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The Composition in Different Size Groups and Index of Relative Importance (Iri) of *Callinectes amnicola* (De Rochebrune, 1883) Food from Okpoka Creek, Niger Delta, Nigeria

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Abstract: The composition in different size groups, and index of relative importance of *Callinectes amnicola* food from Okpoka creek was studied for a period of two years (January 2006 –December 2007). Crabs less than 10mm were absent in the catch. Crab appendages, bivalve shells, bivalve tissues, gastropod shells and annelids were absent in smaller crabs (10-19.9 mm) and (20-29.9 mm). Algae cells were absent in crab (40-49.9 mm to 70-79.9 mm) size groups. Crustacean, Pisces and mollusca were common in the stomachs of the larger size group. The numerical method showed that algae cells (46.9%) were most abundant in size group (10-19.9 mm) followed by 20-29.9 mm (33.1%) size group and 30-39.9 mm (20.0%) size group. Crustacean (shrimp parts 32.7% and crab appendages 35.2%) was numerically higher in (70-79.9 mm) size class. The frequency of occurrence method showed that, Fish flesh accounted for 19.8% 17.6%, 15.4% 13.2%, 11.0% and 9.9% of the stomach contents in the 30-39.9 mm, 20-29.9 mm, 10-19.9 mm (50-59.9 mm, 70-79.9 mm), 40-49.9 mm, 60-69.9 mm size group respectively. Fish scales occurred most in (70-79.9 mm) size group with a value of 19.4% followed by 15.3% (50-59.9 mm) size group whereas the other size groups had between 10.4% and 14.6% in occurrence. The percentage occurrence of fish bones /spines in 10-19.9mm to 70-79.9mm size groups ranged between 8.7% and 17.4%. The highest (17.4%) was recorded in (40-49.9 mm) size group while the least (8.7%) was obtained in (10 – 19.9mm) size group. Bivalve shells (29.5%) and bivalve tissue (28.6%) led in occurrence in (70-79.9mm) size group whereas 28.6% (gastropod shells) encountered in (70-79.9 mm) size group, followed in decreasing order of occurrence by size groups 60-69.9mm (25.0%), 40-49.9 mm (21.2%), 50-59.9 mm (16.3%) and 30-39.9 mm (15.4%). Shrimp parts and crab appendages occurred consistently in (50-59.9 mm to 70-79.9 mm) size groups with the highest values (33.0% and 31.1%) in (70-79.9 mm) size group while the lowest (7.4%) was for (30-39.9mm) size group. Algae cells and higher plant parts accounted for 40.6% and 28.0% respectively of the stomach contents in 10-19.9mm. The point's method that showed shrimp parts contributed 33.3% and 26.3% of the stomach content in the 70-79.9mm and 60-69.9mm size groups respectively. Similarly, crab appendages accounted for 35.5% in 70-79.9mm size group and 31.2% in 60-69.99mm size group. In the 70 – 79.99mm size group, fish flesh was 38.0%, fish scales 18.9% and fish bones/spines (18.9%) respectively. The highest values bivalve shells (31.9%) and bivalve tissues (32.1%) were recorded in (50-59.9mm) and 60-69.9mm) size groups respectively. Whereas the 10-19.9mm and 20- 29.9mm size groups had no bivalve shell or tissue in their stomachs. Gastropods shells values ranged from 17.7% to 23.2% by points with the highest (23.2%) recording in size groups (30-39.99 to 70-79.99 mm) while the least (17.7%) was in (70-79.9 mm) size group. Annelids scored between 4.2% and 37.5% points amongst (30-39.9 mm to 70-79.9 mm) size groups with the highest and lowest values recorded in (70-79.9 mm) and (30-39.9 mm) size groups respectively. Index of relative importance (IRI) in the food items showed importance ranged from 7.14% to 0.07% in 2006 with the highest percentage index of relative importance recorded for bivalve shells (7.14%) and the lowest (0.07%) for the annelids. On the contrary, the percentage index of relative importance values varied from 0.34% to 21.67% based on increasing order of importance in 2007. Bivalve shells had IRI value of 427.44 (21.67%) whereas Annelids had IRI valve of 6.66 (0.34%). Similarly the highest value of 21.67% and lowest (0.34%) were recorded for bivalve shells and annelids respectively.

