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Original Research Article

Evaluation of Gut Contents of Selected Fish Species in Oluwa River, Igbokoda Delta Region, Ondo State, Nigeria

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Abstract: Gut contents of *Sardinella maderensis, Schilbe uranoscopus, Mugil cephalus Oreochromis niloticus, Hepsetus odoe* from Oluwa Rver in Igbokoda Ondo State were evaluate. Length-weight relationship and condition factor, (K) of the fish species were determined to evaluate the significant correlation between body weight and length in the fish species. Percentile evaluation was used to determine the gut contents to reveal the food availability (species compositions) of the environment, and consideration for nutrition management. The results showed condition factor status was below value that indicates fish in good well-being (K = 1) in all the fish samples except in *Oreochromis niloticus*, and these shows that these species were not in favorable environmental condition. Diatoms, small fishes, Dinoflagellate, Insect, crustaceans and other food constituted occurring in the fish with 100% full gut. Negative correlation was revealed among the fish species, which indicated no correlation in the growth length of the fish to the weight gained in Oluwa River Igbokoda. Therefore, anthropogenic influence could be a causative factor to the fish species low condition status in the environment.

Keywords: Condition factor, environmental status, fish species, gut examination, Oluwa River.

1. INTRODUCTION

Feeding habit of a fish is necessary for understanding feeding ecology of the fish community; trophic relationships of the aquatic ecosystem and emphasizing of food habit that forms fish diet, (Hajisamaea *et al.,* 2003; Abdel-Aziz and Gharib, 2007). Generally, study of the food items consumed has given reliable information on particular dietary items that fish dietary and feeding habit. Also, preference for dietary items when there is food competition among fish species in a fish community could be known in the aquatic ecosystem.

Gut content analysis gives much important information on ecological and biological aspects of fish habitat use, energy intake, behavior, condition, and inter- and intra-specific interactions. It forms an essential part of the ichthyological, fishery and fish protection researches. The length and structure and formation of the fish intestine are closely related to its diet, (Miller and Harley, 2002). As the diet together with the ecology are highly variable among different fish taxa, and also can vary among developmental stages for same species of fish as well. Hence, Fish stomach contents can be examined to identify differences in fish habitat-related food availability, feeding strategies, fish and prey community ecology, fish health as well as to gather information regarding the trophic relationships in aquatic communities, (Kamler & Pope 2001). Thus, it is important to investigate the gut content of fish not only for ichthyologist, but also for other specialists in freshwater ecology, and employees in fishery and aquaculture.

Researchers focusing on aquatic macro invertebrates, zooplankton, algae, cyanobacteria and other experts focused primarily on different groups of aquatics, semi-aquatic or riparian organisms. Ichthyologist and fish ecologist need the knowledge of fish feeding habit using gut content analysis in the different specific research areas to bridge the gap of comprehensive source of information (Simpfendorfer *et al*., 2011).

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Knowledge of natural diet in an animal species is generally essential for studies of animal nutritional requirements and the recruitment dynamics within a species and across various habitats to understand trophic, material and energy dynamics and to model outcomes for all ecosystems (Navia *et al.,* 2010). Diet composition analysis can be used to investigate effects of ontogeny or the establishment of exotic species (Chipps & Garvey 2007). Data on feeding ecology aid food webs determination and predict possible changes in food chains, material and energy transfers between and within ecosystems (Rezende *et al*., 2008). It helps us to explain interactions with other organisms - potential competitive interactions among sympatric and predator–prey interactions species. Information on the diet also contributes to the understanding of ecosystem structure, community composition and population dynamics (Litvaitis 2000). In ichthyology, fish ecology and fisheries, information on diet and food habits are important in the decision-making related to natural resources, quantifying the thread of the different endemic as well as exotic fish species to native fish populations (Fritts & Pearsons 2004). Qualitative and quantitative techniques are used to describe food habits and feeding patterns of fishes and detailed description of particular methods of the direct stomach content analysis (Ahlbeck *et al.,* 2012).

