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STOMACH CONTENT ANALYSIS OF *Chrysichthys nigrodigitatus* (LACEPÈDE, 1803) OF THE LAGOS LAGOON NIGERIA WITH RESPECT TO MICROPHYTO BENTHOS

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Abstract: Stomach content analysis provides important insight into fish feeding patterns, accurate description of fish diets and feeding habits and also provides the basic for understanding trophic interactions in aquatic food webs. The aim is to ascertain the type of food consumed by macrobenthic fauna in the marine ecosystem and to identify the sediment composition of the microphyto benthos species that constitute their natural feed component in the Lagos Lagoon. The diet of 200 specimens of *Chrysichthys nigrodigitatus* were investigated in the Lagos Lagoon, Nigeria from September 2015 to December 2015 by the numerical and occurrence methods using Malian traps set over night. Triplicate sediment samples were collected in September, October, November and December 2015 using a Van Veen grab and the microphyto benthos species were identified microscopically. Results revealed that the highest numbers of empty stomachs were observed in September 2015. Ten categories of food items were identified in *C. nigrodigitatus* which are; Leaves, fibres, Crab parts, shells, scales, bones, worms, insect parts and micro algae. Blue-green algae and Diatom were the two major groups of microphytobenthos taxa identified in *C. nigrodigitatus.* The microphytobenthic taxa identified includes Blue-green algae (*Anabaena sp., Aphanocapsa sp., Mycrocystis sp.*) and Diatoms (*Navicula sp., Cyclotella sp., Synedra sp., Nitzschia sp*. The result also showed that the stomach content of *C. nigrodigitatus* has many microphytobenthic taxa both by occurrence and abundance. Their opportunistic omnivore feeding mechanism which is passive feeding mechanism gives the species wider prey abundance. Hence microphytobenthos are important food source for benthic fauna.

Keyword: Blue-green algae, *Chrysichthys nigrodigitatus*, Diatoms, Food items, Lagos lagoon, Stomach contents

1. INTRODUCTION

Understanding the stomach contents of fish is useful in guiding towards formulation of artificial diets in fish culture (Fagade, 1978). Fish exploit food substances in an aquatic ecosystem according to the adaptations possessed (mouth, gill rakers, dentition and gut system) which are related to feeding. According to Miller and Harley (1996), food habit of fish could be related to its structural morphology, the way it captures food and how it digests it. Studies on fish structural adaptations could provide useful information on their food habits and management in ponds (Ipinjolu *et al*., 2004; Malami *et al*., 2004). In the recent past there has been series of works by many authors on stomach content analysis. Olaniyan and Kusemiju (1979) investigated the food and feeding of *Chrysichthys nigrodigitatus*, *Chrysichthys walkeri* and *Chrysichthys filamentosus*. Others are Igbinosun and Robert (1988), Kusemiju (1973), Kusemiju (1975) and Kusemiju (1991). Some aspects of the biology of *Chrysichthys* from Lagos lagoon have been studied by Fagade and Olaniyan (1973) while some aspects of the biology of the resident *Chrysichthys* species in the Lekki lagoon have also been studied by Kusemiju (1976). Kusemiju (1981) worked on the hydrobiology and fishes of the Lekki lagoon. The ecology and natural food of *Pachymelania aurita* MǗLLER in a coastal Nigerian lagoon are reported (Uwadiae *et al*., 2009), the food and feeding habits of some fish fauna in Anwai stream were investigated (Onyeche *et al*., 2013).

Fish gut content analysis provides an important insight into feeding patterns and quantitative assessment of feeding habits. Fish diets can be measured in a variety of ways. Methods of gut contents analysis are broadly divisible into two, viz., qualitative and quantitative. The qualitative analysis consists of a complete identification of the organisms in the gut contents. Only with extensive experience and with the aid of good references it is possible to identify them from digested, broken and finely comminuted materials. Quantitative methods of analysis are three types, viz., numerical, gravimetric and volumetric. All these types of analysis are widely employed by different workers. The following outline of methods is based mainly on the reviews by Hynes (1950), Pillay (1952), Windell (1968), Hyslop (1980) and Chipps *et al*. (2002).

This study investigates the stomach contents of Catfish (*Chrysichthys nigrodigitatus*) in order to ascertain the types of food consumed in the Lagos lagoon, South-Western Nigeria.

