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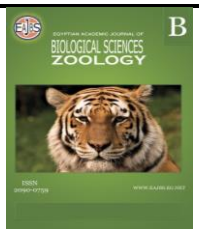

Food Composition, Preference and Feeding Habits of Two Caridean Species in the Interconnecting Lagoons of South-Western Nigeria.

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ABSTRACT

The genus *Macrobrachium* are decapods that have been identified globally in terms of their economic importance and possibility of recruitment into aquaculture. *Macrobrachium macrobrachion* (Herklots 1851) and *Macrobrachium vollenhovenii* (Herklots 1857) are the two largest species of the genus *Macrobrachium* in Nigerian waters. The study investigated the stomach contents of *M. macrobrachion* (Herklots 1851) and *M. vollenhovenii* (Herklots 1857) from three interconnecting lagoons (Badagry, Lagos and Epe) of Southwest Nigeria between June 2013 and May 2015 (24 months). A total of 3294 specimens of *M. macrobrachion* were examined for food and feeding habits from the three lagoons (1606 from Badagry, 778 from Lagos and 910 from Epe Lagoons) while a total of 1435 *M. vollenhovenii* were examined for food and feeding habits from the three lagoons (164 from Badagry, 146 from Lagos and 1125 from Epe Lagoons). The stomach contents of *M. macrobrachion* and *M. vollenhovenii* from the three lagoons were made up of Bacillariophyta, Chlorophyta, Cyanophyta, Bivalves, Crustaceans, Copepods and detrital materials. The results of the food and feeding habit showed that *M. macrobrachion* and *M. vollenhovenii* are omnivorous in nature with the preference for detritus. Thus, there is a change in their feeding habit from omnivorous to planktivores and/or detritivores.

INTRODUCTION

Macrobrachium macrobrachion (Herklots 1851) and *Macrobrachium vollenhovenii* (Herklots 1857) are the two largest species of the genus *Macrobrachium* in Nigerian waters. They are found in the freshwaters as well as the brackish waters (Marioghae, 1982). They are also found in most inland freshwater areas like lakes, rivers, swamps, irrigation channels, canals and ponds as well as estuarine areas. Most species require brackish water in the initial stages of their life cycle although some complete their cycle in inland, saline and freshwater lakes (Banerjee, 2003).

They are universally accepted as food organisms and support a substantial number of local fisheries. The widespread distribution of the African river prawn (*M. vollenhovenii*) and the brackish water prawn (*M. macrobrachion*) across the West African coast includes their attainment of large size, disease resistance, high market

value and good taste (Jimoh *et al*., 2005). According to Wootton (1992), food and feeding habits is an important part of biological and taxonomic studies because it is an essential function of an organism as growth, development and reproduction are all dependent on energy that enters in the form of food. Prawns are known to feed on a wide variety of small epibenthic animals, especially polychaetes, mollusks and other crustaceans. However, *M. vollenhovenii* is an omnivorous detritivore with the preference for animal remains (Marioghae, 1982). They are important for commercial fisheries and aquaculture, as they provide not only food but also revenue to many countries of the world (Bello-Olusoji *et al.*, 2006).

This paper provides information on the comparative study of the food composition, preference and feeding habits of *Macrobrachium macrobrachion* and *Macrobrachium vollenhovenii* in the interconnecting lagoons.

MATERIALS AND METHODS

Collection of Samples:

Monthly samples of *M. macrobrachion* and *M. vollenhovenii* were collected from Badagry, Lagos and Epe Lagoons (Fig. 1) between June 2013 and May 2015 (24 months) from traps, which were set near the shore of the lagoons. The sampling of the prawns was random and unbiased in relation to size. The prawns were immediately preserved in an ice-chest and subsequently transported into a deep freezer at the temperature of -20 ^{o}C in the laboratory of the Department of Marine Sciences for further biological analysis.