Key words: *Callinentes amnicola,* sizes, food, importance, Okpoka creek and Nigeria

INTRODUCTION

Callinectes amnicola is a famous crab belonging to the family Poruntidae. It is one of the most important economic swimming crabs present in the brackish wetland and lagoons in Nigeria (Abbey-Kalio, 1982; Solarin, 1988). *C. amnicola* inhabits muddy bottoms in mangrove areas and River mouths (Defelice *et al.*, 2001). The

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species is generally cherished source of protein and minerals in human diet and animal feeds (Chindah *et al*., 2000 and Emmanuel (2008) and the most important food organism caught in the coastal (inshore) fishery and lagoons in west Africa (Lawal-Are *et al* 2000). They are important in trophic relations of fish and organisms of sand and sandy mud bottoms and provide an important potential link, transferring energy between benthic and pelagic food chains within the estuarine system (Longhurst, 1958; Scott, 1966; Pillay, 1967; Vankul *et al.,* 1972; Warner, 1977; Baird and Ulaanowicz, 1993).

Food provides the basic body functions; growth, development and reproduction of an organism. The successful culture of any fish species requires proper understanding of the various food habits or the ecological niche for the production of different species (Stickney, 1979) and different sizes of the same species. A good knowledge of food and feeding habits of fishes at different stages of their life cycle is inevitable in aquaculture.

Measurements of numbers, volume and frequency of occurrence used traditionally in evaluating stomach contents of fish fall short of depicting true relative value. Numerous small organisms overshadow the importance of a few large ones. Differential digestive rates distort volumetric measurements. Frequency of occurrence tabulations is sensitive to sampling error. An ideal representative value would probably be one, which integrates each of the above plus one for nutrition. An index of relative importance assists in evaluating the relationship of the various food items found in stomachs knowing full well that it may fall short of some theoretical ideal.

The Okpoka creek is one of the most numerous creeks in Niger Delta. The Niger Delta estuarine waters cover an area of about 680km^2. The Bonny/ New Calabar river systems formed about 39% of the total area (Scott, 1966). The Niger Delta area is the richest part of Nigeria in terms of natural resources with large deposits of petroleum products (oil and gas); (Moffat and Linden, 1995; Braide *et al*., 2006). Similarly, the vast coastal features which include forest swamps, mangrove, marsh, beach ridges, rivers, streams and creeks serve as natural habitats for various species of flora and fauna (Alalibo, 1988; Jamabo, 2008).

Consequently, several studies have been carried out in this regard for finfish species and crustaceans from other water bodies. Notable among these are the reports of Stickney (1972) on fishes and invertebrates in Georgia Coastal water, Georgia. Olmi and Bishop, (1983) on the blue crab *Callinectes sapidus* Rathbun from the Ashley River, South Carolina; Prasad *et al*., (1989) on three Portunid crab species. There is a dearth of information on the composition in different size groups and index of relative importance (IRI) of *Callinectes amicola* food from Okpoka Creek in the Niger Delta, area of Nigeria for the evaluation of its ecology with a view to effectively manage the resources for sustainable supply to the citizenry.

MATERIALS AND METHODS

Study Area: The study was carried out in Okpoka creek, which is one of the several adjoining creeks off the Upper Bonny River estuary in the Niger Delta (Fig. 1). The Bonny River Estuary lies on the Southeastern edge of the Niger Delta, between longitudes 6°58′ and 7°14″ East and latitudes 4°19″ and 4°34′ North. It has an estimated area of 206 km^2 and extends 7 km offshore to a depth of about 7.5 m (Irving, 1962, Scott, 1966; Alalibo, 1988). The Bonny River is a major shipping route for crude oil and other cargoes, and leads to the Port Harcourt quays, Federal Ocean Terminal, Onne, and Port Harcourt Refinery company terminal jetty, Okirika. Specifically, the Okpoka creek lies between Longitudes 7°03′ and 7°05′ East and Latitudes 4°06′ and 4°24′ and it is about 6 kilometers long.

Characteristically, the area is a typical estuarine tidal water zone with little fresh water input but with extensive mangrove swamps, inter-tidal mud flats, and influenced by semi-diurnal tidal regime. In the Bonny River estuary, the salinity fluctuates with the season and tide regime is influenced by the Atlantic Ocean (Dangana, 1985). Tidal range in the area is about 0.8m at neap tides and 2.20m during spring tides (NEDECO, 1961).

It is strategically located southwestern flanks of Port Harcourt and Okirika of Rivers State. The creek is bounded by thick mangrove forest dominated by *Rhizophora species* interspersed by White mangrove (*Avecinia* sp.) and Nypa palm. Along the shores of the creek are located the Port Harcourt Trans- Amadi Industrial layout, several establishments, markets, the main Port Harcourt Zoological garden and several communities. The communities are Oginigba, Woji New layout, Azuabie, Okujagu- Ama, Ojimba- Ama, Abuloma, Okuru- Ama, Oba-Ama and Kalio- Ama.