2. MATERIALS AND METHODS

2.1 STUDY AREA

The Lagos Lagoon complex stretches from Cotonou in the Republic of Benin and extends to the fringes of the Niger Delta in Nigeria along its 257 km course (Hill and Webb, 1958). The main body of the lagoon complex which serve as the study site is located between longitude 3° 22' and 3° 40'E and 6°17' and 6°28' N. The lagoon is situated in the rain forest belt of Nigeria which experiences two different seasons namely the wet season (May – October) and dry season (November - April). Two peaks of rainfall linked with excessive floods are generally associated with this area with the major peak in June and a lesser peak in September. The Lagos lagoon has a diurnal tidal system (two high tides and two low tides each day). At high tide, sea water enters the lagoon from the Atlantic Ocean via the harbour and five cowries' creek while at low tide, the water recedes. Being open all through the year the brackish environment is therefore, a consequence of the influence of tidal sea water incursion and freshwater discharge from adjoining creeks and rivers such as Badagry, Majidun, Ogudu, Yewa, Ogun and Osun.

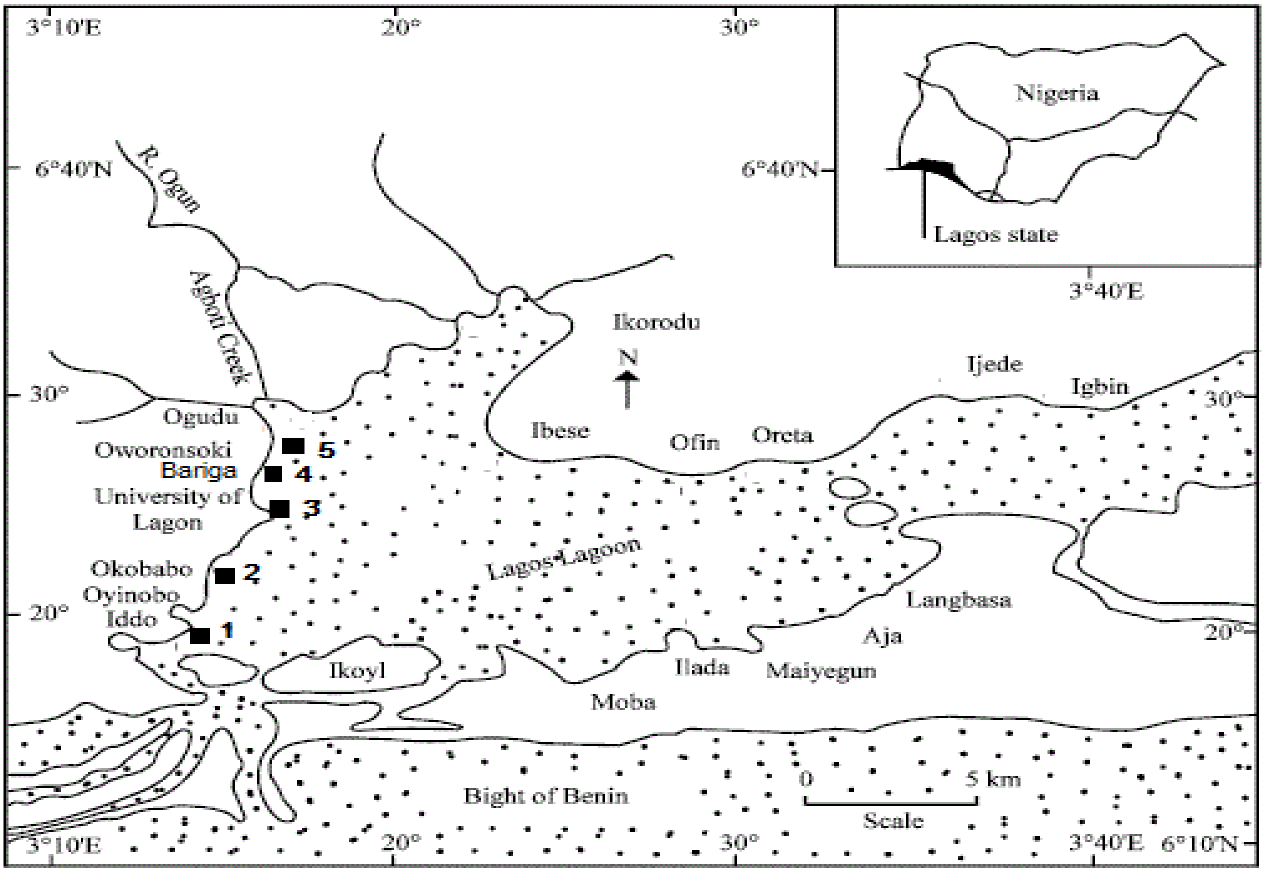

Fig 1: Map of Lagos Lagoon showing the sampling stations

2.2 SPECIMEN AND SEDIMENT COLLECTION

A total of two hundred (200) fish were randomly selected and collected from the fisher folks at five different stations (Iddo, Okobabo, University of Lagos, Bariga and Oworonshoki) of the Lagos Lagoon in South Western Nigeria within the period of 4 months from September 2015 to December 2015 using the Malian trap usually set overnight. Each specimen was identified using the description of Holden and Reed (1972), the randomly selected included individuals of varying age groups. The standard length of the fish was measured using a meter rule and the lengths recorded, each specimen was dissected and stomach contents removed and were preserved with 40% formalin and taken to the laboratory for examination.

