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PRELIMINARY STUDIES ON RED BELLY TILAPIA *COPTODON ZILLII* CAUGHT FROM OYAN DAM, OGUN STATE, NIGERIA

***A.A. IDOWU, W.O. ABDUL, A.A. ALIMI AND M. O.TIJANI**

Department of Aquaculture and Fisheries Management,
Federal University of Agriculture, Abeokuta, Nigeria
***Corresponding Author**: idowudoyin@yahoo.com **Tel**: 234

ABSTRACT

The study was carried out on the biological aspect of Redbelly Tilapia, *Coptodon zillii* collected from Oyan Lake, Abeokuta North Local Government Area, Ogun State, Nigeria, with the aim of contributing to the baseline data for carrying out further studies on its ecology, conservation and development. A total of two hundred and fifty four fish (254) specimens were caught from the Ibaro landing site of the Lake between March and July, 2015. The total length (cm), standard length (cm), head length (cm), body width (cm), body depth (cm), snout length (cm), eye diameter (cm) and body weight (g) were measured. The stomach content was also assessed in order to determine its food and feeding habit. The mean total-length, standard-length, head-length, eye-diameter, snout-length, body-depth, body-width and body-weight during the study were 10.98±0.61cm, 8.56±0.14cm, 2.5±0.08cm, 3.67±0.15cm, 1.52±0.11cm,1.37±0.17cm, 4.05±0.07cm, 34.25±3.02g respectively and their ranges were (4.5-18.7cm), (3.2-15.2cm), (1.1-5.8cm), (2.0-6.8cm), (0.8-3.0cm), (1.1-4.8cm), (1.4-7.3cm) and (6.0-132.0g). A negative allometric (b<3) growth pattern was observed for the stock. The meristic characteristics of *C. zillii* were (DFR) XIV 10 – XVI 14; PVR, AFR III 8 –III 9; PFR 10 – 13 respectively. Stomach analysis showed that diatoms were the most abundant food items in the diet of *C. zillii* numerically, 29.98%, while desmids were the most abundant food items in terms of frequency occurrence, 27.82%. This study concluded that *C. zillii* is not morphometrically and meristically different from the already classified from previous studies. Also, *C. zillii* thrives well on available plants and detritus.

Key words: *Coptodon zillii*, Oyan Lake, Ogun waterside

INTRODUCTION

Fishes are the most diverse among the major vertebrate groups (Moyle and Cech, 1996). Among these, tilapia is one of the most widely cultured fish in the world. Currently, farmed tilapia represents more than 75% of world tilapia production (FAO, 2009). Its contribution has been exponentially growing in recent years. It is easily cultured and highly adaptable to a wide range of environmental conditions. Tilapia is the common name applied to three genera of family Cichlidae (*Sarotherodon*; *Oreochromis* and *Tilapia*) including about 70 *sp*ecies (Meyer, 2002).

Coptodon zillii is widely distributed and has a very wide common range. However, in Egypt, *C. zillii* is widely distributed, supports important commercial fisheries and it is indigenous to Lake Timsah. Many authors have studied the reproduction of *C. zillii*

(Negassa and Getahun, 2003; ElSawy, 2006; Akel and Moharram, 2007). *C. zillii* is euryhaline in nature as it can tolerate a wide range of salinity (Meyer, 2002). El-Sayed (2006) mentioned that *C. zillii*; *Oreochromis mosambicus* and *Oreochromis aureus* are the most salinity-tolerant tilapia species, while other tilapias are generally less euryhaline, and can grow, survive, and reproduce at salinity of 10 to 30‰, depending on the species, size and sex (Phillip and Ruwet, 1982). Fishes belonging to family Cichlidae are moderate in size, living in shallow and vegetative areas (Eccles, 1992). *C. zillii* is one of the most valued fish in North Africa. It constitutes an important part of inland fish production especially in the brackish lagoons of Morocco, Senegal River, Egypt and Libya (Teugels and Thys vanden Audenaerde, 1991). Hadi (2008), studied age and growth of *T. zillii* in Umhfein Lake (Libya). Age and growth determination of *T. zillii* from the Egyptian waters were studied by many authors like Latif *et al.* (1989), Faltas (1995) and El-Kashef (2002), but few in Nigerian waters (Basu and Kalu, 1999), and from the French waters (Panfili and Tomas, 2001).

Length – weight relationship is an important quantitative aspect in studying fish biology which can be used to predict weight from length measurements made in yield assessment (Pauly, 1993). Fish can attain either isometric growth, negative allometric growth or positive allometric growth. Isometric growth is associated with no change of body shape as an organism grows. Negative allometric growth implies the fish becomes more slender as it increases in length while the positive allometric growth implies that fish becomes relatively stouter or deeper bodied as it increases in length (Reedel *et al*., 2007).

Condition factor is used to show the degree of well-being of fish in their habitat, which is expressed by 'coefficient of condition' which is also known as length-weight factor. When condition factor value is higher, it means that the fish has attained a better condition. The condition factor of fish can be affected by a number of factors such as stress, sex, season, availability of feeds and other water quality parameters (Khallaf *et al*., 2013).