Artisanal fishers mainly exploit the fisheries. The fishers use wooden/dug-out canoes ranging in size from 3 to 8m long. The canoes are either paddled or powered by small outboard engines, and manned by an average of two men. From these boats, the fishers operate their cast nets, hook and lines, gillnets, crab pots, etc.

Sampling stations: Six sampling stations were established along a spatial grid of the Okpoka creek covering a distance of about six kilometers. The sampling stations were established based on ecological settings, vegetation and human activities in the area. The sampling station is about one kilometer apart from each other.

Station 1: Located upstream of the Port Harcourt main abattoir at Oginigba waterfront with living houses on the left flank of the shoreline. Vegetation is sparse with mainly red mangrove (*Rhizophora* sp.,) white mangrove, *Avicenia* sp. and Nypa palm (*Nypa fructicans*).

Station 2: Situated at Azuabie/Port Harcourt main abattoir waterfront. It is located downstream of Station 1. The bank fringing the Azuabie/abattoir is bare with no

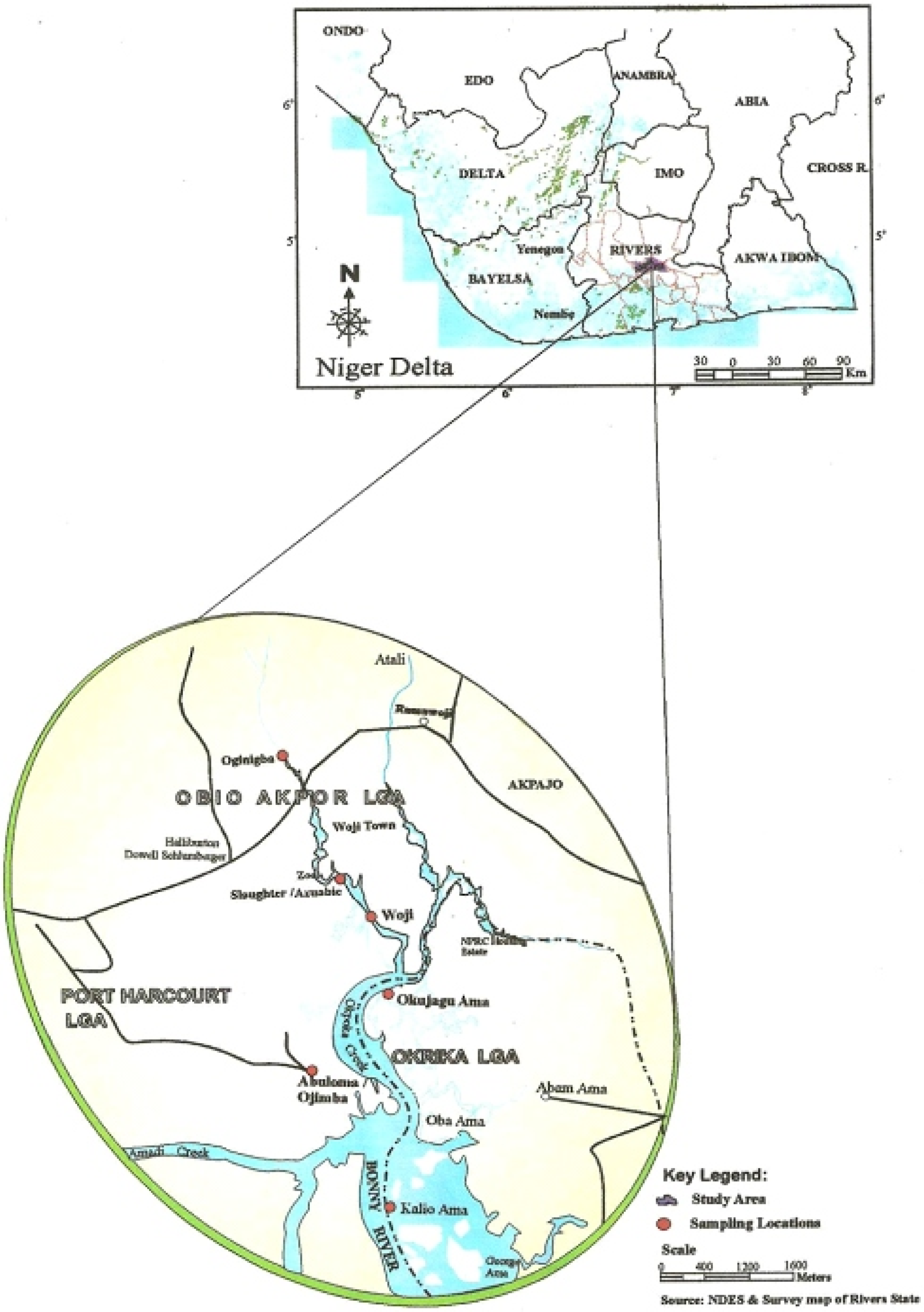

Fig. 1: Map of Niger Delta showing rivers state and the study area.

