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Length-Weight Relationship, Condition Factor and Feeding Habits of *Oreochromisniloticus* from Lake Geriyo, Yola, Adamawa State, Nigeria

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ABSTRACT

The Length-Weight relationship, condition factor and feeding habits of Oreochromisniloticus from Lake Geriyo, Yola, Adamawa state were studied on monthly basis from September to December, 2019. A total of 114 fish samples comprising of 45 males and 69 females were used for the study. The total length, and weight were taken for each fish for the estimation of length-weight relationship and Condition Factor. Stomach contents were analyzed by frequency of occurrence and numerical method. The total length of males, females and combined sexes ranged between 9.9 – 15.9cm, 9.1 – 13.9cm and 9.9 – 15.9cm with the mean values12.22 ± 1.42cm, 11.08 ± 1.47cm and 11.49 ± 1.54cmrespectively.The weight of males, females and combined sexes ranged between 30.5 - 148.7g, 21.1 - 96.2g and 21.1 – 148.7g with the mean values68.32 ± 25.18, 51.67 ± 20.13 and 57.77 ± 23.35g respectively with b-value of 1.2927, 0.9472 and 1.0637. The mean condition factors were 1.8044, 1.9279 and 2.0342 respectively. Out of the 114 stomachs examined for food items, 27 (23.68%) were empty while 87 (76.32%) contained wide range and varying quantities of food items indicating that Oreochromisniloticus from Lake Geriyo is Omnivorous and the habitat is suitable for growth and survival of the fish species.

Keywords: *Oreochromisniloticus, length-weight relationship, condition factor, feeding habits, LakeGeriyo.*

INTRODUCTION

Nile tilapia (*Oreochromisniloticus*) is the most important fish species in tropical and subtropical freshwater, often forming a basis of commercial fisheries in many African countries (Mohammed and Uraguchi, 2013). Its high tolerance to environmental conditions and the ability to accept formulated and natural feeds makes it economically viable (Adeyemi,2009).The fish is one of the most commercially important fish species and also contributes more than 50% of total landings of fish catch per year (Tesfaye and Wolff, 2014,Mitike, 2014). *O. niloticus* is the most widely distributed fish species in Africa countries especially in Ethiopian and Nigerian lakes and rivers (Golubtsov and Mina, 2003; Awoke, 2015).

Length-weight relationship is one of the most commonly used analysis in fisheries (Mendes *et al.*, 2004). Length-weight data of fishes are useful parameters in estimating the length and age structures, population dynamic, growth, mortality rate and wellbeing of the fish (Koffi *et al.*, 2014). They are also an important tools used to obtain information on length frequency distribution, fish condition for stock assessment and management of the fish population (Abowei *et al.*, 2009).

The estimation of yield per recruit in prediction models and in the estimation of biomass from length observation and limited studies has been made on the population dynamics. In fisheries science, the condition factor is used in other to compare the condition fitness of wellbeing of fish and it is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal and Teseh, 1978). Condition factor is also an index to understand the lifecycle of a fish by referring to the coefficient value, derived from its length weight relationship data (Schneider *et al.*, 2000). However, the condition factor of fish is strongly affected by biotic and abiotic environmental variables (Saliu, 2001).

Nile tilapia has a versatile feeding behaviour, characterized by generalized and opportunistic omnivorous feeding behavior (Canonico *et al.*, 2005). Its diet composition may vary within a wide range of seasonal and spatial condition of the environments (Karl *et al.*, 2001). The food composition may also vary depending on size of the fish, maturity, environmental condition and habitat types (Karl *et al.*, 2001).Various authors have studied the food and feeding habits of Nile tilapia in African water bodies including Nigeria (Engdaw *et al.*,2013;Tefera,1993;Teferi *et al.*, 2000; Wakjira, 2013 and Teame *et al.*,2016). All of them reported that Nile tilapia feed on different types of food based on the environment in which they live. However, there is no compiled information on the food and feeding habit of Nile tilapia in these different water bodies, that give the general insight on feeding biology of the fish in the country.

