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Feeding habits and condition factor of *Oreochromis niloticus* in Lake Alau, Northeastern Nigeria

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Abstract
The stomach contents of 100 *Oreochromis niloticus*, sampled between April and August, 2011 in Alau Lake, northeastern Nigeria, were examined. Herbs and algae were the main contents representing 40.15%, 23.36% followed by some mud / sand components, insect parts and fish remains representing 14.60%, 13.87% and 8.03% respectively. *Oreochromis niloticus* was affirmed as an herbivore and a benthic feeder due to the presence of both herbs and mud/sand among its stomach content. The mean stomach fullness percentage was 70.94% and stomach emptiness was 29.06%. The average condition factor of the fishes was 1.69 with the best conditions recorded in the dry months of April and May at 1.74 and 1.94 respectively. The general trend in the condition factor for this species in this study is that relatively higher condition factors were recorded for relatively higher lengths.

Keywords: Stomach contents, *Oreochromis niloticus*, hervbivores, Lake Alau

1. Introduction
The study of the food and feeding habits of freshwater fish species is a subject of continuous research because it constitutes the basics of the development of a successful fisheries management programme on fish capture and culture (Oransaye and Nakpodia, 2005). [16] A through knowledge on the food and feeding habit of fishes provide keys for the selection of culturable species and the importance of much information is necessary for successful fish farming. The food habit of different fish varies from month to month. This variation is due to changes in the composition of food organisms occurring at different seasons of the year.

The importance of fish in the economy and ecology of inland waters has generated sustained interest in recent years with a considerable interest in tilapia species due to the importance of these fish as a cheap source of animal protein (Ikomi, 1996). [12] With an increasing human population exponential efforts have been directed within the last century at improving the extensive and intensive culture of tilapia species all over the world in view of its food value (Akintunde, 1996) [3]

Fish just like any other animal require food for their growth and survival, with the wild providing them with a wide diversity of food which includes those of both plant and animal sources (Pillay, 1992) [13]. Many relevant and non-relevant compounds and ions in water are also reabsorbed into the digestive tract of the fish. Fishes are generally selective of their diet, which is however dependent on the availability of such food, abiotic factors and the physiological condition of the fish itself. These preferences in diet are important factors for consideration in deciding on selection of species for polyculture (Jeje, 1992). [13]

The Nile tilapia (*Oreochromis niloticus*) is a relatively large Cichlid fish native to Africa from Egypt, South to East and Central Africa, as far West as Gambia. It is also native to Israel (Azevedo and Pelicice, 2011) [5]. Abubakar (1987) [2] reported that based on numerous laboratory examinations of the stomach contents, *Oreochromis niloticus* feed mainly on microphytes, chlamydomonas and spirogyra. Other food items include detritus, grains, insect parts, algae and diatoms.

Despite its economic importance and abundance at Lake Alau, recent information on the feeding habit and condition factor of *Oreochromis niloticus* is deficient. This study seeks to fill that gap in knowledge.

2. Materials and Methods

2.1 Study area

Lake Alau is the second largest lake in Borno state, northeastern Nigeria. It is located between latitude 12^0N and 13^0N and longitude 11^0E and 13^0E with total surface area of 56km. the climate is sahelian with two distinct seasons. A rainy season starting from June to September, with a mean rainfall of about 600mm, with a dry harmattan season proceeding the rainy season from October to February. The dry season spans from March to May characterized by intense heat, temperature range of 46-48 has been recorded in this period (Idowu *et al*., 2004, CBDA, 1986, Bankole *et al.*, 1994) [11, 8, 6].

2.2 Sampling procedures

Fish samples were bought at random from fisherfoks in the early hours of the morning (06:00hrs) that have just landed at the main fish landing site of the lake. These were preserved in an ice chest before transporting them to the laboratory for further analysis.

In the laboratory, the fishes were weighed to the nearest 0.01g using a weighing balance and measured for both standard and total length to the nearest 0.1cm with the aid of a measuring board. The digestive tract were removed and the stomach fullness or otherwise recorded. The weight of the stomach contents were obtained by subtracting the weight of the empty stomach from the total stomach weight. Stomach contents were fixed in 4% buffered formalin and preserved in 70% alcohol as prescribed by Morato *et al.* (2000). [14] Stomach content were placed on absorbent paper to remove the water and then placed on the microscope for identification while the extent of fullness was observed physically i.e. full, half full, three quarter full, one quarter full or empty.

The condition factor was calculated according to Bannister (1976) $K = W/L^3 * 100$

Where K is the condition factor; W is weight of the fish in grams and L is the total length of the fish in centimeters.

3. Results

3.1 Food spectrum and importance

Table 1 shows the food items found in the stomach of *O. niloticus* with their respective frequencies of importance. This was dominated by herbs which accounted for 40.15%, followed by algae (23.36%) with mud / sand components, insect parts, and fish remains following in that order representing 14.60%, 13.87% and 8.03% respectively as shown in fig. 1.