visible plants except toilet houses, residential houses, animal pens, boats and badges, while at the opposite side there are few mangrove and Nypa palm. Human activities here include slaughtering of animals, marketing, fishing and boat building. It is located downstream of station 1 and it is main collection point of abattoir wastes and other human and market wastes.

Station 3: It is downstream from the Port Harcourt abattoir at the Woji sand-Crete. It is about one kilometer away from Station 2. The major activities here included sand mining and loading.

Station 4: This station is located at Okujagu-Ama area. There are no industrial activities here. Mainly fishers occupy the area. Nypa palm dominates the marginal vegetation while the opposite side is thickly populated with red mangrove forest. *Rhizophora racemosa* and *Rhizophora mangle*. The main activity is fishing, boat ferrying and occasional sand moving.

Station 5: Is situated at Ojimba cum Abuloma waterfronts. There are no commercial activities apart from ferryboats operations. The shoreline fringes have mainly Nypa palm. The area is shallow and at low tide, the greater part of the bottom mud flat is exposed.

Station 6: Is located in front of Kalio-ama directly between Okpoka and Amadi creeks. The human activities here include jetty operations, oil and non-oil industrial activities, boat traffic and fishing. Vegetation is few dominated by red mangrove interspersed with white mangrove *Avicenia africana*.

Sample collection: The crabs for study were collected fortnightly for twelve (12) calendar months (January to December, 2007) using the square lift net trap at each of the sampling stations along the Okpoka creek. The lift net trap has a square structure made of wooden stick of about 4 cm thick and an area of 4.9m^2. The mesh sizes of the bag-like net were 1.2 cm to 2.0 cm multifilament nylon. The length of the bag is 40 to 60 cm. Strong nylon cords were woven in a net-like fashion from the centre to the middle of each of the four edges. A twine of about 6m long was attached to the centre and the other free end of the twine was tied to a floater, which served as a marker on the water surface to show the position of the gear.

The lift net trap was baited at the centre with animal offal and fish. The trap was operated from a hand-paddled canoe manned by two persons; one rowing while the other sets and hulls the trap into and from the water. The crabs were caught trapped and most of them were observed feasting on the bait until they were hulled into the boat. Sampling lasted for 4 hours on every sampling day and samples were collected between low ebbing and low flooding tide periods. The catches were taken to the laboratory in a cooler and stored in a deep freezer for further analysis.

Crabs were identified to species level carried out using photo cards and available identification keys (Fischer; 1978; Williams; 1974; Schneider; 1990). Therefore each crab was sorted into species, sex and the required metric measurements were taken.

The carapace width and length were measured with a 0.5mm precision vernier caliper to the nearest millimeter (mm) while weight measurement was done using a 0.001g precision Adam (PGW series) weighing balance to the nearest grams (g).

Each category of food organisms in the diet of *C. amnicola* was determined by pooling the various food items for all the stomachs examined using numerical, occurrence and points methods respectively. The general food items recorded for the different methods (numerical, occurrence and point) were pooled for all the stomachs examined during the sampling and relative proportions were plotted to indicate the significance of each category of food organisms in the diet of *C. amnicola.*

An index of relative importance (IRI) was also used to determine the most important food item. The index of relative importance (IRI) was calculated for all the prey items using the formula:

$$IRI = (C_N + C_P) + F \qquad (1)$$

(Hyslop, 1980; Bachok *et al.*, 2004)

Where:

C_N = Percentage of numerical
C_P = Percentage of points
F = Percentage of occurrence.

RESULTS

Tables 1-3 show the food composition in the different size groups of the crab using the different analytical methods. Crabs less than 10mm were absent in the catch. Generally, in the smaller crabs (10-19.9 mm) and (20-29.9 mm) food items such as crab appendages, bivalve shells, bivalve tissues, gastropod shells and annelids were absent. Similarly, algae cells were not encountered in the (40-49.9 mm to 70-79.9 mm) size groups. However, the larger size groups had crustacean, Pisces and mollusca as the major food items in their stomachs.

