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BIOMETRIC RELATIONSHIP, FOOD AND FEEDING HABIT OF *Heterotis niloticus* (Cuvier, 1829) AND *Labeo coubie* (Ruppell, 1832) FROM LOWER RIVER BENUE

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Abstract:

This study investigated the length-weight relationship as well as feeding habit of two important commercial fish species from lower River Benue namely *Heterotis niloticus* and *Labeo coubie*. Fish samples were collected between November 2014 and January 2015 every fortnight for the recording of relevant data (length, weight and stomach content). The result obtained reveals significantly higher biometric parameters in *H. niloticus* compared to *L. coubie*. Many biometric parameters measured correlated significantly with the gut characteristics. The length-weight relationship revealed negative allometric growth for both species. However, sampled fishes were in good condition at the time of the study. Food item isolated in both species revealed an omnivorous feeding habit, hence these fish species may be considered as potential candidates for aquaculture.

Keywords: African bonytongue, African carp, River Benue, Length-weight relationship, Feeding habit

Introduction

The African bonytongue *Heterotis niloticus* is a large fish that is native and widely spread in many parts of Africa (Moreau, 1982, Micha, 1973). Its hardiness and high growth rate make it a possible candidate for aquaculture in Africa (Welcomme, 1988). It is currently estimated that 60% of the breeding and nursery habitat for this species has been lost due to environmental degradation caused by oil spillages, pollution, and destruction of mangrove swamps, (Bake and Sadiku 2005). Although it is currently listed by IUCN Red List Status, as least concern (LC) (IUCN 2012), it is important to make a conscious effort to conserve this fish species to prevent further depletion of stock. African carp *Labeo* is also another major fish genus found in many rivers of African countries such as Nigeria, Senegal, Gambia, Ivory Coast, Liberia, Zaire, and Gabon (Ayotunde *et al*; 2007). Four species of this genus (Labeo) are largely found in rivers, and they include *Labeo senegalensis, Labeo pseudocoubie, Labeo rhohita, and Labeo coubie* (Idodo-umeh, 2005, Ayotunde *et al*., 2007). They are highly valued fish food in African countries and usually known for being rich in protein along with their sweet tastes (Rahman, 1989, Ayotunde *et al.,* 2007). They can grow up to very large sizes and are likely future aquaculture candidate if its biology is well understood.

Research on the exploitation of *H. niloticus* for aquaculture is ongoing in many African countries, notably among these are the works of Yao et al. (2003), Nguenga and Brummett (2003), Olanyan and Zwilling, (1963) and Akegbejo-Samsons et al., (2003). Despite these efforts, the realization of the full aquaculture potentials of this fish is still far in sight. The major setback preventing successful mass propagation of this fish in captivity include problems of artificial reproduction and larval rearing (weaning) (Froese and Pauly, 2012). To our knowledge, no reported accounts exist on the exploitation of *L. coubie* for aquaculture. It is important to note that realizing the full potential of fish for aquaculture purposes would require a good understanding of the biology of the fish. Studies on fish biology are an indispensible aspect of sustainable management and conservation of fish biodiversity (Solomon et al., 2012). Okafor et al. (2012) also stated that insufficient knowledge of the biology of commercially exploited fishes is the main reason for continuous failure experienced in the attempts to culture them in captivity. The continuous decline in fish catches due to lack of monitoring and poor regulation (Adeyemo, 2004, Solomon et al., 2012) makes it imperative to focus research on the biology of fishes in an attempt to provide information that will make domestication a success. This study was designed with the aim of investigating the length-weight relationship, condition factor, as well as food and feeding habit of two importantly exploited fish of River Benue (*H. niloticus and L. coubie*). This is to provide information necessary to understand the welfare and husbandry requirements in the wild so as to adopt same in captivity for a successful domestication program.