Gut content assessment helps in the protection of the fish species and its environment. It help in the understanding of the natural history of a species and its niche contributions in the trophic ecology of aquatic ecosystems (Braga *et al.,* 2012). Consequently, gut content analysis study helps not only to know the diet but also serves as a great source of information on many aspects of fish biology and ecology. Therefore, gut content analysis provides important insight into fish feeding patterns.

The gut content analysis makes possible to answer questions, such as determining the relative importance of different food items to fish nutrition, quantifying the consumption rate of individual prey items, or understanding foraging tradeoffs associated with predator avoidance. it is also important in aspect fish prey relationship and fisheries management, thereby increasing fish production and manipulating forage fish populations to enhance sports fisheries (Pikitch *et al.,* 2004).

Dietary items and feeding habits of some fish species of Nigeria coastal river have been reported by some authors (Abdel-Aziz *et al*., 2007. Zengeya, Tsungai 2014, Iglesias *et al*., 2011). Information on dietary items and feeding habits of *sardinella maderensis, schilbe uranoscopus, oreochromis niloticus, and hepsetus odoe of* Igbokoda River is limited. Hence, the aim of this study was to investigate the dietary items and feeding habits of the selected fish species in Oluwa River in Igbokoda by identifying the dietary items and their abundance, to contribute information towards successful fisheries.

2.0 DESCRIPTION OF STUDY AREA

The study was carried out in Igbokoda River, near Opolo, located in Igbokoda, Ilaje, Ondo State Local Government Area, South-Western, Nigeria. it is one of the largest rivers in Ondo State, and has geographical coordinates latitude 6° 17' 03" N and longitude 4° 49' 06" E (Figure 1). The water shares its border with the Atlantic Ocean, and the area is recognized for artisanal fishery, having history of women's active participation in the production of fish. Some of the fish species inhabiting the Igbokoda River include Carps, Nile perch, Catfish, snakehead, *M. rume* and *H. longifilis*. Igbokoda fish market has been one of the largest South-Western fish markets in Nigeria, with fishing as the dominant occupation.

2.1 Collection of Fish Samples

Specimens of S*adinella maderensis, Schilbe uranoscopus, Oreochromis niloticus, Hepsetus odoe* were randomly collected by the assistance of fishermen from October, 2019 to March, 2020. The samples were transported to the limnology research laboratory of the Federal University of Technology, Akure for examination and analysis.

2.1.1 Identification of Fish Samples

The fish samples were identified using the Food and Agriculture Organization, (FAO), (2005 and 2009) and Olaosebikan and Raji, (2013).

2.1.2 Morphometric measurements of Fish Samples

Fishes total lengths (TL) and standard lengths (SL) were measured to nearest 0.10 cm using a measuring board graduated in cm. The total length was taken from the tip of the mouth to the tip of the caudal fin while the standard length was taken from the tip of the mouth to the base of the caudal fin. Fish weight(s) were measured to nearest 0.10 gram using a digital and sensitive weighing scale with model number JA-5000.