Sixty (60) sediment samples were collected from the five sampling stations using a van Veen grab. To determine the concentrations of benthic microalgae in the sediment samples, triplicate samples of 3ml sediment cores were collected at each sampling Stations using a 10 ml cut-off syringe, which was pushed into the sediment.

2.3 SAMPLE PREPARATION

In the laboratory, the stomach contents were emptied into clean Petri dishes. The food substances found in the stomach was analyzed under light microscope, and each food category within the content was identified using a guide provided by Needham and Needham (1962) and Quigley (1972). The state of fullness of each stomach was recorded and expressed as empty (0/4), one-quarter full (1/4), half-full (2/4), three-quarters (3/4) and full (4/4). The food items observed were identified, counted and recorded. Data obtained was then subjected to frequency of occurrence and numerical methods as reported by Baganel and Tesch (1978) with particular reference to micro algae.

2.3.1. NUMERICAL METHOD

A count was made of the individual food items occurring in each stomach. The total number of individual of a particular food item was expressed as a percentage of the total number of food found in all the specimens examined. The method is relatively fast and easy to carry out, providing identification of prey items (Hyslop, 1980). It has an advantage in that the food item occurring in the largest number might not be the most important food item.

2.3.2. OCCURRENCE METHOD

The stomach contents were examined and individual food item sorted out and identified. The number of stomachs in which each food item occurred was recorded and expressed as a percentage of total number of stomach in which food occurred. The occurrence method supplies information on the various types of food items that are fed on by an organism. However, this method does not consider the quantitative aspect of the food items and accumulation of food that are resistant to digestion.

2.4 LABORATORY PROCEDURE FOR SEDIMENT ANALYSIS

In the laboratory, collected sediments were properly stirred to bring up any microorganism that has settled at the bottom. The stirred sample was decanted into a plastic cup with two drops placed on the glass slide using a pipette and then viewed under binocular light microscope. The micro algae viewed were identified using a catalogue. The sediment was ground up in analytical reagent grade acetone and the total volume made up to 10 ml with acetone and placed in centrifuge tubes. Tubes were wrapped with aluminium foil and placed in the freezer for two hours to extract the pigments (chlorophyll and carotenoid). Samples were centrifuged at 3000 revolutions per minute, for 25 minutes. Subsamples of supernatant were placed in a spectrophotometer to measure absorbence at: 358 nm (Bacterial chlorophyll a), 480 nm (carotenoid), 510 nm (carotenoid), 630 nm (chlorophyll c), 647 nm (chlorophyll b), 664 nm (chlorophyll a), and 750 nm (Turbidity). Results were used to estimate the concentration of chlorophyll a, b and c and carotenoid (mg m–2)(Heil *et al*., in review, Parson *et al*., 1996).

2.5 PHYSIC-CHEMICAL ANALYSIS

Physiochemical parameters of the various sampling stations of the Lagos lagoon were analyzed for 4 months. The parameters that were measured include Dissolved oxygen (DO) was determined using appropriate digital instruments; pH was determined using the pH meter with glass electrode (model 9405); Salinity was determined using hand held refractor meter; Depth and turbidity /transparency, was measured using secchi disc and metre rule, Temperature was measured using mercury-in-glass thermometer; Biochemical Oxygen demand (BOD) was obtained by taking the difference between the DO content of the samples on the day of the sample collection and then 5 days after the samples were collected, then measured using the Horiba water checker (Model U-10); Total Suspended solid (TSS) and Total Dissolved Solid (TDS) were determined using the Filtration Assembly method. All physic-chemical analyses were carried out according to standard laboratory procedures.

3. RESULTS

3.1 ENVIRONMENTAL VARIABLES

Range, mean and standard deviation of physico-chemical parameters of water investigated at the sampling stations are shown in Table 1. The monthly surface water temperature at each site varied between 26 to 33ºC – the highest occurring in October with an average of 29ºC while transparency ranged between 0.15 to 0.49m with 0.49m in November as the highest transparency for the study period with an average of 32.2m. Depth of water varied between 0.24 to 1.20m with an average of 0.73m and the highest depth of 1.20m in the rainy month of September.

Water chemistry was represented by DO range of 2.3 – 4.6 mg/L with the highest being 4.6 mg/L in September and an average of 3.6 mg/L, and BOD values which fluctuated between 800 to 1220 mg/L has 1220 mg/L as the highest occurring in October and an average of 965 mg/L. Salinity ranges from 5-13ppt with 13ppt as the highest occurring in the dry month of December and an average of 7.7ppt. pH values ranged from 5.80-7.70 with the highest being 7.70 occurring in the months of September and November.