Materials and Methods

The study was conducted in Makurdi the Benue State capital (in Nigeria) located at Longitude 7°43°N and Latitude 8°32°E (Fig1). The town is divided into the North and the South Bank by the River Benue from which fish samples were collected. The river contains several species of fish which are of economic importance to the people of the State. This study, however, focused on two species namely *H niloticus* and *L coubie*. The fish samples for this study were obtained from fishermen at three major landing sites of lower River Benue in Makurdi. The fishing gears used by fishers in catching the fish includes; traps, seine nets, cast net, gill nets, clap nets, hook, and line while crafts were canoe and calabash. *H niloticus* and *L coubie* were randomly sampled at each site every fortnight over a period of three months (November 2014 – January 2015). Sampling time was between 6:00 am to 8:00 am, a time when fishermen would be returning to landing site after fishing through the night. Collected samples were fixed in an ice chest and moved to the Department of Fisheries and Aquaculture University of Agriculture Makurdi where data collection of biometric parameters and observation of the stomach content were carried out.

A total of 150 fish specimens each of *H. niloticus* and *L coubie* was obtained from fishermen. Total and standard lengths of each fish species were measured in centimeters (cm) using a meter rule while the weight was taken in grams (g) using an electronic weighing balance.

Figure 1. Map of Makurdi showing location of the study areas of sample collection (Source google maps 2016)

The length-weight relationship was calculated using the equation by Van Snik et al., (1997) as stated below;

Log W= log a + b log L

The condition factor (K) was calculated according to the equation by Pauly (1983) below:

$$(K) = \frac{100W}{L^3}$$

The ventral part of the fish was dissected, and the stomach immediately preserved in sterile bottles containing 5% formalin. Individual stomach fullness was determined, and the content emptied into separate Petri-dishes. While some stomach contents were identified macroscopically, others were identified microscopically using a light microscope. The component food items were identified using identification guide (Barnes 1980, Kaestner 1970) provided in the laboratory of the Department of Fisheries and Aquaculture University of Agriculture Makurdi. The food items encountered were analyzed using frequency of occurrence method (Hynes, 1950) as stated in the formulae below.

Frequency of occurrence =

$$\frac{\text{Total number of stomachs with the particular food item}}{\text{Total number of stomachs with food}} \times 100$$

The gut length and its equivalent weight were also recorded as appropriate.

Statistical Analysis

Data analysis was carried out using Minitab 14 software. Biological parameters were subjected to student t-test to determine if significant differences exist between the two species. Analysis of variance was used to determine monthly differences in parameters measured. When significant differences were observed, means were separated by Fisher's least significant difference. Correlation between various biometric and gut parameters was also done to determine the relationship between these parameters.

Results and Discussion

Table 1 shows some biometric parameters of *H. nilotocus* and *L. coubie* from lower River Benue. The result obtained reveal *H. nilotocus* to be significantly higher in standard length (31.57), total length (34.46), body weight (399.5) and condition factor (0.96) compared to *L. coubie* (23.98; 29.03; 216.7 and 0.84 respectively). However, gut length and weight were higher in *L. coubie* (251.3 and 10.34 respectively) compared to *H. nilotocus* (37.92 and 12.79 respectively). Statistically, stomach fullness was same among both species.

Monthly variations in morphometric parameters of *H. nilotocus* and *L. coubie* are shown in Table 2. The result obtained shows that samples of *H. nilotocus* collected in November were higher in body weight (455.4), condition factor (1.05), gut length (39.19), gut weight (14.05) and stomach fullness (0.49) compared to other months. However, no significant difference was observed for standard length and total length across the months of the experiment. In *L. coubie,* however, samples collected in November were significantly higher in standard length (24.76), total length (29.38), gut length (314.9) and stomach fullness (0.49) compared to other months. The highest body weight and gut weight for this species during the study were observed in December (223.4 and 13.15 respectively).

Correlation of morphometric parameters of *H. niloticus* and *L. coubie* as shows in table 3 reveals high positive and negative correlation between several parameters.

Length-weight relationship of *H. niloticus* and *L. coubie* are shown in Figures 1 and 2. The result indicates that both species have negative allometric growth pattern. However, R^2 value of *H. niloticus* was higher (0.71) compared to *L. coubie* (0.52).