Oreochromisniloticus is an omnivore; its foods include plants, insects, diatoms and algae (Njiru *et al.*, 2006). Habitats and geographical positions tend to dictate on food items to be ingested by a fish species. For example, Banikwa *et al.*, (2004) observed that *Oreochromisniloticus* in Lake Nabugabo had different food items in different habitats. In the shores of Lake Victoria, *O. niloticus* is mostly found at depths ranging from 0-20m (Njiru *et al.*, 2006). Feeding habits of *O. niloticus* in Lakes Victoria, Chad and Turkana have been reported by (Acere, 1985; Dadebo *et al.*, 2005). The authors reported that haplochromine fishes were the main diets of *L. niloticus* in Lake Victoria. As haplochromine fishes became reduced in the eighties, the Late shifted to Rastreneobolaargentea, O. *nilotica* and juvenile L. niloticus (Ligtvoet, *et al.*, 1988). In Lake Chad, Schilbeids were the most important prey of adult Lates; In Lake Turkana, cyprinids and cichlids were the most important prey of the Lates fish whereas, in Lake Chamocyprinid fish, Labeohorie was the most important prey for adult and juvenile Lates (Dadebo *et al.*, 2005).

Notwithstanding, one of the aspect of the study of biology of fish is to determine its food and feeding habit either as a separate investigation or as part of other studies such as breeding, and growth. The knowledge of food and feeding habits of fish provides answers to practical problems which arise in relation to human exploitation. The primary problems in the study of the fish feeding habits is to have broad knowledge of the different species of prey in other to understand the qualitative and quantitative breed between fish and their food organisms. Fish especially in the tropical and sub-tropical water bodies are known to experience growth fluctuation which is due to factors such as changes in environmental parameters and food composition (Obasohan *et al.*, 2012).

The study of food and feeding habits of fresh water fish species is a subject of continuous research. This is because it makes up a basis for the developmentto successful management program on fish capture and culture (Shalloofand Khalifa, 2009). Moreover, studies on natural feeding of fish enable to identify the tropic relationships present in aquatic ecosystems, identifying feeding composition, structure and stability of food webs in the ecosystem (Adeyemi, 2009; Otieno *et al.*, 2014). The information is also vital for management of the fish in the controlled environment and for formulation of the appropriate dietary given to the fish in aquaculture (Adeyemi, 2009). Therefore, understanding of its food and feeding behavior is a key factor to its successful culture in a controlled environment (Shalloof and Khalifa, 2009).

MATERIALS AND METHODS

Study Area

Lake Geriyois situated in Jimeta-Yola Adamawastate capital and located on latitude 09°18’11” N and longitude 12°25’36”E. Lake Geriyois the lake which is flooded by the River Benue. Lake Geriyo occupies natural depression near the upper Benue River in north eastern Nigeria. The lake is flooded by the river during the raining season spanning the months of May to September (Shinggu *et al.*, 2015).

According to the information from the head of the local fishers, the lake was formed naturally from River Benue that was cut off as a result of heavy siltation about 60 years ago, thereby forming a small gully. The gully was later filled with water from the rains and flooding from River Benue. It is a shallow water body with a mean depth of about 2metres. Aquatic vegetation on the lake consist of mass of flooding weeds such as water hyacinth, typha grass, water lily and wild guinea corn which move around the lake surface due to the prevailing winds. The major commercial genera in the lake are Clarias and Tilapia (Shinggu *et al.*, 2015).

Sampling Method

The *O. niloticus* specimens were purchased from the fisher men at the landing sites of the Lake.

The fishes were procured on monthly basis for 4 months (i.e. from September to December, 2019) and transported to the Fisheries Laboratory in Modibbo Adama University of Technology, Yola for identification and measurements. Identification was done using the keys of Holden and Reed (1991), Babatunde and Raji (2013).