Laboratory procedures

The stomachs of the collected prawns were examined and scored with regards to whether they are empty ($^{0}/_{4}$), ¼ full, ½ full, ¾ full and/or full ($^{4}/_{4}$). Each stomach contents were dissected out with the contents washed into a Petri dish. These contents were examined under a binocular microscope. The analysis of the stomach contents was carried out by both the numerical and frequency of occurrence methods as described by Lagler (1978) and Hyslop (1980). The food items were identified with the aid of the keys using several texts (Edmunds, 1978; Schneider, 1990; Anderson, 1999). A total of 3294 specimens of *M. macrobrachion* were examined for food and feeding habits from the three lagoons (1606 from Badagry, 778 from Lagos and 910 from Epe Lagoons) while a total of 1435 *M. vollenhovenii* were examined for food and feeding habits from the three lagoons (164 from Badagry, 146 from Lagos and 1125 from Epe Lagoons).

Statistical Analysis

The data was analyzed using Microsoft Excel for Windows (2007).

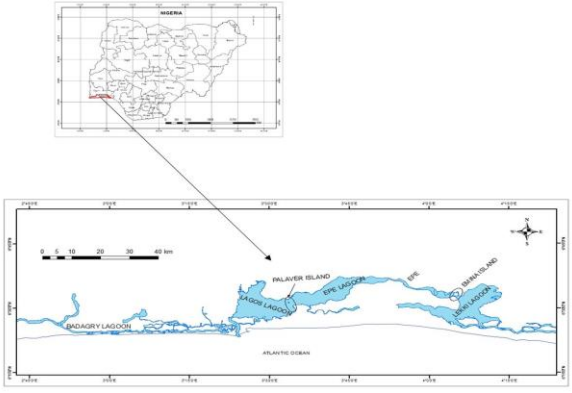

Fig. 1: Map of Badagry, Lagos and Epe Lagoons showing the sampling stations.

RESULTS

Empty Stomachs:

A total of 3,294 specimens of *M. macrobrachion* were examined for food and feeding habits, 400 (24.9%) of the prawns from Badagry Lagoon had empty stomachs, 205 (26.3%) of the prawns from Lagos Lagoon had empty stomachs, while 201 (22.1%) of the prawns from Epe Lagoon had empty stomachs as shown in Table 1. While 1,435 specimens of *M. vollenhovenii* were examined for food and feeding habits, 30 (18.3%) of the prawns from Badagry Lagoon had empty stomachs, 38 (26.0%) of the prawns from Lagos Lagoon had empty stomachs, while 270 (24.0%) of the prawns from Epe Lagoon had empty stomachs as shown in Table 2.

Table 1: Empty stomachs in *Macrobrachium macrobrachion* from Badagry, Lagos and Epe Lagoons (June 2013 – May 2015)

LAGOONS	NUMBER OF PRAWNS EXAMINED	NUMBER OF PRAWNS WITH EMPTY STOMACH	% EMPTY STOMACH
Badagry	1606	400	24.9
Lagos	778	205	26.3
Epe	910	201	22.1
TOTAL	3294	806	24.5

Table 2: Empty stomachs in *Macrobrachium vollenhovenii* from Badagry, Lagos and EpeLagoons (June 2013 – May 2015)

LAGOONS	NUMBER OF PRAWNS EXAMINED	NUMBER OF PRAWNS WITH EMPTY STOMACH	% EMPTY STOMACH
Badagry	164	30	18.3
Lagos	146	38	26.0
Epe	1125	270	24.0
TOTAL	1435	338	23.6

