Continental J. Agricultural Science 8 (1): 29 - 37, 2014
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Printed in Nigeria

ISSN: 2141 - 4203
http://www.wiloludjournal.com
doi:10.5707/cjagricsci.2014.8.1.29.37

DIET COMPOSITION, FEEDING HABITS AND CONDITION FACTOR OF C*hrysichthys nigrodigitatus* IN EBONYI RIVER (A TROPICAL FLOOD RIVER SYSTEM), SOUTHEASTERN NIGERIA

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ABSTRACT

The investigation for the food, feeding habits and condition factor of *Chrysichthys nigrodigitatus* in Ebonyi River was on seventy (70) samples. In the stomach of the *C. nigrodigitiatus* examined, the food items found include: cladocera, copepods, rotifer, diatoms, dinoflagellate, clams, worms, insect parts, fish scales, sand grains and detritus. The stomach contents of the samples examined revealed that the stomach conditions varied in the following order, those with full stomach contents were 41 (58.6%), partially full stomach contents were 12 (17.1%), partially empty stomach were 8 (11.4%) and empty stomach contents were 9 (12.9%). The condition factor (K) values of *C. nigrodigitatus* in each month were calculated. The highest value was recorded in September (1.7) while the lowest value was in November (0.6). Overall mean K value for the population sampled was 0.9. This revealed that the stock is in good condition. Based on these findings, *C. nigrodigitatus* is an "Opportunistic feeder" and a potential species for aquaculture.

KEYWORDS, food, feeding habits, condition factor, *Chrysichthys nigrodigitatus*

Received for Publication: 01/11/14 Accepted for Publication: 10/12/14
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INTRODUCTION

Chrysichthys species of the family Claroteidae (Actinoptergii) are economical important fish, highly valued and threatened freshwater species. The bagrid catfish (*Chrysichthys nigrodigitatus*) is consumed for its nutritional value. They are important resources worldwide especially as food. Food and feeding habits enable the farmer have clear understanding of fish dietary requirements with a view to provide feeds for them in aquaculture (Malami *et al*., 2004). Sufficient food intake aids optimal growth, resulting in production increases and subsequent economic benefits. *Chrysichthys* species are opportunistic feeders changing their diet to abundant food items in the environment. Abundance of a potential food species often determines whether fish will eat it because availability is a key factoring determining what a fish will eat (Lagler *et al*., 1977). Fishes appear to be dynamic in their feeding in different water bodies (Welcomme, 1985). The dietary habits of fish based on stomach analysis, is widely used in fish ecology as an important method to investigate trophic relationship in aquatic communities (Fagbenro *et al*., 2008). Food and feeding habit of species of *Chrysichthys* in Nigeria have been studied in River Ase (Idodo-umeh, 2002), River Ethiope (Oronsaye and Nakpodia, 2005), Cross River (Offem *et al*., 2008), Kainji Lake (Yam *et al*., 2009). Fishes are extremely mobile, showing extensive longitudinal, vertical, and horizontal movement. Therefore the variety of food items present in the stomach of fishes often reflect trophic flexibility or opportunistic feeders as suggested by Warren (1993), the ability of fishes to switch from one diet to another depending on availability.

Condition factor is an index of the degree of wellbeing of a species (Bagenal 1950). The study of condition factor is important to understand the life cycle of fish species and contributes to adequate management ecosystem equilibrium (Haruna and Bichi 2005). Condition index may be used to determine the reproductive time of fish species without sacrificing the organisms, and this could be a valuable tool to develop monitoring programs for the species fisheries and culture programs (Arellano-Martinez and Ceballos-Vazquez, 2001). Condition factor also provides information when comparing two populations of fish living in certain feeding density, climatic and other conditions. Thus, condition factor is important in understanding the life cycle of fish species and it also contribute to adequate management of the species, hence maintaining the equilibrium in the ecosystem. (Uneke 2014). This paper seeks to provide useful biological data for management.

MATERIALS AND METHODS

Study area

This study was conducted in Ebonyi River, a tropical river which lies in the Southeastern part of Nigeria located in Izzi Local Government Area (Fig. 1).The vegetation of the river is mainly tall trees, bamboo plants, palm trees and elephant grasses. The bottom of the river is of fine sand and the surface is colonized randomly by water weeds which form protective covers for the water organisms. The river is subjected to the annual flooding from April to October (rainy season) during which most of the area is flooded and as the result affect the crops in the farm yard near the river. The soil found in that area are mainly loamy soil and sandy soil which is good for agriculture. The dry season occurs between November and March which is characterized by dry and hot light winds. Crop farming activities around the Ebonyi River go hand in hand with the fisheries activities which are closely related to flooding regime. During the flood, when the level of water becomes increasingly high, active farming becomes increasingly intensified. However, towards the end of the flooding regime, the above cycle alternates with the resumption of fishing activities which get to the peak during the dry season.