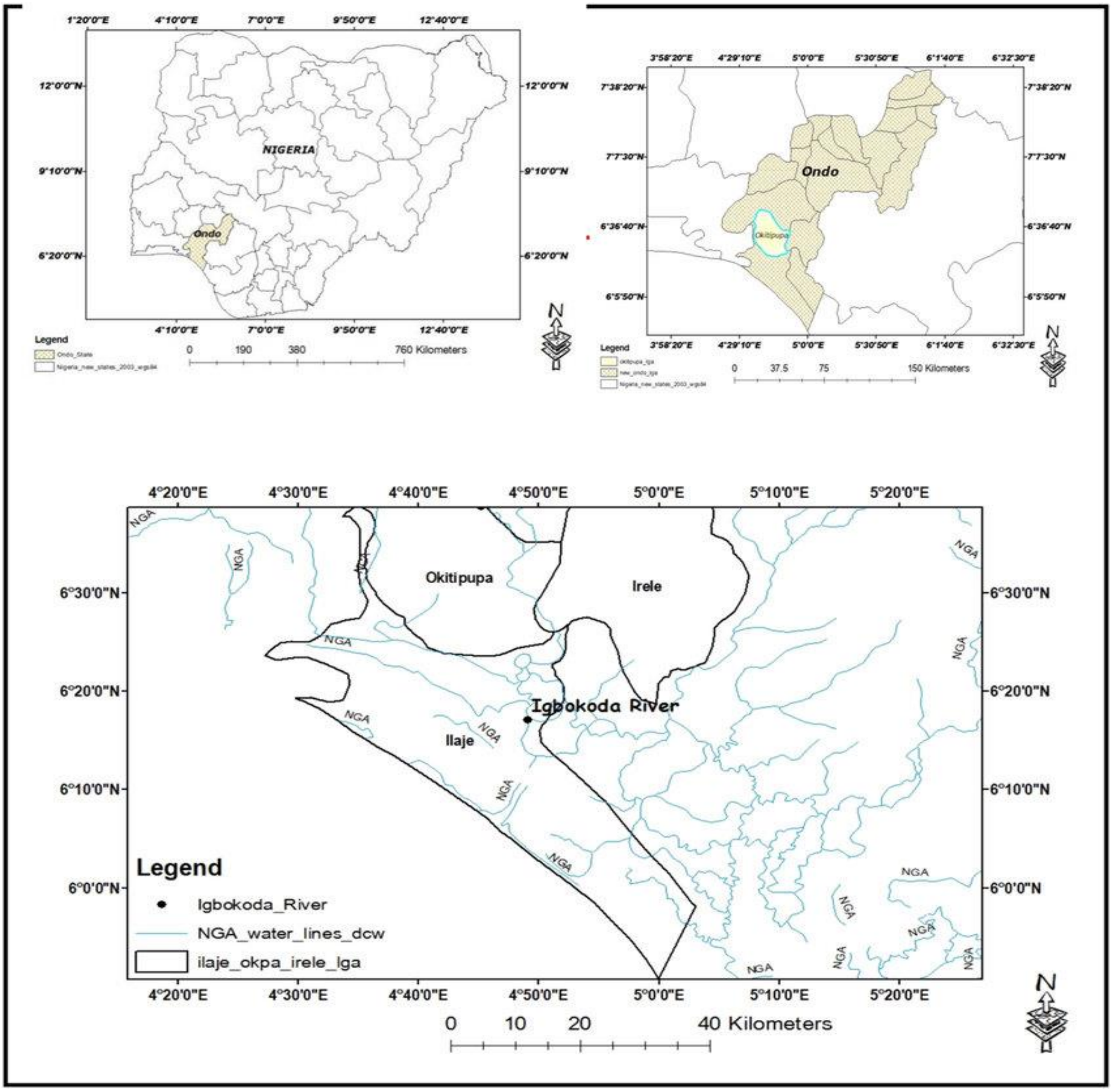

Figure 1: Map of Igbokoda River, Ondo State
Source: Google map

2.3. Determination of Length –Weight Relationship

The relationship between the total length (TL) and weight (W) of fish was expressed by the equation:
$W = aL^b$ (Pauly, 1983) ………….……… (1)

Where;
W= Weight of fish in (g), L= Total Length (TL) of fish in (cm), a= Constant (intercept), b= length exponent (slope).

The "a" and "b" values where obtained from a linear regression of the length and weight of fish. The value "a" and "b" were given a logarithm transformation according to the following formula:
LogW = Log a + blog L …………………. (2)

2.3.1 Determination of Condition Factor of Fish Samples: The condition factor (k) of the fish was estimated from the equation:
$K = 100W/ L^3$ ………………….. (3)

Where K = Condition factor, W= Weight of fish (g), L = Total length of fish (cm).

The mean and total lengths and weights of fish samples collected in each month were used for data analysis according to Sarkar *et al.,* (2013).