Length-Weight Measurements

The total lengths of the fish sample were measured from the tip of the fish's mouth to the hidden base of the tail fin rays and this was measured to the nearest 0.1 centimeter. The weight was measured using a digital electronic weighing balance (Adam AFP 4100L). This was read to the nearest 0.1 gramme.

Sex Determination

The structural sexual dimorphism of the fish specimen was identified through an examination of internal and external sex organs. In adults, eggs was obviously seen in the ovaries and in males the testes was observed typically smooth, whitish organs along the dorsal surface of the body cavity. The sex organs of immature fish specimens appeared as long, thin organs along the dorsal surface of the body cavity; the males exhibited a dorsally directed indentation of their ventral body wall involving the dorsal margin of their anal fin; female in contrast, show a more straight dorsal margin. Also, enlargement of the anal fin complex demonstrates the expanded bases ('spur') of several rays in males which are absent in females; females are bigger than the males and appeared pinkish to grayish in color while males appeared silvery, translucent to whitish as described by Enzewaji (2004) and Kumar *et al.*(2017).

Length –Weight Relationship

Data was analyze using regression. The relationship between length (L) and weight (W) of fish was expressed by equation:

$W= {}_aL^b$

(Le-Cren, 1951; Pauly, 1983)

The above equation and data was transformed into logarithms before the calculations was made therefore,

Log W = log a + b Log L

Where

W = weight of fish in (g)

L = Total length (TL) of fish (cm)

a= Constant (intercept)

b = The Length exponent (slope)

The "a" and "b" values was obtained from a linear regression of the length and weight of fish. The correlation (r^2) that is the degree of association between the length and weight was computed from the linear regression analysis:

$R = r^2$

Condition Factor

The condition factor (k) of the individual experimental fish species was estimated from the relationship and calculated for each month using the formulae described by Worthington and Richardo (1930) as:

$K = (W\ 100/L^3)$

Where

K = condition factor

W = Weight of the fish in (g)

L = Total length of fish in (cm)

Food and Feeding

The fishes were dissected and the stomachs were removed and preserved immediately in 4% formalin for subsequent examination of the food items. The stomachs were scored 0, ¼, ½, ¾, or full according to their fullness as described by Olatunde (1983). Each stomach sample was then opened and the content emptied in a petri dish. Some food items such as grains and insect parts were identified with the naked eye, while others were identified with the aid of a microscope. Slide preparation were made and examined under the light microscope using the X10 and X40 objectives. The stomach contents were analysed using:

Frequency of Occurrence Method

Percentage occurrence method = $\frac{\text{Total number of stomach with the particular food item}}{\text{Total number of all food items}}$ X 100

Numerical Method

Percentage number of a food item= Total number of the particular item X 100

Total number of all food items

Statistical Analysis

Condition factor data was subjected to descriptive statistics to establish means and standard deviations, length-weight relationship data was subjected to regression analysis.

RESULTS

Length - Weight Relationship of Oreochromisniloticus from Lake Geriyo

A total of 114 species of *O. niloticus* were collected from the different landing site of Lake Geriyo. The range of total length, weight, values of 'a' and 'b'or'n' correlation coefficient (r) , number of specimens and values of condition factor were all presented in Table 1. The males were found to range from9.9 to 15.9 cm in total length and total weight was ranged between 30.5 to 148.7 g. In case of females, the total length and weight were ranged from 9.1 to 13.9cm and 21.1 - 96.2 g respectively. The combined sexes were ranged from 9.9 to15.9 cm in total length and total weight was ranged between21.1 to 148.7g. The mean total length for male was calculated as 12.22 ± 1.42cm and the mean total weight calculated as 68.32 ± 25.18 g (N=45). For female, the mean total length and weight were calculated as 11.08 ± 1.47 cm and 51.67 ± 20.13 g (N=69) respectively while the combined sex, the mean total length recorded was 11.49 ± 1.54cm and the mean total weight was 57.77 ± 23.35g respectively. The 'b' value of male (1.6165), female (0.9472), and comined sex (1.0637) in Table 1, all show allometric growth. The length-weight relationship of males, females, and combined sexes, shows linear relationships with significant correlation coefficient of 0.8308, 0.9337, and 0.8915 in male, female, and combine sexes respectively ($p>0.05$) between the length and weight.