The numerical method Table 1 showed that algae cells (46.9%) were most abundant in size group (10-19.9 mm) followed by 20-29.9 mm (33.1%) size group and 30-39.9 mm (20.0%) size group. Crustacean (shrimp parts 32.7% and crab appendages 35.2%) was numerically higher in (70-79.9mm) size class.

The frequency of occurrence method (Table 2) showed that, Fish flesh accounted for 19.8% 17.6%, 15.4% 13.2%, 11.0% and 9.9% of the stomach contents in the 30-39.9 mm, 20-29.9 mm, 10-19.9 mm (50-59.9 mm, 70-79.9 mm), 40-49.9 mm 60-69.9 mm size group respectively. Fish scales occurred most in (70-79.9 mm) size group with a value of 19.4% followed by 15.3% (50-59.9 mm) size group whereas the other size groups had between 10.4% and 14.6% in occurrence.

The percentage occurrence of fish bones/spines in 10-19.9 mm to 70-79.9 mm size groups ranged between 8.7% and 17.4%. The highest (17.4%) was recorded in (40-49.9 mm) size group while the least (8.7%) was obtained in (10-19.9 mm) size group. Bivalve shells (29.5%) and bivalve tissue (28.6%) led in occurrence in (70-79.9mm) size group whereas 28.6% (gastropod shells) encountered in (70-79.9 mm) size group.

This was followed in decreasing order of occurrence by size groups 60-69.9 mm (25.0%), 40-49.9 mm (21.2%), 50-59.9 mm (16.3%) and 30-39.9 mm (15.4%). Shrimp parts and crab appendages occurred consistently

Table 1: Composition of various food items in the stomach of *Callinectes amnicola* of different size groups using Numerical (N) method

		Food Items												
		Crustacea		Pisces			Mollusca			Annelids	Plant Materials			
Size Class (mm)	No Examined	Shrimps parts No%	Crab Appendages No%	Fish Flesh No%	Fish Scales No%	Fish bones/ spines No%	Bivalve Shells No%	Bivalve Tissues No%	Gastropod Shells No%	No%	Algae Cells No%	Higher Plant Parts No%	Sand Grains No%	Unidentified Mass No%
10-19.9	27	13(7.9)	-	14(12.2)	17(6.3)	23(6.7)	-	-	-	-	68(46.9)	14(20.6)	37(24.8)	9(9.6)
20-29.9	26	-	-	16(13.9)	32(11.9)	29(8.5)	-	-	-	-	48(33.1)	18(26.5)	42(28.2)	15(16.0)
30-39.9	28	20(12.1)	-	22(19.1)	29(10.8)	56(16.4)	24(7.9)	-	20(9.9)	1(7.7)	29(20.9)	7(10.3)	-	-
40-49.9	36	-	28(17.6)	10(8.7)	43(16.0)	59(17.3)	52(17.2)	8(12.9)	36(17.8)	2(15.4)	-	-	16(10.7)	16(17.0)
50-59.9	30	37(22.4)	32(20.1)	16(13.9)	38(14.2)	70(20.5)	74(24.4)	12(19.4)	28(13.9)	3(23.1)	-	8(11.8)	10(6.7)	22(23.4)
60-69.9	28	41(24.8)	43(27.0)	14(12.2)	46(17.2)	46(13.5)	72(23.8)	18(29.0)	62(30.7)	3(23.1)	-	6(8.8)	14(9.4)	-
70.79.9	38	54(32.7)	56(35.2)	23(20.0)	63(23.5)	58(17.0)	81(126.7)	24(38.7)	56(27.7)	4(30.8)	-	5(22.1)	30(20.1)	32(34.0)
TOTAL	213	165	159	115	268	341	303	62	202	13	145	68	149	94

( ) percentage values

Table 2: Composition of various food items in the stomach of *Callinectes amnicola* of different size groups using the frequency of occurrence method.

