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Food and Feeding Habits of African Carp (*Labeo Senegalensis,* Valenciennes 1842) in River Rima, North-Western Nigeria

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ABSTRACT

This study was carried out to determine the food and feeding habits of African carp (*Labeo senegalensis*, Valenciennes, 1842) in River Rima Sokoto, Nigeria. A total number of 122 samples were collected between June and December, 2012 from the fishermen of the Kwalkwalawa fish landing site of River Rima. The food materials of the species were analysed by frequency of occurrence method. The structural feeding adaptations of the species were assessed to further confirm the feeding habits of *L. senegalensis.* The total length of the samples ranged from 17.80 to 30.10cm with a mean of 25.88±3.279SD and total weight ranged from 48.20 to 270g with a mean of 155.62±57.678SD. Gut length ranged from 111.00 to 240.00cm with a mean of 144.114±27.43SD. The stomach content analysis showed that the species was an herbivorous detritivore, feeding mainly on plant materials such as *Lymnaea*, *Potamonautes*, worms and algae. Observations on the feeding structures such as the presence of inferior mouth, toothless jaws, palatal and pharyngeal teeth, fine gill rakers, small stomach and long coiled intestine of about six times the total body length further confirmed the aforementioned feeding habits of *L. Senegalensis* in River Rima, North-Western Nigeria.

Key Words: *Labeo Senegalensis*, food, feeding habits, herbivorous detritivore, River Rima

INTRODUCTION

*Labeo senegalensis s*is one of the common species of the Genus *Labeo* found in Nigeria and it is a highly valued food fish in the country and other West African countries (Ayotunde *et al.*, 2007). The species is widely distributed throughout Africa (Leveque, 2003) and it is the largest species of the Genus *Labeo* in the Oueme Basin, Benin Republic (Montchowui *et al*., 2011). It attains a maximum size is about 500 mm in length and 3 kg in weight in Nigerian inland waters (Holden and Reed, 1972). Fishes of the Genus *Labeo* consist of at least 80 species, which comprises about 16% of the African cyprinid ichthyofauna (Reid, 1985). Most *Labeo spp* are important throughout the African continent, contributing significantly to various Fisheries (Delaney *et al*., 2007) where they serve as food fishes, thus supporting the fishing industry (Corbet, 1961).

Dietary analysis of organisms in their natural habitats enhances the understanding of their growth, productivity, abundance, and distribution, as well as knowledge of their trophic relationships (Ikpi *et al*., 2012). Investigations in the tropics have shown that the natural foods of fish tend to vary quantitatively and thus, the growth of the fish is influenced by the quality and quantity of food materials available and

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consumed (Kumar, 2007). Thus, any variation in quality and quantity of food materials will affect the growth rate of the fish. To ensure proper management of any fisheries, information on the ecology, biology and abundance of natural foods needed by the species are necessary. Analysis of the stomach content of fish could provide information about the niche of the particular fish in its ecosystem (Dasgupta, 2001). It also contributes to a better understanding of the tropical dynamics and food webs, which is essential for appropriate fisheries management. Studies on food and feeding habits gives information on seasonal changes of fish because the type and magnitude of food available as well as the season it occurs plays important role in the history of the fish (Olaosebikan and Nzeh, 2008).

Many studies have been carried out on the biology and ecology of this commercially important fish species which has been recognized as aquaculture species (Omoreigie, 2001). These include the works of Blake and Blake (2006), Ayotunde *et al*. (2007), Montchowui *et al*. (2008), Montchowui *et al*. (2010), Ayoade (2011), Offem *et al*. (2011), Adeyemi and Akombo (2012), Ikpi *et al*. (2012), Tiogue *et al*. (2013), Adadu *et al*. (2014) and Abobi *et al*. (2015).

However, there is a dearth of information on the biology and ecology of the species from North-Western Nigeria. This therefore prompts the need to investigate the food and feeding habits of *L. senegalensis* from River Rima, which is an aspect of the biology of the species with a view to providing baseline information for its management in the wild and under culture.

MATERIALS AND METHODS

Study area

The study area was River Rima in Sokoto State, North-Western Nigeria. According to Mamman (2000), Sokoto State falls within the Sudan Savannah and lies between longitudes 11^0 13′ and 13^0 50′ E and latitudes 4^0 to 6^0 N. The Author further reported that rainfall is short and erratic and lasts from late May to September/October and ranges from 500mm in the north to 1,300mm in the south. The mean temperature is 34.3^{OC} and fluctuates between 41^oC in the months of March/April and 15^0C between November and February. The State is drained by River Rima and its tributaries, most of which rise in the southeastern part of the State and into the neighbouring Kaduna State (Ita *et al.*, 1982).

Collection of samples

One hundred and twenty two (122) samples of *L. senegalensis* were obtained from artisanal fishermen of the Kwalkwalawa fish landing site of River Rima in batches between June and December, 2012. The fish were caught using various types of fishing gears which include hand nets, clap nets, cast nets and gill nets of various mesh sizes. The samples were taken to the Forestry and Fisheries Laboratory of Usmanu Danfodiyo University, Sokoto in ice chest after collection and were examined in fresh condition. Those that could not be treated were preserved in a freezer until the next day.