2.4 Fish Gut Contents Assessment

The fish were dissected to remove the visceral, and the visceral were dissected to determine stomach contents. Gut contents classification of the fish species were carried out using degree of fullness according to Manko *et al.,* (2016). Gut samples collected were emptied into a petri dish containing little amount of water which loosen up the materials for easier identification and estimation of number of organisms which were made under a monocular microscope. The contents were identified to the species level where possible and analyzed by numerical and frequency of occurrence methods, (Baker *et al.,* 2014).

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

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

2.4.1. Percentage Numerical Assessment method

This gives an estimate of the proportion of the population that feeds on a particular food item, and calculated with the formula:

$N_o\,(\%) = \frac{Tp}{Ta} \times \frac{100}{1}$ ……………………….. (4)

Where
N_o (%) = Percentage number of a food item
Tp = Total number of a particular food item
Ta = Total number of all food item

2.4.2 Percentage 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). It was calculated with formular:

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

➔ $C_o\,(\%) = \frac{Gi}{Ge} \times 100$…… (Bowen 1983)

……………………………………..…. (5)

Where;
C_o (%) = Percentage of occurrence of a food item
Gi = Total number of stomachs with the particular food item
Ge = Total number of stomachs with food

2.4.3 Frequency of occurrence: this is usually expressed according to:

$F_1 = ni / N$ …………………………………. (6)

Where;
F_1: frequency of occurrence of the food item in the sample
ni: number of stomachs in which the item is found
N: number of stomachs with food in the sample

2.4.4. Numerical method

This method involves counting the number of individuals of each food item present in the stomach of a fish and summing up this number to obtain the grand total number of all food items found in the stomach.

$$\text{Percentage number of a food item} = \frac{\text{Total number of a particular food ite}}{\text{Total number of all feed item}} \times 100$$

…………………………………………………. **(7)**

2.5 Statistical analysis

Analytical and Descriptive statistics were used to analyse data collected. ANOVA was used to test for significant differences at 5% from data of stomach contents, standard and total lengths, weight and condition factors, morphometric parameters and length class interval of the species measured. Length-weight and morphometric was subjected to least square regression and correlation analysis. Student t-test was used to test for significant difference in the fullness index and stomach contents between seasons. Least Significant Difference (LSD) was carried out to rank means where necessary.

3.0 RESULTS

LENGTH AND WEIGHT MEASUREMENT OF *Sardinella maderensis, Schilbe uranoscopus, Oreochromis niloticus, Hepsetus odoe and Mugil cephalus*

A total of 405 fish samples comprising of *Sardinella maderensis* (60 samples), *Schilbe uranoscopus* (80 samples), *Mugil cephalus* (90 samples), *Oreochromis niloticus* (90 samples), and *Hepsetus odoe,* (85 samples). Table 1 shows the standardlength range (cm), weight (g) and their mean ± standard deviations for the fish species; and Table 2 shows length -weight relationship and condition factor of the fish species.

Table 1: Standard Length Range (cm), Weight (g) and Mean ± Standard Deviations for *Sardinella maderensis, Schilbe uranoscopus, Mugil cephalus, Oreochromis niloticus* and *Hepsetus odoe*

Fish Species	Standard Length (cm) [Range]	Mean ± Standard Deviation Standard Length (cm)	Weight (g) [Range]	Mean ± Standard Deviation Weight (g)
Sardinella maderensis	8.40 - 11.60	10.34 ± 0.12	15.60 - 19.20	17.46 ± 0.12
Schilbe uranoscopus	13.20 - 15.60	14.68 ± 0.24	22.30 - 38.90	33.46 ± 0. 06
Mugil cephalus	11.80 - 17.30	14.22 ± 0.34	26.00 - 51.30	38.47 ± 0.80
Oreochromis niloticus	10.50 - 14.80	13.04 ± 0.24	43.30 - 93.70	78.12 ± 1.24
Hepsetus odoe	13.60 - 18.10	16.26 ± 0.22	42.40 - 61.80	35.32 ± 1.12

