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Food and Feeding Habits and Allometric Relationship of *Synodontis schall* in Lower Ogun River, Akomoje, Ogun State, Nigeria

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ABSTRACT

Overfishing and depletion of wild fish stock are a major problem facing the fisheries sector in Nigeria, hence the need to carry out an extensive research on the biology of wild species. The aim of this study was to provide contributory information on the biology of *Synodontis schall* from Ogun River, Nigeria. Ninety fish samples were obtained from local fishermen bi-monthly between February and August, 2015. The length and weight of the specimen were measured and length-weight relationship was determined using the formula W=aLb. Gut content of the specimens was studied using the frequency of occurrence and numerical method. Index of stomach fullness was also determined monthly. Gut content revealed both plants and animal items consisting mainly of insects, rotifers, crustaceans, fish parts, algae etc. indicating omnivorous feeding habit. Percentage stomach fullness was higher during the peak of the wet season (July and August). Total length, standard length and weight of specimens were ranged between 15.4 and 29.0 cm, 10.1 and 23.5 cm and 50 g and 198 g, respectively. Length-weight analyses gave the values of 'b', 'a', and 'r' as 1.520, 1.115 and 0.8967, respectively, exhibiting a negative allometric growth pattern. The study therefore, shed light on the biology of the species and thus, contributes to documented facts about the species from the Akomoje reservoir, with a view towards developing the aquaculture of the reservoir.

Keywords: Allometric growth pattern, frequency of occurrence, length-weight relationship, negative allometric growth, numerical method, Ogun River, stomach fullness, *Synodontis schall*

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INTRODUCTION

Synodontis schall, commonly referred to as upside-down catfish, is a widely distributed catfish species in African freshwater sources (Paugy & Roberts, 1992). The genus has over 112 species (Daget et al., 1991). Reed et al. (1967) described 20 species found in Northern Nigeria. Studies on food and feeding habits of different fish species have been carried out to determine the dietary requirements of these different species and their place in the food chain for the sole purpose of domestication, culture and for defining the relationships between organisms in their habitat and the environment (predator-prey relationships) (Lopez-Peralta & Arcila, 2002, pp. 23–29). The feeding habits of many fish in different water bodies have been investigated and documented as dietary composition may be due to availability, season, age and size.

Length-Weight Relationship (LWR) has been reported to provide information on fish stock composition, mortality, growth rate, production, life expectancy and relative wellbeing of fish populations as an indicator of habitat conditions according to Foulton's condition factor 'K' (Soyinka & Ebigbo, 2012, pp. 392–401), which is a vital tool in biology, ecology, physiology and fisheries assessment (Oscoz, Campos, & Escala, 2005, pp. 73-74). Thus, studies on food and feeding and length-weight relationship among others cannot be overemphasised in the assessment and management of fish (Atama et al., 2013, pp. 82–86).

Various studies have been conducted on some aspects of the biology of this species. Akombo, Akanga, Adikwu and Araoye (2013, pp. 42–48) studied length-weight relationship, condition factors and feeding habits of *Synodontis schall* in Benue River. Shinkafi, Argungu and Akanbi (2010, pp. 304–307) studied the food and feeding habits of catfish (Synodontis nigrita) in Rima River, while Sokoto, Olojo, Olurin and Osikoya (2003, pp. 21–24) studied the food and feeding habits of catfish (S. nigrita) in the Osun River, Osun State. Although some authors have conducted research into this species, there is still need for research into this species from the Ogun River specifically due to its high economic importance, which has resulted in exploitation. In addition, little has been documented on this species from this particular source. Hence, this study was aimed at contributing to information on some aspects of the biology of this species from the Ogun River specifically.

MATERIALS AND METHOD

Description of Study Area

The Ogun River, with a latitude of 6.63 ($6^0$371 60N) and longitude of 3.45 ($3^0$271 0E), is a forest reserve located in Ogun State, Nigeria, West Africa. The location is situated 6.25 km south west (234^0) of the approximate centre of Nigeria and 526 km south west (239^0) of the capital, Abuja, measured with a compass. A 10-square kilometre area around the Ogun River has an approximate population of 313,439

(0.003134) persons per square metre and an average elevation of 40 m above sea level. It discharges into the Lagos lagoon and rises in Oyo state near Shaki at coordinates 8^{0}4110N, 302810E and flows through Ogun state, precisely at the Abeokuta south west local government area of Ogun State and into Lagos state (Ayoade, Sowunmi, & Nwachukwu, 2004, pp. 171–175).