Condition Factor of Oreochromisniloticus from Lake Geriyo

The mean condition factor of *Oreachromisniloticus* from Lake Geriyo for Male 1.8044, Female 1.9279, and Combined sex 2.0342 respectively. Table 1 summarized the result of the condition factor of *Oreachromisniloticus* from September to December, 2019.

Table1. *Morphometric Parameters of Oreochromisniloticus from Lake Geriyo*

Parameters	Males	Females	Combined sex
Number	45	69	114
Length Range (cm)	9.9 – 15.9	9.1 – 13.9	9.9 – 15.9
Mean Length (cm)	12.22 ± 1.42	11.08 ± 1.47	11.49 ± 1.54
Weight Range (g)	30.5 - 148.7	21.1 - 96.2	21.1 – 148.7
Mean Weight (g)	68.32 ± 25.18	51.67 ± 20.13	57.77 ± 23.35
a	1.6165	1.3214	1.4275
b	1.2927	0.9472	1.0637
r^2	0.8308	0.9337	0.8915
k	1.8044	1.9279	2.0342

Condition of Stomach of the Fish Species from Lake Geriyo

The states of the stomachs of *Oreochromisniloticus* from the Lake Geriyo were determined using visual observation before dissection. Table 2: shows the level of feeding intensity of fish species in which 23.68% of the stomachs were empty, 15.79% of the stomach were found with one quarter full stomach (1/4), 28.94% were with half full stomach ($^1/_2$), 19.30% with three quarter full stomach (3/4) while 12.28% were appeared to have full stomach (4/4).

Table2. *Stomach Fullness of O. niloticus from Lake Geriyo*

Stomach fullness	No of fishes	% Fullness
0 (ES)	27	23.68
¼	18	15.79
½	33	28.94
¾	22	19.30
Full	14	12.28
Total	114	100

Food and Feeding Habit of the Fish Species from Lake Geriyo

Table 3 shows the summary of the food items in O. niloticus. The Diatoms accounted for 68.96%

of the content under frequency of occurrence method followed by Chlamydomonas and macrophytes with 64.36% and 54.02 respectively. Sand grains, Daphnia and Spirogyrasphad 3.45, 4.59 and 9.19%, respectively. In the numerical analysis, Chlamydomonassp (18.25%) constituted the most important diet of O. niloticus followed by Diatoms (16.24%), Macrophytes (11.01) while Daphnia, Sand grains, prawn and insect part appeared to be incidental diets.

Table3. *Stomach contents of Oreochromisniloticus from Lake Geiryo.*

Food Item	Frequency of Occurrence		Numerical Method	
	Number	Percentage (%)	Number	Percentage (%)
Diatoms	60	68.96	323	16.24
Chlamydomonas	57	64.36	363	18.25
***Closterium*sp**	24	27.58	83	4.17
Macrophytes	47	54.02	219	11.01
Detritus	42	48.27	139	6.99
Spirogyrasp	8	9.19	4	0.20
***Chironomid*larvae**	13	14.94	49	2.46
Crustacean	28	32.18	81	4.07
Prawns	6	6.89	6	0.30
Daphnia	4	4.59	1	0.05
Insect part	10	11.49	22	1.11
Sand grains	3	3.45	3	0.15

DISCUSSION

The value of regression co-efficient for male was (1.2927), Female (0.9472) and combined sexes (1.0637) respectively exhibited allometric growth. The values of "b" obtained during the period of the study shows that the increase in length is not in equal proportion with the weight under constant specific gravity. This is in consonance with the findings of other works (Abubakar, 2006) and (Kefas, 2016). It has been observed that certain factors such as increase in weight due to intake of water or food, season of the year, and the time of the day when the fish was captured, loss of weight due to food regurgitation and spawning can among other things affects "b" values (Abubakar, 2006; Kefas., 2016). As the values of 'b' increases, the size of the fish also increases because the fish usually grows proportionately in all directions. However, the changes in fish weight in general are actually greater than the changes in its length. However, the body shape of fish tends to change as the length increases (Kefas, 2016). The value of 'b' then becomes greater than 3 as the fish becomes fatter, or when the n value is lower than 3, the fish is slimmer (Golam and Fahad, 2013). There was significant correlation ($P<0.05$) between length and weight exhibiting linear relationship which is similar to observation made by Abubakar (2006) and Abubakar and Ishaya (2000).