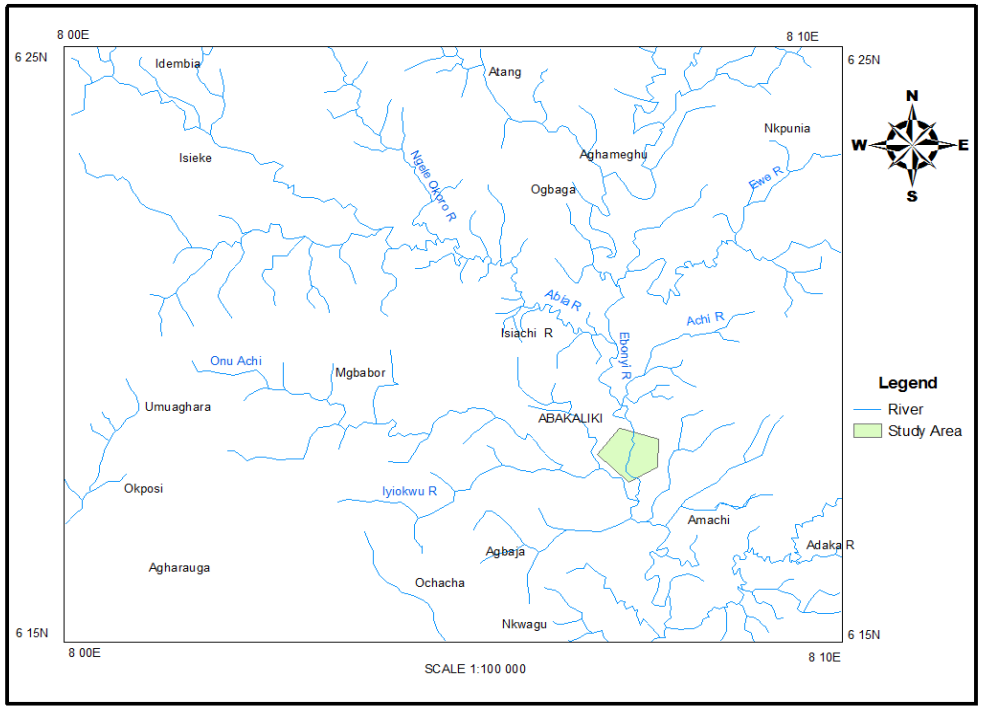

Fig. 1 Map of Ebonyi river showing study area

Sample collection
The fishermen services were utilized at the study area (Ebonyi River) who caught the fish using the net, cast nets, dreg nets of various size between (40mm and 90mm), set net between (75mm and 90mm) and long lines. Other gears used include baskets and traps. A total number of 70 specimens were sampled from August to November 2012.

Laboratory analysis
The samples were sorted and identified to species level using the guides of Olaosebikan and Raji (1998). Total length (TL) and Standard length (SL) were measured to the nearest 0.1cm with a meter rule measuring board. Weight measurements were made with a FEJ-1500A electronic compact weighing balance to the nearest 0.1g. Moreover, each stomach of was opened and the stomach contents were poured into a Petri-dish, then the observation of the food items were carried out with help of compound microscope.

Stomach content analysis
The methods adapted by the Fagade (1983) were used. This include the estimation of the degree of fullness of each stomach by visual means counting the number of individual food item in the stomach and determining the food items only in the stomach where they occur. Only the contents of the stomach were examined since food beyond the pylorus region was normally greatly digested. In each case a cut was made across the adjacent cardiac limb of the stomach to give a U-shaped standard stomach.

Numerical method
This method involves counting the number of each food item present in the stomach of a fish and summing up these numbers to obtain the grand total number of all the food in its stomach. The number of each food item is the expressed as a percentage of the grand total number of all food items (Hynes, 1950, Windell, 1978 and Bowen, 1980). It is usually expressed as:

$$\% \text{ No of a food item} = \frac{\text{Total no of the particular food item}}{\text{Total number of all food items}} \times 100$$

Frequency of occurrence method
This involves counting the number of times a particular food item occurs in the stomach and expressing this as a percentage of the total number of stomachs with food (empty stomach excluded) (Hynes, 1950, Windell, 1978 and Bowen, 1980). This is usually expressed as:

$$\text{Percentage occurrence of a food item} = \frac{\text{Total number of stomach with the particular food item}}{\text{Total number of stomachs with food}} \times 100$$

Condition factor
Fulton's condition factor was computed according to Pauly (1984) as $K = 100W/ L^3$

Statistical analysis
Analysis of variance (ANOVA) was used for the statistical analysis.

