

# MICROPHYTO BENTHOS INDEX OF GUT CONTENT OF *Sesarma huzardii* (DESMAREST, 1825) OF THE LAGOS LAGOON NIGERIA.

<sup>1</sup> JEYOL, M. C.\* and <sup>2</sup>UMAR, N. J.

<sup>1</sup> Department of Biological Sciences, Federal University Wukari. [anongo@fuwukari.edu.ng](mailto:anongo@fuwukari.edu.ng). [+234 8038764051](tel:+2348038764051)

<sup>2</sup>Department of Marine Sciences, University of Lagos. [nuvasjakes4u@yahoo.com](mailto:nuvasjakes4u@yahoo.com)  
+234 8039197418

\*Corresponding author: [anongo@fuwukari.edu.ng](mailto:anongo@fuwukari.edu.ng). [+234 8038764051](tel:+2348038764051)

## ABSTRACT

The diet of 200 specimens of *Sesarma huzardii* were investigated in the Lagos Lagoon, Nigeria to ascertain food type consumed by *Sesarma huzardii* and microphyto benthos species that constitute their natural feed component, which provides useful information on the trophic relationship in the Lagos Lagoon. Samples were collected from September 2015 to December 2015 using the numerical and occurrence methods using the Malian traps set over night. Duplicate sediment samples were collected in September, October, November and December 2015 using a Van Veen grab and the microphyto benthos species were identified microscopically. The highest numbers of empty stomachs were observed in September and November. Seven (7) categories of food items were identified in *S. huzardii* which were plant materials, crustaceans, scales, bones, worms, insect parts and micro algae. Blue-green algae and Diatoms were the two major groups of microphytobenthos identified in their stomach and in the sediment samples. The Blue-green algae identified includes (*Anabaena* sp., *Aphanocapsa* sp.) and Diatom was *Navicula* sp., *Synedra* sp., *Cyclotella* sp.. The result also showed that the stomach content of *S. huzardii* had more preference for plant materials and microphytobenthos both by occurrence and abundance than the other food items identified. This preference is due to the species diverse feeding mechanism which is the active feeding mechanism. The high diversity of diatoms in the sediments reflect a damagingly high levels of nutrients arising from increased anthropogenic activities and population growth of Lagos resulting to high waste generation. Microphytobenthos are important food source for benthic fauna.

**Keywords:** Blue-green Algae, Diatoms, Diet, Lagos Lagoon, *Sesarma huzardii*,

## INTRODUCTION

Crabs occur commonly in West Africa and are a major food items caught in the marine, coastal and lagoon fishery. Their distribution has been documented by FAO (1992). The mangrove crabs (Sesarmidae) are the dominant species of crabs in the mangrove swamps where they live and burrow beneath sediments, the estuaries and lagoons. The subfamily Sesarminae has high morphological and habitat diversity where most members are amphibious and are associated with mangrove ecosystems (Kristensen *et al.*, 2010). Mangrove ecosystems fringe tropical and sub-tropical coastlines throughout the world and function as nurseries for a wide variety of

vertebrate and invertebrate marine species (Olafsson *et al.*, 2002). The study of the feeding habits of fish and other animals based upon analysis of stomach content has become a standard and universal practice for detailed exploration of diet composition and feeding ecology (Hyslop 1980; Ortega-Jimenez *et al.*, 2024). This gives a reasonably accurate quantification of the diet of marine species in the full array of habitats (Triay-Portella *et al.*, 2022; Ortega-Jimenez *et al.*, 2024).

The mangrove crab inhabits a large area of mangrove swamps in Lagos Lagoon, a tropical estuarine lagoon. However, the area has been subjected to reclamation for housing, road construction and deforestation for domestic firewood leading to destruction of their habitats or displacement from the lagoon. Though the mangrove crab is not a major food item for the coastal communities, it has played significant ecological role in the mangrove ecosystem by helping to clean up the mangrove areas and by feeding on the fallen leaves (Dahdouh-Guebas *et al.*, 1999; Olafsson *et al.*, 2002). The crabs facilitate decomposition of mangrove detritus and recycling of nutrients by macerating and fragmenting the litter through ingestion and gut passage. The crab fecal material consists of macerated and incompletely digested leaf litter, which provides easier access for colonization by bacteria and other organisms of the detritus food chain (Kristensen and Pilgaard, 2001; Kristensen *et al.*, 2010). Several studies have shown that these crabs consume mangrove leaves as their major food source. Several studies on the biology and ecology of the economically important crabs have also been documented (Chindah *et al.*, (2000); Lawal-Are and Kusemiju (2000); Akin-Oriola *et al.*, (2005); Lawal-Are (2009, 2010).