Study of stomach content of fish is a continous exercise that provides information for successful fisheries management which gives important insight of feeding patterns and quantitative assessment of food habits. Lagler (1949) in Zacharia (2004) reported that gut contents only indicate what fish would feed on. Description of fish diets and feeding habits also provides the basis for understanding trophic interactions in aquatic food webs. Food and feeding habits helps farmers have clear knowledge of fish dietary requirements with a view of providing/improving feeds for them in aquaculture (Malami *et al*., 2004). Sufficient food intake aids optimal growth, resulting in production increase and subsequent economic benefits. Pius and Benedita (2002) reported the use of gut content for reducing intra and inter specific competition of fish in the ecosystem. *C. zillii* was selected for this study due to its economic importance for the purpose of assessing the impact of Oyan Lake on the length-weight relationship, growth rate and condition factor of the fish, the stomach content of the fish. The aim of this work is to assess the morphological and meristic features, length-weight relationship and the stomach contents of *Coptodon zillii* in Oyan Lake.

MATERIALS AND METHODS

DESCRIPTION OF THE STUDY AREA

Oyan Lake is located on 7°15' North latitude and 3°16'East longitude at an elevation of 43.3m above sea level on the confluence of Oyan and Ofiki rivers which are tributaries of Ogun River (Ikenweiwe, 2005). The lake has a maximum length of 27 km and a maximum width of 6 km. The storage capacity of the lake is 2.7×10^8 m^3. The purpose of the lake was to provide water for irrigation of 12,500 hectares of land in lower Ogun and to generate 9.00 megawatts of electricity. The catchment area of the Lake is 9,000 km^2 (Ikenweiwe, 2005).

The average annual flow at the dam site was estimated at 1.7×10^9 m^3 and the dam provided a normal level reservoir capacity of 2.7×10^8 m^3. According to Ikenweiwe (2005) the dam consisted of an earth fill embankment with a gated concrete service spillage and auxiliary spillways, the earth's fill of the embankment consisted of a central impervious core of clay lateritic material surrounded by a shell of compacted granule. The total length of the earth embankment is 10.44 m. The maximum height of the dam is 30 m. The gated concrete consists of a central portion with four radial spillway gates of 15 m by 7 m and downstream stilling basin which is 70 m long with retaining walls of reinforced concrete to support the earth embankment. In each of the three spillways piers, an outlet of 1.8 m diameter steel pipe was provided (Ikenweiwe, 2005). Oyan Lake as a multi – purpose reservoir belongs to Ogun- Oshun River Basin Development Authority, a parastatal of the Federal Ministry of Agriculture and Water Resources, Nigeria.

COLLECTION OF FISH SAMPLES

The fish samples were collected from the commercial fishermen at Ibaro landing site, Oyan Lake. A total number of two hundred and fifty four (254) samples of *C. zillii* were randomly selected and bought from the fishermen's fish landings every other week, between March and July (2014). The fishermen used a wide range of fishing gears such as cast nets, gillnets, and non-return to catch fish, and an outboard engine canoe to convey the fish to the landing centre.

DETERMINATION OF MORPHOMETRIC AND MERISTIC CHARACTERS OF FISH SAMPLES

After collection, the fish were immediately preserved with ice chest and rapidly conveyed to the wet laboratory of the Department of Aquaculture and Fisheries Management, Federal University of Agriculture, Abeokuta, Nigeria, where they were further preserved in the freezer at -2 ^oC. After 24 hours, samples were brought out of the freezer and allowed to thaw. Morphometric and meristic characters of *C. zillii* samples were determined according to standard methods.

Determination of morphometric characters

Data on morphometric characters such as the total length (TL, cm) standard length (SL, cm), head length (HL,cm), bodyweight (BW, g), were measured within 24 hours. TL, SL and HL were measured and described according to Olaosebikan and Raji (1998) using a digital Vernier calliper to the nearest cm, and the total body weight, measured with a sensitive Sartorius balance (Model EB3) to the nearest 0.1 g.

Determination of meristic features

The meristic counts were carried out using

dorsal fin ray (DFR), caudal fin ray (CFR), pectoral fin ray (PFR), pelvic fin ray (PVR), anal fin ray (AFR) (Turan *et al.*, 2011).

Determination of stomach contents

Fish samples were initially sorted into three groups based on size, the small (weight; length (>50 g; 8.3-10.0 cm), medium (50-90 g; 10.0-13.3 cm) and big (>90 g; 13.3-18.7 cm). The stomach content analysis of each of the group was carried in the wet laboratory of the Department of Aquaculture and Fisheries Management, FUNAAB. Numerical method and frequency of occurrence methods (Hyslop, 1980) were used. The fullness of each stomach of the fish was recorded and expressed as empty (0/4), one quarter full (1/4), half-full(2/4),three-quarter full(3/4), and full(4/4). The fish was cut opened with a sharp scalpel and the stomach removed and preserved in 4% neutralized formalin. For the analysis, the stomach was cut across a longitudinal section and the contents emptied in a Petri dish and then examined under the binocular-light microscope.

