



STOMACH CONTENTS AND INDEX OF FOOD SIGNIFICANCE OF *OREOCHROMIS NILOTICUS* (L.) IN KIRI RESERVOIR, SHELENG, ADAMAWA STATE, NIGERIA.

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ABSTRACT

Studies on natural feeding of fish to identify the trophic relationships present in aquatic ecosystems, identifying feeding composition, structure and stability of food webs was carried out. The study was designed to generate a baseline information on the food and feeding habits of *Oreochromis niloticus*, in Kiri reservoir, Shelleng LGA, Adamawa State, Nigeria. Sampling was done twice in a month for a period of six months from May to October 2015. On the landing site, fish specimen were randomly sorted and identified using keys. In the laboratory, each specimen was dissected using a pair of scissors to remove the gut. The entire stomach of the fish was removed and graded according to fullness. Stomach contents was sorted into categories and analyzed using Relative Frequency (RF) and point's method. % RF and % PP (Percentage of total Points) was then used to determine the Index of Food Significance IFS. The major food items in terms of frequency of occurrence were Pithopora (55.71%), while insect parts has the lowest frequency of occurrence with 15.70%. The Index Food Significance (IFS) of *O. niloticus* showed that Filamentous Algae and Colonial Green Algae are the secondary diet of the fish species in Kiri Reservoir, with *Cladophora* (IFS= 1.04%) *Pithopora* (IFS=1.06%) and *Volvox* (IFS=1.45%), Green Algae, Cyanobacteria and Diatom are among the incidental diet, with an IFS <0.1%. This report revealed the food of *O. niloticus* composed mainly of plant origin; this could help in important measure towards the data needed to create a food web in Kiri reservoir

Keywords: Stomach Content, Index of Food Significance, *Oreochromis niloticus*, Kiri Reservoir, Shelleng

INTRODUCTION

The food present in every environment is vital as it determines the types and species of organisms that constitutes the food chain or web. Studies on natural feeding of fish permit to identify the trophic relationships present in aquatic ecosystems, identifying feeding composition, structure and stability of food webs (Abdel-Aziz and Gharib, 2007). The study of the food and feeding habits of freshwater fish species is a subject of continuous research because it constituted the basis for the development of a successful fisheries management programme on fish capture and culture (Oronsaye, and Nakpodia, 2005; Oso *et al.*, 2006).

Various works have been done on the diets of Cichlids and other fish species from various lakes in Nigeria and few other lakes and reservoirs from southwestern Nigeria except those from Ero reservoir (Durr and Gonzalez, 2002). Komolafe and Arawomo, (1998), worked on the distribution and feeding habits of *Oreochromis niloticus* (L.) in Opa reservoir, Ile-Ife. The primary diet of *O. niloticus* has been inconsistent in much of the research papers. Some studies classified *O. niloticus* as omnivorous and others as herbivorous (Canonico *et al.*, 2005). For example, the species were essentially planktivorous, showing preference for phytoplankton species such as blue-green, green algae and diatoms in Lake Chamo (Bwanika *et al.*, 2004) and in Crater Lakes of Uganda (Teferi *et al.*, 2000). On the other hand, *O. niloticus* was found to be omnivorous in Lake Abu-Zabal, Egypt (Shalloof and Khalifa, 2009) and in Ero Reservoir, Nigeria (Oso *et al.*, 2006). Their feeding habits also vary with age and size (Tadesse, 1998). As the sizes of the fish increases, the consumption of large quantities of various phytoplankton evidently increased (Tefera, 1987; Tadesse, 1998). *O. niloticus* is able to modify their feeding habits depending on the availability of natural foods as well (Njiru *et al.*, 2004). For instance, in Lake Victoria, Nile tilapia exhibited a traffic shift from predominantly herbivorous to a more diversified diet where the importance of algae decreases while fish, plants and invertebrates increases (Njiru, 2008). The present study is designed to generate baseline information on the food and feeding habits of *O. niloticus* in Kiri reservoir. The information would be useful to create a food web in the reservoir, and eventually a trophic model that can be used in fisheries management and sustainable utilization of the reservoir

MATERIALS AND METHODS

The study area was Kiri reservoir in Shelleng Local

Government Area of Adamawa State, Nigeria. It is located within; Longitude 9° 40' 47" N 12° 00' 51" E. The reservoir was built by damming the Gongola River to provide irrigation to Savannah Sugar Company (SSC) a large scale sugarcane plantation and processing company set up as a joint venture between the Nigerian Federal Government and the Commonwealth Development Corporation (CDC), London. The CDC was the managing agent for the project and the construction contract was awarded to NECCO, a company largely owned by the government. The savannah sugar company was acquired by Dangote industries in 2002. The reservoir is 11.2km long, 20m high zoned embankment, with an internal clay blanket. The reservoir was completed in 1982 (ICE, 1990). The reservoir has a capacity of 615m³ (Enplan, 2004).

