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The Food and Feeding Habits of Fish Species Assemblage in a Niger Delta Mangrove Creek, Nigeria

[1]B.J. Oribhabor and [2]A.E. Ogbeibu

[1]Department of Fisheries and Aquaculture, Faculty of Agriculture, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria

[2]Department of Animal and Environmental Biology, University of Benin, P.M.B. 1154, Benin City, Nigeria

Corresponding Author: B.J. Oribhabor, Department of Fisheries and Aquaculture, Faculty of Agriculture, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria

ABSTRACT

The food and feeding habits of twenty-five species of fish in Buguma Creek, Niger Delta, Nigeria was investigated between November 2004 and June 2006. The fish samples were caught by the use of hooks and lines and cast nets. The frequency of occurrence, numerical and fullness methods were used for analyzing the food items. Of the 1149 specimens examined, 299 (26%) were empty stomach 150 (13.1%) were fully loaded stomach while 222 (19.3%), 275 (23.9%) and 203 (17.7%) were, ¾, ½ and ¼, respectively. Animal preys which dominated the stomach contents of the dominant predatory fishes were insects, shrimps, lobsters, crabs, fishes, polychaetes, amphipods, isopods, pagurid decapods, molluscs and nematodes. Other items found in the stomachs of some species were pebbles in *P. jubelini*, *A. regius*, *P. senegalensis*, *P. elongatus* and *D. margaritas*; and in *D. margarita*; and mud in *P. Jubelini*, *P. sebae* and *D. margarita*. Extraneous insect wing reproductive termite, *Termes flavipes* was found in the stomach contents of *A. gigas* and *P. sebae*. The food items in the stomach of the fish species indicated that they were euryphagous, i.e. feeding on a wide range of organisms, except for bottom feeders in the family's Cichlidae and Mugilidae. The predatory fishes were either benthopelagic or benthic feeders. Unspecialised flexible dietary habits, an optimal strategy for survival in habitats where food sources are subject to fluctuation was the overall picture of the diet that emerged from the fishes.

Key words: Food and feeding habits, fish species assemblage, mangrove creek, Niger delta, Nigeria brief

INTRODUCTION

The extensive Niger Delta mangrove (over one million hectare) is the largest in Africa (Spalding *et al*., 1997) with diverse fish resources. The mangrove and its diverse fish resources are fast being depleted due to uncontrolled anthropogenic activities. There have been warnings, that supportive data have not been collected and that fish and decapods use of mangrove may not be the same in all areas of the globe (Chong *et al*., 1990).

Adult fishes feed in a variety of ways, ranging from sieving phytoplankton or grazing algae, to suction feeding on benthic invertebrates and to devouring other fishes whole or in portions (Bone *et al*., 2004). There is paucity of information on the food and feeding of fish species assemblage of Nigerian coastal waters. The food and feeding interrelationship of the fishes occurring in Lagos lagoon have been discussed, Fagade (1971) reported that two common species

Tilapia melanotheron and *Tilapia guineensis* fed on similar food items, algae filaments diatoms and unidentified organic matter; Fagade and Olaniyan (1972) found that *Ethmalosa fimbriata fimbriata* fed on phytoplankton, zooplankton and unidentified food; Fagade and Olaniyan (1973) found that food of Lagos Lagoon fishes covers a wide spectrum and most of the available invertebrates are being utilized as food by the fishes. They defined fishes feeding on macroscopic animals as predatory species while those whose food include much bottom deposit (detritus) are called bottom or deposit feeders. They further grouped predatory species into piscivorous species i.e, fishes found feeding principally on fishes and non- piscivorous species, those fishes feeding more on other macroscopic animals other than fishes. They concluded that the division is not water-tight as some over-lapping exists. In the Niger Delta, Odum and Anuta (2001) reported that the main food items of *Phractolamus ansorgii* from Warri River were detritus, algae and sand grains and that the fish fed more actively in the dry season while diet diversity decreased with increased size. Alfred-Ockiya (2000) examined the found habits of goby, *Porogobius schelgelii* from the artisanal fisheries of the Bonny River in the Niger Delta and reported that they are omnivores, with detritus, diatoms and blue-green algae being the primary food items, followed by sand granules, macrophytes and nematodes as secondary food items. Stomach content has been used by many investigators to establish the food habits of fishes (Hartley, 1948; Hynes, 1950; Ball, 1961; Corbet, 1961; Munro, 1967). In fishes with no well-defined stomach, the contents of the entire gut were analysed (Corbet, 1961). Olaniyan (1969) suggested salinity as an important ecological factor in the distribution of fish fauna in the Lagos Lagoon. Fagade and Olaniyan (1973) posited that the availability of the food of the fish species can also influence their distribution. Wright (1986) attributed salinity to be the most important factor affecting fish population in shallow water creeks of a Nigerian mangrove swamp. Little *et al.* (1988), attributed high species record in East African mangrove creeks to the constant high salinity (approximately 35%) measured throughout the study period.

Although Oribhabor and Adisa-Bolanta (2009) have reported the food and feeding of tilapia species in Buguma Creek, Nigeria, this work which is the sixth in a series to provide data on the biology and ecology of fish species of the creek, is the first to document the food and feeding habits of the fish community of the creek and any Niger Delta mangrove creek.