Determination of length weight relationship and condition factor, K

The relationship between the standard length and weight of fish was determined using Log W = Log a + b Log L

Where, W=Weight of fish (g), L is observed total length (cm), 'a' is the regression intercept and 'b' is the regression slope; 'r' values were later derived as the regression coefficients. The condition factor, K, of the fish was determined using Fulton's equation;

$K = 100W/L^3$

Where W= Weight in gramme

L = Length in centimeter

Data Analysis

Data on morphometric, meristic and stomach contents were subjected to descriptive and inferential statistics (regression analysis) using Statistical Package for Social Sciences (*SPSS* Version 17.0) to determine if there was any morphological and genetic diversion among the population of *C. zillii* in the study area.

RESULTS

Morphological Characteristics of *Coptodon zillii*

Table 1 shows the morphometric data characteristic data of *C. zillii* in Oyan dam during the study period. The mean total length (TL) in cm for the study periods (March to July, 2014) ranged from 10.4±2.0 to 11.3±2.9. The means of standard length (SL) in cm, for the study periods ranged from 8.0±0.2 to 8.8±0.2, Also, the mean head length and body depth in cm (HL and BD) ranged from 2.3±0.07 and 3.5±0.1 to 2.6±0.1 and 4.1±0.1.

Mean values of eye diameter and snout length, ED and SL (cm) of fish samples for the study periods ranged from 1.3±0.02 and 1.0±0.02 to 1.6±0.04 and 1.5±0.06. Body width of fish samples ranged from 3.9±0.1 to 4.3±0.1 cm. Mean values of their body weights (g) ranged from 24.5±1.8 to 39.5±1.6.

The mean values for TL, SL, HL, eye diameter, snout length, body depth, body width and body weight of the stock in the dam were 10.98±0.61, 8.56±0.14, 2.5±0.08, 3.67±0.15, 1.52±0.11,1.37±0.17, 4.05±0.07, 34.25±3.02 respectively, for the period of this study.

Table 1: Morphometric characteristics of *Coptodon zillii* in Oyan Lake

Morphological characteristics	Total length(cm)	Standard length(cm)	Head length(cm)	Body depth(cm)	Eye diameter (cm)	Snout length(cm)	Body width(cm)	Body weight (g)
Month								
March	11.3±1.9 (8.3-13.3)	8.6±0.1 (6.5-13.5)	2.4±0.04 (1.7-3.5)	3.3±0.1 (2.7-5.9)	1.4±0.02 (1.1-1.9)	1.2±0.03 (0.9-1.9)	4.3±0.1 (3.0-6.3)	35.0±2.2 (11.0-90.0)
April	11.3±2.9 (4.5-17.5)	8.8±0.2 (3.2-14.5)	2.7±0.08 (1.5-5.8)	3.8±0.09 (2.2-5.7)	1.5±0.03 (1.2-2.2)	1.4±0.03 (0.1-2.1)	4.0±0.1 (1.4-6.5)	38.0±3.3 (19.0-94.0)
May	10.4±2.0 (6.0-15.4)	8.0±0.2 (5.0-12.0)	2.3±0.07 (1.1-3.4)	3.5±0.1 (2.0-5.4)	1.3±0.02 (0.8-1.8)	1.0±0.02 (0.6-1.7)	3.9±0.1 (2.2-5.4)	24.5±1.8 (6.0-66.0)
June	11.0±2.5 (8.5-18.7)	8.8±0.3 (6.4-15.2)	2.6±0.1 (1.7-5.8)	4.1±0.1 (3.0-6.8)	1.9±0.08 (1.0-3.0)	1.9±0.1 (1.0-4.3)	4.0±0.1 (1.6-7.2)	39.5±1.6 (6.0-132.0)
July	10.9±1.5 (6.6-18.7)	8.6±0.2 (4.8-13.7)	2.5±0.07 (1.5-4.5)	4.0±0.1 (2.0-5.2)	1.6±0.04 (1.1-2.6)	1.5±0.06 (0.7-2.7)	4.2±0.1 (1.7-7.3)	30.1±2.0 (13.0-128.0)
Mean±SE	10.98±0.16	8.56±0.14	2.5±0.08	3.67±0.15	1.52±0.11	1.37±0.17	4.05±0.07	34.25±3.02

Meristic Characteristics of Coptodon zillii in Oyan Lake

Meristic characteristics of *C. zillii* in Oyan Lake is shown in Table 2 during the study. The meristic characteristics obtained were (DFR) XIV 10 – XVI 14, PVR 10 – 13, AFR III 8 – III 12, PFR 10 – 12.

Table 2: Meristic characteristics of *Coptodon zillii* in Oyan Lake

Meristics features	Range
Dorsal Fin Ray	XIV 10 – XVI 14
Pelvic Fin Ray	10 – 13
Anal Fin Ray	III 8 – III 12
Pectoral Fin Ray	10 – 12

Length-Weight Relationship of *Coptodon zillii*

In this study, the ' b', 'a', and r^2 values of *C. zillii* for the month of March were 2.07, 1.746 and 0.91 respectively. The 'b', 'a', and r^2values for the month of April were 2.02, 0.512 and 0.988 respectively. This also indicated negative allometric growth pattern.