Collection of Specimen

A total of 90 specimens of the fish were procured from artisanal fishermen every fortnight for six months (March-August, 2015) at the bank of the lower Ogun River, Akomoje. The specimens were serially labelled by number, after which they were transported to the laboratory in ice boxes. The use of ice boxes was in order to reduce posthumous digestion to the barest minimal before subsequent analyses. These collections were done in the morning on each occasion to avoid serious heat effect of the sun that could have caused faster spoilage or shrinkage in spite of the use of ice boxes because of distance. Identification was done using the keys of Reed, Burchard, Hopson and Yaro (1967, p. 226) and Holden and Reed (1972, pp. 46–49).

Length-Weight Measurement

The standard length (SL) of the fish samples were measured using a measuring board. The anterior tip of each fish was placed against a stop at the beginning of the measuring scale with the fish's mouth closed. SL was taken as the length from the tip of the fish′s mouth to the hidden base of the tail fin rays and this was measured to the nearest 0.1 cm. Total body weight (TBW) was measured using a digital electronic weighing balance (Adams AFP 4100L). This was read to the nearest 0.1 g.

Sex Determination

The gender of the Synodontis species can only be identified after dissection. Thus, the fish were dissected and their gonads were inspected using the keys of Nikolsky (1963). In the young males, the testes were thin and thread-like with very small projections, whitish in colour and extended to about one third of the abdominal cavity. In the adult males, the testes were creamy in colour with very conspicuous granules. The young females had thin, pink to white tubular structures occupying about one fifth of the abdominal cavity. In the adult females that were about to spawn eggs, the ovaries were readily discernible as they had increased in size and filled most of the abdominal cavity (Bagenal, 1978; Halim & Guma′a, 1989).

Laboratory Procedure

Individual fish specimens were dissected using a sterile scalpel blade and a pair of scissors from a dissecting kit. The fish were opened up ventrally from the anal opening to the head.

The fish were dissected and their stomachs removed with care so that the content remained intact and its fullness was individually observed and recorded and preserved immediately in 4% formalin for subsequent examination of the food items. The stomachs were scored 0, ¼, ½, ¾ or full according to their fullness (Table 1). Each stomach sample was then opened and the content emptied in a petri dish. Some food items such as sand grains and insect parts were identified with the naked eye, while others were identified with the aid of a microscope. Slide preparation was made and the samples were examined under a light microscope using objectives X10, X40 and X100.

Table 1
Stomach fullness description

Stomach size	Description
Full stomach (1)	The stomach bulges considerably with food
¾ full stomach	The stomach is almost full but not bulging
½ full stomach	Food occupies about 50% of the stomach volume
¼ full stomach	Stomach wall very flabby, can seem empty at times
Empty stomach (0)	No visible food in the stomach when dissected and examined under the microscope

Source. Olatunde (1978, pp. 197–207)

Numerical Abundance Method

The number of individual food types in each stomach was counted and expressed as a percentage of the total number of food items in the sample studied.

$$\% \text{ Number of a food item} = \frac{\text{Total number of the particular food item}}{\text{Total number of all food items}} \times 100$$

Frequency of Occurrence Method

The number of stomachs in which each item occurred was recorded and expressed as a percentage of the total number of stomachs examined.

$$\% \text{ Occurrence of food item} = \frac{\text{Total no. of stomachs particular food items}}{\text{Total number of stomachs with food}} \times 100$$

Length-Weight Relationship

The LWR of the fish was calculated using the equation

$$W=aL^{b} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [1]$$

where W =the observed weight of the fish
L=the observed length
a and *b*=constants

b is the slope usually between 2 and 4 and *a* is the intercept on the length axis (Bagenal, 1978, p.).

The logarithmic transformation of equation (1) gives a straight-line relationship:

$$\text{Log}W=\text{Log}a+b\text{Log}L \ldots\ldots\ldots\ldots\ldots\ldots [2]$$

When $Log_{10}W$ is plotted against $Log_{10}L$, the regression coefficient is 'b', and Log a represents the intercept on the y-axis.

Statistical Analysis

The dietary items in the stomach of all the specimens were pooled together and presented based on the frequency of occurrence and numerical abundance or importance. They were further statistically summarised in charts according to the size of the fish and according to the monthly occurrence.