Food Items in *Macrobrachium macrobrachion* and *Macrobrachium vollenhovenii:*

The food items found in the stomachs of *M. macrobrachion* and *M. vollenhovenii* are presented in Tables 3 and 4. The food items were made up of twelve major categories. These were Bacillariophyta, Chlorophyta, Cyanophyta, Bivalves, Crustaceans, Copepods, Gastropods, Rotifers, Detritus, Plant materials, Sand grains/Pebbles and Un-identified matters. Bacillariophyta were made up of *Aulacoseira granulata*, *Biddulphia rhombus*, *Skeletonema costatum*, *Synedra crystallina*, *Synedra nana* and *Synedra ulna.* Chlorophyta is made up of *Chara* spp. Cyanophyta consist of *Lyngbya limnetica*, *Oscillatoria trichodes* and *Microcystis aureginosa*. Bivalves are made up of *Tivela tripla* (Clam), Crustaceans were made up of shrimp eggs, shrimp parts, shrimp exoskeleton, whole shrimp and the egg stage development of the prawns. Copepods were made up of *Acartia clausii*, copepod eggs and tadpoles. Gastropods are made up of *Pachymelina aurita* and Rotifers are made up of *Lecane bulla*.

Planktons were the major food items found in the stomach contents of *M. macrobrachion* and *M. vollenhovenii* from the three lagoons. Using the numerical analysis for *M. macrobrachion* and *M. vollenhovenii* in the three lagoons,

Bacillariophyta (diatoms) constitute the largest plankton. In Badagry Lagoon, it occurred at 15.77% and 23.20%, 28.88% and 27.45% in Lagos Lagoon while at Epe Lagoon, it occurred at 33.48% and 24.11% respectively. The corresponding values for the frequency of occurrence estimates were 21.81% and 39.55% in Badagry Lagoon, 35.78% and 50.93% in Lagos Lagoon while that of Epe Lagoon were 42.60% and 32.51% respectively. The numerical analysis for the crustaceans found in the contents of the stomach of both *M. macrobrachion* and *M. vollenhovenii* for the three lagoons showed that it constituted 11.43% and 19.75% in Badagry Lagoon, 8.25% and 9.16% in Lagos Lagoon and 16.22% and 23.43% in Epe Lagoon respectively. The corresponding values for the frequency of occurrence estimates were 12.77% and 23.13% in Badagry Lagoon, 11.52% and 12.04% in Lagos Lagoon while that of Epe Lagoon were 12.27% and 18.36% respectively.

Chlorophyta (green algae) were not seen in the stomach contents of *M. macrobrachion* from the three lagoons. *M. vollenhovenii* from Epe Lagoon had higher numerical and frequency of occurrence of 0.16% and 1.64% respectively than that for Lagos Lagoon while none was recorded for Badagry Lagoon.

Cyanophyta (blue-green algae) for *M. macrobrachion* was found in both Badagry Lagoon (0.01%, 0.25%) and Lagos Lagoon (1.21%, 10.47%) by numerical and occurrence methods respectively, while none was observed for Epe Lagoon. For *M. vollenhovenii*, it was found in both Lagos Lagoon (1.10%, 11.11%) and Epe Lagoon (0.03%, 0.58%) by numerical and occurrence methods respectively, while none was observed for Badagry Lagoon.

Bivalves found in the stomach contents of *M. macrobrachion* occurred only in Epe Lagoon (0.01%, 0.14%) by numerical and occurrence methods respectively. While in *M. vollenhovenii*, it was found in both Badagry Lagoon (0.09%, 4.48%) and Epe Lagoon (0.03%, 0.82%) by numerical and occurrence methods respectively, while none was observed for Lagos Lagoon. Gastropods contributed 0.07%, 1.00% by numerical and occurrence methods respectively for *M. macrobrachion* in Badagry Lagoon which was the largest of the three lagoons. For *M. vollenhovenii*, it constituted 0.06%, 4.48% in Badagry Lagoon, 0.10%, 2.78% in Lagos Lagoon and 0.09%, 1.29% in Epe Lagoon by numerical and occurrence methods respectively. Rotifers were not found in the stomach of *M. macrobrachion* from the three lagoons while for *M. vollenhovenii*, it was only found in the Epe Lagoon at 0.01% and 0.12% by numerical and occurrence methods respectively and none was recorded in Badagry and Lagos Lagoons. Copepods were not found in the stomach of *M. macrobrachion* from the three lagoons while in *M. vollenhovenii*, it was only found in the Epe Lagoon at 0.03% and 0.47% by numerical and occurrence methods respectively and none was recorded in Badagry and Lagos Lagoons.