Table 2: Length Weight Relationship and Condition Factor of Fish Species (*Sardinella maderensis, Schilbe uranoscopus, Oreochromis niloticus, Hepsetus odoe* and *Mugil cephalus*) Collected from Oluwa River Igbokoda

Fish Species	b	R^2	Condition Factor (K)	Remark
Sardinella maderensis	1.08	0.95	0.98	Negative Allometry
Schilbe uranoscopus	3.34	0.89	0.68	Positive Allometry
Mugil cephalus	2.32	0.88	0.80	Negative Allometry
Oreochromis niloticus	3.47	0.85	1.86	Positive Allometry
Hepsetus odoe	2.40	0.81	0.70	Negative Allometry

GUT CONTENT ANALYSIS OF *Sardinella maderensis, Schilbe uranoscopus, Oreochromis niloticus, Hepsetus odoe* and *Mugil cephalus*

Table 3 shows the degree of stomach fullness grades and number of the fish samples per grade for the five fish species. Diatom is the most abundant algal found in the gut of the fish species

Table 3: Stomach Fullness of *Sardinella maderensis, Schilbe uranoscopus, Oreochromis niloticus, Hepsetus odoe* and *Mugil cephalus*

Stomach Fullness Grade↓	Fish Species →	*S. maderensis*	*S. uranoscopus*	*O. niloticus*	*H. odoe*	*M. cephalus*
Empty stomach (0) = 0%		0	0	0	0	0
Quarter full stomach (¼) = 25 %		(10) = 16.67	(30) = 37.50	(15) = 16.67	(25) = 29.41	(20) = 22.22
Half full stomach (½) = 50 %		(35) = 58.33	(20) = 25.00	(50) = 55.56	(30) = 35.29	(40) = 44.44
Three quarter full (¾) = 75 %		(10) = 16.67	(15) = 18.75	(20) = 22.22	(15) = 17.65	(20) = 22.22
Full stomach (1) = 100%		(5) = 8.33	(15) = 18.75	(5) = 5.56	(15) = 17.65	(10) = 11.11
Total (number) = %		(60) =100	(80) = 100	(90) = 100	(85) = 100	(90) = 100

Table 4 shows the degree of stomach fullness grade and number of the fish samples per grade for the five fish species.

Table 4: Percentage Numerical value of Gut Contents in *Sardinella maderensis, Schilbe uranoscopus, Oreochromis niloticus, Hepsetus odoe* and *Mugil cephalus*

Fish Species→	*S. maderensis*	*S. uranoscopus*	*O. niloticus*	*H. odoe*	*M. cephalus*
Food items↓Percentage→	%	%	%	%	%
Diatoms	44.83	51.16	56.86	31.57	53.66
Crustaceans	18.97	9.30	27.45	15.79	12.20
Dinoflagellate	13.79	4.65	5.88	12.28	14.63
Baccillariophyta	5.17	4.65	3.92	7.02	14.63
Others					
Plant part	5.17	4.65	0	0	0
Sand particle	5.17	0	0	0	0
Snail	0	6.98	0	0	0
mullet	0	0	0	0	7.32
Rotifer	0	0	0	0	2.44
Unidentified	5.17	0	0	0	0
Fruit	1.72	4.65	0	0	0
Insect	3.45	6.98	5.88	33.33	0

