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Stomach Content Analysis and Length–Weight Relationship of *Synodontis nigrita*: A Case Study of Nwonyo Lake, Ibi Local Government Area, Taraba State, Nigeria.

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ABSTRACT

Fishes are important source of protein, understanding dietary preferences will enhance managing fisheries, informing conservation efforts, advancing scientific knowledge and ecosystem health. This study was based on 50 sample of *Synodontis nigrita* (false upside-down fish), food and feeding habit, the length – weight relationship and their sex ratio in Nwonyo Lake, Ibi Local Government Area, Taraba State, Nigeria. The stomach content was observed by emptying the stomach to check the degree of fullness. The lengths and weights were measured for their length weight relationship. Then the sex ratio was observed and analyzed using number method and occurrence method. The result showed that *Synodontis nigrita* is an omnivorous fish with dietary preference for algae (29.4% and 17.7%), then Dinoflagellate had (10.49% and 14.22%) and unidentified food content was the lowest with 1.03% and 0.88% for the number and occurrence methods respectively. The result also showed a negative allometric growth (b<3) for both male and female samples. The sex ratio result showed that there was more female than male (Sex ratio = 0.851) at this study site. The findings from this study therefore confirmed the Length-weight and condition factor as useful methods of evaluating growth and well-being of fish in the water bodies, and more females than male *Synodontis nigrita* were found in the study site.

Keywords: Food and feeding habit, Length – weight relationship, *Synodontis nigrita*, Sex ratio.

INTRODUCTION

Fishes are sources of food for humans and other animals, rich in protein and vitamins, especially vitamin A. Fish is one of the healthiest and inexpensive source of animal protein and therefore provide relief from malnutrition (Ashraf *et al.*, 2011; Adeniyi *et al.*, 2012). The most important minerals in fishes are Chlorine, Phosphate, Calcium, Sodium, Iron and Phosphorus, while other minerals needed are in trace amount (Womeni *et al.*, 2014; Salma and Nizar, 2015). *Synodontis nigrita* is known as the false upside-down catfish, is a species of upside-down catfish that occurs widely in North Africa (Rainer and Daniel, 2016). *Synodontis nigrita* is the largest

genus of the catfish belonging to the family Mochokidae. They are highly valued food and contribute significantly to the fishery of African Inland waters (Baras and Laleye, 2003; Owolabi, 2008). In Nigeria, *Synodontis nigrita* are of high demand by fishermen and consumers because they are easy to catch and are of excellent flavor (Yongo *et al.,* 2013). They have high tolerance to environmental conditions and are widely distributed. They are one of the most dominant species among the Mochokidae present in Lake Nwonyo. It is a palatable fish with high protein percentage content as it is in great demand; however, its amour-like head makes it bony in structure. (Olele, 2011).

Food is a fundamental element in the life of living organism including fish, being the source of energy and nutrient for growth, reproduction, movement that are vital for survival in the aquatic environments. The study of the food and feeding habit of fish is based on the stomach content analysis commonly used in fishery ecology to show the position of fish within the food web and provide information on the distribution of different prey items to the diets (Baker *et al.,* 2014). Food items encountered in the stomach of any fish species, provide information on the feeding habit (Bigg and Perez, 1985; Cortes, 1997) and indicate the types, abundance and distribution of food organisms that can be found in a particular water body. It also indicates the type of food organisms that can be cultured and used as starter feeds when the artificial breeding program of a fish species is fully developed. *Synodontis nigrita* feed on variety of food items including all types of phytoplankton, zooplanktons, insects and other bottom fauna. This could be due to morphological adaptation and omnivores predation habits (Wakil *et al.*, 2014). *Synodontis nigrita* can switch from one type of food item to the other depending on availability (Wakil *et al.,* 2014). *Synodontis nigrita* are bottom-feeders and may be detritivores, some species may also be able to adapt to filter feeding, it allows them to cope with seasonal and habitat changes and give them a better ability to colonize different habitat (Admassu *et al.,* 2015).