By occurrence method, plant materials occurred in *M. macrobrachion* and *M. vollenhovenii* at 64.68%, 70.90% in Badagry Lagoon, 72.25%, 82.41% in Lagos Lagoon and 63.75%, 59.88% in Epe Lagoon respectively. The occurrence of Sand grains/Pebbles in *M. macrobrachion* and *M. vollenhovenii* constituted 39.97%, 44.03% (Badagry Lagoon), 40.66%, 41.67% (Lagos Lagoon) and 25.25%, 24.80% (Epe Lagoon) respectively. Also observed were unidentified masses, which probably were part of the detritus or undigested food items. It occurred at 13.60%, 13.48% in Badagry Lagoon, 12.91%, 19.44% in Lagos Lagoon and 8.74%, 7.25% in Epe Lagoon for *M. macrobrachion* and *M. vollenhovenii* respectively. The stomach contents of *M. macrobrachion* and *M. vollenhovenii* from Badagry, Lagos and Epe Lagoons are presented in Figs. 2 – 7.

Table 3: Food items in *Macrobrachium macrobrachion* from Badagry, Lagos and Epe Lagoons (June 2013 – May 2015)

Stomach Contents	Badagry Lagoon				Lagos Lagoon				Epe Lagoon			
	Numerical Method		Occurrence Method		Numerical Method		Occurrence Method		Numerical Method		Occurrence Method	
	No	%	No	%	No	%	No	%	No	%	No	%
Bacillariophyta	6227	15.77	263	21.81	6911	28.88	205	35.78	10362	33.48	302	42.60
Cyanophyta	5	0.01	3	0.25	289	1.21	60	10.47	-	-	-	-
Bivalves	-	-	-	-	-	-	-	-	2	0.01	1	0.14
Crustaceans	4512	11.43	154	12.77	1975	8.25	66	11.52	5019	16.22	87	12.27
Gastropods	26	0.07	12	1.00	8	0.03	2	0.35	3	0.01	2	0.28
Detritus	12060	30.55	879	72.89	6002	25.09	454	79.23	5788	18.70	553	78.00
Plant materials	14985	37.95	780	64.68	8108	33.89	414	72.25	9282	29.99	452	63.75
Sand grains/Pebbles	-	-	482	39.97	-	-	233	40.66	-	-	179	25.25
Unidentified mass	1660	4.20	164	13.60	588	2.46	74	12.91	495	1.60	62	8.74

Table 4: Food items in *Macrobrachium vollenhovenii* from Badagry, Lagos and Epe Lagoons (June 2013 – May 2015)

Stomach Contents	Badagry Lagoon				Lagos Lagoon				Epe Lagoon			
	Numerical Method		Occurrence Method		Numerical Method		Occurrence Method		Numerical Method		Occurrence Method	
	No	%	No	%	No	%	No	%	No	%	No	%
Bacillariophyta	2343	23.20	53	39.55	2129	27.45	55	50.93	8631	24.11	278	32.51
Chlorophyta	-	-	-	-	1	0.01	1	0.93	56	0.16	14	1.64
Cyanophyta	-	-	-	-	85	1.10	12	11.11	11	0.03	5	0.58
Bivalves	9	0.09	6	4.48	-	-	-	-	10	0.03	7	0.82
Crustaceans	1994	19.75	31	23.13	710	9.16	13	12.04	8386	23.43	157	18.36
Copepods	-	-	-	-	-	-	-	-	11	0.03	4	0.47
Gastropods	6	0.06	6	4.48	8	0.10	3	2.78	32	0.09	11	1.29
Rotifers	-	-	-	-	-	-	-	-	1	0.01	1	0.12
Detritus	2625	26.00	101	75.37	1849	23.84	95	87.96	6773	18.92	541	63.27
Plant materials	2895	28.67	95	70.90	2702	34.84	89	82.41	11222	31.35	512	59.88
Sand grains/Pebbles	-	-	59	44.03	-	-	45	41.67	-	-	212	24.80
Unidentified mass	225	2.23	18	13.43	271	3.49	21	19.44	523	1.46	62	7.25