		Food Items												
		Crustacea		Pisces			Mollusca			Annelids	Plant Materials			
Size Class (mm)	No Examined	Shrimps parts No%	Crab Appendages No%	Fish Flesh No%	Fish Scales No%	Fish bones/ spines No%	Bivalve Shells No%	Bivalve Tissues No%	Gastropod Shells No%	No%	Algae Cells No%	Higher Plant Parts No%	Sand Grains No%	Unidentified Mass No%
10-19.9	27	10(10.6)	-	14(15.4)	15(10.4)	13(8.70)	-	-	-	-	26(40.6)	14(28.0)	6(24.0)	4(12.5)
20-29.9	26	-	-	16(17.6)	20(13.9)	19(12.8)	-	-	-	-	22(34.4)	18(23.0)	6(24.0)	15(46.9)
30-39.9	28	7(7.4)	-	18(19.8)	21(14.60)	23(15.40)	10(8.2)	-	16(15.4)	1(7.7)	16(25.0)	7(14)	-	-
40-49.9	36	-	24(26.7)	10(11.0)	20(13.9)	26(17.4)	24(19.7)	8(22.9)	22(21.2)	2(15.4)	-	-	7(28.0)	4(12.5)
50-59.9	30	24(25.5)	18(20.0)	12(13.2)	22(15.3)	25(16.8)	28(23.0)	8(22.9)	17(16.3)	3(23.1)	-	3(6.0)	-	10(31.3)
60-69.9	28	22(23.4)	20(22.2)	9(9.9)	18(12.5)	20(13.4)	24(19.7)	9(25.70)	26(25.0)	3(23.1)	-	2(4.0)	-	-
70.79.9	38	31(33.0)	28(31.1)	12(13.2)	28(19.4)	23(15.4)	36(29.50)	10(28.6)	23(28.6)	4(30.8)	-	6(12.0)	6(24.0)	9(28.1)
TOTAL	213	-94	90	91	144	149	122	35	104	13	64	50	25	32

( ) percentage values

Table 3: Composition of various food items in the stomach of *Callinectes amnicola* of different size groups using the Point (PT) method

		Food Items												
		Crustacea		Pisces			Mollusca			Annelids	Plant Materials			
Size Class (mm)	No Examined	Shrimps parts No%	Crab Appendages No%	Fish Flesh No%	Fish Scales No%	Fish bones/ spines No%	Bivalve Shells No%	Bivalve Tissues No%	Gastropod Shells No%	No%	Algae Cells No%	Higher Plant Parts No%	Sand Grains No%	Unidentified Mass No%
10-19.9	27	9(9.1)	0(0)	4(5.1)	20(6.9)	30(8.1)	0(0)	0(0)	0(0)	-(0)	95(40.8)	57(20.0)	10(8.7)	15(11.0)
20-29.9	26	0(0)	0(0)	5(6.3)	37(12.7)	43(11.6)	0(0)	0(0)	0(0)	-(0)	80(34.3)	68(23.9)	19(16.5)	25(18.4)
30-39.9	28	14(14.1)	0(0)	10(12.7)	40(13.7)	55(14.8)	40(11.0)	7(6.3)	60(19.4)	5(4.2)	58(34.9)	35(12.3)	0(-0)	0(0)
40-49.9	36	00	16(11.3)	7(8.9)	43(14.8)	50(13.5)	68(18.6)	10(8.9)	72(23.2)	10(8.3)	0(0)	0(0)	14(12.2)	28(20.6)
50-59.9	30	17(17.2)	31(22.0)	14(17.7)	46(15.8)	58(15.6)	80(31.9)	24(21.4)	65(21.0)	30(25.0)	0(0)	40(14.0)	16(13.9)	30(22.1)
60-69.9	28	26(26.3)	44(31.2)	9(11.4)	50(17.2)	65(17.5)	78(21.4)	36(32.1)	58(18.7)	30(25.0)	0(0)	25(8.8)	26(22.6)	0(0)
70.79.9	38	33(33.3)	50(35.5)	30(38.0)	55(18.9)	70(18.9)	99(27.1)	35(31.3)	55(17.7)	45(37.5)	0(0)	60(21.1)	30(26.1)	38(27.9)
TOTAL	213	99	141	79	29.1	371	365	112	310	120	233	285	115	136
MEAN		14.4	20.14	11.29	41.57	53.0	52.14	16.0	44.29	17.47	33.29	40.71	16.43	19.43
STD		12.46	20.65	8.90	11.27	13.54	39.54	15.57	30.74	17.78	42.88	23.52	9.99	14.92

( ) percentage values

in (50-59.9 mm to 70-79.9 mm) size groups with the highest values (33.0% and 31.1%) in (70-79.9 mm) size group while the lowest (7.4%) was for (30-39.9mm) size group. Algae cells and higher plant parts accounted for 40.6% and 28.0% respectively of the stomach contents in 10-19.9 mm.

The point's method (Table 3) showed shrimp parts contributed 33.3% and 26.3% of the stomach content in the 70-79.9 mm and 60-69.9 mm size groups respectively. Similarly, crab appendages accounted for 35.5% in 70-79.9mm size group and 31.2% in 60-69.99 mm size group.