The length – weight relationship (LWR) and Condition factor (K) have been used widely by aquatic biologist and fisheries managers to assess fisheries ecology, population dynamics and fish stocks in natural aquatic ecosystem and in semi controlled aquatic mediums (Ricker, 1968). In addition, the ecological health and productivity level of aquatic ecosystem can be evaluated through length-weight models and condition factors (Deekae and Abowei, 2010) that are also powerful tools to assess growth patterns and the wellbeing of fishes (Muchlisin *et al.,* 2010; Ndaiye *et al.,* 2015). In general, the growth of fishes could be negative allometric, positive allometric or isometric. Negative allometric growth with slopes $b<3$ implies that the fish becomes slenderer as it increases in weight while positive allometric with slope $b>3$ indicates that the fish becomes more rotund as length increases (Deekae and Abowei, 2010). In isometric growth ($b = 3$), there is no change in body shape as the fish grows (Deekae and Abowei, 2010; Khristenko *et al.,* 2017). Condition factor is a useful index to assess the status of the fishes and can be used to monitor aquatic ecosystem (Oni *et al.,* 1983). It indicates the degree of plumpness of fish in their habitat and stand as a measure of various ecological and biological factors such as season, water quality parameter, food availabilities, stress, toxicity and gonadal development (Khallaf *et al.,* 2003). In general, the fish shows a better condition or wellbeing

when a higher value of the condition indices is recorded (Amos *et al.*, 2021).

MATERIALS AND METHODS

Study Area

The Nwonyo lake is located in Ibi Local Government Area, in Taraba state, Nigeria. The Lake is a large lake, running a stretch of about 15Km tributary to River Benue. It is located 5Km North of the Ibi community.

Methodology

Fifty (50) fish samples were collected from the study area on weekly basis, for four (4) weeks and the samples were examined while fresh. They were then taken to the laboratory where they are dissected and stomach contents were removed and observed. The apparatus used for the laboratory work were; dissecting blade, scissors, forceps, measuring board, measuring rule, weighing balance, dial clippers, pairs of dividers, microscope, normal saline, glass slide and wash glass. The stomach content was emptied into a clean petri dish. The stomach contents of each specimen were examined under a Motic compound microscope to identify the food items. Using a guide to identification of freshwater microorganisms and a reference manual on common zooplankton of freshwater areas of Chesapeake Bay (Draft 2003), the food components found in the stomach were identified and categorized. This approach enabled accurate determination of the dietary composition of the specimens. The state of fullness of each stomach was recorded and expressed as empty (0/4), almost empty (1/4), half full (2/4), almost full (3/4) and full (4/4). After conducting laboratory observations, statistical analysis was carried out to quantify the findings. The food items in the stomach contents were analysed using frequency of occurrence and numerical methods. In the occurrence method, the stomach contents were examined under a microscope, individual food items were identified, and recorded the number of stomachs in which each item occurred. This was then expressed as a percentage of the total number of stomachs containing food. Similarly, in the numerical method, the occurrence of each food item was counted in the stomachs and expressed as a percentage of the total number of fish stomachs examined. To ensure accuracy, other internal organs and fatty tissues were carefully dissected from the guts. This approach gave the opportunity to gain a comprehensive understanding of the dietary habits of the fish.

Mathematically, Frequency of occurrence, $\%O_i = \frac{N_i}{N} \times 100$

Where: O_i = frequency of occurrence of given food i

N_i = number of stomachs containing prey i

N = number of stomachs with food

Then in the numerical method, a count is made of individual items occurred in each stomach. The total number of individuals for a particular food item was expressed as a percentage of total number of foods found in all specimen examined.

