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SHORT COMMUNICATION

FOOD AND FEEDING HABITS OF *Lates niloticus* (Linnaeus, 1762) FROM RIVER RIMA IN NORTH-WESTERN NIGERIA

B. A. Shinkafi and I. Rasaq

Department of Forestry and Fisheries, Usmanu Danfodiyo University,
Sokoto, Nigeria

Introduction

The study of the food and feeding habits of fishes is one of the most important production parameters of fish populations, as it constitutes the basis for the development of a successful fisheries management programme in fish capture and culture (Oronsaye and Nakpodia, 2005). Nature offers a great diversity of organisms that are used as food by fish and these differ in size and taxonomic group (Olojo *et al.*, 2003). Fish must thus exploit its food in aquatic environment and the adaptation for these is the reason of some morpho--logical traits related to feeding (Adeyemi, 2010). The relationship between body structures and fish diet could be important for predicting their diet, how they feed and the mechanics of feeding (Wootton, 1992). A lot need to be investigated on the feeding behavior of fishes, kind of organisms they eat and the mechanism that have developed for their digestion through observation and examination of the content of stomach and also the digestive tract.

Nile perch has yielded a dramatic increase in total fishery and fishery related employment and to ensure proper management of the fisheries, information on the ecology, biology and abundance of natural foods needed by the species is necessary (Kitchel and Schindler, 1997). Several workers have reported on the food and feeding habits of *L. niloticus* from different water bodies and these include Ogutu-Ohwayo (1990), Mkumbo and Ligtvoet (1992), Balogun (2000), Dadebo *et al*. (2005) and Katunzi *et al*. (2006).

Various works on food and feeding habits of fishes from River Rima have been reported by many authors. These include the works of Ipinjolu *et al*. (1988), Shinkafi and Ipinjolu (2001); Malami *et al*. (2005); Shinkafi and Maradun (2008) and Shinkafi *et al*. (2011). The present study is therefore aimed at providing information on the food and feeding habits of *L. niloticus* in River Rima, the likes of which have not been reported on the species in the river elsewhere.

Materials and Methods

Study Area

The fish samples were collected from Kwalkwalawa fish landing site of River Rima, which is along the road to the permanent campus of Usmanu Danfodiyo University, Sokoto. Sokoto lies between longitudes $4^{o}8'$E and $6^{o}5'$E, and latitudes 12^{o}N and $13^{o}58'$N

(Mamman, 2000). The climate of Sokoto is tropical continental, with much of the rains between June and September, while the long dry season is from October to May (Ita *et al*., 1982).

River Rima flows in a south-western direction over 100km and joins River Sokoto to form the Sokoto-Rima River System. The Sokoto-Rima River flows in a south-westerly direction up to Zogirma, where it changes direction and run southwards before emptying into the River Niger. Rainfall in the area is from May/June to early October, when the natural water bodies are often flooded (Umar and Ipinjolu, 2001).

Fish Samples and Size Measurements

The samples were taken to the Forestry and Fisheries Laboratory of Usmanu Danfodiyo University, Sokoto where they were examined fresh. Those that could not be treated were preserved in a freezer until next day. The sex of the samples was identified by visual examination for the presence of external genital papilla in bigger male sample which is usually absent in the females (Linder, 2009) and by presence of testes or ovaries after the dissection in the smaller specimens.

The lengths of the samples were measured using a metric ruler (in cm). The measurement of the fish was taken by placing it on a flat board. The parameters measured include the total length (TL) and gut length (GL). The weights of the samples that is total weight (TW) and stomach weight (SW) were obtained using electric top-loading balance (Metler balance).

The guts of the fish were removed by making a longitudinal incision along the mid-ventral line from the mouth to the anus to expose the visceral organs; the guts were removed carefully by detaching it from other internal organs and fatty tissues and measured (in cm). The stomach was cut-off from the gut and weighed (in g).

Stomach Fullness and Contents Identification

The stomachs were scored 0, 25, 50, 75 and 100% according to their fullness with food material (Olatunde, 1979).