The condition factor reflects the well-being of the fish (Abowei, 2010). It gives information when comparing two populations living in certain feeding, density, climate and other conditions when determining the period of gonad maturation, and when following up the degree of feeding activity of species to verify if it is making good use of its source (Ighwela *et al.*, 2011). Condition factor can also be affected by factors like sex, season, age and maturity stages of fish (Abowei, 2010). It usually decreases as the fish increases in size. The values of the condition factor in this study were 1.8044, 1.9279 and 2.0342 for the males, females and combined sexes respectively. These values were lower than the range of 2-4 recommended by Bagenal and Tesch (1978) as suitable forfresh water fishes. This means that *O. niloticus* in Lake Geriyo is not in good condition. Even though the female were in a slightly better condition (1.9279) than the male (1.8044) the difference was not significant ($p>0.05$). These findings did not agreed with the work of Midhat *et al.*, (2012) reported that the males of *S.schall* in River Nile at Gizza had better condition (1.83) than the females (1.64). Oni *et al.*, (1983) reported that condition factor was not constant for a species or population over a time interval and might be influenced by both biotic and abiotic factors like feeding regime and state of gonadal development.

The food items of *Oreochromisniloticus*in Lake Geriyo were, green algae, macrophytes, detritus, sand grains, insect parts etc. The feeding habits were similar to those reported by Fagade and Olaniyan (1972) in the Lagos Lagoon; and

Fagade (1979) on *Tilapia guineensis* from Lekki Lagoon. Apart from the major food items, they also picked a variety of other food items. Liem (1984) stated that cichlids were able to exploit more than one source. This ability to exploit different varieties of food makes *O. niloticus* to be omnivorous. Several other workers have also reported on the high degree of overlap in diet of fishes from the same community (Akinwumi, 2003; Olufeagba, *et al*. 2002).*O. niloticus* observed to be omnivorous having high frequency of occurrence of plant foods than animal foods were observed in the gut. The food and feeding habits of *O. niloticus* in Lake Geriyo as reported in the present study is in agreement with earlier reports for these fish species found in some other water bodies. Brown (1985) reported that this fish species fed mainly on detritus, insects and plant materials in Ikpoba River. Ikomi and Sikoki (2001) observed that the presence of tiny unicuspidteeth in the mouth of the fish suggests that fish species feed on plants, leaves, buds and seeds of water lilies and are thus herbivorous feeders.

The analysis of stomach fullness showed that 27 (23.68%) of the stomachs were empty while 87 (76.32%) contained varied quantity of food. Lalèyè *et al.*, (2006) observed 36% empty

stomachs in *S. schall* and 35% in *S nigrita*in Ouémé River, Benin. This high number of empty stomachs may be attributed to inadequate food in the Lake, post-harvest digestion or the method of catching of the specimens. Aramowo (1976) reported more than 67% empty stomachs for *Citharinus* species (Cuvier, 1816) caught with gill nets in Lake Kainji. This he explained might have been due to the food items having been regurgitated or digested as the fish struggled during the catches. The presence of artificial corn meal in the diet is an indication that the fishermen were using corn meal as baits.

Conclusion

The findings of this study revealed that the Length-weight relationship of *O. niloticus* in Lake Geriyo was correlated with the **b** values indicating allometric growth pattern. Both males and females of this species were in good condition throughout the study period. The research also revealed that *O. niloticus* in LakeGeriyo is an omnivorous.

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