RESULTS

In the stomach of the *C. nigrodigitiatus* examined, the food items found include: cladocera, copepods, rotifer, diatoms, dinoflagellate, clams, worms, insect parts, fish scales, sand grains and detritus. Among the stomach of *C. nigrodigitiatus* examined, some were found to be empty. Table 1 shows the summary of the food items in *C.*

nigrodigitiatus, Cladocera accounted for 27.7% of the content under numerical method followed by Diatom with 17.6% and Dinoflagellate with 12.4%. In the frequency of occurence analysis, Cladocera (15.9%) and Diatom (15.9%) constituted the most important diet of *C. nigrodigitiatus* followed by Dinoflagellate (13.5%) while Sand grains seems to be complementary.

Table 1: Occurrence of food items in *C. nigrodigitatus*

Food Items	Numerical method		Occurrence method	
	number	Percentage (%)	number	Percentage (%)
zooplankton				
Cladocera	304	27.7	61	15.9
Copepod	40	3.7	17	4.4
Rotifer	54	4.9	21	5.5
phytoplankton				
Diatom	192	17.6	61	15.9
Dinoflagellate	136	12.4	52	13.5
Clams	62	5.7	5	1.3
Worms	32	3.0	28	7.3
Sand grains	86	7.9	41	10.7
Insect parts	78	7.1	32	8.3
Fish scales	58	5.3	32	8.3
Detritus	52	4.7	34	8.9

Of all the *C. nigrodigitiatus* examined, those with full stomach were most in number than those any other stomach fullness conditions constituting (58.6%) of the total samples followed by those with partially full stomach, constituting (17.1%). Partially empty stomach constituted the least (11.4%). There is no significant difference ($p = 0.05$) in the frequency of occurrence within the months while there is significant difference ($p = 0.05$) in the frequency of occurrence with the stomach fullness condition (Table 2).

Table 2: Monthly analysis of stomach fullness condition

Months	Full stomach		¾ stomach		¼ stomach		Empty stomach	
	no.	%	no.	%	no.	%	no.	%
August	15	62.5	5	20.8	1	4.2	3	12.5
September	6	50.0	3	25.0	2	16.7	1	8.3
October	8	57.1	1	7.1	2	14.2	3	21.4
November	12	60.0	3	15.0	3	15.0	2	10.0
Total	41	58.6	12	17.1	8	11.4	9	12.9

Analysis of stomach fullness condition in relation to total length class distribution revealed that all the length classes of the samples had full stomach. Larger fish samples (≥ 26 cm TL) showed 100% of full stomach, length class 14-16 and 24-26 cm TL had all the different stomach conditions present while the other length classes had one or two different stomach conditions absent. There is no significant difference ($p = 0.05$) in the frequency of occurrence within the different sizes of the species while there is significant difference ($p = 0.05$) in the frequency of occurrence with the stomach fullness condition (Table 3).

Table 3: Analysis of stomach fullness condition in relation to length class distribution

Total length (cm)	Full stomach		¾ stomach		¼ stomach		Empty stomach		No. of fish sampled
	no.	%	no.	%	no.	%	no.	%	
14-16	6	33.3	6	33.3	3	16.7	3	16.7	18
16-18	10	71.4	3	21.4	-		1	7.2	14
18-20	8	72.7	1	9.1	2	18.2	-		11
20-22	6	75.0	-		2	25.0	-		8
22-24	4	50.0	1	12.5	-		3	37.5	8
24-26	2	28.6	2	28.6	1	14.2	2	28.6	7
26-28	1	100.0	-		-		-		1
28-30	4	100.0	-		-		-		4
Total	41	58.6	12	17.1	8	11.4	9	12.9	70

The analysis of diet composition in relation to length class distribution showed that small (≤ 22 cm TL) fish samples had all the different food compositions found in the samples while large(≥ 22 cm TL) fish samples had some foods absent, however not a restricted diet. There is significant difference ($p = 0.05$) in the frequency of occurrence within the different sizes of the species and also there is significant difference ($p = 0.05$) in the frequency of occurrence with the diet composition (Table 4).

Table 4: Analysis of diet composition in relation to length class distribution

Total length (cm)	phytoplankton	zooplankton	sand grains	clams	worms	Insect parts	Fish scales	detritus
14-16	20	18	6	1	4	10	6	3
16-18	20	19	10	1	8	10	8	11
18-20	14	12	9	1	6	5	3	3
20-22	13	15	6	2	3	3	4	6
22-24	10	10	5	-	3	1	3	5
24-26	9	9	2	-	2	1	4	1
26-28	6	7	-	-	-	1	-	1
28-30	9	9	3	-	2	1	4	4
Total	101	99	41	5	28	32	32	34

The condition factor values of *C. nigrodigitatus* in each month were calculated. The highest value was recorded in September (1.7) while the lowest value was in November (0.6). Overall mean value for the population sampled was 0.9 (Table 5).