In the 70-79.99 mm size group, fish flesh was 38.0%, fish scales 18.9% and fish bones/spines (18.9%) respectively. The highest values bivalve shells (31.9%) and bivalve tissues (32.1%) were recorded in (50-59.9 mm) and 60-69.9 mm) size groups respectively. Whereas the 10-19.9 mm and 20-29.9mm size groups had no bivalve shell or tissue in their stomachs. Gastropods shells values ranged from 17.7% to 23.2% by points with the highest (23.2%) recording in size groups (30-39.99 to 70-79.99 mm) while the least (17.7%) was in (70-79.9 mm) size group. Annelids scored between 4.2% and 37.5% points amongst (30-39.9 mm to 70-79.9 mm) size groups with the highest and lowest values recorded in (70-79.9 mm) and (30-39.9 mm) size groups respectively.

Table 4 and 5 show the results of the index of relative importance (IRI) in the food items in the stomachs of *C. amnicola* based on the three analytical methods. The results as shown based on the order of decreasing relative importance ranged from 7.14% to 0.07% in 2006 with the highest percentage index of relative importance recorded for bivalve shells (7.14%) and the lowest (0.07%) for the annelids (Table 4). On the contrary, the percentage index of relative importance values varied from 0.34% to 21.67% based on increasing order of importance in 2007. Bivalve shells had IRI value of 427.44 (21.67%) whereas Annelids had IRI valve of 6.66 (0.34%). Similarly the highest value of 21.67% and lowest (0.34%) were recorded for bivalve shells and annelids respectively (Table 5).

DISCUSSION

The results also showed significant changes in food habits relative to size of crabs. This variation in food habit was also reported by Lawal-Are (2003) and Chindah *et al.* (2000). However, Emmanuel (2008) observed no distinct changes in the food habit relative to size in the same species (*Callinectes amnicola*). The observed changes in food habit relative to size differences may be due to food selection resulting from the absence of suitably sized prey in the environment (Moore and Moore, 1976; Whitefield, 1977).

The presence of algae and plant materials as dominant food in the gut of the juveniles (size classes I to III) against the semi-adult and full adult (IV- VII) may have resulted from the fact that the juveniles being less active, forage more on algae and slow moving fauna. Fish and other animals were common in the stomach of adults. It is possible that the digestive system of adults is more developed than the juveniles. (Warner, 1977; Chindah *et al.*, 2000). Warner (1977) and Paul (1981) had observed in their studies that the organism forage more on algae during their early stages and at maturity depends largely on fauna such as shrimps, brachyuran, bivalves, gastropods, fish, polychaetes and others.

Juvenile and adult blue crabs have been characterized as opportunistic benthic omnivores, detritovores, cannibals and scavengers, with food habits determined by local abundance and availability of prey (Laughlin, 1979; Guillory *et al.*, 1996). Laughlin (1979) however concluded that it is difficult to place blue crabs in one trophic level and starvation is less likely in species with opportunistic feeding habits than in species with specialized feeding habits.

Changes in fish diet with locations have been reported (Arendt *et al.,* 2001; Joyce *et al.*, 2002). When the present study results, are compared with the results of earlier workers on the same species, a minor shift in food items requirement was observed, which could be attributed to differences in habitats, relative abundance of prey organisms and individual species food habits as reported by Hseuh *et al.* (1992), Rosas *et al.* (1994), Reigada and Negreiros-Frasozo (2004) and Chande and Mgaya (2004).

Generally, the food of the swimming crab, *calinectes amnicola,* revealed that the crab is an opportunistic benthic predator as the stomach content showed mainly the presence of Crustacea (shrimp parts and crab appendages), Pisces (fish flesh, fish scales, fish bones/spines), and mollusca (Bivalve shells, bivalve tissues, and gastropod shells). Other food items frequently observed are plant materials composed of algae and plant parts were observed in relatively high number. Minor food items observed include, annelids, sand grains and unidentified materials.

This finding compared favorably with the results of Lawal-Are (1998), on *C. amnnicola* in the Badagry Lagoon Nigeria; Lawal-Are and Kusemiju (2000) on *Callinectes amni.cola* in the Badagry lagoon. Chindah *et al.,* (2000) on *Callinectes amnicola* of the New Calabar River, Nigeria; Lawal-Are (2003) on *Callinectes amnicola* in the Badagry and Lekki Lagoons and Emmanuel (2008) on the same species from Lagos Lagoon and its adjacent Creek, South-West Nigeria.

Sand particles were also observed in the stomachs, which were not considered as food, but probably picked up along with the main food items from the bottom. This is in agreement with reports of Nikolsky (1963), Alfred-Ockiya and George (1998), Allison (2006) and Chindah *et al.* (2000).