The respective results for other months May, June and July were: 2.35, 0.44 and 0.934; 2. 56, 0.945 and 0.927; and 2.70, 0.263 and 0.985. All monthly growth patterns were the same, negative allometry, the combined values from March to July were 2.435, 0.198, and 0.983 respectively.

The monthly condition factors, k of *C. zillii* from March to July were estimated as 2.77, 2.618, 2.33, 2.428 and 2.423 g/cm^3 respectively.

Table 3: **Length – Weight Relationship of *Coptodon zillii* in Oyan Lake Abeokuta North Local Government Area**

Month	Condition Factor	LWR			
		a	B	r^2	LWR Equation
March	2.77	1.746	2.078	0.91	Log W=2.078LogL+1.746
April	2.618	0.512	2.026	0.988	Log W=2.026LogL+ 0.512
May	2.33	0.044	2.354	0.934	Log W=2.354LogL –0.044
June	2.428	0.945	2.562	0.927	Log W=2.562LogL + 0.927
July	2.423	0.263	2.707	0.985	Log W=2.707LogL + 0.263
Combined	2.435	0.198	2.435	0.983	Log W=2.435LogL + 0.198

Empty Stomach Analysis

From Table 4, out of 254 stomachs examined, 117 stomachs were empty. Empty stomachs were most prevalent in the month of March and least in May. Also, in Table 5, 63.24% of the medium-size fish had empty stomach and small-fish had 28.20% and by-size samples had 8.54% empty stomachs.

Stomach fullness of *Coptodon zillii*

Table 6 shows the result of stomach fullness of *C. zillii* in Oyan dam during the study. The state of fullness of each stomach was represented as empty ($^0/_4$) one-quarter full ($^1/_4$), half full ($^2/_4$), three quarter ($^3/_4$) and full ($^4/_4$) and the percentage were 117%, 22%, 30%, 45%, and 40% respectively.

Table 4: Stomach fullness of *Coptodon zillii* in Oyan Lake

	Empty ($^0/_4$)	One-quarter full ($^1/_4$)	Half-full ($^2/_4$)	Three-quarter full ($^3/_4$)	Full ($^4/_4$)
Number of fish	117	22	30	45	40
% stomach	46.06	8.66	11.81	17.71	15.74

Table 5: Monthly variation in empty stomach of *C. zillii*

Month	Number examined	Number of empty stomach	%empty stomach
March	49	30	25.64
April	71	16	13.67
May	50	15	12.82
June	31	28	23.93
July	53	28	23.93
Total	**254**	**117**	**46.06**

Table 6: Variation in empty stomach by size of *C. zillii*

Size / Standard length (cm)	Number examined	Number of empty stomach	%
Small-size fish (8.3-10.0)	85	33	28.20
Medium-size fish (10.0 -13.3)	140	74	63.24
Big -size fish (13.3-18.7)	29	10	8.54

Food Items in the Stomach of Coptodon zillii

The stomach contents of *C. zillii* in Oyan Lake are present in Table 6. The stomach contents were made of 10 major categories of foods which include the blue- algae, green algae, desmids, diatoms, crustaceans, invertebrates, protozoans, rotifers, detritus and plant parts. Diatoms were the most important food items recorded by numerical method (29.98%) and constituted (24.10%) by frequency of occurrence method.*Blue-green algae (Oscillatoria sp, Anabaena sp, Phormidium sp, Polycystis sp, Ceolospharium sp, Aphanocapsa and sp.)* constituted 11.22% and 13.69% by numerical and occurrence methods respectively.Green-algae (*Mougeotia sp., Pediatrum sp.,Bulbochaete sp., Ceolastrum sp. ,Ankistrodesmus sp., Zygnema., Tetraspora sp., Protococcus sp., Microspora sp., Oedogonium sp., Spirogyra sp., Tribonema sp.)* constituted 10.00% and 16.36% by numerical and occurrence methods respectively. *Desmids (Closterium sp., Desmidium sp., Penium sp., Gonatozygon sp., Genicularia sp, Docidium sp, Netrium sp, Tetmemorous sp, Cosmarium sp, Spirotanae sp.)* constituted 23.72% and 27.82 by numerical and occurrence. This showed that desmids were the most consumed by occurrence method. Diatoms (*Nitzschia sp., Frustulia sp., Epithermia sp., Stephanodiscus sp., Cyclotella sp., Diatoma sp., Fragillaria sp., Synedra sp.,Tabelleria.,Melostra sp.,Cymbella sp.*) constituted 29.98% and 24.10% by numerical and occurrence methods respectively.Crustaceans (*Cyclops sp., Magaritifera sp.)* constituted 0.98% by numerical method and 2.36% by frequency of occurrence methods.

Invertebrates (Leech, Flatworm and Nematode), Protozoans (*Chilodonella sp.*) and Rotifers (*Rotonia sp*) respectively constituted 0.79% and 4.01%; 0.03% and 0.14%; 0.01% and 0.14% by numerical and frequency of occurrence methods respectively. Detritus was 13.61% and 7.44% in the respective methods. Meanwhile, plant parts in the stomach were 9.72% by numerical method and 4.07% by frequency of occurrence method.

