned embankment structure constructed of residual soils formed the weathered granites underlying the site together with some sedimentary material from old river – terraces.

The main spillway, together with adjacent length of auxiliary spillways on either side of it are located in a saddle on the western side of the Dam. This saddle is well separated from the earth dam by massive rock outcrops reaching up to elevation 114m (Rock Castle).

The spillway discharges into a channel, excavated for this purpose.

During this period of study, sampling for *Tilapia zilli*commenced in Aril, 2015 and extended till December, 2015. The fishing methods employed were cast netting and gill netting.

2.4. Gill Netting

The grill net used was 250 meters long with five different mesh sizes of 50 meters each. These were 11.4cm, 10.2cm, 7.6cm, 5.1cm and 2.5cm set either parallel or perpendicular to the shoreline between 6.00pm and 6.30pm in the evening and allowed to fish over night. During each gill net set measurement were obtained for water depths. The fish caught were removed from the net the following morning between 7:30am and 8:30am.

2.5. Cast Netting

A cast net of 7.6cm mesh size was used to catch *Tilapia zillii.* The fish caught were immediately killed so as to stop any regurgitation and further digestion in the fish gut. The Dam was divided into three sections for fish collection. The inshore area of the Dam was about 9 -12 meters from the shoreline while the offshore area was beyond this measurement. The fishes caught either by gill net or cast net were then brought into the laboratory and measured to the nearest millimeters for total and standard lengths and to the nearest gram for the weight.

2.6. Food Items

The fish caught by gill netting were not used for food studies because the food items in the stomachs have either undergone digestion or regurgitated as the fish struggled for escape. Hence, fish caught carefully removed. The stomach content for each specimen was weighted to the nearest o.1gm and the volume of food obtained by water displacement in a measuring cylinder [30].

The analysis of the stomach contents was done by the frequency of occurrence method according to Hynes, [25]; Jaunccy, [29] and the numerical method after Damman, [12].

In fed formulation, two factors are mainly put into consideration, namely maximum production in terms of growth, and profitability factors, [4] proposed systems for species selection for translocation or aquaculture based on the estimates of their growth rates under natural or culture conditions these estimate with data on the market value were used to generate a general bio-economic selection index for identifying candidate species for aquaculture.

To give an indication of how well a particular fish species might fit into a pond culture environment, the frequencies of organisms of the food groups in the stomach or gut and in the pond system to which they would be stocked in compared after Azubuike, [4].

2.7. The Condition Factor

The condition factor K expresses the "condition" of fish in terms of its general "well-being" in its habitat Condition factor expressed as:

$$K = \frac{100^{W}}{L^{n}}$$

Where n = an exponent (Slope of straight line graph from logarithm weight against logarithm standard length as shown in Fig 8).

W = weigh of fish (gm)

L = Length in centimeter (cm)

3. RESULTS

3.1. Size Distribution

A total number of 306 *Tilapia zillli*specimens were caught during the period of study. The smallest specimen had a standard length of 7.00cm and a total length of 9.00cm and a weight of 13gm, while the biggest specimen caught has standard length, total length and weight of 52.3cm, 60.1cm, and 30gm respectively. The length frequency distribution pattern of *T. zillii*indicates that a wide range of sizes of this fish were caught all-through the sampling months.

Table-1. Spatial Distribution of *Tilapia zillii*in Tiga Dam

Reservoir Station	Number of Fish	Percentage Composition (%)
Upper area (A)	64	21.0
Middle area (B)	147	48.0
Lower area (C)	95	31.0
Total	306	100

Source: Distribution of tilapia zilli in Tiga dam, 2015

Spatial Distribution: As shown in Table 1, 306 fish samples were caught with the set gill nets and 21.0% of these were caught in the upper area (A) of the reservoir, while 48.0% and 31.0% were caught in the middle (B) and the dam area (C) of the reservoir respectively.

Season Distribution: An increase in volume of water in the Dam was observed in the rainy season while a decrease in volume was evidence from large areas of shoreline that were exposed in the dry season.

Vertical Distribution: The depth distribution of *T. zillii*in relation to the net shown that the specimens were found at all depths as shown in Table 2. The width of the net was 1.32m and the percentage of fish caught at the middle of net was 47.06% of the total catch while the specimens caught at the bottom of the net and upper part of the net were 34.31% and 18.63% respectively.