Benthic macro-invertebrates are organisms that inhabit the bottom substrate (i.e. sediments, debris, logs, aquatic macrophytes, filamentous algae) in aquatic habitat for at least part of their life cycle (Ajao and Fagade, 2002). Macro-invertebrates are those retained by mesh sizes greater than 200µm but less than 50µm (Slack *et al.*, 1973). Benthic macrofauna species are important as food for economically important fish and shell fish species in most aquatic environment where they are the major secondary producers (Fagade, 1971; Fagade and Olaniyan, 1973), thereby playing a very significant role in the aquatic/marine ecosystem. They have been employed as indicators of organic pollution and other human-induced stress factors in Lagos Lagoon (Ajao and Fagade, 1990; Ajao and Fagade, 2002).

Studies on other aspects of other species of crabs have also been reported (Olalekan and Lawal-Are, 2013; Lawal-Are and Nwankwo, 2011) on the Tropical Estuarine Lagoon. Studying the diet of *Sesarma huzardii* helps to predict food web interactions (Chaffai *et al.*, 2020). This work seeks to identify those microphyto benthos species that constitutes the natural feed component of the hairy mangrove crab, a benthic macrofauna in the Lagos lagoon, Nigeria and to compare the microphyto benthos found in the stomach and sediments where they inhabit.

