Original Research Article

Aspects of the Biology of Silver Catfish (*Chrysichthys nigrodigitatus*) in Nwaniba River, Southeast Nigeria.

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Abstract

The Aspects of the Biology of the Catfish (*Chrysichthys nigrodigitatus)* were investigated from August to October 2015 in Nwaniba River, Akwa Ibom State, Nigeria. A total of two hundred (200) specimens were analyzed for gut contents using Numerical and Frequency of Occurrence methods. The results revealed that the species feed on various food items ranging from plant origin to animal materials with dietary preference classified into eight major groups consisting of Crustaceans 39 (23.2%), Fish parts 26 (15.6%), Detritus 23 (13.7%), Plant parts 20 (11.9%), Undefined 20 (11.9%), Mollusca 19 (11.3%), Insects 13 (7.7%), and Nematodes 8 (4.7%) respectively. Of the 200 stomachs examined, 35 (17.5%) were empty stomachs, 80 (40%) had quarter-full stomachs, 50 (25%) had half-full stomachs, 13 (6.5%) had three quarter-full stomachs and 22 (11%) had full stomachs. The condition factor calculated for the species varied during the studies period with a mean value of 0.77 in August, 0.72 in September and 0.73 in October. Based on the food items isolated in the gut, the species could be considered as an Omnivorous fish in Nwaniba River. Further research should be done to ascertain the food preference of the species over a longer period of time covering both wet and dry season. This will enable definite conclusion on its food preference.

Keywords: *Chrysichthys nigrodigitatus,* Diet composition, Condition factor, Nwaniba River,

Introduction

Fishes are sources of food for human beings and other animals, rich in proteins and vitamins, especially, vitamin A (Retinol) (Alune and Andrew, 1996; Osuigwe and Obiekezie, 2007; Fayeofori, 2013). Statistics have shown that fish accounts for more than forty percent of the protein diet of two–thirds of the global population (Eyo, 1992 and FAO, 1999). It is unfortunate that the protein requirement of most African countries still grossly outweighs its supply. In Nigeria, less than 40% of the total protein requirement by the people is met, out of which fish constitutes about 41% (Bernard *et al.,* 2011).

As the human population inevitably increases, the demand for fish as a source of protein will grow (Abolarin, 1996). Fishes such as those in the family Claroteidae are highly used and commercialized. The commercially important fish species in this family are the Catfish (*Chrysichthys species*) known as "Inanga" in Ibibio language. *Chrysichthys nigrodigitatus* (Lacepede 1802) is a common silver colored African catfish occurring in

Nigeria and several West African countries. It is a highly valuable fish species amongst the indigenous African populations (Akinsanya *et al.,* 2007).

All fish require energy which must be obtained from its food sources for growth, reproduction and migration (Anupama, 2000; Oronsaye and Nakpodia 2005). Understanding food and feeding habits of fish is useful to all scientists who are concerned with any aspect of fisheries (FAO, 1992). The study of dietary habits of fishes based on stomach content analysis is widely used in fish biology and ecology to indicate the position of a species within a food web and to provide information on the contribution of different prey items to the diet (Owolabi, 2008). It also help in understanding food consumption, feeding and assimilation rates, catabolism, habitat segregation (Gomos *et al.*, 2002), defining predator-prey relationships, estimation of trophic level (Sa-a *et al*. 1997) and in the creation of trophic models as a tool for understanding complex ecosystems (Lopez-Peralta and Arcila 2002).

Chrysichthys species has been found to be a typical example of fish without strict feeding habit. It is regarded as an omnivore, because of its ability to use just any food material present in its environment (Yem *et al*., 2009). Royle (2001) reported that potential food resources of fish consist of all materials present in its environment. Fishes have been known to feed on a wide variety of items ranging from sand particles, phytoplankton, zooplanktons, leaves, roots, crustaceans, insects, insect larvae, worms, fishes etc, (Omondi *et al.,* 2011; Shalloof and Khalifa*,* 2009 and Yalcin *et al.,* 2001). The more so Idodo-Umeh (2002) reported that *C. auratus*, *C. nigrodigitatus* and *C. furcatus* were omnivorous bottom feeders.

Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish (*Ndimele et al.*, 2010). In fisheries science, it is used to compare the "condition", "fatness" or wellbeing of fishes. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal and Tesch, 1978). It is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene and keke, 2005). Various works have been done on the diets of *Chrysichthys nigrodigitatus*, and other fish species from various rivers in Nigeria and few other lakes and reservoirs (Uneke, 2015; Fagbenro *et al*. 2000; Yem *et al*., 2009; Idodo-Umeh 2002; Atobatele and Ugwumba, 2011; and Offem *et al.,* 2008). In Nwaniba River, few or no extensive work has been carried out on some aspects of the biology of commercial important species. Therefore, this present paper is a contribution to understanding the biology of *Chrysichthys nigrodigitatus* which include diet composition, stomach fullness and condition factor with a view to developing its aquaculture.

Materials and Methods

Study Area

Nwaniba River lies between $5^0$2'51" North of latitude and $8^0$2'41" East of longitude (Fig. 1). The annual rainfall in this region is about 2500mm with a mean annual temperature of 32 ^oC and a relative humidity of 75%. The source of this river is traced to two flood plains; one flows from Itam River in Itu Local Government Area through Mbiakong River, while the other from Obot-Ifiayong creek down to this river, and runs through Otoh-nkemba where it flows to Ibiaku-uruan, Oron, Calabar, Cameroun and Atlantic Ocean.

The riverbank is covered with vegetation such as Elephant grass (*Pennisetum purpureum*), shrubs and trees, Screw pine (*Pandamus spp*), Mangrove palm (*Nypha fruticans*), Pneumatophorous plant with prop roots, and other tropical hydrophytes for

example Water hyacinth (*Eichhorina crassipes*), Water lilies (*Nymphaea lotus*), *Ceratophyllum demersum,* and Bladderwort (*Utricularia spp*) e.t.c. The River also has a beach called Esuk Nwaniba, which serves as harbor for fishermen. It is at this beach that the fishes are sold out to the fish sellers for public consumption or other purposes.

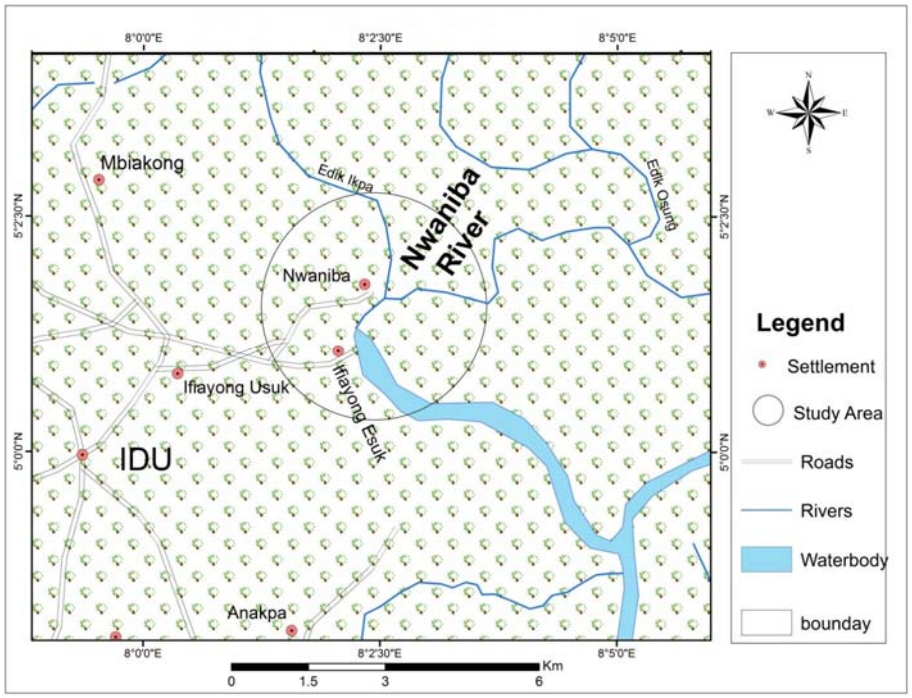

FIG 1: MAP OF STUDY AREA SHOWING NWANIBA RIVER.