TDS ranges from 129-2535 mg/L with the highest occurring in November and the lowest in September with an average of 919 mg/L while TSS ranges from 6-16 mg/L with highest occurring in December and an average of 10.6 mg/L.

3.2. PERCENTAGE OF EMPTY STOMACH

The percentage of empty stomach in the 200 specimens of *Chrysichthys nigrodigitatus* was examined for food items and feeding habits. 59 (29.5%) of the fish had empty stomach as shown in Table 2. Analysis of monthly variation in empty stomachs showed that the highest occurrence of empty stomachs was observed in September 2015 with a value of 22 (44%), while the lowest was observed in November 2015 for 8 (18%) specimens. Empty stomach was not subjected to any kind of variation neither size nor sex.

STATIONS	1			2			3			4			5		
PARA-METERS	MIN	MAX	MEAN ±SD	MIN	MAX	MEAN ±SD	MIN	MAX	MEAN ±SD	MIN	MAX	MEAN ±SD	MIN	MAX	MEAN ±SD
pH	7.20	7.50	7.30±0.122	7.00	7.70	7.30±0.255	7.00	7.70	7.30±0.286	6.80	7.70	7.40±0.402	5.80	7.30	6.80±0.580
Depth(m)	0.55	0.74	0.67±0.074	0.28	0.85	0.64±0.218	0.43	1.20	0.80±0.273	0.24	0.97	0.71±0.278	0.52	1.10	0.85±0.209
Turbidity(m)	0.30	0.49	0.40±0.676	0.15	0.37	0.28±0.776	0.21	0.39	0.34±0.100	0.17	0.39	0.33±0.901	0.17	0.33	0.27±0.640
DO (mg/l)	3.2	3.8	3.4±0.249	2.3	4.2	3.3±0.745	3.4	4.3	3.7±0.354	3.4	4.0	3.8±0.228	3.6	4.6	4.1±0.354
BOD (mg/l)	800	970	905±65.765	800	950	870±58.737	800	1050	965±97.596	900	1040	948±57.172	1020	1220	1140±78.740
TDS (mg/l)	2320	2535	2463±84.150	129	157	146±11.562	670	729	689±24.294	672	746	709±26.505	510	677	589±59.348
TSS (mg/l)	9	15	11±2.278	6	15	10±3.269	8	14	11±2.291	8	16	12±2.861	7	13	9±2.278
TEMP(°C)	26	32	29±2.165	29	33	31±1.581	27	31	30±1.658	28	32	31±1.500	28	33	30±1.920
Salinity(‰)	5.0	11.0	8.0±2.165	5.0	10.0	8.0±1.803	5.0	13.0	9.0±3.2202	6.0	9.0	7.0±1.299	5.0	10.0	7.0±1.785

Table 1: Range, Mean and Standard Deviation of Physico-chemical parameters at the Sampling Stations 1, 2, 3, 4 and 5

Key: Station 1: Iddo, Station 2: Okobabo,

Station 3: University of Lagos, Station 4: Bariga and Station 5: Oworonshoki

Table 2: Monthly variation in percentage of empty stomach of *C. nigrodigitatus* from the Lagos Lagoon

Months	Number examined	Number with empty stomach	% Empty stomach
September	50	22	44
October	50	15	30
November	50	8	18
December	50	14	28
Total	200	59	29.5

3.3. FOOD COMPOSITION OF THE STOMACH CONTENTS

The stomach contents of *C. nigrodigitatus* are presented in Table 3. Leaves was the most important food item both by numerical and occurrence method (17.4% and 36.2%), worm formed the least frequently consumed food item by the numerical method (0.6% and 2.8% by occurrence) while *Aphanocapsa* is the least by occurrence of 1.4% and (3.2% by numerical method). The other food types include fibre which had occurrence of 13.5% and 6.1% by numerical method, crab parts constituted 10.6% by occurrence and 3.4% by numerical method, shell constituted 12.1% and 2.7% by occurrence and numerical methods respectively, scale constituted (7.1% by occurrence), 4% by numerical method, bone has the second highest proportion both by occurrence and numerical methods with 46.8% and 14.5% respectively, insects constituted 16.3% by occurrence and 7.2% by numerical method, *Veliga* made up 3.5% by occurrence and 1.0% by numerical, *Paracalanus* constituted 5.7% and 1.6% by occurrence and numerical method respectively, *Acartia* constituted 3.5% by occurrence and 0.9% by numerical method, *Navicula* constituted 14.9% by occurrence and 8.5% by numerical method, *Nitzschia* constituted 7.1% and 2.4% by occurrence and numerical method respectively, *Cyclotella* constituted 10.6% by occurrence and 4% by occurrence, *Synedra* constituted 16.3% by occurrence and 9.8% by numerical method, *Anabaena* constituted 2.1% and 3.2% by occurrence and numerical methods respectively, *Mycrocystis* (4.3% by occurrence, 6.4% by numerical method) and sand grain (7.8% by occurrence, 3.1% by numerical method).