## **MATERIALS AND METHODS**

### **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.

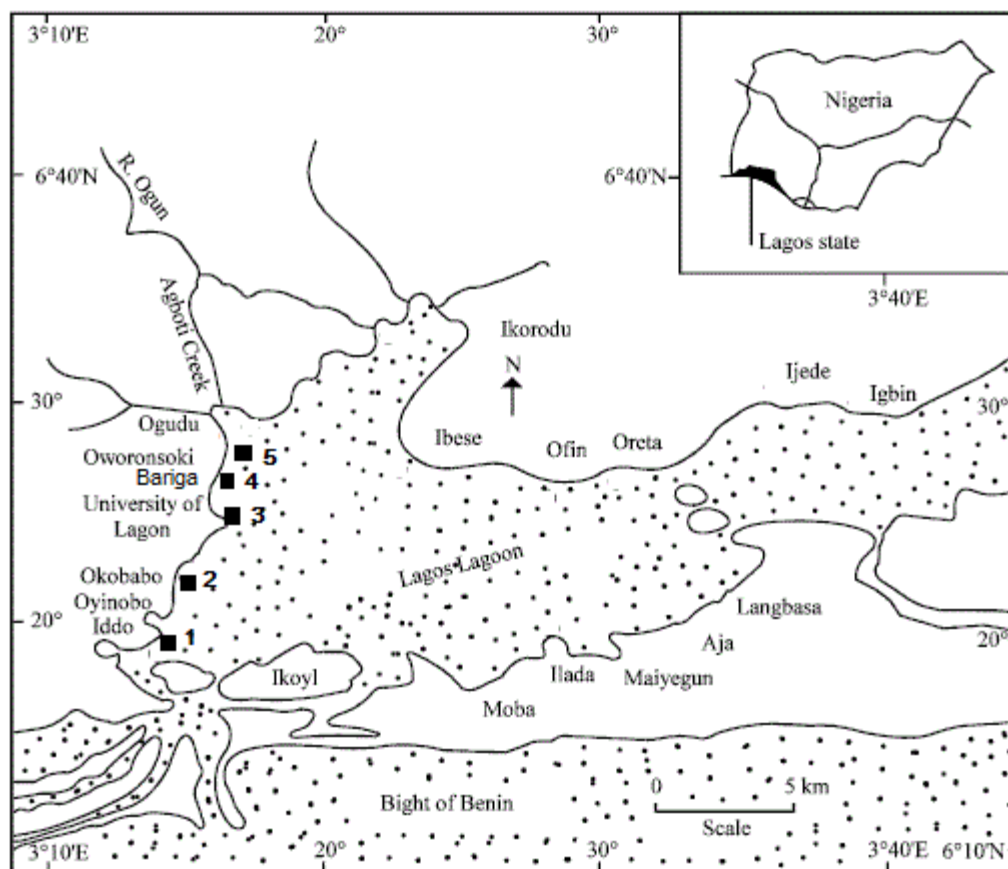


Figure .1: Map of Lagos Lagoon showing the sampling stations

### Physic-Chemical Analysis

Physiochemical parameters of the various sampling stations of the Lagos lagoon were analyzed for 4 months (September, October, November and December). All the physic-chemical parameters were measured according to standard laboratory procedures. The parameters that were measured include: Dissolved oxygen (DO) determined using appropriate digital instruments, pH determined using the pH meter with glass electrode (model 9405); Salinity determined using hand held refractor meter; Depth and turbidity was measured using secchi disc and metre rule, Temperature was measured using mercury-in-glass thermometer;; Transparency, Biochemical Oxygen demand (BOD) was determined 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.

## **Specimen Collection**

A total of two hundred (200) hairy mangrove crab samples 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. Each specimen was identified using the description of Holden and Reed (1972) and the random selection included individuals of varying age groups. The standard length and carapace length of the crab species were measured using a meter rule and the lengths recorded, dissected and the stomach contents removed and preserved with 40% formalin and taken to the laboratory for examination.

In the laboratory, the stomach contents were emptied into clean Petri dish. 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 method as reported by Baganel and Tesch (1978) with particular reference to micro algae.

## **Numerical Method**

This involved a count of the individual food item occurring in each stomach. The total number of individuals 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.

## **Occurrence Method**

The stomach contents were examined and individual food item sorted out and identified. The number of stomach in which each food item occurred was recorded and expressed as a percentage of total number of stomach in which food occurred. This 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.

## **Laboratory Procedure for Sediment**

In the laboratory, sediment samples 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 was viewed under binocular light microscope. The micro algae viewed were identified using a catalogue. To determine the concentrations of benthic microalgae, three replicates of 3 ml sediment cores were collected at each sample site using a 10 ml cut off syringe, which was pushed into the sediment. 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 absorbance 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 ( $\text{mg m}^{-2}$ ) (Heil *et al.* in review, Parson *et al.* 1996).

## RESULTS

### Environmental Variables

Range, mean and standard deviation of physico-chemical parameters of water from the Lagoon investigated at the sampling stations are shown in Table 1. The monthly surface water temperature at each site varied between 26 and 33°C and highest being 33°C occurring in October with an average of 29°C while transparency ranged between 0.15 and 0.49m with 0.49m in November as the highest transparency for the study period and an average of 32.2m. Depth of water varied between 0.24 and 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 and 1220 mg/L has 1220mg/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 5.80-7.70 with the highest being 7.70 occurring in the months of September and November. TDS ranges from 129-2535mg/L with the highest occurring in November and the lowest in September with an average of 919mg/L while TSS ranges from 6-16mg/L with highest occurring in December and an average of 10.6mg/L.

**Table 1: Range, mean and standard deviation of Physico-chemical parameters at the sampling stations 1, 2, 3,4 and 5.**

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

**Key : Station 1: Iddo,  
Station 2: Okobabo,  
Station 3: University of Lagos,  
Station 4: Bariga and  
Station 5: Oworonshoki**

### Percentage Empty Stomach

The percentage empty stomach of *Sesarma huzardii* for four months of study is shown in Table 2. 200 specimens of *Sesarma huzardii* were examined for food and feeding habits out of which 55 (27.5%) of the crab had empty stomach as shown in Table 2. Analysis of monthly variation in empty stomachs showed that the highest occurrence of empty stomachs was noted in November 2015 with 16(32%), while the lowest was noted in December with 11 (22%). Empty stomach was not subjected to any kind of variation of neither size nor sex.

**Table 2: Percentage Empty Stomach for September, October, November and December of *Sesarma huzardii***

Months	Number examined	Number with empty stomach	% Empty stomach
September	50	14	28
October	50	14	28
November	50	16	32
December	50	11	22
Total	200	55	27.5

### Composition of Microphyto Benthos Taxa in Sediment Samples

The result from the sediment analysis reveals the composition and abundance of microphyto benthic species found embedded on the sediment of the various sampling stations from the Lagos lagoon on a monthly basis. A total of 23 microphyto benthic species were discovered and they 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., *Scenedesmus* sp., *Pleurosigma* sp.