The carnivorous way of feeding was also seen to be associated with an herbivorous habit in some as the

Table 4: Index of relative importance (IRI) and percentage (IRI) of food items in the stomach of *Callinects amnicola* from Okpoka Creek (2006)

Food items	Freq. Occ. (FO)	%FO	Numerical (N)	%N	Point (PT)	%PT	Index relative importance	% IRI
Shrimp parts	194	12.6	311	14.3	730	15.4	374.22	7.012
Crab appendages	14	0.9	162	7.4	370	7.8	13.68	0.26
Fish flesh	74	4.8	106	4.9	225	4.8	46.56	0.87
Fish scales	161	10.5	178	8.2	390	8.23	172.20	3.23
Fish bones/spines	200	13.0	287	13.2	675	14.3	357.50	6.70
Bivalve shells	207	13.5	293	13.5	695	14.7	380.70	7.14
Bivalve tissues	63	4.1	69	3.2	155	3.4	27.06	0.51
Gastropod shells	196	12.8	223	10.3	475	10.0	259.84	4.87
Annelids	23	1.5	24	1.1	65	1.4	3.75	0.07
Algae cells	72	4.7	228	10.5	335	7.1	82.62	1.55
Higher plant parts	64	4.2	67	3.1	140	3.0	25.62	0.48
Sand grains	45	2.9	119	5.5	220	4.7	29.58	0.55
Unidentified mass	90	5.9	108	5.0	255	5.4	61.95	1.16
Total	1536		2175		4730		5335.38	

Table 5: Index of relative importance (IRI) and percentage (IRI) of food items in the stomach of *Callinects amnicola* from Okpoka Creek (2007)

Food items	Freq. Occ. (FO)	%FO	Numerical (N)	%N	Point (PT)	%PT	Index relative importance	% IRI
Shrimp parts	185	15.5	256	12.1	590	13.0	389.05	19.72
Crab appendages	128	10.7	169	8.0	410	9.0	181.9	9.22
Fish flesh	56	4.7	95	4.5	180	4.0	39.95	2.02
Fish scales	127	10.6	195	9.2	470	10.3	206.7	10.48
Fish bones/spines	125	10.5	254	12.0	610	13.4	266.7	13.52
Bivalve shells	186	15.6	273	12.9	660	14.5	427.44	21.67
Bivalve tissues	54	4.5	66	3.1	170	3.7	30.6	1.55
Gastropod shells	148	12.4	214	10.1	530	11.7	270.32	13.70
Annelids	21	1.8	30	1.4	105	2.3	6.66	0.34
Algae cells	47	3.9	246	11.6	330	7.3	73.71	3.74
Higher plant parts	46	3.9	80	3.8	140	3.1	26.91	1.36
Sand grains	26	2.2	164	7.7	230	5.1	28.16	1.43
Unidentified mass	44	3.7	77	3.6	140	3.1	24.79	1.26
Total	1193		2119		4544		1972.89	

juvenile crabs fed more on plant materials. This suggestion agreed with Lawal-Are (2003) on the same species. Similarly, the number and variety of food organisms found in the gastric stomach of the individual crab indicated that the species (*Callinectes amnicola*) is more of a predator than a scavenger.

This observation is in agreement with Chindah *et al* (2000) and Emmanuel (2008) on the same species but negates the observation of Blundon and Kennedy (1982) who reported *Callinectes sapidus* as mostly a scavenger. Laughlin (1979) demonstrated that the feeding habits of *C. sapidus* change with age and with the distribution of its prey. While Blundon and Kennedy (1982) also noted that changes in diet are influenced by morphological changes of feeding related structures such as Chelae and mouthparts, during growth.

The index of relative importance (IRI) food groups in *Callinectes amnicola* was Crustacea 7.2, Pisces 10.80% and Molluscs 12.6% in 2006 and 28.94% (Crustacea), Pisces (26.02%) and Molluscs (36.92%) in 2007, suggesting that the *Callinectes amnicola* in the study area primarily feed on these three prey groups. This is in agreement with the findings of Hsuel *et al.* (1992) who also reported a cumulative Index of Relative Importance (IRI) of food groups for fish, bivalve, brachyuran and gastropod as 85% in *C. simils* and 91% in *C. sapidus*. They further reported that both *Callinectes* fed primarily on these four groups. However, Bachok *et al.* (2004) reported that the high occurrence of certain prey items in diets of fish does not necessarily mean that such food items were of nutritional importance to the consumer.

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