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Food habit and growth pattern of Nile Tilapia *Oreochromis niloticus* in Wase Dam, Nigeria

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Abstract
The food habit and growth pattern of one hundred and thirty seven (137) samples of *Oreochromis niloticus* in Wase Dam, Kano State was investigated. Stomach contents were analyzed using frequency of occurrence and numerical methods. The fish fed mainly on algae (60.58%), insect part (42.34%), detritus (27.00%), fish fry (24.81%) and unidentified materials (21.16%). The diversity of food items found in the stomach categorizes the fish as an omnivore, with tendency of being a planktivore. The length-weight relationship (b-value) obtained for the male, female and combined sexes suggested a negative allometric growth. The mean condition factor (K) computed for male, female and combined sexes were 2.18, 1.97 and 2.10.

Keywords: Food items, growth pattern, Nile tilapia, *Oreochromis niloticus*, Wase Dam, Nigeria

1. Introduction
There are numerous inland water bodies in Nigeria with various sizes ranging from small, medium to large with abundant fish species that are of commercial importance. Fish is known to be a valuable and accessible source of protein in addition to income generation and that is why proper management of this resource is of great importance.
Fish is known to feed on various items in the aquatic environment, which constitute its food. Oronsaye and Nakpodia (2005) [13] reported that food habit is a subject of continuous research due to the fact that it constituted the basis for successful management programme whether in capture or culture fisheries. Additionally, Abdel - Aziz and Gharib (2007) [2] did report that studies on natural feeding of fish provide important information on the trophic relationships in the aquatic environment.
Growth pattern, which expresses the relationship between length and weight is widely used to study the natural populations of fish. This help to determine growth as well as monitor the health status of fish (Victor *et al*., 2014) [18] in the aquatic environment.
Food composition and growth pattern therefore, are essential in understanding the biology of fish population in any water body. It also provides useful information on the diets, life span, stock composition and fish production, amongst others for better management.
Oreochromis niloticus, known as Nile Tilapia is an important fish in aquaculture and capture fisheries. It is commonly widely distributed and commonly found in Nigerian water bodies (Araoye, 2008) [4]. It grows to reasonable size, where up to 3.5kg have been observed.
Studies have been carried out on food habit and growth pattern of *Oreochromis niloticus*. This include the works of Abari *et al*. (2015) [1] in Doma Dam and Ohaturuonye *et al*. (2017) [11] in Oguta Lake. However, there is no such baseline information for this important fish species in Wase Dam. This study aims at providing this useful information for better management of this valuable fish species in the dam.

2. Materials and Methods
2.1.1 Study Area
Wase Dam is located about 30km north - east of Kano city and originated from Jakara River, which got its name from one of the early historic settlement near Kano city. The dam was completed in 1976 and is a perennial water body. It has a catchment area of 559km^2; maximum height and width of 14.33m and 75.28m; surface area of 1,659ha.

2.1.2 Fish sample identification and collection
Samples of *Oreochromis niloticus* were identified at point of collection using manuals according to Paugy *et al*. (2003) [16], Froese and Paugy (2013) [5] based on morphometric and meristic features.
Fresh samples of fish were collected at random from fishermen catches that used gill nets on the dam. Different sizes were collected and transported to the laboratory for analysis in ice - chest box.

2.1.3 Body measurement
Standard, which is the distance from the snout tip to the caudal peduncle and total lengths, which is the distance from snout tip to the longer portion of the caudal fin of each sample was measured using measuring board in centimeters (cm) and weight in grams (g) using assorted weighing balance depending on the size of the fish.

2.1.4 Stomach contents analysis
Each fish samples was dissected by opening the body cavity with a scissors and the whole gut removed. The contents of each stomach were emptied in a petri dish, drops of distilled water added and stirred to separate them. The contents were observed under the stereo microscope, sorted and identified using manuals by Mellanby (1979) [9], counted and recorded. Frequency of occurrence and numerical method were used to determine the proportions of the stomach contents.

2.1.5 Growth pattern
The length - weight relationship was obtained using the formula according to Pauly (1984 *cited in* Yem 2019) [19] as follows;
$W = aL^b$
Which, was transformed to Log 10 as Log W = Log a + b Log TL, where, log length was plotted against log weight to obtain a, b and r values.
Where,
W = body weight of fish (g)
TL = Total length of fish (cm)
a = slope
b = intercept (this determines type of growth)
Condition factor (K) was calculated using the formula below according to (Pauly, 1984 *cited in* Yem *et al*., 2019):

$$K = \frac{100 \times W}{L^3}$$

Where;
K = Condition factor
TL = Total length (cm)
W = Body weight of fish (g)

2.1.6 Statistical Analysis
Descriptive statistic was used to calculate means, standard deviation, minimum and maximum values of data collected. Data were also subjected to analysis of variance (ANOVA) to test for any significant difference at 5% confidence level.