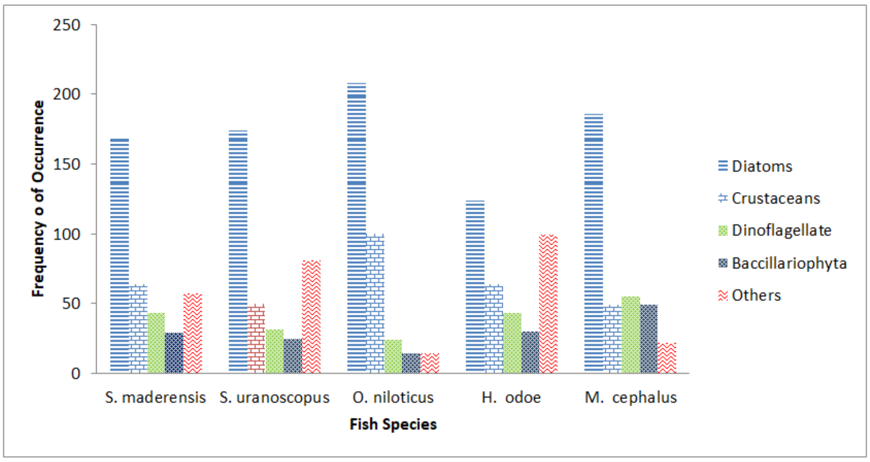

Figure 2: Frequency of Occurrence of Food items in gut of *Sardinella maderensis, Schilbe uranoscopus, Oreochromis niloticus, Hepsetus odoe* and *Mugil cephalus*