Table 1: Frequency of occurrence of food items in the stomach of *Oreochromis niloticus*

Food items	Frequency of occurrence	
	Number	Percentage (%)
Fish remains	11	8.03
Algae	32	23.36
Herbs	55	40.15
Mud/sand	20	14.60
Insect parts	19	13.87
Total	**137**	**100**

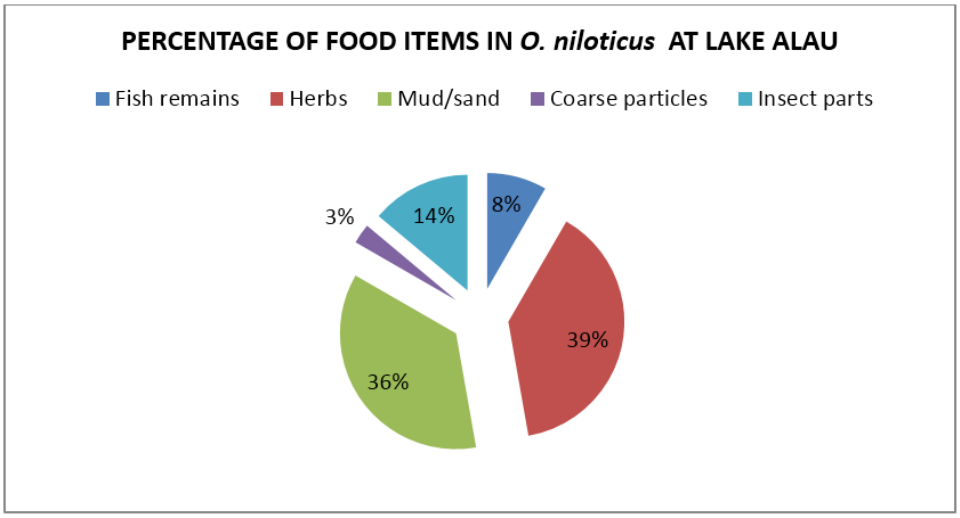

Fig. 1: Percentage of food item types in the stomach of *Oreochromis niloticus*

3.2 Monthly variation in feeding intensity and food types

Table 2 below shows the percentage of stomach fullness or emptiness of *O. niloticus*. Over 70% of the stomach dissected were full, representing stomachs that are either completely filled, ¾ full and ½ full while a little over 29% were empty which include both completely empty and ¼ full stomachs. However, there were variations in the fullness and emptiness across the months sampled with the highest percentage fullness of 75.56% and 73.68% recorded between the months of April and May while the least recorded were in June (69.88%) and August (65.0%) as shown in fig. 2.

Table 2: feeding activity of *Oreochromis niloticus* by months (based on number of fish, percentage of fullness and emptiness)

Months	Number of fishes examined	Percentage of fullness	Percentage of emptiness
April	20	75.56	27.44
May	20	73.68	26.32
June	20	69.88	30.12
July	20	70.56	29.44
August	20	65.00	35.00
Mean		**70.94**	**29.06**

N.B: Fullness includes full, ¾ full and ½ full stomachs. Emptiness includes ¼ full and empty stomachs

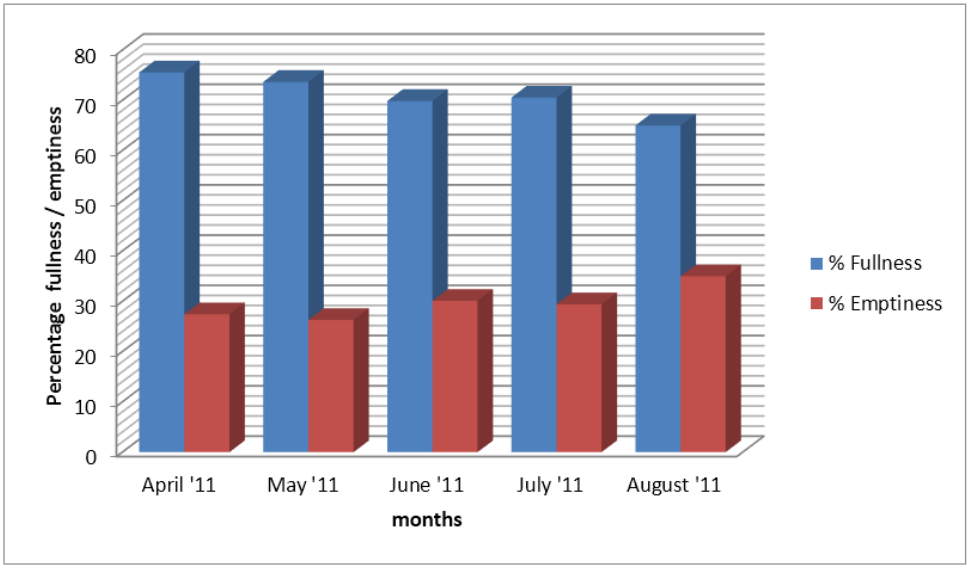

Fig. 2: Percentage fullness / emptiness of the stomach of *Oreochromis niloticus*

Figure 3 below showed varied mean monthly condition factor of *O. niloticus* with the highest being in May and April with 1.94 and 1.74 respectively and the least being in July (1.55).