Fish specimens were procured from artisanal fishers and middlemen at their landing site for the study. Sampling of landed catches was done twice in a month for a period of six months from May to October, 2015. The fishers used a wide range of fishing gear such as hook and line, long line, cast nets, gill nets and traps. On the landing site, fish specimen were randomly sort and identified using keys and descriptions by Olaosebikan and Raji, (1998) and Idodo-Umeh, (2003). Both male and female species were bought and conveyed immediately to the laboratory in plastic containers with ice-block for laboratory analysis on the same day as they were bought. A total of 200 species were sampled for this study. In the laboratory, the Total Length (cm) of each fish was taken from the tip of the mouth to the extended tip of the caudal fin using a measuring ruler to the nearest 0.1 cm. Standard Length (cm) for each fish was taken as measurement from the tip of the mouth to the caudal peduncle to the nearest 0.1 cm. The total body weight in grams was measured for each fish species to the nearest 0.01 g using a top loading Mettler balance.

In the laboratory, each specimen was dissected using a pair of scissors to remove the gut. The entire stomach of the fishes was removed and graded according to fullness. The graded stomach of each specimen was dissected length wise and emptied into a petri-dish for examination and identification. Each stomach content was dispersed with small amount of distil water, sub-samples was taken from the stock and observed under a binocular dissecting microscope.

Stomach Content Analysis

The dissected stomach of each specimen and its degree of fullness was estimated by an arbitrary 0 -

20 point scale: thus 0, 2.5, 5, 10, 15 and 20 points was allotted to empty, trace, quarter-full, half-full, three quarter-full and fully distended stomachs respectively. Stomach contents sorted into categories and analyzed using Relative Frequency (RF) and point's method as described by Hyslop, (1980) and used by Chipps *et al.* (2002).

In the RF, the frequency of a particular food item in all stomachs was expressed as a percentage of the frequencies of all food items. For the point's scheme, each stomach was allotted 20 points regardless of the fish size and these was shared amongst the various contents, taking account of their relative proportion by volume. The points gained by each food item in all stomachs examined was computed and expressed as a percentage of the total points of all food items. The point scheme gave an indication of bulk contribution of each food category to the diet composition. % RF and % PP (Percentage of total Points) was then used to determine the Index of Food Significance IFS as follows:

Relative Frequency= $f/n \times 100\%$. Where,
 f = frequency of individual food item
 n = frequency of all food items

$$IFS = \frac{\%RF \times \%PP}{\sum(\%RF \times \%PP)} \times 100$$

Food with IFS $\geq 3\%$ was regarded as primary, ≥ 0.1 to $<3\%$ as secondary, whereas food with $<0.1\%$ was regarded as incidental. (Odo *et al.*, 2012)

RESULTS AND DISCUSSION

A total of 200 *O. niloticus* specimens were examined for their stomach contents, out of which 102 were Males, and 98 Females, out of which 161 had contents with various degree of fullness, while 39 specimens had empty stomachs. Males had 26 specimen with three-quarter stomach full, 24 specimen with one-quarter stomach full, 19 specimen with empty stomach, 17 species with full stomach, 16 specimen had half-full stomach. The females had 22 species with full stomach, 21 specimen had one-quarter stomach full, 20 specimen had empty stomach, and 19 specimen had half-full stomach. While, 16 specimen had three-quarter full stomach (Table 1)