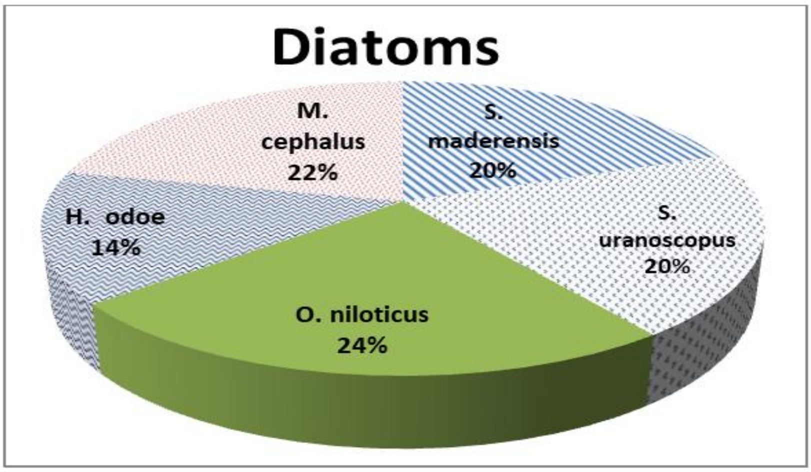

Figure 3: Percentage Diatoms in Gut of fish species

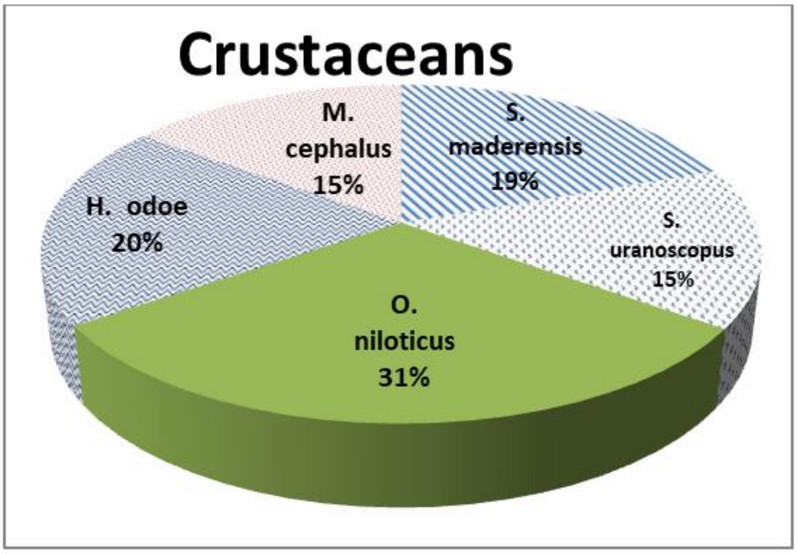

Figure 4: Percentage Crustaceans in Gut of fish species

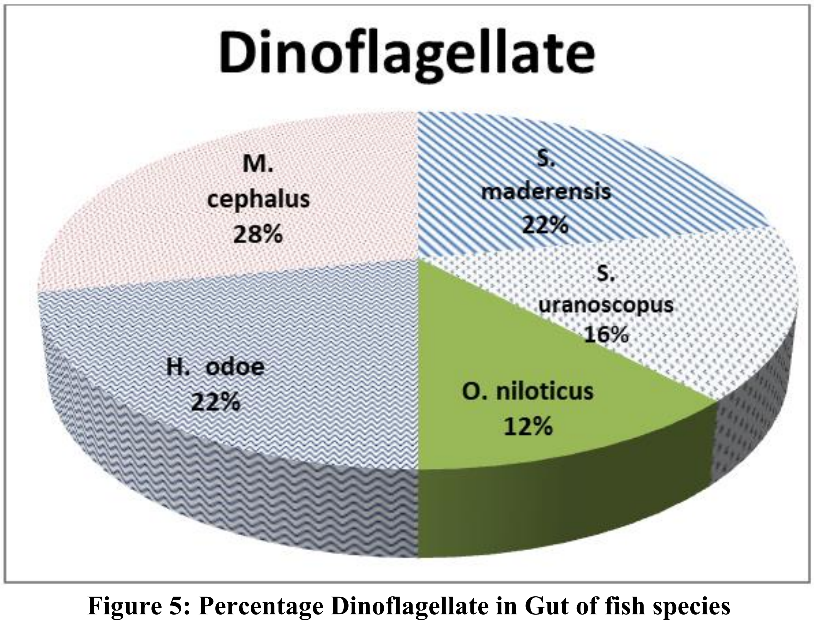

Figure 5: Percentage Dinoflagellate in Gut of fish species

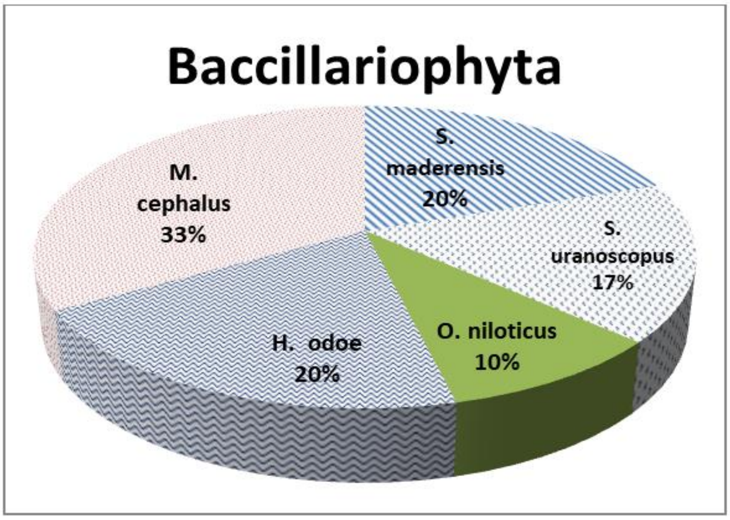

Figure 6: Percentage Baccillariophyta in Gut of fish species

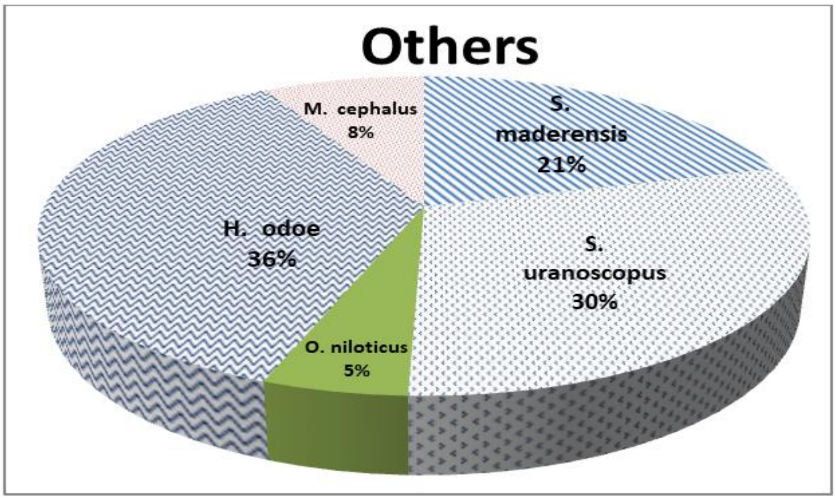

Figure 7: Percentage other contents in Gut of fish species

4.0 DISCUSSION AND CONCLUSION

4.1 DISCUSSION

Growth assessment carried out on the fish species indicated fish length is proportional to weight depending on the species type. According to Olurin and Aderibigbe (2006), differences in total length and body weight distributions are dependent of sex and developmental stages of fish. Kunda *et al.,* (2008) proposed that fluctuations observed in some length groups might be ascribed to variation in sample sex, size, gonad condition and amount of gut content. Increases in total length resulted in corresponding increases in body weight and it is in line with the work of Nwani *et al*., (2004). The isometric values obtained indicated both positive and negative values which is corroborated by the work of Zafar *et al*., (2003) and Agoola and Anetekhai, (2008), who reported values of fish when equal to 3 as isometric, when lower than 3 as negative allometric and when higher than 3 as positive allometric. *Sardinella maderensis* "b" value was negative allometric, *Schilbe uranoscopus* "b" value was positive allometric, *Mugil cephalus* 'b' value was negative allometric, *Oreochromis niloticus* 'b' value was positive allometric, and *Hepsetus odoe* 'b' value was negative allometric. All reports are in line with the work of Agboola & Anetekhai, (2008).

The condition factor (K = 1) in the fish samples were below lower (K<1), except in *O. niloticus*, and these indicated that the fish species state of well-being is below expected status (K=1). This can be indicative of unfavourable environmental status; the condition factor usually increases when sexual maturation approaches. Individual fish species conditions determined based on the analysis of length weight data reflected that the heavier fish at a given length is in better condition. It also indicates the conducive environmental condition (Ibrahim *et al., (*2008), (Froese, 2006).