Collection of Samples

Samples of *Chrysichthys nigrodigitatus* were obtained monthly between August and October 2015 from the commercial landings of the fishermen using gill-nets and transported in ice-chest box to the University of Uyo Zoology laboratory for fresh examination. Various sizes of *Chrysichthys nigrodigitatus* ranging from small, medium to large were sorted out and used for the study.

Chrysichthys nigrodigitatus samples were identified using key guides of Olasebikan and Raji (1998). Each specimen was measured to the nearest 0.1 cm total length (TL) using a measuring board of 1-50cm (range) and weighed fresh using a digital balance to the nearest 0.1g. A longitudinal incision was made with the aid of stainless steel scissors and forceps along the mid-ventral line from the mouth to the anus to expose the visceral organs and the gut was carefully removed with pair of throngs.

Fulton's condition factor (CF) was determined using the expression according to Ricker (1975):

K = (W/L3)100,
Where;
K= condition factor,
W = total weight (g),
L = total length (cm) and
3 = the cubic relationship between length and weight.

Stomach Fullness Classification

Stomach contents classification of *Chrysichthys nigrodigitatus* based on degree of fullness was determined according to methods by Ugwumba and Ugwumba (2007)

The condition of the stomach was determined visually and categorized as follows:

0/4	=	empty stomach
¼	=	one quarter full stomach
2/4	=	half full stomach
¾	=	three quarter full stomach
4/4	=	full stomach

Identification of Stomach Contents

The stomach contents were emptied into petri-dish to which 10% saline was added to disperse the contents. The food items were sorted into categories, viewed under microscope and identified to species level where possible using key guides by Mellanby (1975). Stomach contents were analyzed using two (2) methods, frequency of occurrence and numerical methods.

Frequency of Occurrence
The number of stomachs in which each food item occurred was sorted out and expressed as percentage of the total number of fish stomachs examined.
F1 = 100 ni / n ……. (Bowen, 1983)

Where
F1: frequency of occurrence of the i food item in the sample
ni: number of stomachs in which the i item is found
n: number of stomachs with food in the sample.

Numerical Method

The number of individual of each food item was counted and summed up to give the total of each food item, then the grand total of all items was calculated and expressed as percentage of the overall items found in each stomach (Crisp *et al.,* 1978)

Statistical Analysis

All data collected were subjected to statistical analysis using statistical package for social science (SPSS 2007) software. The coefficient of regression was used to assess the length-weight relationships

RESULTS

A total of 200 species of *C. nigrodigitatus* was collected from Nwaniba River**.** Table 1 shows the numerical abundance and frequency occurrence of diet Composition. *Chrysichthys nigrodigitatus* fed on food items that are of plant and animal sources. These are grouped into detritus, fish parts, plant parts, crustacean, insects, nematodes, mollusca and unidentified materials for both frequency of occurrence and numerical methods. Crustacean was determined as the highest item ingested by the fish while nematodes were the lowest items.