The stomach contents of *O. niloticus* was identified

and grouped into their various categories. Using the Frequency of Occurrence method it showed that pithopora occurred more in the diet of *O. niloticus* with a frequency of 55.71%, followed by ulothrix and volvox both with a frequency of 47.14% each, *Cladophora* with 45.71%, *Spirogyra* with 44.28%, *Lyngbya* with 41.42%, *Synedra* with 37.14%, *Clamydomonas* and *Spirulina* with 31.42% each, *Pediastrum* with 28.57%, *Euglena* spp with 23.54%, *Oscillatoria* with 22.85%, *Closterium* sp and sand grain had 20.00% each, *Copepod* spp had 19.98%, *Paramecium* had 15.78%, while fish scale, insect parts and rotaria had the lowest frequency of occurrence with 15.71%, 15.70% and 12.69% respectively. The point method computation showed that; among the food item with the highest points include; *pithopora* with 11.45%, *volvox* with 10.73%, *spirogyra*, and *ulothrix*, with 9.22% each, *cladophora* had 8.06%, *Closterium* spp and *Synedra* had 6.93% and 6.27% respectively, *Clamydomonas* had 5.22%, *Pediastrum* had 4.66%, *Spirulina* and *Lyngbya* had 4.60% and 4.47% respectively, those with low points include; *Paramecium*, *Copepod* spp and Sand grains, with 3.32%, 3.21% and 2.48% respectively, others are; *Euglena* spp with 2.43%, *Oscillatoria* with 2.24%, scales with 2.06%, *rotaria* had 1.97% and insect parts had only 1.19% The Relative Frequency of the stomach contents showed that *volvox* and *spirogyra* has the highest with 13.52% and 10.29% respectively, followed by *Ulothrix* with 9.78%, *Pithopora* with 9.27%, *Cladophora* with 6.50%, *Closterium* spp with 9.59%, *Synedra*, *Lyngbya* and *Clamydomonas* with 5.78%, 4.90% and 4.63% respectively, others include; *Pediastrum* with 4.51%, *Copepod* spp 4.46%, *Spirulina* with 4.25%, while Sand grains, *Paramecium* and *Euglena* spp had 3.57%, 2.68%, and 2.67% respectively, and *Oscillatoria* had 2.27%. *Srotaria*, scales and insect parts has the lowest Relative Frequency of 1.75%, 1.62% and 1.02% respectively. The Index Food Significance (IFS) of *O. niloticus* shows that Filamentous Algae and Colonial Green Algae are the secondary diet of the fish species in Kiri Reservoir, with *Cladophora* (IFS= 1.04%) *Pithopora* (IFS=1.06%) and *Volvox* (IFS=1.45%), Green Algae, Cyanobacteria and Diatom are among the incidental diet, with an IFS $<0.1\%$. (Table 2)

Table 1: Degree of Stomach Fullness of *Oreochromis niloticus*

Sex	Full	Three-quarter	Half-full	One-quarter	Empty	Total
Male	17	26	16	24	19	102
Female	22	16	19	21	20	98
Total	39	42	35	45	39	200

Table 2. Index Food Significance of *Oreochromis niloticus*

Food Items	F r e q Occ	PP (%)	R F (%)	$IFS = \frac{\%RF\%PP}{\sum(\%RF\%PP)} \times 100$
Green Algae				
<i>Chlamydomonas</i>	31.42	5.22	4.63	0.46
<i>Closterium</i> spp	20.00	6.93	5.95	0.41
<i>Pediastrum</i>	28.57	4.66	4.51	0.21
Filamentous Algae				
<i>Spirogyra</i>	44.28	9.22	10.29	0.94
<i>Cladophora</i>	45.71	8.06	6.50	1.04
<i>Ulothrix</i>	47.14	9.22	9.78	0.90
<i>Pithopora</i>	55.71	11.45	9.27	1.06
Colonial green algae				
<i>Volvox</i>	47.14	10.73	13.52	1.45
Cyanobacteria				
<i>Lyngbya</i>	41.42	4.47	4.90	0.52
<i>Spirulina</i>	31.42	4.60	4.25	0.20
<i>Oscillatoria</i>	22.85	2.24	2.27	0.06
Diatom				
<i>Synedra</i>	37.14	6.27	5.78	0.36
Protozoa				
<i>Euglena</i> spp	23.54	2.43	2.67	0.32
<i>Paramecium</i>	15.78	3.32	2.68	1.33
Rotifers				
<i>Rotaria</i>	12.69	1.97	1.75	0.11
Copepoda				
<i>Copepod</i> spp	19.98	3.21	4.46	0.98
Sand grains	20.00	2.48	3.56	0.48
Scale	15.71	2.06	1.62	0.03
Insect parts	15.70	1.19	1.02	0.01
Total		100.00	100.00	