3.0 Results and Discussion
One hundred and thirty seven (137) samples of *Oreochromis niloticus* comprised of 81 males and 56 females were used for the study. Males' standard length ranged between 4.50cm - 19.50cm with mean 12.52 that of females between 5.00cm - 20.50cm with mean 13.17 and combined sexes 4.50cm - 20.50 with mean 12.78 (Table 1). This did not show any significant difference ($p>0.05$). This shows that males were bigger than female, which contradicts the finding of Gomez-Marque *et al*. (2008) [6] that reported standard lengths of 8.90cm-14.80cm and 9.0cm-16.50cm for males and females respectively but similar to that of Mortuza and Al-Misnel (2013) [8] who reported standard lengths of 7.60cm-27.30cm, 6.90cm-26.10cm and 7.60cm-27.30cm for male, female and combined sexes respectively. Similarly, Obasohan *et al*. (2012) [10] that did report standard length of 12.40cm-15.30cm with mean 13.6. This could be due to sizes caught, habitat difference amongst other factors. The weights of males, females and combined sexes ranged between 20.00g-145.00g, 20.00g-160.00g and 20.00g-160.00g respectively. Obasohan *et al*. (2012) [10] reported weights range of 61.90g-112.70g while Mortuza and Al-Misnel (2013) [8] did report weights of 14.80g-430g, 13.10-402g and 13.10-430g for males, females and combined sex respectively.
Composition of items ingested by *O. niloticus* in the dam includes fish fry, insect parts, phytoplankton (algae), detritus and unidentified items. The major food items were phytoplankton (algae) followed by insect parts then detritus while the lowest was unidentified materials. Oso *et al*. (2006) [14] reported algae (green, filamentous and colonial) especially *Closterium* sp. and macrophytes as major items consumed by the species. Others include detritus, sand grain and insect parts. Omondi *et al*. (2013) [12] did report algae as the predominant item consumed by *Oreochromis niloticus* if all sizes. Other items included detritus, zooplankton. The disparity in some of the items could be as a result of the difference in aquatic environment, abundance and availability of such items and sizes of the samples used amongst other factors. Similarly, Adeyemi *et al*. (2009) [3] did report *O. niloticus* to have fed on plant parts as the dominant food item, followed by algae and detritus. Other items included unidentified particles, sand grain, crustacean and insect part. The combination of both plant and animal materials in the diet of *O. niloticus* make the species to be an omnivore. Oso *et al*. (2006) [14] and Adeyemi *et al*. (2009) [3] reported the species as an omnivore, which is similar to the findings of this study. The species in Wase Dam could also be called a planktivore because of the relatively high percentage of phytoplankton found in the stomachs examined. *O. niloticus* in various lakes is capable of using a wide range of food resources including algae, detritus, higher plant material, chironomids, zooplankton and fish (Shalloof and Khalifa, 2009) [17].
Length-weight relationship values for males, females and combined sexes are 1.51, 1.50 and 1.52 respectively. In an ideal situation, b = 3, but the values of this study were less than 3, which show that the fish exhibit negative allometric growth pattern; the length and weight are not growing proportionately. Mortuza and Al-Misnel (2013) [8] reported b values for male female and combined sexes of *Oreochromis niloticus* as 3.16, 2.98 and 3.08, which showed positive allometric growth. The values are also higher than the ones reported for this study. Gupta and Gupta (2006) [7] did report b value to fluctuate between 2 and 4. This could be due to difference and/or condition of the environment, fishing pressure and spawning period to mention but a few. Studies have shown that the length of fish maintain a steady relationship with the weight. As b value increases the size of fish also increases because fish grows in all proportionately in all direction. Coefficient of regression (r) for the sexes exhibited positive correlation between the lengths and

weights, which shows close relationship between these parameters though the fish is grow slimmer.

Condition factor (K) expresses the condition of fish in a given environment, which include rate of well-being, robustness or fatness. Mean condition factors males, females and combined sexes were 2.18, 1.97 and 2.10. This shows that males *Oreochromis niloticus* are doing better than females in the dam. Mortuza and Al-Misnel (2013) [8] reported K value for male, female and combined sexes as 1.16, 1.02 and 1.09 respectively, which is not up to the ones reported for this study. A number of factors such as sex, seasons, stress, environmental conditions and food availability also affect condition of fish. There was no significant difference ($p>0.05$) in the condition factors between sexes of the species during the period of study.

4. Conclusion

Oreochromis niloticus fed on items that ranged from plant to animal materials. Plankton forms an important item of the species in the dam. The ability of the fish to feed at different trophic level makes the fish to live successful in the dam. Samples examined were in good condition though with negative allometric values. Other studies such as the physico-chemical parameters, limnology and pollution status of the dam need to be done. There should also be a workable management plans for the water body in order to protect the fisheries.

Table 1: Body measurement of *Oreochromis niloticus* in Wase Dam, Kano State

Sex	Male	Female	Combined Sex
No	81	56	137
Standard Length (cm) Mean ± SD	4.50-19.50 12.52±2.93	5.00-20.50 13.17±2.73	4.50-20.50 12.78±2.86
Total Length (cm) Mean ± SD	6.00-22.00 14.93±3.28	6.00-24.00 15.81±3.12	6.00-24.00 15.29±3.23
Weight (g) Mean ± SD	20.00-145.00 73.22±27.49	20.00-160.00 82.98±31.20	20.00-160.00 77.14±29.31

Table 2: Food composition of *Oreochromis niloticus* in Wase Dame, Kano State

Food Items	Frequency of occurrence %	Numerical method %
Fish fry	24.81	11.20
Insect parts	42.34	20.65
Phytoplankton (Algae)	60.58	44.25
Detritus	27.00	15.64
Unidentified materials	21.16	8.26

Table 3: Growth parameters of *Oreochromis niloticus* in Wase Dam, Nigeria

Sex	No	a	b	r
Male	81	0.08	1.51	0.94
Female	56	0.11	1.50	0.84
Combined sexes	13	0.10	1.52	0.90

Table 4: Mean Condition factor (K) of *Oreochromis niloticus* in Wase Dam, Kano State

Sex	Male	Female	Combined Sex
No	781	56	137
Total Length (cm)	4.50 - 19.50	5.00 - 20.50	4.50 - 20.50
Range of Condition factor (K)	0.69 - 4.26	0.85 - 4.26	0.69 - 4.26
Mean Condition Factor (K)	2.18±0.76	1.97±0.69	2.10±0.74

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