The distribution and abundance of microphyto benthos in the Lagos lagoon for the duration of the study is shown in Tables 3, 4, 5 and 6. Total species abundance was highest at station 3 in September followed by station 1 in the months of October (63), November (54) and December (41) and station 4 in December (41). The total species diversity was highest at sampling stations 1 and 2 recording highest diversity at station 2 with 8 in October, stations 1 and 2 in November and December respectively with 7 species and lastly station 1 again with total species of 6 in September.

### Food Composition of the Stomach Contents

The food composition of the stomach content of *S. huzardii* is presented in Table 7. The stomach composition are represented with plant materials constituting the highest proportion of 62.1% and 42.5% by occurrence and numerical methods respectively, followed by bones with 20.7% and 4.2% by occurrence and numerical methods, crustaceans constituted 16.6% and 4.9% by occurrence and numerical method, scales constituted 10.3% by occurrence and 3.7% by numerical method, sand grain constituted 14.5% and 3.3% by occurrence and numerical methods respectively, insect parts constituted 18.6% and 4.6% by occurrence and numerical method respectively, *Navicula* constituted 16.6% by occurrence and 4.9% by

**Table 3: Distribution and Abundance of Microphyto benthos in Lagos lagoon for the Month of September**

MICROPHYTOBENTHIC TAXA	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
<i>Campylodiscus clypeus</i> (Ehr.) Kutzing	-	-	-	8	-	8
ORDER II: PENNALES						
<i>Synedra ulna</i> (Nitzsch) Ehrenberg	-	6	5	-	10	21
<i>Nitzschia aciculari</i>	-	-	-	11	-	11
ORDER III: NAVICULALES						
<i>Navicula tripunvtata</i>	5	-	19	-	-	24
ORDER IV: THALASSIOSIRALES						
<i>Cyclotella comta</i> var. <i>Radiosa</i> (Grunow)	10	10	-	-	-	20
ORDER V: COCCONEIDALES						
<i>Cocconeis scutellum</i> (Ehrenberg)	-	-	-	7	-	7
DIVISION: CYANOPHYTA						
CLASS: CYANOPHYCEAE						
ORDER I: HORMOGONALES						
<i>Oscillatoria sancta</i> Sancta	-	9	-	4	10	23
<i>Anabaena</i>	6	-	11	-	7	24
ORDER II: CHROOCOCCALES						
<i>Microcystis aeruginosa</i>	10	-	30	-	-	40
<i>Aphanocapsa</i>	-	5	-	-	-	5
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: VOLVOCALES						
<i>Volvos aureus</i>	5	-	-	-	8	13
ORDER II: SPHAEROPLEALES						
<i>Scenedesmus dimorphus</i>	-	-	-	-	9	9
CLASS: ZYGNEMATOPHYCEAE						
ORDER: ZYGNEMATALES						
<i>Spirogyra porticalis</i> (O.F. Muller)	5	-	8	10	-	23
TOTAL SPECIES DIVERSITY	6	4	5	5	5	
TOTAL SPECIES ABUNDANCE	41	30	73	40	44	



**Table 4: Distribution and Abundance of Microphyto benthos in the Lagos lagoon during the Month of October**

MICROPHYTOBENTHIC TAXA	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
<i>Alaucoseira granulata</i> var. <i>angustissima</i> Muller	-	-	7	-	6	13
<i>Campylodiscus clypeus</i> (Ehr.) Kutzing	-	-	-	10	-	10
<i>Coscinodiscus centralis</i> Ehrenberg	-	5	-	-	-	5
<i>Coscinodiscus radiatus</i> Ehrenberg	8	5	-	4	-	17
ORDER II: PENNALES						
<i>Synedra ulna</i> (Nitzsch) Ehrenberg	12	7	-	-	5	24
<i>Nitzschia aciculari</i>	6	5	-	-	-	11
ORDER III: NAVICULALES						
<i>Navicula tripunctata</i>	9	-	-	-	7	16
ORDER IV: THALASSIOSIRALES						
<i>Cyclotella compta</i> var. <i>Radiosa</i> (Grunow)	10	-	6	13	5	34
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: CLADOPHORALES						
<i>Cladophora glomerata</i> (L.) Kutzing	-	10	-	-	-	10
DIVISION: CYANOPHYTA						
CLASS: CYANOPHYCEAE						
ORDER I: HORMOGONALES						
<i>Oscillatoria sancta</i> Sancta	-	5	-	6	-	11
<i>Anabaena</i>	-	5	11	9	3	28
ORDER II: CHROOCOCCALES						
<i>Microcystis aeruginosa</i>	11	-	8	-	-	19
<i>Aphanocapsa</i>	7	7	-	-	-	14
TOTAL SPECIES DIVERSITY	7	8	4	5	5	
TOTAL SPECIES ABUNDANCE	63	49	32	42	29	