Frequency of Occurrence; $\%O_i = \frac{N_i}{N_t} \times 100$

Where; O_i = percentage of food item i

N_i = number of particular food item i

N_t = total number of food (gut content) items Degree of fullness

The total length (distance between the snout and the tip of the caudal fin) and standard length (the tip of the mouth to the hidden base of the tail fin rays) were measured in

centimetres on each sample with the aid of meter rule. The weight of each fish was measured in grams using the digital electronic weighing balance (WT6000KF) LCD and the condition factor was calculated and recorded described by Worthington and Richard (1931) as adopted by Amos *et al.*, (2021).
Length-weight relationship: Mathematical expression: W = aL^b, where W is body weight (g), L is standard length (cm), 'a' is the regression constant, and 'b' is the slope of the regression line. Logarithmic transformation: Log W = loga + blogL.
Condition factor: Formula: K = (W / L^b) x 100, where K is the condition factor, W is body weight (g), and L is total length (cm), Pauly (1983) as adopted by Ja'afaru and Tashara (2009).

RESULTS

The results of food content for *Synodontis nigrita* are expressed in Table 1. Twenty-three (23) out of all the specimens observed had a full (4/4) stomach with a percentage of 46%, 13 had almost full with 26%, 9 of the 50 specimens had half full stomach content with 18%, 5 of them had their stomach content almost empty having 10% while, none was recorded with an empty stomach.

Table 2 presented the stomach content of *Synodontis nigrita* or food items found in fish species observed, using numerical method, algae was found to be the highest stomach content counted in the species with 171 having about 29.43% of the total count followed by diatom which was about 72 and had 12.39% of the total count. The least count was the unidentified items which had only 6 counts with 1.03%, followed by the ciliate with 32 count and 5.50%.

Table 3 showed the occurrence method for the analysis of the stomach content of the specimens sampled. Forty (40) of the fish samples had Algae in their stomach content with 17.77% which signifies that this fish species mostly feed on Algae. Thirty-two (32) of the fish samples had dinoflagella in their stomach content with 14.22%, and the unidentified food items had the least count of 2 occurrences and just 0.88%, followed by sand grain, with 8 of the fish samples having leading to just 3.35% of the total count.

Table 4 showed a statistical representation for the length – weight recorded for the specimens. The mean total length of the fish was 16.28cm. However, the maximum and minimum total lengths observed were 20.80cm and 12.00cm respectively. For the length of the fishes considered, the minimum and maximum standard length were 10.00cm and 34.00cm, 3.35, 0.47 and 13.45 respectively. The body weight was estimated to have an average of 34.14g. The minimum and maximum body weights recorded were 19.00g and 66.00g. The condition factor for the fishes examined were estimated from the results in table 4, it was observed that the average condition factor was estimated to have a value of 0.82.

Table 5 showed the condition factor estimated for male and female fishes examined in this study, the average condition factor for the female (0.8266) was higher than that of the male fishes (0.8018). This implies that the spread in the condition factor among the female specimens was narrower than that in the male.

Table 6, presented the sampling distribution observed in relation to the sexes of the fishes involved in the study the female fishes

appeared more than the male (sex ratio = 0.851)

Table 1: Occurrence of fullness of stomach

Degree of fullness	Frequency	Percentage (%)
Full	23	46
Almost full	13	26
Half full	9	18
Almost empty	5	10
Empty	0	0
Total	50	100

Table 2: Stomach content of *Synodontis nigrita* using Numerical method

Food Item	Number	Percentage (%)
Dinoflagella	61	10.49
Diatom	72	12.39
Protozoa	48	8.26
Rotifera	53	9.12
Ciliate	32	5.50
Mud	48	8.26
Detritus	36	6.19
Sand grain	54	9.29
Algae	171	29.43
Unidentified	6	1.03

Table 3: Stomach content of *Synodontis nigrita* using Occurrence method

Food Item	Number	Percentage (%)
Dinoflagella	32	14.22
Diatom	30	13.33
Protozoa	21	9.33
Rotifera	16	7.19
Ciliate	12	5.33
Mud	19	8.44
Detritus	16	7.11

Sand grain	8	3.35
Algae	40	17.77
Unidentified	2	0.88

Table 4: Estimate for Length-weight relationship

	Total Length (cm)	Standard length (cm)	Body weight (g)	Condition Factor K
Mean	16.28	13.45	34.14	0.82
Standard error	0.27	0.47	1.49	0.04
Standard deviation	1.87	3.35	10.51	0.26
Minimum	12.00	10.00	19.00	0.31
Maximum	20.80	34.00	66.00	1.72
Count	50.00	50.00	50.00	50.00