Food and feeding habit of *H. niloticus* and *L. coubie* using the frequency of occurrence method is represented in Fig 3. The result shows the presence of mud (26.25%), digested food (13.75%), detritus (15%), insect larvae (18.75%), algae (26.25%), plant part (15%) and some unidentified food items (6.25) as the dietary composition of *L. coubie.* However, the gut of *H. niloticus* consisted of detritus (6.25%), insect larvae (20.00%), algae (18.75%) plant part (22.5%) sand (35.0%), copepods (17.5%) and unidentified items (1.25).

Table 1. Morphometric parameters *H. nilotocus* and *L. coubie* from lower River Benue

Parameters	***H niloticus***	***L. coubie***	**P-Value**
Standard length	31.57 ±0.59^a	23.98 ±0.61^b	0.001
Total length	34.46 ±0.61^a	29.03 ±0.68^b	0.011
Body weight	399.5 ±22.9^a	216.7 ±18.6^b	0.012
K	0.96 ±0.04^a	0.84 ±0.05^b	0.035
Gut length	37.92 ±0.75^b	251.3 ±13.10^a	0.035
Gut weight	12.79 ±0.41^b	10.34 ±0.88^a	0.035
Stomach fullness	0.43 ±0.04	0.44 ±0.04	0.135

Mean in the same column with different superscripts differ significantly (P<0.05)

Table 2. Monthly morphometric parameters *H. nilotocus* and *L. coubie* from lower River Benue

		H. niloticus		
Parameters	**November**	**December**	**January**	**P-Value**
Standard length	31.52 ±1.12	31.47 ±0.35	31.72 ±1.39	0.098
Total length	34.77 ±1.01	34.16 ±0.43	34.45 ±1.48	0.121
Body weight	455.4 ±46.3^a	345.1 ±12.6^c	398.1 ±47.3^b	0.012
K	1.05 ±0.08^a	0.86 ±0.02^c	0.96 ±0.09^b	0.05
Gut length	39.19 ±0.99^a	37.43 ±0.79^b	37.13 ±1.86^b	0.05
Gut weight	14.05 ±0.82^a	12.57 ±0.34^b	11.78 ±0.80^c	0.035
Stomach fullness	0.49 ±0.07^a	0.40 ±0.06^b	0.39 ±0.06^b	0.002
		L. coubie		
Standard length	24.76 ±1.24^a	23.94 ±1.17^b	23.24 ±0.72^b	0.01
Total length	29.38 ±1.34^a	29.29 ±1.32^b	28.42 ±0.89^c	0.03
Body weight	217.2 ±38.3^b	223.4 ±33.3^a	209.6 ±25.5^c	0.02
K	0.81 ±0.09^c	0.83 ±0.07^b	0.88 ±0.09^a	0.05
Gut length	314.9 ±14.70^a	269.00 ±23.3^b	170.2 ±16.1^c	0.05
Gut weight	9.60 ±1.27^b	13.15 ±2.04^a	8.26 ±0.85^c	0.05
Stomach fullness	0.49 ±0.07^a	0.50 ±0.08^a	0.32 ±0.06^b	0.02

Mean in the same column with different superscripts differ significantly (P<0.05)

Table 3. Correlation matrix of the morphometric parameters of *H. niloticus* and *L. coubie*

Correlations	*H niloticus*	*L. coubie*	Correlations	*H niloticus*	*L. coubie*
TL/SL	0.93**	0.88**	**K/BW**	0.45**	0.12
BW/SL	0.76**	0.83**	**GL/ BW**	0.34**	0.53**
K/SL	-0.06	-0.17	**GW/ BW**	0.57**	0.79**
GL/SL	0.54**	0.67**	**SF/ BW**	0.34**	0.51**
GW/SL	0.66**	0.73**	**GL/ K**	-0.18	-0.29**
SF/SL	0.49**	0.41**	**GW/ K**	-0.05	-0.14
BW/TL	0.72**	0.85**	**SF/ K**	-0.09	0.12
K/TL	-0.17	-0.37**	**GW/ GL**	0.39**	0.69**
GL/TL	0.54**	0.68**	**SF/ GL**	0.37**	0.29**
GW/TL	0.67**	0.81**	**SF/ GW**	0.58**	0.35**
SF/TL	0.49**	0.43**			