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Table 3: Summary of food items of stomach content of *C. nigrodigitatus* based on Numerical and Occurrence Methods

Food items	Numerical method		Occurrence method	
	Number	Percentage	Number	Percentage
Leaves	108	17.4	51	36.2
Fibre	37	6.1	19	13.5
Crab part	21	3.4	15	10.6
Shell	17	2.7	17	12.1
Scale	25	4.0	10	7.1
Bone	90	14.5	66	46.8
Worm	4	0.6	4	2.8
Insect	45	7.2	23	16.3
Veliga	6	1.0	5	3.5
Paracalanus	10	1.6	8	5.7
Acartia	5	0.9	5	3.5
Navicula sp.	53	8.5	21	14.9
Nitzschia sp.	15	2.4	10	7.1
Cyclotella sp.	25	4.0	15	10.6
Synedra sp.	61	9.8	23	16.3
Anabaena sp.	20	3.2	3	2.1
Aphanocapsa sp.	20	3.2	2	1.4
Mycrocystis sp.	40	6.4	6	4.3
Sand grain	19	3.1	11	7.8

3.4. COMPOSITION OF MICROPHYTO BENTHIC TAXA IN STOMACH CONTENT

The composition of microphyto benthic taxa in specimens of *Chrysichthys nigrodigitatus* were Blue-green algae (*Anabaena*, *Aphanocapsa*, *Mycrocystis*) and Diatoms (*Navicula*, *Nitzschia*, *Cyclotella*, *Synedra*). *Synedra* constituted the highest proportion with (26%), followed by *Navicula* (23%), *Cyclotella* (11%) and *Nitzschia* (6%) while the species of the blue-green algae occurred in much lower proportion with the highest being *Mycrocystis* sp. with (17%), *Anabaena* (8%) and *Aphanocapsa* (9%) all by abundance as shown in Figure 1.

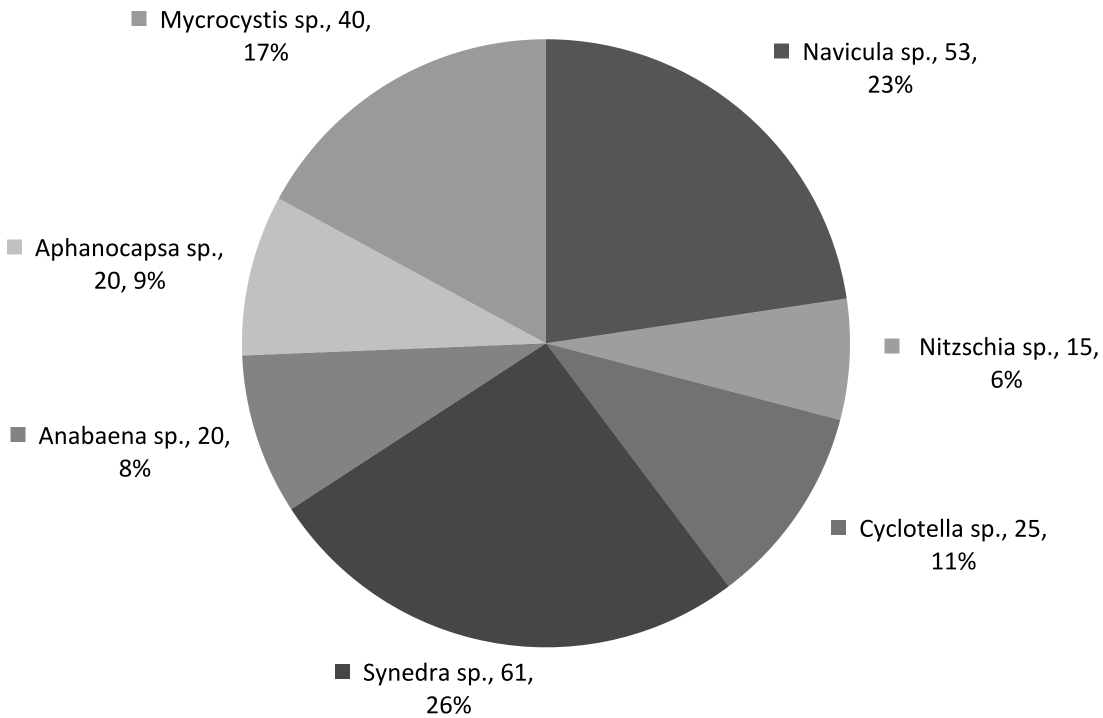

Fig 1: Percentage composition of microphytobenthic taxa in *C. nigrodigitatus* from the Lagos lagoon.