Table 7: Stomach content of *Coptodon zillii* in Oyan Lake

FOOD ITEMS	NUMERICAL		OCCURRENCE	
	NO	%	NO	%
BLUE GREEN ALGAE	1011	11.22	92	13.69
Oscillatoria sp.	78		9	
Anabaena sp.	100		9	
Phormidium sp.	329		27	
Polycystis sp.	403		29	
Ceolospharium sp.	75		10	
Aphanocapsa sp.	26		8	
GREEN ALGAE	901	10.00	110	16.36
Mougeotia sp.	111		11	
Pediastrium sp.	24		3	
Bulbochaete sp.	7		2	
Ceolastrium sp.	220		13	
Ankistrodesmus sp.	44		7	
Zygnema sp.	176		20	
Tetraspora sp.	4		2	
Protococcus sp.	12		2	
Microspora sp.	47		6	
Oedogonium sp.	14		3	
Spirogyra sp.	186		12	
Tribonema sp.	56		29	
DESMIDS	2136	23.72	187	27.82
Closterium sp.	212		27	
Desmidium sp.	148		16	
Penium sp.	247		27	
Gonatozygon sp.	503		43	
Genicularia sp.	623		33	
Docidium sp.	54		4	
Netrium sp.	9		4	
Tetmemorous sp.	68		12	
Cosmarium sp.	172		15	
Spirotanae sp.	96		6	
DIATOMS	2774	29.98	218	24.10
Nitzschia sp.	662		45	
Frustulia sp.	16		5	
Epithemia sp.	48		6	
Stephanodiscus sp.	26		7	
Cyclotella sp.	104		11	
Diatoma sp.	867		50	
Fragillaria sp.	13		2	
Synedra sp.	326		31	
Tabellaria sp.	22		9	
Melostra sp.	595		49	
Cymbella sp.	15		3	
CRUSTACEANS	75	0.86	15	2.23
Cyclops sp.	25		4	
Magaritifera sp.	53		11	
INVERTEBRATES	78	0.79	26	4.01
Leech	13		7	
Flatworm	5		4	
Nematode	54		15	
PROTOZOANS	3	0.03	1	0.14
Chilodonella sp.	3		1	
ROTIFER	1	0.01	1	0.14
Rotaria sp.	1		1	
DETRITUS	1226	13.61	50	7.44
PLANTPARTS	876	9.72	27	4.07

DISSCUSSION

Data analysis from biometric examination of fish has been very useful in growth study and in estimation of the physiological state of fish (Tsadu, 2006). Length – weight is greatly affected by many factors related to population variability, sampling, and estimation methods.

In this present study there was no significant difference in the meristic characteristics of *Coptodon zillii* in Oyan Lake for the period of study (March, April, May, June and July). The meristic characteristics were (DFR) XIV 10 – XVI 14, PVR 10 – 13, AFR III 8 – III 12, PFR 10 – 12 respectively and this is similar to the Mozambique Mouth brooders (Moyles, 1976 in Ujjania *et al.,* 2015). This study has revealed that *C. zillii* is not morphometrically and meristically different from the already classified one in this part of the world.

The development of fish can either be isometric or allometric depending on the exponent b which is the regression coefficient of the length – weight relationship which range is usually between 2.0 - 4.0 when b = 3.0 it indicates that the fish growth is either symmetrical or isometrical while values different from 3.0 indicates allometric growth (Tesch, 1971 in Dankwa, 2011). Fish maintains its shape throughout life in isometric growth while the aspect of growth population which exhibits allometric growth may be out of proportion or the adult may be different from the young ones in appearance (Tesch, 1971 in Dankwa, 2011). b values in this study are therefore valid as they fell within the same range provided.

In this study, the *C. zillii* were grouped into monthly grouping from March to July, and combined. The growth pattern for March, April, May, June, July and combined showed negative allometric growth which have b values ranged from of 2.02 and 2.70. b values in the study indicated that the length weights index were closely correlated which may be responsible for its robustness in Oyan Lake of Abeokuta North Local Government Area. This is similar to the report of Alex (2012), Mossad (1990) and Ibrahim *et al* (2008). A positive correlation of r^2 which ranged from 0.91 to 0.988 was observed. The Length – Weight relationship equation for the period of study shows a strong relationship between the length-weight and body weight measurement of the fish, there was no increase in body weight with corresponding increase in total length.

The difference in weight of all the specimens may be as a result of individual condition factor, as it relates to well-being and degree of fatness (Pauly, 1983). Mean values of condition factors of *C. zillii* in Oyan lake were similar to the values observed in the work of Fafioye and Oluajo (2005) who worked on Epe Lagoon, Nigeria. When condition factor of fish is 1 or higher, it means the fish has attained a better condition. Condition factor of fish can be affected by stress, sex, season, variability in feeds and other water quality parameters (Khallaf *et al*., 2003).