(**=P<0.01)
Where TL= Total length, SL= Standard length, BW= body weight, K= condition factor, GL= gut length, SF= Stomach fullness, GW= gut weight

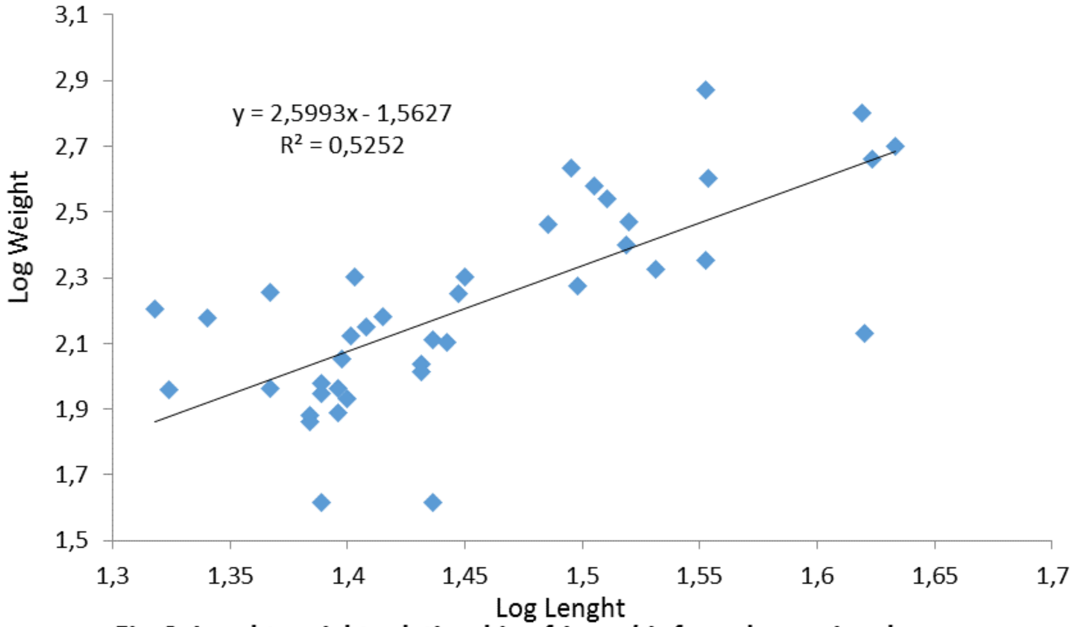

Fig. 2: Lenght-weight relationship of *L. coubie* from lower river benue

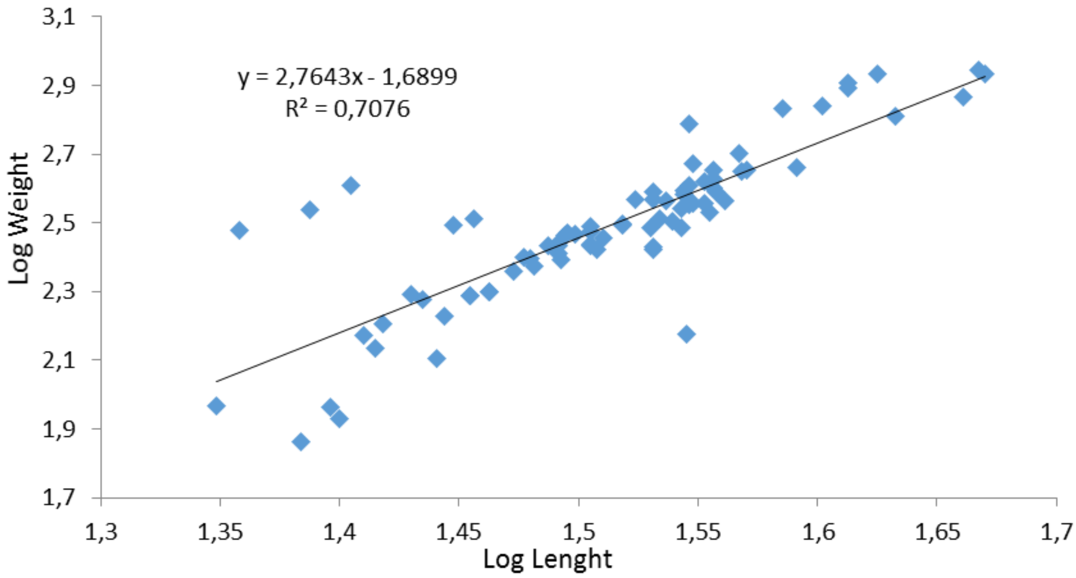

Fig.3: Lenght-weight relationship of *Heterotis niloticus* from lower river benue