**Table 5: Distribution and Abundance of Microphyto benthos in the Lagos lagoon during the Month of November**

MICROPHYTOBENTHIC TAXA	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
<i>Alaucoseira granulata</i> var. <i>angustissima</i> Muller	7	5	7	4	7	30
<i>Campylodiscus clypeus</i> (Ehr.) Kutzing	-	5	-	-	3	8
<i>Coscinodiscus centralis</i> Ehrenberg	5	4	-	2	-	11
<i>Coscinodiscus radiatus</i> Ehrenberg	5	1	5	-	-	11
ORDER II: PENNALES						
<i>Ceratium tripos</i> (O.F. Muller) Nitzsch	-	8	-	-	-	8
<i>Synedra ulna</i> (Nitzsch) Ehrenberg	13	-	9	-	-	22
<i>Nitzschia aciculari</i>	5	-	-	-	-	5
ORDER III: NAVICULALES						
<i>Navicula tripunvtata</i>	-	5	-	-	7	12
<i>Pinnularia</i>	-	-	4	6	-	10
ORDER IV: THALASSIOSIRALES						
<i>Cyclotella comta</i> var. <i>Radiosa</i> (Grunow)	8	5	7	-	-	20
ORDER V: STRIATELLALES						
<i>Grammatophora marina</i>	11	-	-	-	-	11
ORDER VI: COCCONEIDALES						
<i>Cocconeis scutellum</i> (Ehrenberg)	-	-	5	3	1	9
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: CLADOPHORALES						
<i>Cladophora glomerata</i> (L.) Kutzing	-	10	-	-	-	10
TOTAL SPECIES DIVERSITY	7	7	6	4	4	
TOTAL SPECIES ABUNDANCE	54	43	37	15	18	

**Table 6: Distribution and Abundance of Microphyto Benthos in the Lagos lagoon during the Month of December**

MICROPHYTOBENTHIC TAXA	1	2	3	4	5	Total
DIVISION: BACILLARIOPHYTA						
CLASS: BACILLARIOPHYCEAE						
ORDER I: CENTRALES						
<i>Alaucoseira granulata</i> var. <i>angustissima</i> Muller	5	5	-	5	-	15
<i>Campylodiscus clypeus</i> (Ehr.) Kutzing	-	7	-	-	-	7
<i>Coscinodiscus centralis</i> Ehrenberg	-	-	-	-	5	5
<i>Coscinodiscus radiatus</i> Ehrenberg	6	-	2	5	-	13
ORDER II: PENNALES						
<i>Ceratium tripos</i> (O.F. Muller)	6	-	-	-	-	6
<i>Synedra ulna</i> (Nitzsch) Ehrenberg	10	-	11	8	-	29
<i>Nitzschia aciculari</i>	5	-	-	-	3	8
ORDER III: NAVICULALES						
<i>Navicula tripunvtata</i>	-	7	-	-	-	7
<i>Pinnularia</i>	-	-	4	-	6	10
<i>Pleurosigma</i>	-	-	-	-	5	5
ORDER IV: THALASSIOSIRALES						
<i>Cyclotella comta</i> var. <i>Radiosa</i> (Grunow)	-	8	11	5	9	33
ORDER V: STRIATELLALES						
<i>Grammatophora marina</i>	4	-	-	-	-	4
ORDER VI: COCCONEIDALES						
<i>Cocconeis scutellum</i> (Ehrenberg)	-	3	-	-	-	3
ORDER VII: THALASSIONEMATALES						
<i>Thalassionema nitzschoides</i> (Grunow)	5	-	-	8	-	13
DIVISION: CHLOROPHYTA						
CLASS: CHLOROPHYCEAE						
ORDER I: CLADOPHORALES						
<i>Cladophora glomerata</i> (L.) Kutzing	-	9	-	-	-	9
DIVISION: CYANOPHYTA						
CLASS: CYANOPHYCEAE						
ORDER I: CHROOCOCCALES						
<i>Aphanocapsa</i>	-	-	5	10	12	27
TOTAL SPECIES DIVERSITY	7	6	5	6	6	
TOTAL SPECIES ABUNDANCE	41	39	33	41	40	