The correlation coefficient "r" = This means that as the length of the fish increases, the weight also increases in the same proportion. The correlation coefficient "r" was negative for *S. maderensis, S. uranoscopus, O. niloticus, H. odoe and M. cephalus*.

and revealed non-proportionality in increase experienced between length and weight. This means that there was a negative correlation between length and weight of the fish samples in Oluwa River Igbokoda, and could be species type specific (Froese, 2006).

Gut content analysis of *S. maderensis, S. uranoscopus, O. niloticus, H. odoe and M. cephalus* indicated 0% had empty stomachs, 16.67% had ¼ full stomachs, 58.33% had 2/4 full stomachs, 16.67 % had ¾ full stomachs and 8.33 % had full stomachs of the 60 specimens *S. maderensis;* 80 *S. uranoscopus* specimens collected had 0% had empty stomachs, 37.5% had ¼ full stomachs, 25% had 2/4 full stomachs, 18.75% had ¾ full stomachs and 18.75% had full stomachs, and out of 90 specimens collected on *M. cephalus*, 0% had empty stomachs, 22.22% had ¼ full stomachs, 44.44% had 2/4 full stomachs, 22.22% had ¾ full stomachs and 11.11% had full stomachs. The result is corroborated by the findings of Ude *et al.,* (2019) and Oso *et al.*, (2011) who reported the variety in stomach content of fish species.

4.2 CONCLUSION

The assessment revealed fullness of the stomachs was not in relation to length nor weight of the fish species, and food items that constituted the diet of the fish samples from Oluwa River in Igbokoda revealed diatoms, baccillariophyta, fish, dinoflagellate, Insect, crustaceans and other materials constituted the food items occurring in the stomachs of the fish species, with diatom occurring as the most abundant food items.

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