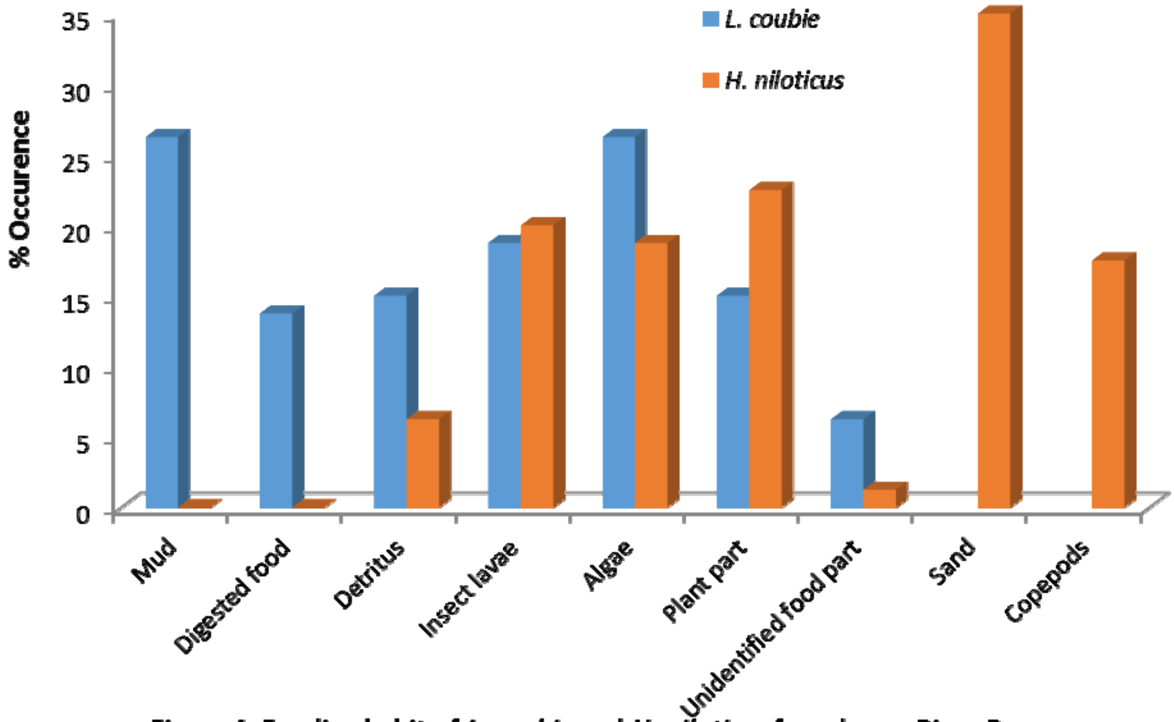

Figure 4: Feeding habit of *L. coubie* and *H. niloticus* from lower River Benue

Dietary habits based on stomach content analysis is widely used in fish ecology as an important means of investigating trophic relationship in the aquatic communities (Ekwu 2006 and Arendt et al. 2001). It is also important in the creation of trophic models as a tool for understanding complex ecosystems (Lopez and Arcila 2002). Numerous studies have shown that natural food tends to vary quantitatively and qualitatively within a year (Ekpo 1993, Ugwuba and Adebisi 1992), hence the need to continually study this concept over a period. From the shape of the mouth and the gills arrangement of *H niloticus,* it could be concluded that filter-feeding habit is aided by the possession of a fine gill raker (Bake and Sadiku 2002). Hence, it is capable of filtering planktons and other food substances in the water. Although this species has earlier been described as more of plankton feeder (Reed et al. 1967 and Bake and Sadiku 2002), this study has shown that it is an omnivore. Larger (1977) had also earlier describe it has more of an omnivore. While Edoghotu et al. (2014) based on their observation which isolated macrophytes, plankton, insects and worms in the gut of the fish also concluded it is omnivorous in feeding habit. Insect larvae and detritus have been previously reported to be significant in the food of *H. niloticus* by Fagbenro *et al*., (2000). However, the observed food types in this study for *H. niloticus* suggest that aside filter feeding, the fish probably grazed on other benthic community species by scraping, nimble or nipping plants off their substrate. Hence, the presence of the muddy substance, detritus, and sand in the food composition isolated in this study. However, the variety of food items present in the diet of *L. coubie* showed that it explores all the major biotopes for food, hence indicating *L. coubie* to be an omnivorous or euryphagous feeder. Euryphagy is an important characteristic of culturable fish species. This means that *L. coubie* have brighter prospects for culture in ponds where production of planktons can be significantly influenced by fertilizer application. This result is similar to the findings of Idodo-Umeh (2003) who reported that the diet of *L coubie* was mainly epipelagic algae and mud. Lagler (1977) had earlier described the stomach of an omnivore as a food grinder which requires a long gut length. The gut length and weight recorded in this study (mean of 251.3cm) suggests a long gut transit time for the food of this fish which is typical of omnivores.