Sex identification

The sexes of the fishes were identified by visual examination of reproductive organs. The sexes were distinguished by the presence of the external genital papilla in male sample which is limited or poorly seen in the female (Balogun, 1987).

Length and weight measurements

The lengths of the samples were measured using a metric ruler (in centimetre). The measurement of the fish was taken by placing it on a flat board. The parameters that were measured include the total length (TL), head length (HL), fork length (FL), standard length (SL), girth and gut length (GL). The weights of the samples were obtained using electric top-loading (Metler) balance. Total weight (TW), gutted weight (GW) and stomach weight (SW) were all measured.

Observations of feeding adaptations

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

Stomach fullness

The stomachs were scored 0, 25, 50, 75 and 100% fullness as described by Olatunde (1979).

Stomach content analysis

The guts of the samples were removed by making a longitudinal incision along the mid-ventral line from the anus to the mouth to expose the visceral organs (Olatunde, 1979). The guts were removed carefully by detaching it from other internal organs and fatty tissues. The gut length (GT) was measured to the nearest centimetre on a graduated measuring board. The stomach was cut off from the gut and weighed on an electric top-loading balance (Model: (Metler Toledo) to obtain the stomach weight (SW) in grams (g).

Identification of food items

Each stomach of the samples was slit open and the contents emptied into a Petri-dish. The content was then checked and identified using a microscope. The food materials were identified with the aid of keys provided by Needham and Needham (1962) and Mellanby (1975).

Data analysis

The stomach contents were analysed by frequency of occurrence method (Hynes, 1980). This is the number of times a particular food item occurred in the stomach and is counted and expressed as a percentage of the total number of stomachs with food (empty stomachs excluded). The method presents the food spectrum of the species and thus, the importance of the food item relative to the population could be assessed. The frequency of occurrence of each food item is expressed as follows:

$P = (b/a) \times 100$ (Hynes, 1980), Where, a= Total number of fish examined with food in their stomach, b = Number of fish containing a particular food item, p= percentage of occurrence of each food item.

The minimum, maximum, mean and standard deviation of the samples' total length, standard length, head length, stomach weight, gutted weight and girth were analysed using descriptive statistics with the aid of the SPSS statistical package (Version 16).

RESULTS

Morphometric features

The total length of *L. senegalensis* samples in this study ranged from 17.80cm to 30.10cm, (mean=25. 08±3.28SD) while the total weights ranged from 48.20 to 270g with a mean of 155.62±57.68SD. The minimum, maximum, mean and standard deviations of all the morphometric features are shown in Table 1. There were 82 males and 40 females. Gut lengths of the samples ranged from 111.00 to 240.00cm with a mean of 144.12±27.43.

Categorization of Stomach fullness

Table 2 shows the categorization of stomach fullness of *L. senegalensis* based on different percentage from River Rima. As shown in the Table, 31.15% of the samples (38) had food content in their stomachs while 68.85% (84) were found with empty stomachs. Twenty percent (20) of the samples have 25% of their stomach filled with food items. Only of the fish observed have 100% stomach filled with food items.

Table 1: some morphometric indices of *L. senegalensis* from River Rima (N=122)

Parameter	Minimum	Maximum	Mean	SD
Total length (cm)	17.80	30.10	25.08	3.28
Standard length (cm)	13.00	25.00	19.34	2.67
Forked length cm	15.70	27.10	21.92	2.82
Head length (cm)	2.00	4.00	3.06	0.52
Girth (cm)	2.70	5.50	4.24	0.69
Total weight (g)	48.20	270.00	155.63	57.68
Gutted weight (g)	43.50	249.90	141.03	52.18

Table 2: Categorization of stomach fullness of *L. senegalensis* in River Rima

Stomach fullness (%)	No. of samples	Percentage (%)
0	84	68.85
25	20	16.39
50	8	6.56
75	2	1.64
100	8	6.56
Total	122	100.00

Stomach content analysis

Table 3 presents the stomach content analysis of *L. senegalensis* caught from River Rima based on frequency of occurrence method. Of the total number of 122 samples examined, only 38 (31.15%) contained food in their stomachs. The most dominant food item found was plant material (about 8%) followed by bottom, crabs (*Potamonautes spp*) with about 7%. Detritus and *Lymnaea* (duckweed) had a presence of about 5%. The least food items were bottom algae and worms (about 3%).

Based on the 2 size classes, where 12 samples were found in the < 20cmTL category, only 6 samples had food in their stomachs, with only plant parts, detritus and *Lymnaea* been found in equal proportion (about 2%). In the larger sized category (≥ 20cm TL), of the 110 samples examined only 32 (29%) contained food in their stomachs. The most dominant food item is plant parts (about 7%) followed by *Lymnaea* and *Potamonautes spp* (5%), while detritus, worms and algae are the least and in equal proportion (3%). There is no variation in the diet of the samples based on sex, with the pattern being similar to that of larger samples (< 20cm TL).