Table 5: Monthly condition factor values of *C. nigrodigitatus*

Months	Highest	Lowest	Mean
August	1.1	0.6	0.8
September	1.7	0.6	0.9
October	1.2	0.7	0.9
November	1.1	0.6	0.8
Overall	1.7	0.6	0.9

Condition factor values of *C. nigrodigitatus* in relation to length class distribution revealed that the whole stock were in relatively good condition irrespective of size. (Table 6).

Table 6: Condition factor values of *C. nigrodigitatus* in relation to length class distribution

Total length class	Highest	Lowest	Mean
14-16	1.7	0.7	1.0
16-18	1.0	0.7	0.8
18-20	0.9	0.7	0.7
20-22	0.9	0.6	0.7
22-24	1.0	0.6	0.8
24-26	0.8	0.6	0.7
26-28	0.7	0.6	0.7
28-30	0.6	0.6	0.7
Overall	1.7	0.6	0.9

DISCUSSION

The food items observed in the stomach of *C. nigrodigitatus* in Ebonyi River shows that catfish feed on a wide range of food items which include: sand grains, worms, insect parts, fish scales, detritus, cladocera, copepod, diatom, rotifer, dinoflagellate and clams. Moreover, the variety of food items found in the stomach of the *C. nigrodigitatus* examined in Ebonyi River shows its ability to switch feeding from the less abundant prey species to the most abundant potential prey species. Based on the above observation, *C. nigrodigtatus* can be described as an "opportunistic feeder". Of all the samples examined, those with full stomach were most in number than those with any other stomach fullness conditions. The level of empty stomach observed during this study may be due to the method used by the fishermen in exploiting *C. nigrodigitatus* because the fish caught by hooks and lines often have higher than average proportion of empty stomachs since hungry fish are mostly out to strike at baits. So the methods employed by the fishermen in catching the fish affect the proportion of empty stomachs encountered. From this study, the occurrence of sand grains, detritus, insect parts and worms in the stomach contents of *C. nigrodigitatus* could be interpreted as bottom feeding because these items are abundant in the benthos which goes in line with Idodo-Umeh (2002). It was discovered that *C. nigrodigitatus* switch from one diet to another and this changing of diet depend on the availability of diet found within its aquatic habitats in order to stay in line with water level, water clarity and the variety of food that becomes available to it as the seasons change. From these observations, it is obvious that *C. nigrodigitatus* is an omnivorous fish and therefore feed on the wide range of food which includes: zooplankton, phytoplankton, detritus, insect larvae, worms and sand grains. This is in agreement with Ajah *et al*., (2006) who reported that juveniles of *C. nigrodigitatus* were omnivorous, consuming 32% gastropods, 30% nematodes, 14% diatoms and 8% crustaceans while adults were planktotrophic consuming 23% diatoms, 33% chlorophyceae and 22% crustaceans. According to Ikusemiju and Olaniyan 1977, *C. nigrodigitatus* may be regarded as generalist mesopredators, they reported that the species feed mainly on adult molluscs and crustaceans in Lagos lagoon. *C. nigrodigitatus* is also regarded as a carnivore that feeds throughout the water column (Ajani, 2001). The presence of fish scales in this fish could be due to scale eating habits. This is in agreement with studies by (Idodo-Umeh, 2003). However, the author cautioned that evidence available from the examination of the stomach contents

is not conclusive as prey fish and fish remain from the substratum could also account for the presence of fish scales in stomach contents. The inclusion of sand grain in the stomach of fish has been attributed as an accidental ingestion along with other food items (Fagbenro *et al*., 2000).

Phytoplankton and zooplankton were the most dominant food items while the least food item is clams. Plankton consumption decreased with increase in size. This may be due to the minute size of plankton while bigger fishes tend to ignore it and feeds on whatever is available. Smaller fishes consumed more different food items than the larger fishes. This is in line with the finding that the species is an opportunistic feeder switching from one diet to another according to availability (Offem *et al*., 2008).

The low condition factor recorded in October may be due to reduced availability of food and prey items. However, *C. nigrodigitatus* population of this study is in good condition because the Ebonyi river is characterized by forest and grass land which is in agreement with Offem *et al*., (2008), they reported that the forest inland wetlands of Cross River provided better condition for *C. nigrodigitatus*. The small fish were in better condition than the larger fish.

CONCLUSION

C. nigrodigitatus is an opportunistic feeder which feed on a very wide range of food items, therefore the formulation of its feeds will be easy because almost every available material could be used in the formulation. Therefore, *C. nigrodigitatus* is recommended for rearing in fish ponds by aquaculturists.

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