Table-2. Depth Distribution in Relation to Net

Tilapia zillii	Number Caught	Upper part of Net	Middle part of Net	Bottom part of Net
Male	139	21	79	39
Female	167	36	65	66
Total Number	306	57	144	105
Percentage Composition	100	18.63	47.06	34.31

Source: Depth Dstribution of tilapia zilli in tiga dam, 2016

Horizontal Distribution: The number of fish specimens caught at the inshore area was greater than those caught at the offshore area. Out of 306 *T. zillii*specimens caught by gill-netting 33.00% of these were from the offshore area while 67.00% at the inshore area as shown in Table 3.

Table-3. Number of fish from Rurum and Head water catches of *Tialapiazillii*in Tiga Dam

	Number of Fish caught	Percentage Composition (%)
Rurum catches	101	33.00
Head water catches	205	67.00
Total	306	100

Source: Distribution of tilapia zilli in Tiga dam, 2015

Gill Net Selectivity: As shown in Table 4, the composition of fish caught by 2.5cm, 5.1cm, 7.6cm, 10.2cm, and 12.7cm. Stretched mesh sizes were 15.0%, 39.22%, 29.41%, 9.15% and 7.19% respectively. The size ranges of the fish specimen caught by each mesh size are shown in Table 4. The mean total length of the specimens caught by 2.5cm, 5.1cm, 7.6cm, 10.2cm and 12.7cm stretch mesh sizes were 12.25cm, 17.00cm, 22.00cm, 31.00cm and 45.25cm respectively.

Table-4. Size of Tilapia zillii caught by different stretched mesh sizes

Mesh Sizes					
	2.5cm	5.1cm	7.6cm	10.2cm	12.7cm
Total fish caught	46	120	90	28	22
Size ranges (cm)	(9.0-15.5)	(12.0-22.0)	(14.0-30.0)	(20.0-42.0)	(30.06-60.5)
Mean Total length (cm)	12.25	17.0	22.0	31.0	45.25
% composition	15.03%	39.22%	29.41%	9.15%	7.19%

Source: Sizes of tilapia zilli in tiga dam, 2015

3.2. Food and Feeding Habits

Feeding Pattern: The feeding pattern and habit of *T.zillii*in Tiga Dam were studied at three hour intervals between 6.30am and 6.30pm. at 6:30am in the morning, the stomachs examined were about three quarter full. The stomach content at 9:30am were also about three-quarter full. However, most of the specimens caught by 12:30pm showed full stomach contents. At 3:30pm, the observed specimens revealed that the stomachs were about three quarters full. The stomach observation in the evening catches showed that food items occupied

about half of the stomachs. *T. zillii* therefore, fed during the day and the peak feeding time was around mid-day [6].

3.3. Food Composition

The stomach of 152 specimens of *T.zilli*were examined and nineteen of these had empty stomachs. Table 5 show the stomach content analyses of fish samples and the percentage frequency of occurrence of each food item respectively. As observed from the table, the species fed mostly on green algae, higher plants and zooplankton. The undigested higher plants found in the stomachs were identical with plants at the shoreline of the dam [4].

Table-5. Stomach content of *Tilapia zilli* in Tiga Dam

S/N	Food items	Frequency of Occurrence	Percentage (%)
1.	Green Algae		
	Filamentous		
	Euglena	9	6.87
	Spyrogyra	2	0.15
	Ulothrix	13	9.92
2.	Zooplankton		
	Copepedsp	5	3.82
	Phacussp	20	15.27
	Ostrcodsp	2	0.15
3.	Higher plant materials	44	33.59
4.	Insect remains	7	5.34
5.	Fish scales	2	0.15
6.	Fish eggs	8	6.11
7.	Unidentified food materials		

Source: Stomach conentents of tilapia zilli in tiga dam, 2015

3.4. Seasonal Variation in the Food of Fishes

There was a slight variation in the food of *Tilapia zilli* of Tiga Dam, during the dry and rainy seasons. Out of 10 food items fed upon by the fish as shown in Table 6, only three food items were not available in the dry season (November to April) and only one (1) food item did occur in the fish diet during the rainy season (May – October) as indicated in table 6.

Table-6. Food items available in the dry and rainy season

S/N	Rainy Season (May-Oct)	Dry season (Nov-April)
	Euglena	Euglena
	Spirogyra	Ulothrix
	Ulothrix	Copepod sp
	Copepod sp	Phacussp
	Phacussp	Ostracodsp
	Higher plant materials	Higher plants
	Insect remains	Fish eggs
	Fish scale	Unidentified food material
	Fish eggs	
	Unidentified food materials	

Source: Food items available in tiga dam, 2015

3.5. Food Composition in Relationship to Size

There was variation in the food items eaten by fish samples caught in Tiga Dam. Tilapia zillii specimens with size ranges between 10.0cm – 20.0cm total length, fed on five food items. However, bigger fish samples with sizes ranging from 25.0cm-40.0cm in total length had seven food items in their stomachs. The food items found in the stomach of fish size groupings were similar. These food items were mainly green algae, insect remains, fish scales, fish eggs and higher plant materials.