Table 1: Numerical abundance and frequency occurrence of diet Composition of *Chrysichthys nigrodigitatus* from Nwaniba River

Food items	**Numerical Abundance (N)**	**Relative percentage occurrence (%)**	**Total (%)**
DETRITUS			
Mud	13	7.74	13.7
Sand particles	10	5.95	
FISH PARTS			
Partially digested fish	21	12.5	15.5
Fish Scales	5	2.98	
PLANT PARTS			
Netrium	2	1.19	
Anabaena	6	3.57	11.9
Spirogyra	10	5.95	
Macrophyte matter	2	1.19	
CRUSTACEANS			
Corophium	3	1.79	
Neomysis	16	9.52	
Streptocephalus	1	0.59	23.2
Daphinia	13	7.74	
Mysis	2	1.19	
Estheria	4	2.38	
INSECTS			
Stonefly nymph	0	0	
Capnia	6	3.57	7.74
Perlinella	3	1.79	
Choroterpes	4	2.38	
NEMATODES	8	4.76	4.76

MOLLUSCA *Ancylus species* *Pisidium*	13 6	7.74 3.57	11.3
OTHERS *Diatoms* *Unidentified*	8 12	4.74 7.14	11.9

Of the 200 stomachs examined, 17.5% were empty stomachs, 40% had quarter-full stomachs, 25% had half-full stomachs, 6.5% had three quarter-full stomachs and 11% full stomachs (Table 2), while Table 3 shows the monthly diet composition. However, the morphometric parameters of *Chrysichthys nigrodigitatus* from Nwaniba River for the period of sample is shown on Table 4.

Table 2: Stomach fullness analysis of *Chrysichthys nigrodigitatus* from Nwaniba River

Month	Number of Stomach examined (N)	Empty Stomach (0/4) fullness	¼ (25%) fullness	½ (50%) fullness	¾ (75%) fullness	¾ (100%) fullness
August	80	17 (21.3%)	28 (35%)	17 (21.3%)	5 (6.2%)	13 (16.2%)
September	72	8 (11.1%)	31 (43.1%)	21 (29.1%)	5 (6.9%)	6 (8.3%)
October	48	10 (20.8%)	21 (43.8%)	12 (25%)	3 (6.2%)	3 (6.2%)
Total	200	35	80	50	13	22

Table 3: Monthly diet composition of *Chrysichthys nigrodigitatus* from Nwaniba River

Month	**Diet Composition**							
	Detritus	Fish parts	Plant parts	Crustaceans	Insects	Nematodes	Mollusca	Others
August	6 (11.1%)	10 (18.5%)	9 (16.7%)	10 (18.5%)	2 (3.7%)	0 (0%)	4 (7.4%)	13 (24.1%)

September	8 (13.1%)	9 (14.8%)	7 (11.5%)	19 (31.1%)	5 (8.1%)	3 (4.9%)	6 (9.8%)	4 (6.6%)
October	9 (16.9%)	7 (13.2%)	4 (7.5%)	10 (18.9%)	6 (11.3%)	5 (9.4%)	9 (16.9%)	3 (5.7%)
Total	23 (13.7%)	26 (15.6%)	20 (11.9%)	39 (23.2%)	13 (7.7%)	8 (4.7%)	19 (11.3%)	20 (11.9%)

Table 4: Morphometric parameters of *Chrysichthys nigrodigitatus* from Nwaniba River

Months	**Parameters**								
	No. of Samples	Length range (cm)	Mean length (cm) ±SE	Weight range (g)	Mean weight (g) ± SE	a	b	r	K
August	80	10.5 -22.2	15.134 ± 0.239	10.2-51.04	26.73 ±1.097	−1.271	2.271	0.868	0.77
September	72	11.2 -19.9	15.008 ± 0.221	12.1-50.02	24.21 ±0.916	−1.071	2.076	0.857	0.72
October	48	11.5 - 17.0	14.073 ± 0.189	13.4-37.54	20.34 ±0.674	−0.753	1.789	0.776	0.73

Where: *a = intercept on x axis,*

b = slope,

r = coefficient of regression,

K = condition factor,

SE = standard error, (p >0.05)

Discussion

The morphology of *Chrysichthys* is adapted for bottom feeding although stomach contents may prove otherwise as the variety of food items contained in the stomach often reflect the ability of the fishes to obtain food from different locations (Atobatele and Ugwumba, 2011). However, Idodo-Umeh (2003) stated that morphological features couldn't limit *Chrysichthys* as exclusive bottom feeders, as stomach content indicates food items from different locations. The wide food spectrum of *C. nigrodigitatus* is an indication of flexibility

in trophic level, which gives the fish ecological advantage to feed effectively on different categories of diet based on the availability of the food items (Warren, 1993; Offem *et al.,* 2008).