RESULTS

Stomach Fullness

Results of the study showed 20 specimens (22.22%) with empty stomachs that was 0 and ¼ fullness representing an empty stomach, while 57 (63.3.78%) had a full stomach, which included ¾ and 1 stomach fullness (Table 2). Monthly variation in stomach fullness showed the specimen had a full stomach more often in the rainy season (Table 3).

Table 2
Percentage total stomach fullness of Synodontis schall

Stomach fullness	**No of samples**	**Percentage**
0	14	15.56
¼	6	6.67
½	13	14.44
¾	23	25.55
1	34	37.78
TOTAL	**90**	**100**

Note. Fullness includes full stomach 1 and ¾ full, half full stomach ½, Emptiness includes ¼ full and 0 stomach

Table 3
Monthly categorisation of percentage fullness

MONTH	Specimen examined	Empty stomach	% empty	Full stomach	% fullness
MARCH	6	3	50	3	50
APRIL	12	7	58.33	5	41.67
MAY	9	5	55.56	4	44.44
JUNE	13	3	23.08	10	76.92
JULY	24	1	4.17	23	95.83
AUGUST	26	1	3.85	25	96.15

Food and Feeding

The results of the stomach content analysis of *S. schall* examined during the study period (March-August, 2015) revealed that the fish was an omnivore that fed on a variety of food items comprising different types of algae, plant materials, insect parts and larvae, fish scales, rotifers, diatoms, crustaceans, detritus and many unidentified food items (Table 4). Algae appear to be the most abundant and important food item both in number and occurrence, representing about nine of the total food items identified in the specimens' stomach, with Polycystis sp. contributing 97.1% and 17.99%, respectively in number and occurrence (Figure 1).

Table 4
Food items in the stomach of S. schall

Food items	Occurrence	% Occurrence	Numerical	% Numerical
ALGAE				
Phormidium sp.	22	31.4	41	0.82
Coelospharium sp.	17	24.2	25	0.50
Polycystis sp.	68	97.1	899	17.99
Aphanocapsa sp.	23	32.8	128	2.56
Oscillatoria sp.	8	11.4	52	1.04
Closterium sp.	51	72.8	83	1.66
Oedogonium sp.	12	17.1	33	0.66
Spirogyra sp.	47	67.1	64	1.28
Unidentified algae	5	7.14	68	1.36
DIATOMS				
Diatoma sp.	63	90	315	6.31
Synedra sp.	52	74.2	184	3.68
INSECTS				
Insect parts	38	54.3	506	10.13
Insect larvae	50	71.4	471	9.44
CRUSTACEAN				
Daphnia sp.	14	20	258	5.13
Ceriodapnia sp.	8	11.4	43	0.86
Copepods sp.	5	7.14	36	0.76
ROTIFERS				
Philodina sp.	29	41.4	48	0.96
Epiphines sp.	25	35.7	62	1.24
Parts of plants	**32**	**45.7**	**511**	**10.23**
Fish scale	**43**	**61.4**	**203**	**4.06**
Detritus	**56**	**80**	**715**	**14.31**
Unidentified items	**41**	**58.5**	**248**	**4.96**

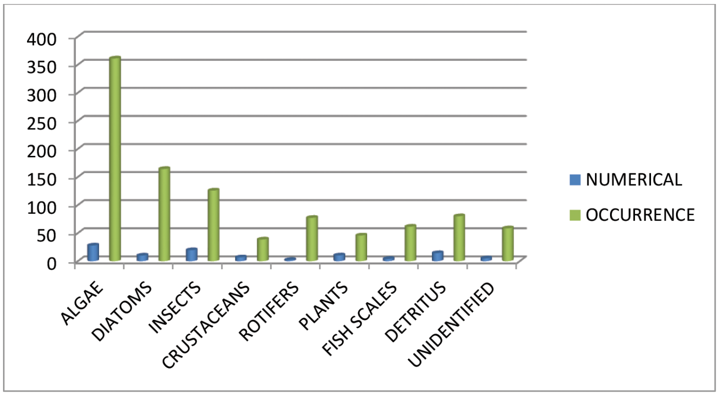

Figure 1. Percentage occurrence and numerical importance of food items in *S. schall*

Length-Weight Relationship of *S. schall*

Figure 2 below shows the log transformed length-weight relationship (LWR) of *S. schall* specimen during the study period. The morphometric features, which include Standard Length (SL), Total Length (TL) and the Total Body Weight (TBW), were calculated in order to determine the LWR.

SL ranged from 10.1 to 23.5 cm with mean (16.56±3.52cm); TL ranged from 15.4 to 29.0 with mean (21.8±3.68 cm) and TBW ranged from 50 g to 198 g with mean (117.99±37.9 g).