The bigger fish samples fed on the above items as well as zooplankton specimens Omotoyin, [36]. The protein requirement of fish changes with the size of fish, water, temperature, physiological functions, protein quality, non-protein diet in a given ration, [10].

3.6. Food in Relation to Habitat

There are many species of plants surrounding Tiga Dam on which *T. zilli* fed upon. Also found in the habitat were numerous species of zooplankton on which the fish was feeding upon selectively [9]. In all, there were seven specimens of Zooplankton, phytoplankton and higher plants which contributed to the food items of *T. zillii* in Tiga Dam. This fish utilized the abundance of food found in the habitat to its advantages as shown in table 5.

3.7. Condition Factor in Relation to Sex of Fish

A total number of 167 females and 139 males were observed and the mean condition factors of the females was a little bit higher than the males as shown in Table 7. This is an indication that the females are fatter than the males of the same length. This fact that both males and females *T.zilli*have higher values of condition factor in an evidence that the species thrived well in Tiga Dam.

3.8. Monthly Mean Condition Factor

The monthly mean condition factor K for *T. zillii* in Tiga Dam is shown on table 7. On this basis, the value of K at all times of the year are quit high, thereby indicating the good condition of *T. zilli*in Tiga Dam. The results however, indicate that the condition factor of the fish is not affected by seasonal variation.

Table-7. Condition Factor K in relation to sex and size of *Tilapia zillii* in Tiga Dam

	Sex		**Sex**	
	Male	Female	Small	Large
Number of Fish	139	167	121	185
Mean K	1.855±0.154	1.910±0.134	1.817±0.112	1.825±0.130

Source: Condition factor of tilapia zill in tiga dam, 2015

4. DISCUSSION

The result obtained in this study showed that about 33% of the specimens of *Tilapia zillii*caught in Tiga Dam were in the offshore area while majority of the specimens were concentrated in the inshore areas. This pattern of distribution agrees with the observations made by Petr, [37] in Volt Lake where he reported that *T.zillii*were found mainly in the shallow inshore area and Ita, [28] who reported that 77.8% of this fish were

caught at the inshore area of Lake Kainji. Similar observations were made by Gwahaba, [23] in Lake George, Uganda who associated inshore concentration of *cichlid* fishes to the presence of breeding adults with the subsequent build up of the young ones. The concentration of *T.zillii* species aquatic macrophytes which form the main bulk of their food. This was also observed by Arawomo, [3]; Eyo, [14] for Distichodus species in Lake Kainji where the distribution was governed by the presence of emergent grasses in the shallow inshore areas of the lake.

The food of *T.zillii* in Tiga Dam consisted of mainly higher plants and algae [5]. Similar results were obtained by Fryer, [18] in Lake Nyasa, Petr, [37] in Lake Volta and Akintunde and Imevbore, [1] in Lake Kainji where the reported that this species fed on aquatic macrophytes. The higher plants being fed upon by *T.zillii* in Tiga Dam constitute part of the weeds infesting the shoreline. *T.zillii* can be said to be weed feeding fish species. The concentration of large number of specimens of the fish at the shoreline might help to prevent a dense weed cover.

This high growth of *T.zilli* can be attributed to the quality of the food which is a factor of great importance determining growth rate. Most of these aquatic plants on which *T.zilli* feed have their roots in the shoreline mud which is extremely fertile.

From the results obtained in this study, *T.zilli* specimens have been observed to breed successfully in large numbers in Tiga Dam. Food is also available for the fish species in abundance while the growth is relatively high in the environment. Though *T.zilli* specimens do not occur presently in large numbers in the commercial gills nets of 10.2cm and 11.4cm mesh sizes, the exploitation of this fish species probably with a lesser mesh size of 8.9cm might enhance faster growth and reduce overcrowding of the numerous fry of this species that were observed along the shorelines of the Dam. Their removal will also help to maintain the much needed protein in man.

5. CONCLUSION

*T.zilli*s extremely hardy, adaptable and very cheap to maintain. Thus it is adequately suitable for fish farmers to culture. *T.zilli* could be used to control the menace of weeds in lakes. Since *T.zilli* are very prolife, the are adequately suitable for rearing in ponds. Economically, they are good to rear due to non-selectivity of food items that comes to their way.

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