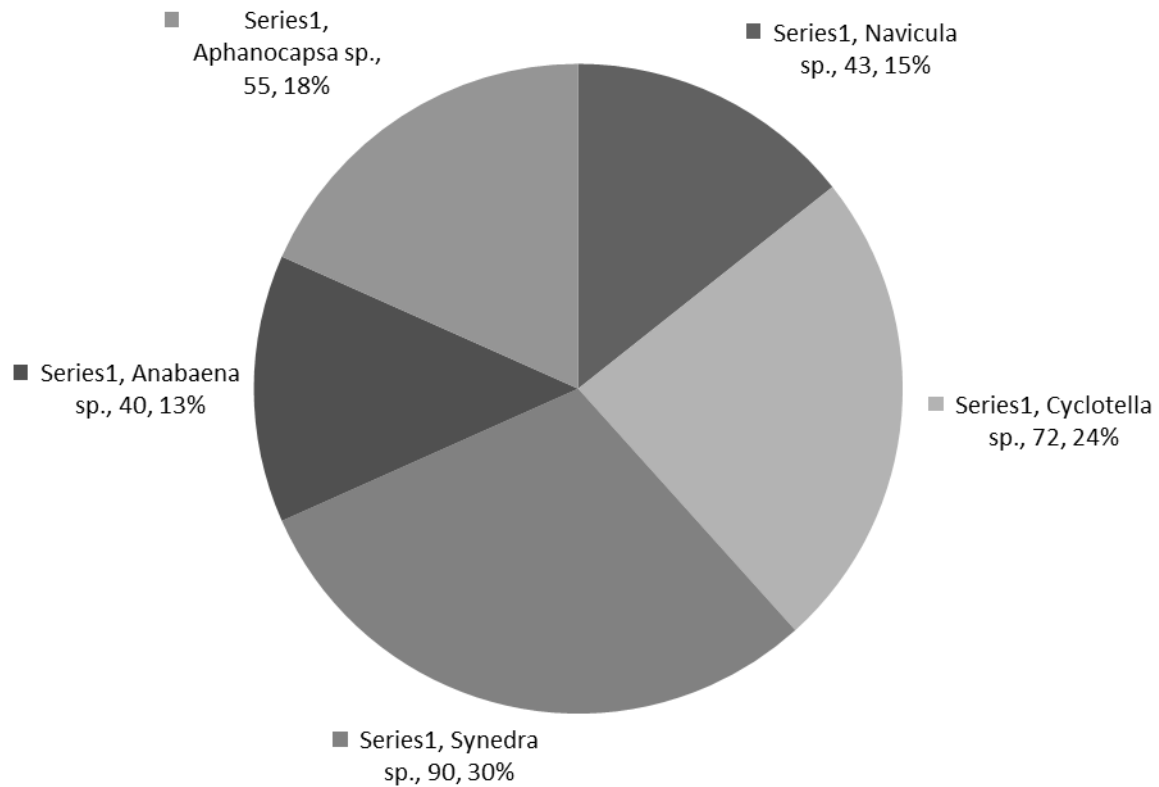
numerical method, *Cyclotella* constituted 13.1% and 8.2% by occurrence and numerical methods respectively, *Synedra* occurred with 19.3% and 10.3% by numerical methods, *Anabaena* constituted 9.0% and 4.6% by occurrence and numeric methods respectively, while *Aphanocapsa* is the least in terms of occurrence with 5.5% and 6.3% by numerical method and worms is the least in terms of numerical method with 2.5% and 13.1% by occurrence method.