3.5 COMPOSITION OF MICROPHYTO BENTHOS TAXA IN SEDIMENT SAMPLE

The result from the sediment analysis reveals the composition and abundance of microphyto benthic species found embedded on the sediment of the five sampling stations (Station 1 is Iddo; Station 2 is Okobabo; Station 3 is University of Lagos; Station 4 is Bariga and Station 5 is Oworonshoki) from the Lagos lagoon on a monthly (September, October, November and December basis) are shown in Table 4, 5, 6 and 7. A total of 23 microphyto benthic species were identified which include; *Spirogyra sp., Mycrocystis sp., Navicula sp., Volvox sp., Anabaena sp., Cyclotella sp., Synedra sp., Nitzschia sp., Aphanocapsa sp., Euglena sp., Alaucoseira sp., Grammatophora sp., Coscinodiscus sp., Thalasionema sp., Ceratium sp., Aphanocapsa sp., Oscillatoria sp., Cladophora sp., Campylodiscus sp., Cocconeis sp., Pinnularia sp., Scenedesmut sp., Pleurosigma sp.*

The total species diversity was highest at Oyinobo Iddo (Site 1) for all the months (September, October, November and December) of study and at Okobabo (site 2) in the month of November only (Tables 4, 5, 6, 7). In contrast, the highest species abundance were observed at University of Lagos (Site 3) with 73 in the month of September, at Oyinobo Iddo (site 1) in the months of October and November with 63 and 54 respectively and 41 species abundance in December at Bariga (site 4) (Tables 4, 5, 6, 7).

4. DISCUSSION

The percentages of empty stomachs were as low 29.5% in the present investigation but higher when compare with other researches. It was confirmed that *Chrysichthys* *nigrodigitatus* and *Chrysichthys filamentosus* in Lekki lagoon fed on no fish egg, larvae or fry. They observed 22% empty stomachs in *Chrysichthys walkeri* while chironomid larvae accounted for the most important food item in *Chrysichthys filamentosus*. They recorded 13.3% empty stomachs with ostracods accounting for the most important food item both by numerical and occurrence methods (Ikusemiju and Olaniyan, 1977) which also agrees with the findings in this investigation with regard to the methods. The percentage of empty stomach in this study is related to prey availability and types of traps or gears used (Ogunmoriye and Bello-Olusoji (2021), and seasons (Ouakka *et al*., 2017). Although, the average retention time of food for grey mullet was 4-5 hours, however, the degree of fullness in the stomachs is unlikely to represent the intensity of feeding since retention time is relatively low (Odum, 1970).

In this present study, *C. nigrodigitatus* fed mainly on algae, diatoms, plant materials, crustaceans, worms, fish parts, detritus and sand grains, therefore is considered as omnivorous with predatory behaviour too, which is in line with the findings and observations made by Burton (1994) who stated that "*Clarias gariepinus* is considered to be omnivorous displaying both scavenging and predatory behaviour." The results obtained in this study showed that the most frequent food component was plant materials (36.2%) in the *C. nigrodigitatus* which suggest that the species is an omnivorous bottom dweller that occupy different ecological niches with changing environmental factors at varying times, and this agrees with the findings of Oronsaye and Nakpodia (2005) and Ogunmoriye and Bello-Olusoji (2021).

Oronsaye and Nakpodia (2005) observed about 68% frequency of detritus materials in the stomach contents of *C. nigrodigitatus* which disagrees with the findings in this present study with plant materials with a frequency of 17.4% (numerical method) and 36.2% (occurrence method). They remarked that the *C. nigrodigitatus* observed during their study was clearly an omnivorous detritivore. However, the findings from Ogunmoriye and Bello-Olusoji (2021) also reflect that *C. auratus* and *Notoglanidium macrostoma* from River Ogbese, Ondo State are omnivorous due to the wide range of food items from plant to animal materials.

Table 4: Distribution and Abundance of Microphytobenthic Taxa in the Lagoon for the month of September

Microphytobenthic Taxa	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
Campylodiscus clypeus (ehr.) Kutzing	-	-	-	8	-	8
ORDER II: PENNALES						
Synedra ulna (nitzsch) ehrenberg	-	6	5	-	10	21
Nitzschia aciculari	-	-	-	11	-	11
ORDER III: NAVICULALES						
Navicula tripunvtata	5	-	19	-	-	24
ORDER IV: THALASSIOSIRALES						
Cyclotella comta var. Radiosa (grunow)	10	10	-	-	-	20
ORDER V: COCCONEIDALES						
Cocconeis scutellum (ehrenberg)	-	-	-	7	-	7