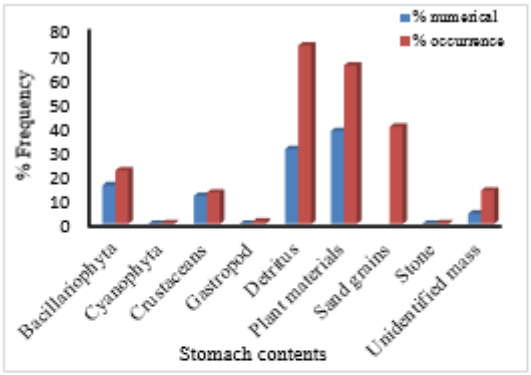

Fig. 2: Stomach contents of *M. macrobrachion* from Badagry Lagoon (June 2013 – May 2015)

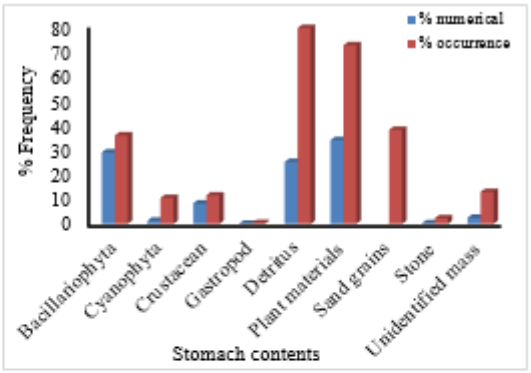

Fig. 3: Stomach contents of *M. macrobrachion* from Lagos Lagoon (June 2013 – May 2015)

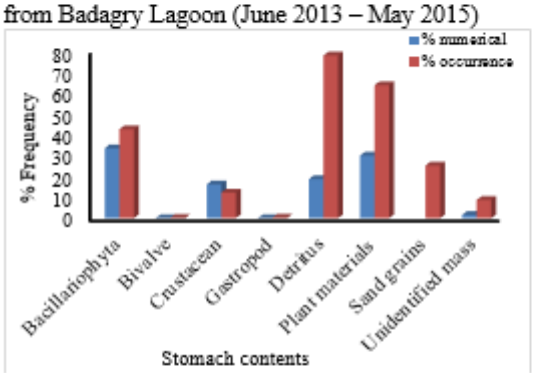

Fig. 4: Stomach contents of *M. macrobrachion* from Epe Lagoon (June 2013 – May 2015)

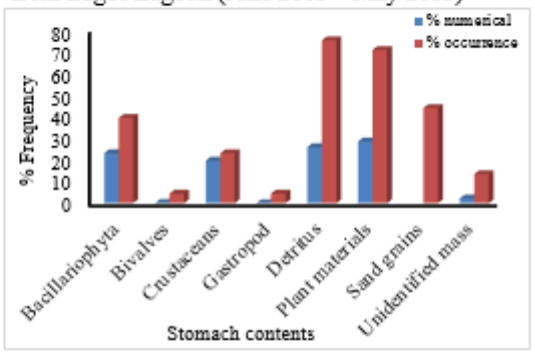

Fig. 5: Stomach contents of *M. vollenhovenii* from Badagry Lagoon (June 2013 – May 2015)