The percentage of empty stomach of *C. zillii* was 46.06% (117 specimens) in this present study. Result from this present study shows that *C. zillii* fed mainly on blue – green algae, green algae, desmids, diatoms, crustaceans, invertebrates, protozoan, rotifers, detritus and plant parts. Diatoms were the most abundant food item in the diet of *C. zillii* by number. Desmids were the most abundant food item in the diet in terms of frequency of occurrence as its the percentage higher than that of diatoms. Fagade (1971), in

Akinwunmi (2003), reported that *C. zillii* feed mostly on higher plants, algae, and detritus, the feeding habits change with size or age of the fish. The middle sized group fed mostly on higher plants, filamentous algae and detritus while the juvenile and adult group fed exclusively on filamentous algae. The presence of detritus and plant parts found in some of the guts showed that *C. zillii* seldom browse on live benthic invertebrates and bacteria laden detritus (Kuton and Kusemiju, 2000; Olufeagba *et al*., 2002 and Osho *et al.,* 2006).

From this study, it showed that *C. zillii* fed mainly on diatoms, desmids, detritus and blue green algae contrary to Akinwumi, (2003) who reported that *C. zillii* fed mainly on higher plants, filamentous algae and detritus, also Agbabiaka, (2010) who reported that *C. zillii* fed mainly on algae and vegetative matters.

Diatoms were the most consumed food items. They were most prominent and abundant in by numerical methods. They contributed the highest percentage of food items throughout the study period. The percentage ingested by the fish *s*pecie was high using numerical methods. Desmids were the next food items next in abundance by numerical methods, and the most consumed by occurrence methods. Rotifers were the least consumed food items, they constituted the least food consumed food items by numerical and occurrence methods.

Other food items of importance for this fish includes the blue – green algae (*Oscillatoria sp., Anabaena sp., Phormidium sp., Polycystis sp., Ceolospharium sp.)* which were abundant by numerical and occurrence methods. the green – algae which include *Mougeotia sp., Pediatrium sp., Bulbochaete sp., Ceolastrium sp., Ankistrodesmus sp., Zygnema sp., Tetraspora sp., Protococcus sp., Oedogonium sp., Spirogyra sp., Tribonema sp.* were also abundant by numerical and occurrence methods. Desmids (*Closterium sp., Desmidium sp., Penium sp., Gonatozygon sp., Genicularia sp., Docidium sp., Netrium sp., Tetmemorus sp., Cosmarium sp., Spirotanea sp.)* were abundant by numerical methods but the most abundant food items consumed by occurrence methods. diatoms (*Nitzschia sp., Frustulia sp., Epithemia sp., Stephanodiscus sp., Cyclotella sp., Diatoma sp., Fragillaria sp., Synedera sp., Tabelleria sp., Melostra sp., Cymbella sp.)* were the most abundant food items consumed by numerical methods and abundant by occurrence methods. protozoans (*Chilodonella sp.)* were very few in abundance with only a little above the rotifer (*Rotania sp.)* by number and occurrence.

Generally, the content of the stomachs showed a clear pattern of distribution of food items with the diatoms, desmids and detritus occurring in most months during the study period.

CONCLUSION

This study revealed that the length-weight relationship *C. zillii* in Oyan lake exhibited negative allometric growth pattern and the fish is in good condition in the habitat. Meanwhile, from this study, the fish could be described as opportunistic feeder as it thrives on available plants and detritus materials in the water. To this end, this fish is a good candidate for aquaculture in Nigeria.

REFERENCES

Agbabiaka, L.A. 2010. The current Ichtyofauna of River Otamiri, South-Eastern Nigeria. *Int. Journal of Tropical Agric. And Food Systems. 4(1): 7-9.*

Akel, E.H.K.H., Moharram, S.G.

2007. Reproductive biology of *Tilapia zillii* (Gerv, 1848) from Abu Qir bay, Egypt. *Egypt. J. Aquat. Res.*, 33: 379-394.

Akinwumi, F. O. 2003. Food and Feeding Habits of Tilapia zilli (Pisces: Cichlidae) in Ondo State University Fish Farm. . *Proceedings of 16th Annual Conf. Fisheries Soc. of Nigeria (FISON*). 195-198.

Alex, N., Justin , D., Magaira. and Cyrus, R 2012 .Length- Weight Relationship and Condition Factor of Tilapia *sp*ecies grown in Marine and Fresh Water ponds. 122: 123-124.

Basu, M., Kalu M. 1999. Study and comparison of length-weight relationship and condition factor of *Tilapia zillii* (Gervais) in Lake Alau and Monguno hatchery. The Borno State, Nigeria.Fourth Indian Fisheries Forum. Kochi. Kerala, pp. 357-360.

Bayerle, G. B., Williams, J.E. 1968. Some Observtions of food selectivity by Northern Biology and evolution. Oliver and Boyd, Edingbergh, Scotland.

Bolger, T., Connolly, P. L. 1989: The selection of suitable indices for the measurement and analysis of fish condition. *J. Fish Biol*. 34,171–182.

Dankwa, H.R. 2011. Length-Weight Relationship and Growth Parameters of Grey Mullets (Pisces: Mugilidae) in Two Estuaries in Ghana . *West African Journal of Applied Ecology*, 18: 53-61.