Each stomach was slit opened and the contents emptied into a Petri-dish. The contents were then checked and identified; small items were observed under a microscope. They were then identified with the aid of keys provided by Needham and Needham (1962) and Mellanby (1975).

Feeding Structures and Adaptations

The nature, function and modification of mouth, lips, dentition, gill rakers and gut system as structural feeding adaptations were studied based on the descriptions of Reed *et al*. (1967), Gosline (1971) and Lagler *et al*. (1977).

Data Analysis

The stomach contents were analyzed by frequency of occurrence method (Hynes, 1980). Each food item was identified and number of stomachs in which each food occurred were counted and expressed as a percentage of stomach containing food, the method

showed the proportion of individuals eating a particular food item. The occurrences of each food item were expressed as a percentage of all stomach with food as follows:

$$P = (b/a)\, x\, 100$$ (Hynes, 1980).

Where, a=Total number of fish examined with food in the stomach; b=Number of fish containing a particular food item; P=Percentage of occurrence of each food item.

The relationship between the fish total length (TL) and gut length (GL) and Fish total weight and stomach weight were computed using a linear regression model as follows:

$Y = a + bX$ (Steel and Torrie, 1980)

Where, Y=Gut length (cm) or stomach weight (g); X=Fish total length (cm) or total weight (g); a=Constant; b=Exponent.

Results and Discussion

Fish Samples

A total of 55 samples of *L. niloticus* were used for this study. The samples were divided into two different size groups of <25cmTL and in this group, 9 samples were obtained. The other group is made up of ≥25cmTL, where 46 samples were obtained. There were 27 males and 28 females.

Total lengths ranged from 13.50 to 35.00cm, with a mean of 27.66±4.64SD and total weights ranged from 25.30 to 493.10g with a mean of 290.43±101.33SD. The gut lengths (GL) ranged from 5.00 to 18.00cm with a mean of 12.17±2.68SD.

Stomach Fullness

Table 1 shows the stomach fullness of *L. niloticus*. About 36% of the samples had food contents, while almost 64% were found to have empty stomach. The proportion (63.64%) of *L. niloticus* found with empty stomach in this study could be attributed to post harvest digestion which may have occurred after the fish were caught which was mostly at night. According to Reed *et al*. (1967) and Mkumbo and Ligvoet (1990), the species is a nocturnal feeder and thus, the observation of large number of empty stomachs may be the long period of time for the fish to be removed from the nets used in trapping them. Similar reports of large percentages of empty stomachs in *L. niloticus* have been reported by Balogun (2000) and Dadebo *et al*. (2005).

Stomach Contents

Table 2 shows the frequency of occurrence of the food items with respect to whole samples, sex and the 2 size classes. Fish remains of unidentifiable species accounted for the largest proportion (18.18%) of food items found in large size samples. Tilapia and *Alestes spp* were the two fish species identified. Same pattern is maintained based on sex and in the larger samples, while all the stomachs of the smaller samples (<25cmTL) were found to be empty. It was also observed that *L. niloticus* is piscivorous, as its diet consisted solely of fish species such as *Alestes spp, Tilapia spp* and fish parts. This agrees with the reports of Ogutu-Ohwayo (1990) that the Nile perch in Lake Victoria greater than 25cm TL feed to a large extent on smaller fish species likes *Alestes, Micralestes, Tilapia, Oreochromis,*

Haplochromis and Shrimps. Lack of variation in contents of stomachs based on sex and size, and throughout the months of study, is a pointer to the strict carnivorous (piscivorous) nature of the fish as reported by Mkumbo and Ligtvoet (1992).

Samples could not be obtained in the months of September and October and this may be due to peak of high water level, allowing the fish to disperse and hide during spawning (Katunzi *et al*., 2006) and thus becoming more difficult to access by the fishermen (Laleye *et al*., 2006).

Relationships of total length to gut length and total weight to stomach weight

The results of regression analysis for the relationship between total weight and stomach weight for the whole samples and based on sex and the 2 size classes are presented in Table 5. There was high significant ($P<0.01$) relationship between the two parameters. Based on sex, higher correlation of the relationship was found in females ($r=0.588$) than in males ($r=0.319$). There was also higher correlation in the TW-GW relationship in the smaller samples ($r=0.897$) than in the larger ones ($r=0.108$).