DIVISION: CYANOPHYTA						
CLASS: CYANOPHYCEAE						
ORDER I: HORMOGONALES						
Oscillatoria sancta sancta	-	9	-	4	10	23
Anabaena	6	-	11	-	7	24
ORDER II: CHROOCOCCALES						
Microcystis aeruginosa	10	-	30	-	-	40
Aphanocapsa	-	5	-	-	-	5
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: VOLVOCALES						
Volvos aureus	5	-	-	-	8	13
ORDER II: SPHAEROPLEALES						
Scenedesmus dimorphus	-	-	-	-	9	9
CLASS: ZYGNEMATOPHYCEAE						
ORDER: ZYGNEMATALES						
Spirogyra porticalis (o.f. muller)	5	-	8	10	-	23
TOTAL SPECIES DIVERSITY	6	4	5	5	5	
TOTAL SPECIES ABUNDANCE	41	30	73	40	44	

Table 5: Distribution and Abundance of Microphytobenthic Taxa in the Lagoon for the month of October

MICROPHYTOBENTHIC TAXA	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
Alaucoseira granulata var. angustissima Muller	-	-	7	-	6	13
Campylodiscus clypeus (Ehr.) Kutzing	-	-	-	10	-	10
Coscinodiscus centralis Ehrenberg	-	5	-	-	-	5
Coscinodiscus radiatus Ehrenberg	8	5	-	4	-	17
ORDER II: PENNALES						
*Synedra ulna (*Nitzsch) Ehrenberg	12	7	-	-	5	24
Nitzschia aciculari	6	5	-	-	-	11
ORDER III: NAVICULALES						
Navicula tripunvtata	9	-	-	-	7	16
ORDER IV: THALASSIOSIRALES						
Cyclotella comta var. Radiosa (Grunow)	10	-	6	13	5	34
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: CLADOPHORALES						

Cladophora glomerata (L.) Kutzing	-	10	-	-	-	10
DIVISION: CYANOPHYTA						
CLASS: CYANOPHYCEAE						
ORDER I: HORMOGONALES						
Oscillatoria sancta Sancta	-	5	-	6	-	11
Anabaena	-	5	11	9	3	28
ORDER II: CHROOCOCCALES						
Microcystis aeruginosa	11	-	8	-	-	19
Aphanocapsa	7	7	-	-	-	14
TOTAL SPECIES DIVERSITY	7	8	4	5	5	
TOTAL SPECIES ABUNDANCE	63	49	32	42	29	

Table 6: Distribution and Abundance of Microphytobenthic Taxa in the Lagoon for the month of November

MICROPHYTOBENTHIC TAXA	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
Alaucoseira granulata var. angustissima Muller	7	5	7	4	7	30
Campylodiscus clypeus (Ehr.) Kutzing	-	5	-	-	3	8
Coscinodiscus centralis Ehrenberg	5	4	-	2	-	11
Coscinodiscus radiatus Ehrenberg	5	1	5	-	-	11
ORDER II: PENNALES						
*Ceratium tripos (*O.F. Muller) Nitzsch	-	8	-	-	-	8
*Synedra ulna (*Nitzsch) Ehrenberg	13	-	9	-	-	22
Nitzschia aciculari	5	-	-	-	-	5
ORDER III: NAVICULALES						
Navicula tripunvtata	-	5	-	-	7	12
Pinnularia	-	-	4	6	-	10
ORDER IV: THALASSIOSIRALES						
Cyclotella comta var. Radiosa (Grunow)	8	5	7	-	-	20
ORDER V: STRIATELLALES						
Grammatophora marina	11	-	-	-	-	11
ORDER VI: COCCONEIDALES						
Cocconeis scutellum (Ehrenberg)	-	-	5	3	1	9
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: CLADOPHORALES						

Cladophora glomerata (L.) Kutzing	-	10	-	-	-	10
TOTAL SPECIES DIVERSITY	7	7	6	4	4	
TOTAL SPECIES ABUNDANCE	54	43	37	15	18	

Table 7: Distribution and Abundance of Microphytobenthic Taxa in the Lagoon for the month of December