### Percentage Composition of Microphyto Benthic Taxa in the Stomach Content

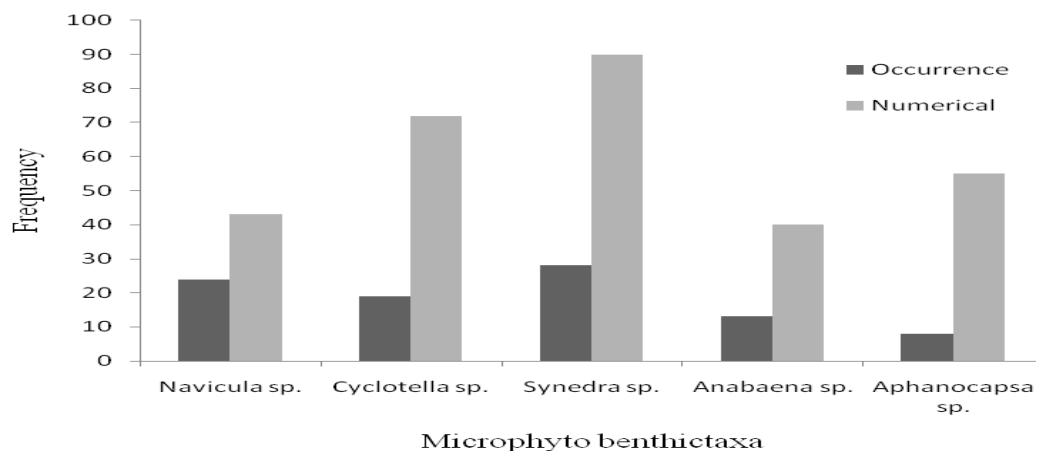
Stomach content of *Sesarma huzardi* which constitutes Diatoms (*Navicula*, *Synedra*, *Cyclotella*) and Blue-green algae (*Anabaena*, *Aphanocapsa*) were identified as shown in Fig 1 with higher number of species and higher abundance. The highest is *Synedra* (30%), *Navicula* (15%), *Cyclotella* (24%), *Anabaena* (13%) and *Aphanocapsa* (18%). In *S. Huzardii* the percentage abundance is higher than the occurrence as well as shown in Fig 2. The bars for numerical method which is the abundance are much higher than those of occurrence method.

**Table 7: Summary of variation of stomach content of *S. huzardii* between the Numerical and Occurrence Methods**

Food Items	Numerical Method		Occurrence Method	
	Number	Percentage	Number	Percentage
Plant material	372	42.5	90	62.1
Crustacean	43	4.9	24	16.6
Scale	32	3.7	15	10.3
Bone	37	4.2	30	20.7
Worm	22	2.5	19	13.1
Insect parts	40	4.6	27	18.6
<i>Navicula</i> sp.	43	4.9	24	16.6
<i>Cyclotella</i> sp.	72	8.2	19	13.1
<i>Synedra</i> sp.	90	10.3	28	19.3
<i>Anabaena</i> sp.	40	4.6	13	9.0
<i>Aphanocapsa</i> sp.	55	6.3	8	5.5
Sand grain	29	3.3	21	14.5



**Fig 2: Percentage composition of microphytobenthic taxa in *S. Huzardi* direct from the Lagos lagoon.**



**Fig 3: Summary of microphytobenthos composition in the stomach content of specimens of *S. huzardii***

## DISCUSSION

The percentages of empty stomachs in *S. huzardii* was 27.5% in the present investigation. Odum (1970) cited by Wells (1984) highlighted that the average retention time of food for grey mullet was 4-5 hours. Consequently, the degree of fullness in stomachs of the hairy mangrove crab is unlikely to represent the intensity of feeding since retention time is relatively low.

In this present study, *S. huzardii* fed mainly on algae, diatoms, plant materials, crustaceans, worms, fish parts, detritus and sand grains, is therefore considered as omnivorous displaying both scavenging and predatory behaviour, which is in line with the findings and observations made by Kristensen *et al.* (2010) who stated that a species of leaf-eating sesarmid crab (*Neoepisesarma versicolor*) fed a pre-diets of leaves and leaves and sediments were undoubtedly hungry for meat after 17 days of nitrogen-deprived diets. This reflects the importance of prey-meat diet varieties as observed in the stomach contents of *S. huzardii* in this present study. The results obtained in this study also revealed that the most frequent food component was plant materials (62.1%) in *S. huzardii*. This agrees with the findings of Bergamino *et al.*, 2015 that the *Sesarma* species especially, *S. catenata* preferred decomposed leaves of terrestrial riparian trees, followed by decomposed and mature leaves of *S. maritime* suggesting that plants represents an important energy pathway within some estuarine ecosystems. Several studies have shown that these crabs consume mangrove leaves as their major food source (e.g. Robertson, 1986; Steinke *et al.*, 1993; Thongtham and Kristensen, 2005), and stomach analyses reveal that leaf fragments account for 55 - 95% of the total content (Malley, 1978; Dahdouh-Guebas *et al.*, 1999; Thongtham *et al.*, 2008). Sesarmid crabs primarily consume leaves at the sediment floor or pull them into their burrows for later ingestion and reducing tidal exports of mangrove derived organic matter considerably (Slim *et al.*, 1996; Olafsson *et al.*, 2002).