Freq Occ= Frequency of Occurance; PP= Point method; RF= Relative Frequency

A total of 200 *O. niloticus* specimens were examined for their stomach contents, out of which 76.09% had contents with various degree of fullness, while 23.91% specimens had empty stomachs, this is in contrast with the report of Osho *et al.*, (2006), in a tropical reservoir, who recorded that a total of 95 (31.77%) had stomach content, while, 204 (68.23%) had empty stomachs out of the 299 specimen investigated, and it also contradict the report of Workiyie and Abebe (2015), who observed a total of 931 fish, 326 (35%) contained food and 605 (65%) had empty stomachs. The difference can be the time the fish were caught, because *O. niloticus* typically feeds during daytime hours. This suggests that, it exhibits a behavioral

response to light as a main factor contributing to feeding activity

The stomach contents of *O. niloticus* was grouped into their various categories. Using the Frequency of Occurrence method shows that Filamentous Algae (*Pithopora*, *Ulothrix*, *Cladophora*, *Spirogyra*), and Green algae (*Chlamydomonas*, *Pediastrum* and *Closterium* sp), are the major contributor in the diet of the fish, this agrees with the reports of Bwanika *et al.* (2004), who reported that *O. niloticus* in Lake Chamo are planktivorous, showing preference for phytoplankton species such as blue-green, green algae and diatoms and also the report of Teferi *et al.* (2000), in Crater Lakes of Uganda. Also agrees with the report of Workiyie and Abebe, (2015), who said that the dominant food items of *O. niloticus* in Lake Hayq were green algae (42.2%) and blue-green algae (41.8%). The significant quantities of these contributions were due to mainly *Cosmarium* (38.5%) and *Microcystis* (31.00%).

The report of the present study contradict the food items found in *O. niloticus* by Oso *et al.* (2006), which had Higher plant remains macrophytes that accounted for 49.29% of the content followed by *Chlamydomonas* with 47.29%. Detritus/mud and *spirogyra* had 44.82 and 42.36% respectively. Diatoms could be the second important food choice for the species, Workiyie and Abebe, (2015), reported that it constitute 11.6 % of the total food counted in *O. niloticus* from Lake Hayq. Among the zooplankton identified and counted by Workiyie and Abebe, (2015), in Lake Hayq, *Cladocera* (*Daphnia*) contributed 3.60% of the entire diet consumed by *Oreochromis niloticus*. This contradict the report of the present study which recorded *Euglena* spp, *paramecium*, *rotaria* and *copepod* spp as the zooplanktons identified. The planktons composition of the lake plays important role in the differences of stomach contents.

The report of the present study conforms to the report of Agbabiaka, (2012), who reported that from the Frequency of Occurrence in the stomach content of adult species of *T. zilli*, it showed that it ingests more of vegetative matter (59.52%), algae (50.00%) as well as larvae of aquatic invertebrates (21.43%). The low presence of sand in the gut confirms the reports of Fagade and Olaniyan, (1972), Thomas and Micheal, (1999), Kuton and Kusemiju, (2000) Olufeagba *et al.*, (2002) and Osho *et al.*, (2006) and Agbabiaka (2012) that *Tilapia* seldom browse on live benthic invertebrates and bacteria-laden detritus.

The Index Food Significance of *O. niloticus* reveals that the diets; *Cladophora*, *Pithopora*, and *Volvox*, are secondary diets to the fish species, while

the Green Algae, Cyanobacteria, Diatoms and insect parts constitute its incidental diet with IFS of (<0.1%). This report is in contrast with Shep *et al.* (2013) who reported a different results for Tilapia in Ayame Lake, they reported that the main food item of *T. zillii* were macrophytes (15.90 %) and insects diptera (11.62 %), Hymenoptera forms its Secondary diet with (1.0%), while Arachnids and Fish constitute it's the incidental diet with (0.41%) and (0.06%) respectively. This sharp contrast is tied to the nature of the differences of the lakes, Ayame Lake is covered by a dense rain forest. The lake waters therefore are characterised by a typical dark colour resulting from an intense vegetal decomposition, this gives most insects a favorable niche to thrive

CONCLUSION

This report revealed the stomach content and Index of Food Significance of *O.niloticus* in Kiri Reservoir. The results showed that the food composed mainly of plant origin and this could help in important measure towards the data needed to create a food web in Kiri reservoir, and eventually a trophic model that can be used in fisheries management.

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