MICROPHYTOBENTHIC TAXA	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
Alaucoseira granulata var. angustissima Muller	5	5	-	5	-	15
Campylodiscus clypeus (Ehr.) Kutzing	-	7	-	-	-	7
Coscinodiscus centralis Ehrenberg	-	-	-	-	5	5
Coscinodiscus radiatus Ehrenberg	6	-	2	5	-	13
ORDER II: PENNALES						
*Ceratium tripos (*O.F. Muller)	6	-	-	-	-	6
*Synedra ulna (*Nitzsch) Ehrenberg	10	-	11	8	-	29
Nitzschia aciculari	5	-	-	-	3	8
ORDER III: NAVICULALES						
Navicula tripunvtata	-	7	-	-	-	7
Pinnularia	-	-	4	-	6	10
Pleurosigma	-	-	-	-	5	5
ORDER IV: THALASSIOSIRALES						
Cyclotella comta var. Radiosa (Grunow)	-	8	11	5	9	33
ORDER V: STRIATELLALES						
Grammatophora marina	4	-	-	-	-	4
ORDER VI: COCCONEIDALES						
Cocconeis scutellum (Ehrenberg)	-	3	-	-	-	3
ORDER VII: THALASSIONEMATALES						
Thalassionema nitzschoides (Grunow)	5	-	-	8	-	13
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: CLADOPHORALES						
Cladophora glomerata (L.) Kutzing	-	9	-	-	-	9
DIVISION: CYANOPHYTA						
CLASS: CYANOPHYCEAE						

ORDER I: CHROOCOCCALES						
Aphanocapsa	-	-	5	10	12	27
TOTAL SPECIES DIVERSITY	7	6	5	6	6	
TOTAL SPECIES ABUNDANCE	41	39	33	41	40	

The result in this study also showed that there was no monthly variation in occurrence of food item found in the stomach contents of silver catfish, instead there was monthly variation in quantity of food items identified. Abundance in plant materials decreases on monthly basis from September continually down to December. Most studies of food and feeding habits of fishes from varying habitats have shown that those of any species differ in time, space and at different stages of growth (Desilva, 1973). Ikusemiju and Olaniyan (1977) reported change in food habit as related to size for the catfish *Chrysichthys walkeri* in Lekki lagoon.

The present study provides supporting evidence that microalgae constitute important food resource for benthic fauna where suspension feeders use a mixture of benthic microalgae and phytoplankton. Analysis of the stomach content of *C. nigrodigitatus* shows that the microalgae are their major composition of their food diet.

The high species diversity of diatoms and algae in the sediment samples than in the stomach contents reveals abundance of preys. The results of this study from the sediment analysis which reflects the composition and abundance of Microphytobenthos taxa from the various sampling stations of the Lagos lagoon also corroborated with the reports of Nwankwo and Akinsoji (1989), which demonstrated the dominance and widespread distribution of diatoms notably *Navicula* and *Nitzschia* in their study area (which is in close proximity to the site where specimens of *C. nigrodigitatus* used for this study was collected). Benthic microalgae are embedded in a complex sediment structure, so grazers move through the interstitial system or upon the surface and capture mobile flagellates and diatoms, or browse the epigrowth on sand grains.

The occurrence of diatoms and cyanobacteria as the only microalgae encountered in this study may be linked to their abundance in aquatic sediment Nwankwo and Akinsoji (1989). Several studies by Colijn and De Jonge (1984) have shown that on sandy and muddy substrate, edaphic microalgae living on a variety of benthic surfaces are often dominated by diatoms whereas coccal and filamentous green algae and Cyanobacteria are usually known to occur at some seasonal stages (Hillebrand, *et al*., 1999).

The overwhelming abundance of diatoms in the stomach content may be connected to the nutritive value of diatom species. According to Pratoomyot *et al*. (2005), although most microalgal species are similar in nutrient composition, they differ in amount of fatty acids level. The fatty acids content of microalgae differed according to taxonomic group and the growth conditions (Brown, 2002). Diatoms has been reported to contain more fatty acids than other green microalgae and cyanobacteria because diatom cells accumulate lipids while other microalgae and blue green microalgae do not accumulate lipids (Hoek *et al*.,1995; Pratoomyot *et al*., 2005). Since survival rate and growth rate of aquatic animals are related with the fatty acids content of their feeds (Tamtin *et al*., 2004), most aquatic animals tend to consume food sources rich in fatty acid such as diatoms.

Most evidence points to a predominance of passive feeding preferences in grazer–microalgae interactions (Steinman 1996, Brendelberger, 1997; Hillebrand *et al*., 2000). *C. nigrodigitatus* which are suspension feeders that feed on a mixture of benthic microalgae and phytoplankton.

5. CONCLUSIONS

The lower number of empty stomachs could be attributed to the sampling techniques employed in relation with the average digestion period during capture. This indicates the influence of capturing method on the stomach fullness and the need for immediate recovery and analysis of fish samples after capture. The diversity of food substances identified in the stomach of *C. nigrodigitatus* revealed the diversity in the specialized and versatile food habit of the species in the Lagos lagoon and applicably, stomach content analysis showed the food requirements of the species in the natural habitats based on importance. This is indicated by occurrence and abundance which may serve as a yardstick for satisfying the species condition under culture. This study also demonstrated the importance of microphytobenthos as food resource for zoobenthos, and therefore sets the base for further and in depth research into the food value of these microalgal species for aquaculture purposes.

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