The result of this study shows that *Chrysichthys nigrodigitatus* from Nwaniba River fed on wide range of items from plant to animal materials where Crustacean is the predominant item. This is in agreement with findings of Atobatele, (2013) who reported that *C. nigrodigitatus* and *C. auratus* had similar food items, with Crustacean dominating in terms of percentage occurrence and numerical abundance. Other food items included mollusks, plant parts, fish parts, insects, detritus and others, indicating that *C. nigrodigitatus* is an omnivorous. Similar results have been reported for *C. nigrodigitatus* from Lekki lagoon (Ugwumba and Ikusemiju, 1994; Idodo-Umeh 2003). The wide variety of items encountered in the stomachs of the fish species show that they are non-selective in feeding and it appears that they are capable of utilizing different sources of food. Shep *et al*., (2013) observed that such feeding on a wide range of food comprising both plants and animal, making the fish euryphagous. However, Ekpo *et al.,* (2014) also reported that the index of food dominance enables these fishes to be categorized into 4 broad groups: planktophagous, herbivorous, predators and detritivores. The inclusion of sand grains in the stomach of fish has been attributed as an accidental ingestion along with other food items (Fagbenro *et al*. 2000).

Feeding intensity of fish can be determined based on degree of fullness of stomach (Yem *et al.,* 2009). The relatively high percentage of almost empty stomach suggests that the quantity of food was low during the period of this study. However, result of stomach fullness analysis is not in line with findings of Yem *et al.,* (2009) who recorded relatively high percentage of full stomach, which suggests that food was abundant throughout the period of study in Kainji Lake, Nigeria.

The result of *Chrysichthys nigrodigitatus* from Nwaniba River shows low value for Condition factor (K) during the periods of study. This agrees with findings of Atobatele and Ugwumba, (2011) who reported low condition factor for *C. nigrodigitatus* after the second peak in September and October and may be due to reduced availability of food and prey items. According to Bagenal and Tesch (1978), if the condition factor "k" ≥ 0.5, the fish is in a good condition but if the value of "k" ≤ 0.5, the fish is assumed to be in bad condition. In this study, the overall mean condition factor value "k" estimated was 0.74 which is > 0.5, indicating that the population was in good condition. However, Uneke, (2015) recorded overall mean condition factor value "k" to be 1.21, indicating that the population was in good condition. The exact relationship between length and weight differs within species and sometimes reflects food availability and growth within the period prior to sampling (Abowei and Ezekiel, 2013; Uneke, 2015). However, these conditions are variable and dynamic, individual average condition of each population varies seasonally and yearly.

Conclusion

Chrysichthys nigrodigitatus from Nwaniba River fed on wide range of food items from plant to animal materials and can therefore be said to be omnivorous, the high percentage of almost empty stomachs during period of sampling, indicates low quantity of food materials, hence the fish exhibited allometric growth pattern.

However, *Chrysichthys nigrodigitatus* is among the abundant commercially important fish found in the River and common especially during the wet season. Since *Chrysichthys nigrodigitatus* from Nwaniba River has aquaculture potential, culture trial is therefore recommended to sustain its demand as source of protein requirement. Hence, Plant and animal

components should constitute the major diet of *Chrysichthys nigrodigitatus*. It is hoped that the present data will complement the limited information on the food, feeding habit, condition factor and length-weight relationship of *Chrysichthys nigrodigitatus* in Nwaniba River, and prove useful in the management and conservation of this important commercial fish species.

Further research should be done to ascertain the food preference of the species over a longer period of time covering both wet and dry season. This will enable definite conclusion on its food preference for domestication and cultivability.

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