The results showed *b*, *a*, and *r* values for *S. schall* to be 1.520, 1.115 and 0.8967, respectively.

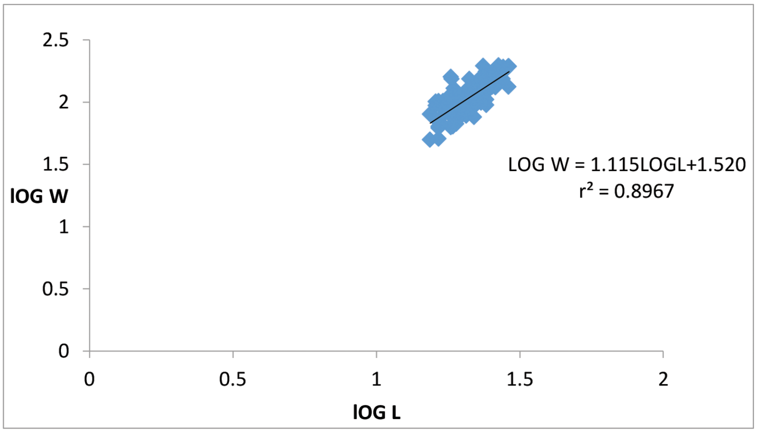

Figure 2. Length-Weight relationship of *S. schall* in Lower Ogun River, Akomoje

DISCUSSION

Monthly variation in stomach content in terms of fullness of this species of fish was as expected. Percentage of empty stomach was observed to be highest during the dry season compared with the rainy months. This could be attributed to the abundance of food items of choice for *S. schall* during the rainy season. This abundance is likely due to the high availability of high organic matter emptied into the water body resulting in high productivity in the waters, which in turn resulted in high phytoplankton production and subsequent abundance of zooplankton and nekton production. This high number of empty stomachs may also have been due to the method employed during harvesting of the specimens. This corroborates the findings of Olojo et al. (2003, pp. 21–24), who reported similar finding in the Osun River for S. nigrita and posited that there was variation in the feeding habits of *S. schall* according to the seasons. Akombo et al. (2014, pp. 42–48) reported similar findings i.e. better condition factors for *S. schall* during the rainy months attributed to availability and sufficiency of food items. Generally, *S. schall* could be said to have a wide choice of food items to consume during the rainy spell when there are more aquatic plants and insects in the water than in the dry months.

S. schall during the study was observed to feed on varieties of food items that included plankton, invertebrates and plant material. This proved the omnivorous feeding nature of the fish as revealed by other researchers (Akombo et al., 2014, pp. 42–48; Olojo et al., 2003, pp. 21–24). The diversity of natural food items found in the stomach of *S. schall* specimens was an indication that the feeding habits of the species was euryphagous, feeding on a broad range and variety of food available in the environment. Natural food items found in the species such as detritus, insect parts, crustaceans and fish scales showed that the species was an omnivorous bottom feeder, which could be due to the position of the mouth in this species. Hassan (2007) in his study posited that *S. schall* in the Nile was an omnivorous bottom-feeding fish species as sand, mud and fish remains were present in its stomach upon dissection. The preference of *S. schall* for phytoplankton, detritus, plant materials, insect parts and larvae in this study could probably have been due to the predominance of these food items in the environment. This finding was corroborated by Olojo et al. (2003, pp. 21–24), who reported high occurrence of similar food items in the stomach of *S. nigrita* in the Osun River.

The LWR of the species during the study period gave a straight linear graph as shown, revealing negative allometry for the species in the water body with a 'b' value less than 3. This result is similar to that of previous research on *Synodontis* sp. from different water bodies. Adeyemi (2010, pp. 69–74) and Akombo et al. (2014, pp. 42–48) also observed negative allometry in the growth pattern exhibited by the different species of this family. The LWR of fish, also known as its growth index, is very important in fishery management as it is used in the estimation of average weight per length group (Abowei, 2010, pp. 16–21). However, the 'b' values obtained in this study fell outside the 2-4 range reported by Bagenal and Tesch (1978).

CONCLUSION

The findings of this study provided baseline information on some biological aspects of this species in the lower Ogun River. It also confirmed that the fish species was benthic, omnivorous and euryphagous in nature although the species can fit into different trophic levels in the food chain. It also affirmed that the *S. schall* in the Ogun River were positively correlated with the 'b' values, indicating a negative allometric growth pattern.

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