Table 4 shows the regression equations for the relationship between total length and gut length of the samples based on sex and the 2 size classes. The high b values in all the equations showed that increase in total length results in corresponding increase in the gut length. The r values of the equations showed almost same correlation in both sexes ($r=0.736$ and $r=0.793$ in males and females, respectively). All the equations were highly significant ($P<0.01$).

Structural feeding adaptations

The structural feeding adaptations of these species showed that the terminal mouth found in this species suggest feeding on food substances in mid and open waters (Lagler *et al*., 1977), while the wide mouth indicate taking larger prey during their meal. The jaw teeth borne on pre-maxillary and maxillary bones may be used in cutting, grasping and tearing their prey (Reed *et al*., 1967). The sharply pointed incisors and cardiform teeth are used in grasping, puncturing and holding of dietary items, probably motile and larger organisms, further confirming the predatory nature of the species (Wootton, 1992). The widely spaced gill rakers suggest that tiny food particles are not important in their diet (Lagler *et al*., 1977). The wide and muscular oesophagus is used in swallowing large and whole preys (Wootton, 1992) while the Y-shaped stomach indicates accommodating prey probably larger than the fish (Lagler *et al*., 1977). The short gut size may be an indication of feeding on animal (protein) materials whose site of digestion is the stomach. According to Lagler *et al*. (1977) and Smith (1980), shortened gut system is important to carnivorous mode of life. These further confirm the piscivorous nature of the species in River Rima.

Table 1: Categorization of stomach fullness of *L. niloticus* from River Rima

Stomach Fullness	No. of Samples	%
0 (empty)	35	63.64
25	13	23.64
50	1	1.82
75	2	3.64
100	4	7.27
Total	55	100.00

Table 2: Frequency of occurrence of food items based on sex and size of *L. niloticus* from River Rima

Food Items	Whole samples		Size classes				Sex			
			<25cmTL		≥25cmTL		Male		Female	
	F	%	F	%	F	%	F	%	F	%
Tilapia spp.	7	12.73	0	0.00	7	12.73	4	7.27	3	5.46
Alestes spp.	3	5.46	0	0.00	3	5.46	2	3.64	1	1.82
Fish remains	10	18.18	0	0.00	10	18.18	5	9.09	5	9.09
Empty stomachs	35	63.64	9	16.37	26	47.28	16	29.09	19	34.55
Total	55	100.01	9	16.37	46	83.28	27	49.09	28	50.92

Table 3: Monthly analysis of the stomach content of *L. niloticus* from River Rima

Month	No. of samples	No. of stomachs with food	%	No. of empty stomachs	%
July	18	6	33.33	12	66.67
August	10	4	40.00	6	60.00
October	17	7	41.18	10	58.82
December	10	3	30.00	7	70.00

Table 4: Relationship between the total length and gut length of *L. niloticus* from River Rima

Parameter	N	a	b	SE of b	r
All samples	55	-0.022	0.441	0.051	0.763
Sex					
Males	27	1.677	0.369	0.068	0.736
Females	28	-1.049	0.490	0.074	0.793
2 size classes					
<25cmTL	09	-1.146	0.493	0.059	0.953
≥25 cmTL	46	3.235	0.331	0.145	0.325

Model: GL= a+bTL; GL=gut length and TL=total length; a=Constant and b= Exponent

Table 5: Relationship of total weight and stomach weight of *L. niloticus* from River Rima

Parameter	N	a	b	SE of b	r
All samples	55	1.159	0.014	0.004	0.439
Sex					
Males	27	1.755	0.012	0.007	0.319
Females	28	0.788	0.014	0.004	0.588
2 size class					
<25cmTL	9	0.584	0.013	0.002	0.897
≥25cmTL	46	3.860	0.006	0.008	0.108

Model: SW = a+bTW; SW=stomach weight; TW=total weight; a=Constant and b= Exponent

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