Eccles, D. H. 1992. FAO *sp*ecies identification sheets for fishery purposes. Field guide to the freshwater fishes of Tanzania, United Nations Development Programme, Rome, 145 pp.

El-Kashef MA 2002. Fishery biology of some Nile fishes. Ph.D.Thesis, Fac. Sci., Zagazig Univ.

El-Sawy, W.M.T. 2006. Some biological aspects of dominant fish population in Lake Edku in relation to prevailing environmental conditions. M.Sc. Thesis, Faculty of Science, Zagazig University, Egypt. El-Sayed, A. F. M.: 2006, Tilapia culture. CABI Publishing, Wallingford OX 108 DE, UK.273 pp.

El – Shazly A, 1993. Biological Studies On Four Cichlid Fishes (Tilapia nilotica, Tilapia galilae, Tilapia zillii, Tilapia aurea). Thesis M.Sc. Fac. Sci. Zagazig Univ. Egypt.

El-Zarka, S. A., Koura, R., Shaheen, A. H. (1970). Selectivity of wire basket traps for tilapias (*T.nilotica, T,galilae*, and *T. zillii*). *J. Cons. Int. Explor. Mer*., 282-291.

Fafioye, O. O., Oluajo, O. A. 2005 Length-weight relationships of five *sp*ecies in Epe Lagoon, Nigeria. *Afr. J. Biotech*. 4(7):749-751.

Fagade, S.O. 1971. The food and feeding habits of Tilapia in Lagos Lagoon. *J. Fish Biol* 3: 199 -201.

Fagade, S.O., Olaniyan, C.I.O. 1972. The biology of the West African Shad.*Ethmalosa Fimbriata* (Bowdich)in the Lagos Lagoon, Nigeria. *Journal of fish Biology*. 4:519- 533.

Faltas, S. N., Akel, E. H. Kh. 2003. Investigation of beach seine catch of Abu Qir Bay (Egypt) .*Bull. Nat. Inst. Oceanogr. & Fish. , A.R.E.*, 29: 117- 135.

FAO, Food and Agriculture Organization of the United Nations,2009. 2007 FAO year book.

Fryer, G., Iles, T. D. 1972. The Cichlid Fishes of Great Lakes of Africa: Their Biology and Evolution. Oliver and Boyed, Edinburgh, 641pp.

Hadi, A.A. 2008. Some observation on the age and growth of Tilapia zillii (GERVAIS, 1848) in Umhfein Lake (Libya). *J. Sci. Appl.*, 2: 12-21.

Hyslop, E. J. 1980. Stomach contents analysis: a review of methods and their application. *J.Fish. Biol,* 17(4):411-429.

Ibrahim, S. M., Shalloof, K. A. Sh., Salama, H. M 2008. Effect of Environmental Conditions of Abu-Zabal Lakeon Some Biological, Histological and Quality A*s*pects of Fish,Cairo. *Global Veterinaria*. 2:257-270.

Ikenweiwe, N.B. 2005. Limnology and Plankton abundance in relation to fish production in Oyan Lake, south western Nigeria. Ph.D Thesis, University of Agriculture, Abeokuta, Nigeria. 238p.

Khallaf EA, El-Nenaei, AA 1987. Feeding ecology of *Oreochromis niloticus* (Linneaus) and *Tilapia zilii* (Gervias) in a Nile canal, Hydrobiology. 146:57-62.

Khallaf, E., Galal, M., Athuman, M 2003. The biology of *Oreochromis niloticus* in a polluted canal.*Ecotoxicology*. 12:405-416.

Khallaf E. A., Alne – nae, A. A. 1986, Reproduction of Tilapias in a Nile Canal and its interaction with the environment, M. Sc. Thesis Fac. of Sci., Almonofya Univ. Egypt.

Kuton, M.P., Kusemiju, K. 2000. The Feeding Interrelationship of four Cichlids in the Lekki Lagoon,Nigeria. *Journal Sci. Res. Dev.* 5: 169-176.

Lagler, K.F. 1949. Studies in freshwater biology, Ann Arbor, Michigan. Latif , A . A.; Latif A.A, Khallaf ESA, El-Nenaei AA (1989). Effect of selectivity of trammel nets upon growth and mortality of two Tilapia *sp*ecies. *Bull. Natl .Inst. Oceanogr.Fish.* 2: 253-260.

Malami, G.Z., J.K. Ipinjolu, W.A. Hassan, Magawata, I. 2004. Feeding adaptations often fish *sp*ecies in river Rima. North Western Nigeria. A paper presented at the 2004 Annual conference of Zoological society of Nigeria held at institute of developmental research, Ahmadu Bello University Zaria. Pp 115.

Meyer, D.E. 2002. Technology for successful small-scale Tilapia culture (CR*SP* Research Report 02-179). CR*SP* Research Reports (Aquaculture Collaborative Research support Program). [Abstract from original paper published in: D. Meyer (Ed). 6to Simposio Centroamericano de Aquacultura Proceedings: Tilapia Sessions, 22–24. Tegucigalpa, Honduras, pp. 97-106.