Table 3: Monthly mean weight, total length and condition factor of *Oreochromis niloticus*

Month	Weight (g)		Total length (cm)		Condition factor (K)	
	Range	Mean	Range	Mean	Range	Mean
April	49.8 – 220.5	105.6	14.2 – 23.1	18.03	1.50 – 1.96	1.74
May	68.7 – 190.3	111.2	16.4 – 23.0	18.7	1.23 – 2.00	1.94
June	60.3 – 320.0	189.7	17.0 – 27.0	22.5	1.23 – 1.79	1.57
July	59.5 – 290.0	181.4	16.5 – 27.0	22.3	0.97 – 2.81	1.55
August	91.3 – 350.0	191.4	17.5 – 30.0	22.5	1.07 – 1.92	1.63

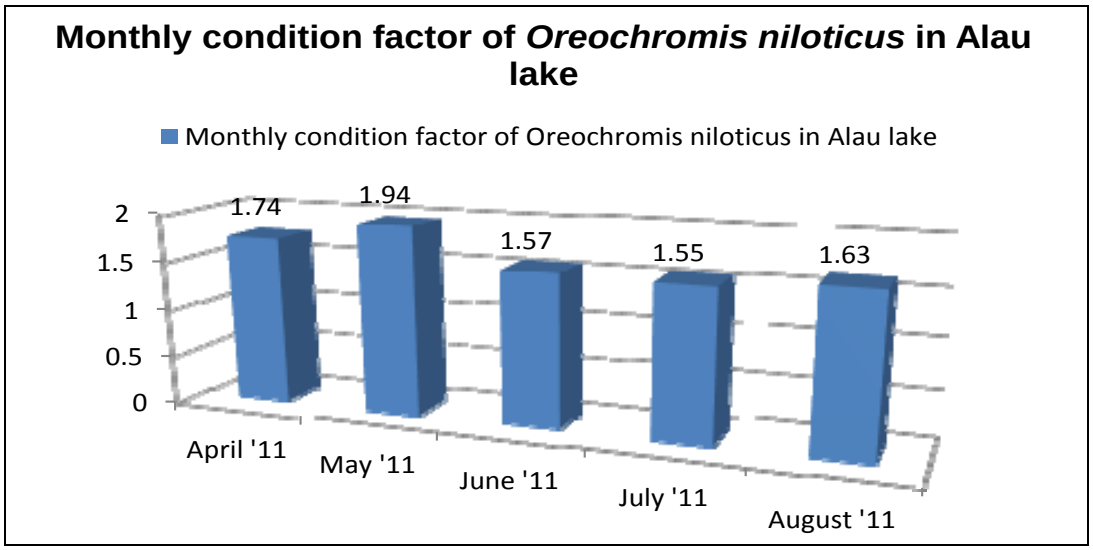

Fig 3: Mean monthly condition factor of *Oreochromis niloticus*

4. Discussion

The major food items of *Oreochromis niloticus* in Lake Alau were mainly herbs, algae and fish remains, some mud/sand components were also encountered. The feeding habits were similar to those reported by Fagade and Olaniyan (1979) [9] in the Lagos lagoon and Fagade (1984) [9] on *Tilapia guineansis* from Lekki lagoon. The food items observed during the investigation / study was also in line with algae, detritus, higher plant materials, fish and insect obtained by Omandi *et al*., (2013) [15] in Lake Baringo, Kenya. The study reaffirmed Oso *et al*., (2006) [12] observation that cichlids have the capability to exploit more than one food type.

Examination of the stomach content of the fish species showed that there was a relatively high percentage of mud / sand in its stomach which is indicative of the species as a bottom feeder and the presence of higher plant remains (herbs) in significant proportion is an indication of the herbivorous nature of the species.

The condition factor of the fish by months showed a general good well-being of the species in Alau Lake; however this is lower than the findings of Abubakar (1997) [1] in River Kaduna. The highest condition factor figures were gotten within the months of April and May which were the dry months, which is in agreement with the findings of Anene (2005) [4] on the cichlids of a man-made lake in Imo state, southeastern Nigeria. This relatively lower condition factor could also be attributable to the general principle that condition factor is not constant for a fish species or population over a time interval as they might be affected by biotic and abiotic factors which fluctuate with time. The sustained months of militant insurgency in this region and the noise of heavy artillery could also be a factor in disorienting the fish population in Lake Alau. It was also observed that the smaller length fishes recorded the higher condition factors compared to the longer length ones which is in agreement with the findings of Anene (2005) [4] but disagrees with that of Utete & Chikova (2013) [7] who reported higher condition factors with larger sized *Oreochromis niloticus* compared to the smaller sized ones.

5. Acknowledgements
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