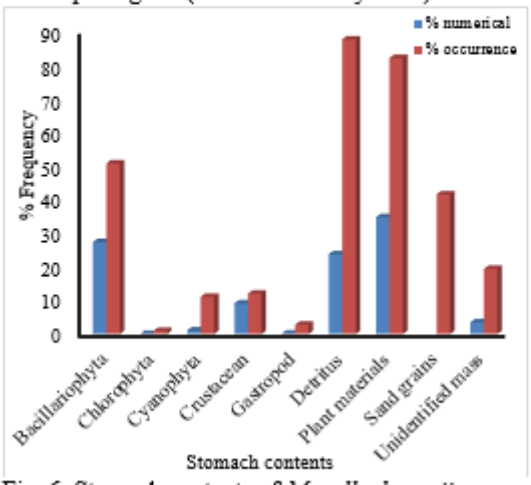

Fig. 6: Stomach contents of *M. vollenhovenii* from Lagos Lagoon (June 2013 – May 2015)

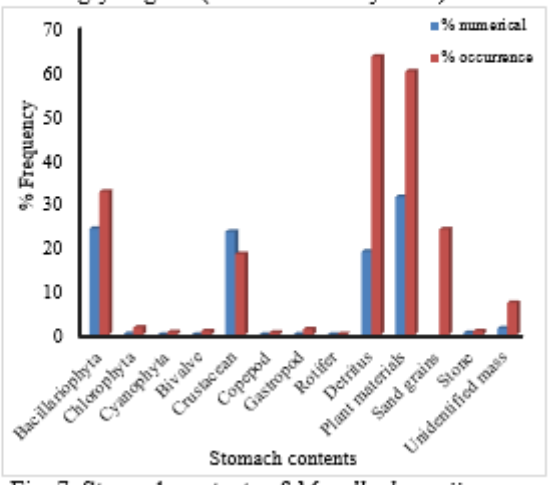

Fig. 7: Stomach contents of *M. vollenhovenii* from Epe Lagoon (June 2013 – May 2015)

DISCUSSION

The result of the food and feeding habit showed that 75.5% of *M. macrobrachion* examined had food in their stomach while 24.5% had empty stomachs. In *M. vollenhovenii*, 76.4% had food in their stomach while 23.6% had empty stomachs. This proportion of these empty stomachs might be because of their frequent feeding coupled with high rate of digestion. It could also be that the period of feeding before been caught was a short or a larger part of the food items had been rapidly digested during the catch and subsequent transportation. Prawns collected during the rainy season (June to November), were observed to have fuller stomach contents than those collected during the dry season (December to May) except for some months in each of the Lagoons where there were no collections at all (off-season). The reason for this

might be as a result of the rainwater, which brought along lots of nutrient from runoffs. Thus, resulting in a high amount of food for the prawns. This result is in conformity to the work of Jimoh *et al*. (2011b) and Anetekhai (1986).

However, it was observed that plant matters were more predominant than animal matters in both *M. macrobrachion* and *M. vollenhovenii*. Thus, there seemed to be a change in their feeding habit from omnivorous to planktivores and/or detritivores. This could also be that the animal tissue digested relatively faster than the plant matters. Therefore, *M. macrobrachion* and *M. vollenhovenii* could be said to be omnivorous in nature with the preference for detritus as was also observed by Jimoh *et al*. (2011b). This also agreed with the findings of Bello-Olusoji *et al*. (1995) that prawns could function as a primary consumer, secondary consumer and detritivore in the aquatic system and hence be classified as an omnivore. Adetayo and Kusemiju (1994) also reported that *Penaeus notialis* are detritivorous and omnivorous with filamentous algae and detritus constituting the most important food items while Obande and Kusemiju (2008) gave a similar report on *Atya gabonensis.*

Conclusion:

The essence of the study was to determine the diet of the species and its implication for the management of its fisheries and culturability of their uses as a commercially important prawn. The results of the food and feeding habit of *M. macrobrachion* and *M. vollenhovenii* showed that both species are omnivorous in nature with the preference for detritus. Thus, there is a change in their feeding habit from omnivorous to planktivores and/or detritivores.

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