Molnar, J. 2008. "Assessing the global threat of invasive *sp*ecies to marine biodiversity."*Frontiers in Ecology and the Environment.* 6 (9), :485-492.

Mosaad, M. N. M. 1990. Biological studies on five fish *sp*ecies from Lake Qarun, Egypt Length–weight releationship and condition factor. *Proc. Zool. Soc, Egypt* 21:331-344.

Moyle, P.B. 1976. Fish introduction in California: History and impact on native fishes. *Biol. Conserv*., 9(2):101-118

Negassa, A., Getahun, A. 2003. Breeding season, length-weight relationship and condition factor of introduced fish, *Tilapia*

zillii Gervais 1848 (Pisces: Cichlidae) in Lake Zwai, Ethiopia. *SINET Ethiopian J. Sci*., 26: 115-122.

Olaosebikan, B. D., Raji, A. 1998. Field guide to Nigerian freshwater fishes. Federal College of Freshwater Fisheries Technology, New Bussa, Nigeria. 106pp.

Olufeagba, SO, Aluko, P.O., Eyo, A.A. 2002. Dietary protein requirements of *Triploid. Heterobranchus. J. Aquatic Sci. 17:1-4.*

Osho J. A., Ayodele, I. A., Fagbuaro, O. 2006. Food and Feeding Habits of *Oreochromis niloticus (L)* and *Sarotherodon galilaeus* (L) in a Tropical Reservoir. *World Journal of Zoology* 1(2):118 – 121.

Panfili, J., Toma´s, J. 2001. Validation of age estimation and back-calculation of fish-length based on otolith microstructures in tilapias (Pisces, Cichlidae). *Fishery Bulletin 99: 139–150.*

Pauly, D., 1993. Fisbyte section editorial. Naga. ICLARM Q. 16, 26. *Journal of Tropical Agric. and Food Systems.* 4(1): 7-9.

Pauly, D., 2007. FishBase. World Wide Web electronic publication http://www.fishbase.org/search.php Version (accessed on October 2007).

Pauly, D 1993. Linear regressions in fisheries research. Journal of the Fisheries Research Board of Canada, 30:409-43 Pike in Aquaria. *Trans*. Am. Fish. Soc 97. 28 – 31.

Pauly, D. 1995. Anecdote and the Shifting baseline syndrome of fisheries. Trends in ecology and evolution. Pp 10:430. *Vol. 10.*

Phillip, J. C. L., Ruwet, J. C. L. 1982. Ecology and distribution of Tilapias ICLARM, Conf. Proc. Manila, Phillipines. 7: 15 - 59.

Pius, M.O., Benedicta, O.O. 2002. Food and feeding inter-relationship. A preliminary indicator to the formulation of the feed of some Tilapia fishes. *Tropical Journal of Animal Science*. 5(1): 35 – 41.

Riedel, R., Caskey, L.M., Hurlbert, S.H 2007. Lengthweight relations and growth rates of dominant fishes of the Salton Sea: implications for predation by fish-eating birds. , 23:528-535

Siddiqui, A. Q. 1977. Reproductive biology of *Tilapia zillii* (Gervais) in Lake Naivasha, Kenya. *Environ. Biol. Fish.* 1979; **4**: 257–262.

Tesch F. W. 1971. Age and growth. In Methods for assessment of fish production in fresh waters, 2nd edn. (W. E. Ricker, ed.), pp 98–130. Blackwell, Oxford.

Teugels, G.G., Thys van den Audenaerde, D.F.E. 1991. Tilapia. p. 482-508. In J. Daget, J.-P. Gosse, G.G. Teugels and D.F.E. Thys van den Audenaerde (eds.) Check-list of the freshwater fishes of Africa (CLOFFA). ISNB, Brussels; MRAC, Tervuren; and ORSTOM, Paris. Vol. 4. (Ref. 5163). Trans.Am. Fish. Soc. 102, 378 – 383.

Tsadu, S. M., Ojutiku, R. O., Anyawale A. V. 2006. A Survey of Fungi Contamination of some Fish Species from Tagwai Daru, Minna, Niger State, *Nigeria. Journal of Tropical Biosciences*. 6: 1-5pp.

Turan, C., Gurlet M., Ergudin D., Yaghoglu, D., Ozturk D. 2011. Systematic Status of *Sp*ecies (Mugilidae) in the Mediterranean Sea. *Turkish Journal of Fisheries and*

Aquatic Sciences, 11: 315 – 312.

Ujjania, N.C., Monika Dubey, Sharma, L.L.,Vijay Kumar Balai., Srivastva, R.M. 2015. Bio-invasion of exotic fish tilapia (*Oreochromis mossambicus* P. 1852) in Lake Jaisamand, India. *International Journal of Fisheries and Aquatic Sciences,* 3(2):174-177

Zacharia, P.U. 2004. Methods of stomach content analysis of fishes- Winter School on Towards Ecosystem Based Management of Marine Fisheries – Building Mass Balance Trophic and Simulation Models. Technical notes Edited by Dr. K.S. Mohamed, Director, Winter School & Senior Scientist, Central Marine Fisheries Research Institute [CMFRI], Pp 200.

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