Table 3: Frequency of occurrence of food items based on 2 sizes and sex of *L. senegalensis* from River Rima

Food items	All samples		Size classes				Sex			
	< 20cm TL				≥ 20cm TL		Female		Male	
	F	%	F	%	F	%	F	%	F	%
Plant parts	10	8.20	2	1.64	8	6.56	6	4.92	4	3.28
Detritus	6	4.92	2	1.64	4	3.28	3	2.46	3	2.46
Worms	4	3.28	0	0.00	4	3.28	2	1.64	2	1.64
Lymnaea	6	4.92	2	1.64	6	4.92	2	1.64	4	3.28
Potamonautes spp	8	6.55	0	0.00	6	4.92	4	3.28	4	3.28
Algae	4	3.28	0	0.00	4	3.28	2	1.64	2	1.64
Empty	84	68.85	6	4.92	78	63.93	21	17.21	63	51.64
Total	122	100	12	9.84	110	90.16	40	32.79	82	67.21

F= Frequency of occurrence, %= Percentage of occurrence

Monthly analysis of the stomach contents

The samples were collected between June and November, 2012. Table 4 shows the six months categorization of the stomachs of *L. senegalensis* from River Rima. More fish were obtained in September (60) than in the other months while the least number of samples were collected in August (6). However, stomachs of all samples in July (10) contained food, whereas very few stomachs contained food in September (6), even though the largest number of samples was obtained in that month.

Table 4: Monthly analysis of the stomach contents of *L. senegalensis* from River Rima

Month	No. of samples	No. of stomachs with food	% of stomachs with food	No. of empty stomachs	% of empty stomachs
June	22	10	45.45	12	54.55
July	10	10	100.00	0	0.00
August	6	2	33.33	4	66.67
September	60	6	10.00	54	90.00
October	8	2	25.00	0	75.00
November	16	6	37.50	10	62.50

Observations of the structural feeding adaptations

Based on the macroscopic observations of the structural feeding adaptations of samples of this study, *Labeo senegalensis* have inferior mouths, toothless jaws, with palatal and pharyngeal teeth that are in three rows. The gill rakers are thin and are arranged very close to each other. The oesophagus is short and the intestine is long and coiled about six times the total body length. The samples had roundish or bulgy stomach.

DISCUSSION

The large proportion of the empty stomachs (68.9%) in this study could be attributed to post harvest digestion, which may have occurred after the fish were caught before their removal from the nets used in trapping them. Similar reports of large percentages of empty stomachs have been reported by Fagade (1978), Ipinjolu *et al*. (1996), Balogun (2000), Dadebo *et al.* (2005) and Shinkafi *et al*. (2011).

The presence of most plant materials such as plant parts, duckweed (*Lymnaea*) and algae in the guts of the samples indicated that the species is an herbivore with tendency to feed on animal materials such as crustaceans (*Potamonautes*) and worms whose presence indicated bottom feeding nature of *L. senegalensis* in River Rima. A similar finding was reported for this species in the Idah Area by River Niger (Adeyemi and Akombo, 2012) and for *L. coubie* in Lower Benue River (Adadu *et al.*, 2014). The presence of detritus in the gut of the samples of this study was further evidence of a bottom feeding (Ayotunde *et al.*, 2007; Ayoade, 2011 and Ikongbe *et al.*, 2014).

The stomachs of smaller samples of *L. senegalensis* (< 20cm TL) were found to contain only plant materials and detritus, while the larger samples (≥20cm) exhibited a more versatile feeding nature. This indicated that the food preference of the species changes with size as reported for *Clarias gariepinus (*Ayinla and Faturoti, 1990), *Brienomyrus longianalis* (Ikomi, 1996) and *Synodontis Clarias* (Shinkafi and Ipinjolu, 2001). No variation in the diet of the species based on sex was observed. Similar finding was reported by Shinkafi and Rasaq (2013).

The presence of food in all the stomachs during the month of July which corresponds to the flood season in the study area may probably be due to more abundance of the food materials, (Lowe-McConnell, 1975; Ikomi and Sikoki, 2003 and Shinkafi and Maradun, 2008).

Observations of the structural feeding adaptations revealed that the presence of inferior mouth indicates bottom feeding (Olaosebikan and Nzeh, 2008), while the toothless jaws, palatal and pharyngeal dentition, fine gill rakers, long and coiled intestine, which is about six times the total body length are all pointers to

the more herbivorous nature of the species as similarly reported by Dasgupta (2001) and Adeyemi and Akombo (2012). This is further confirmed by the presence of more plant materials than any other food substance (Ayotunde *et al*., 2007) in the stomachs of the samples. The presence of detritus, bottom crustaceans (*Potamonautes*) and worms is further evidence of the bottom feeding nature of the species in the study area.

Conclusion

Based on the analysis of stomach contents by frequency of occurrence method as well as observations of the feeding structures, *L. Senegalensis* was found to be an herbivorous detritivore in River Rima, North western Nigeria.

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