The crabs showed a carnivorous feeding habit as their stomach contents consisted of diatoms, algae, plant materials and insect parts. These were items commonly found in the mangrove swamps inhabited by the crab with the diatoms and algae coming in with the tidal water. The overwhelming abundance of diatoms in the stomach content of *S. huzardii* may be connected to their predatory nature. Similarly, Oluwakoyode-Oluyi (2016) reported that the Stomach content of *S. huzardii* reflects an opportunistic omnivore as stomach content showed the presence of algae filament (34.8%), *Nitzschia linearis* (26.5%) and *Navicula cuspidate* was the most abundant with 36.9%. The least abundant was *Oscillatoria limnosa* with 1.6% by numerical method and by the frequency of occurrence. *Navicula cuspidate* also constituted the most abundant food items with 1.31%, *Nitzschia linearis* with 0.69%, algae filament was 0.93% and *Oscillatoria limnosa* was 0.22%.

Kristensen *et al.*, 2017 concluded in their findings that the data from all mangrove locations suggest that sesarmid and urcidid crabs ingest and assimilate mixtures of available food items. Leaf litter in the form of brown leaves was always the most important C source, while animal tissue in the form of live and dead “prey” or MPB in the form of diatoms at the sediment surface were the dominant N sources. The abundance of the microphytobenthos in *S. huzardii* may be

due to the fact that *S. huzardii* are bottom dwellers who feed directly from the sediments where microphytobenthos are produced and embedded

It is a common opinion in the literature that the majority of leaf-eating sesarmid crabs augment their nitrogen supply by ingesting sediment and assimilating the associated microalgae and bacteria (Robertson, 1986; Bouillon *et al.*, 2002; Skov and Hartnoll, 2002). This is based on the observation that many sesarmid crabs spend a considerable amount of time feeding on sediment (e.g. Skov and Hartnoll, 2002; Thongtham *et al.*, 2008).

The occurrence of diatoms and cyanobacteria as the only microalgae encountered and the overwhelming abundance of diatoms from the sediment analysis than in the stomach content of *S. huzardii* proved the distribution, composition and abundance of microphyto benthos taxa from the various sampling stations of the Lagos lagoon. Diatoms belong to the Bacillariophyta and are found in all marine and freshwater habitats and in moist terrestrial habitats. According to a group of Drexel University Scientists, diatoms might be efficient indicators of damagingly high levels of nutrients in freshwater streams and marine habitats (Otto, 2016). Eutrophication caused by run-off of agricultural fertilizer, sewage and other forms of pollution, feeds algae and plants in water resulting to overgrowth. High loads of nutrients can cause increased productivity in algae resulting to algal blooms and low DO and fish kills. Diatoms are also recognised as good indicators of land use change and water quality (Chessman *et al.*, 2007; Chessman and Townsend, 2010; Lavoie *et al.*, 2014; Stevenson, 2014), since they respond quickly to environmental change (Tan *et al.*, 2017)

There was no monthly variation in the food items in the stomach and the quantity of food items identified. However, Oluwakayode-Oluyi (2016) reported a high abundance of *S. hurzadii* from March to May with a decline in abundance in June to August

## CONCLUSIONS

The lower empty stomachs in the *S. hurzadii* 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 crab samples after capture. The diversity of food substances identified in the stomach of *S. huzardii* revealed the diversity in the specialized and versatile food habit of the species in the Lagos lagoon and applicably stomach content analysis showed their food requirements in the natural habitats based on importance indicated by occurrence and abundance methods and 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.

## CONFLICT OF INTEREST

The authors declared that there is no conflict of interest

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