Variation in condition factor (K) reflects information about the physiological state of the fish in relation to changes in its environment (King 1996). *H. niloticus* were observed to be in the best condition in November with the mean condition factor of about 1.00. This is an indication that the environmental conditions of the water body are at optimum level, giving the fish the best condition of growth and development than the other month of the study. However, the mean value of condition factor observed in *H. niloticus* was higher than those observed for *L. coubie*. This may be due to their feeding on a broad range of material compared to the *L. coubie* as observed in their feeding habit. Results of the length–weight relationship indicated that specimens of *H. niloticus* and *L. coubie* exhibited negative allometric growth in the study. Hence, both populations can, therefore, be considered as having homogenous groups with body weights varying indifferently from the cube of total length. The negative allometric exhibited by the species may be as a result of the hydrological, ecological and human factors. Many authors have reported both isometric and allometric growth for different fish species from various water bodies. Allometric growth patterns for *Tilapia* species from Umuoseriche Lake have been reported by King (1991). Also, isometric growth for *Pseudotolithus elongatus* from QuaIboe estuary was reported by King (1996). Isometric growth pattern for *E. fimbriata* had also been reported from Cross River estuary in Nigeria by Pervin and Mortuza (2008). The b value for *L. coubie* (2.599) is the same with the report of Ikpi et al. (2012) on the same specie. This study is also in accordance with the study by Offem (2006) on *L. mrigala* (2.657) in Kaptai Lake, Bangladesh. It is however, different from the isometric value (3.08) recorded for *L. coubie* in the tributaries of the Volta River, Ghana (King 1996). The differences observed in this study, and those of cited authors are based on the difference in the study area, species and spectrum of food available in the environment at the times these studies were conducted.

Conclusions

This study has shown that both *L. coubie* and *H. niloticus* are omnivorous feeders and are in good condition in the lower river Benue during the time of the study. Based on the assertions of this study it is recommended that other aspect of the biology of these important species be the focus of future research. In addition, wild fingerlings of these species can be collected for nutrition trials based on their observed feeding habit reported in this study.

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