Table 5: Condition Factor for Male and Female *Synodontis nigrita*

Estimates of:	Male	Female
Mean	0.802	0.826
Standard error	0.061	0.046
Minimum	0.386	0.313
Maximum	1.718	1.456
Count	23	27

Table 6: Sex Ratio

	Observed	Expected	Chi-square	DF	P-Value
Male	23	25	0.32	1	0.571
Female	27	25			
Total	50	50			

DISCUSSION

Degree of fullness can be referred to the level of fullness in an organism's stomach, the result indicated that the fishes were more with full stomach compared to that empty which had none. These could be as a result of abundance of food within their reach at the time of data collection. This contradict Amos and Newton (2024) who reported fish species that were with food items and no empty stomach.

Food and feeding habits of fish has apart from its relevance in aquaculture and optimization of fish yield; it also describes habitat types, and ecological productivity. The *Synodontis nigrita* feeds on nine major food items which are algae, dinoflagellate, diatoms, protozoa, rotifera,

ciliate, mud, detritus and sand grain. From the results shown above, and the food contents in their stomachs and occurrence, this species of fish is an omnivorous feeder as the diet cover a wide spectrum of food ranging from various types of planktons to invertebrates and plants. This finding was similar to those reported by (Shankafi *et al.,* 2010) and Lauzanne (1998) who described *Synodontis nigrita* as eclectic.

The presence of mud and sand grain in the stomach content indicated that it is a bottom feeder. It was observed that the fish exhibits an overlapping in food and feeding habits in order to avoid specific competition for food availability, this is an important strategy for survival and an advantage over the fish species competing for specific food items. It was also observed that *Synodontis nigrita* from the Nwonyo Lake feeds predominantly on algae and algae contributes bulk of their diet, which agreed with the result of Olojo *et al.* (2003). Most of food items such as rotifera, protozoa and other bottom deposits that were reported by Adeyemi *et al,* (2009) were observed in *Synodontis nigrita* from the study site.

The length-weight relationship gave information on the structural and functional dynamics of fish population. In this study, it did not confirm the cube law which specified that an ideal fish must have an isometric growth pattern with b-value equalling 3.00. A negative allometric growth was observed, which implied that the fish became thinner as they grow, this agreed with the work of Amos and Newton (2024). (Arame *et al.* 2020) who pointed out that *Synodontis nigrita* exhibited negative allometric growth indicating that fish becomes thinner as they increase in weight which makes the observation in this study valid. This negative allometric growth trend could be attributed to the multiple degradation factors such as proliferation of invasive floating plants, dumping of domestic wastes, overfishing, and introduction of invasive exotic fishes, uses of chemical fertilizers, pesticides and agricultural activities occurring in the study site. This was noted by Amos and Newton (2024) who reported that illegal fishing, wrong mesh sizes and anthropogenic activities can give rise to negative allometric growth pattern of fishes in water bodies.

The low condition factor (k<1) for *Synodontis nigrita* suggested that this specie was in poor condition. Edah *et al.* (2010) explained that condition factor is mainly influenced by sex and maturity. The low k-value recorded by *Synodontis nigrita* during the study period indicated that habitat factors may have led to elongated and undernourishment of the fish. Similar observations were reported by Alhassan *et al.* (2014) and Amos and Newton (2024).

CONCLUSION

This study investigated the food and feeding habits, length-weight relationship, and sex ratio of *Synodontis nigrita*, revealing it to be an omnivorous fish with a preference for algae and dinoflagellates. The study also found a negative allometric growth pattern and a female-dominated sex ratio, although the sex ratio difference was not statistically significant. The findings from this study therefore confirmed the Length-weight relationship and condition factor as useful methods of evaluating growth and well-being of fish in the water bodies, and more females than male *Synodontis nigrita* were found in the study site.

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