MATERIALS AND METHODS

The Buguma Creek is located southeast of the Niger Delta between longitude 6°47'E and 6°59'N and latitude 4°36'N and 4°59'N Fig. 1. Detailed description of the three fish sampling stations have been given by Oribhabor and Ogbeibu (2010).

The fish samples collected monthly from November, 2004 to June 2006 at flood tides were caught by the use of hooks and lines and cast nets. The fish samples collected from three stations were ice-packed, kept chilled under ice-blocks in a plastic cooler and immediately transported to the laboratory. In the laboratory, fish specimens were pooled, sorted and identified to species level using the keys and descriptions of Scheider (1990) and Olaosebikan and Raji (1998).

The gut of each specimen was removed and preserved in a specimen bottle containing 4% formaldehyde. Each stomach was cut open and the contents washed into a petri dish using 4% formaldehyde. The food items were identified to the least taxon possible and counted. The frequency of occurrence, numerical and fullness methods (Hynes, 1950; Bagenal, 1978; Ogbeibu and Ezeunara, 2002) were used for analyzing the food items.

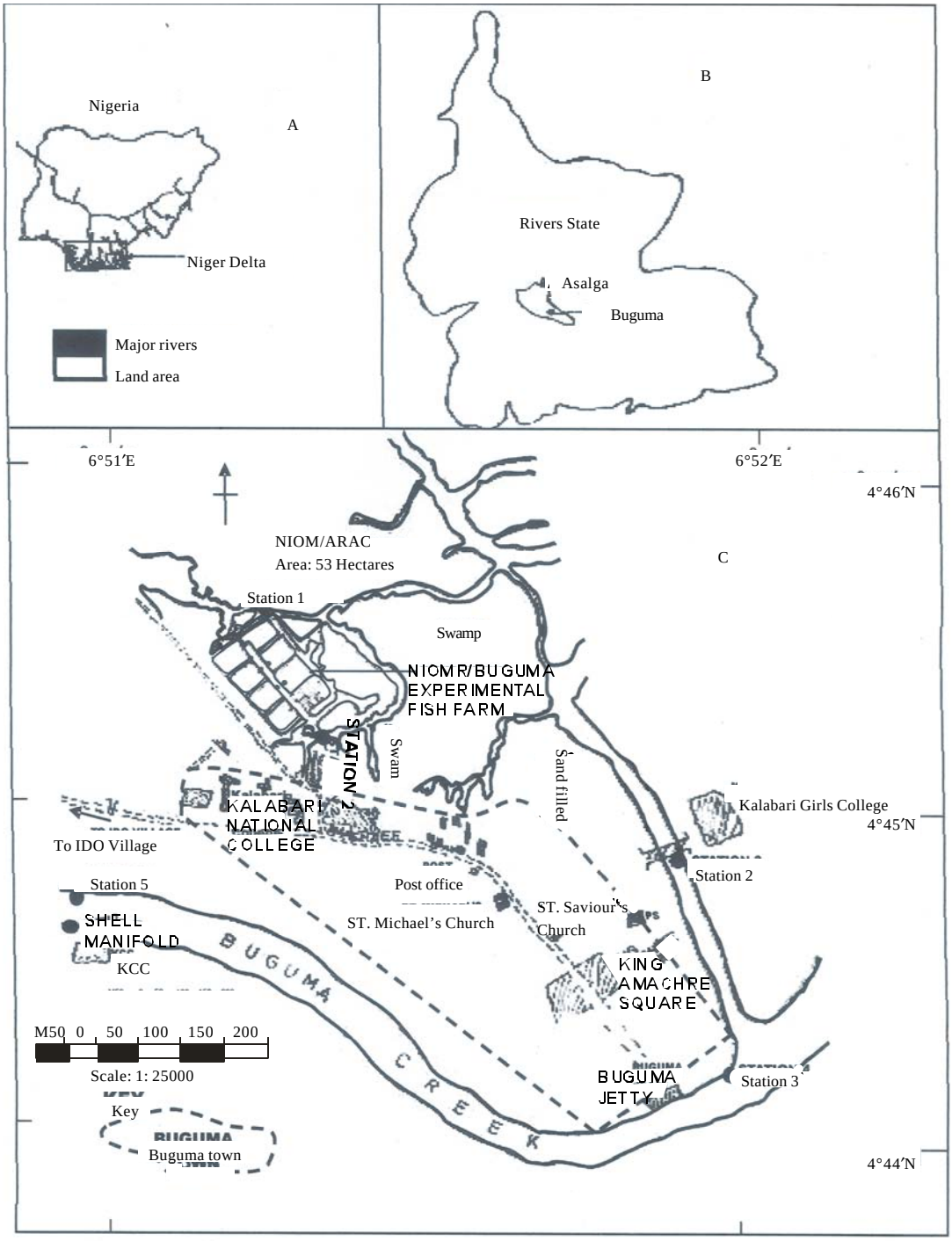

Fig. 1: Map of the study area: (A) Nigeria showing Niger Delta, (B) Rivers state showing Buguma and (C) The study creek showing fish sampling stations

Table 1: Filled portion of stomachs in buguma creek fishes, Nov. 2004-June. 2006

Fish species	No. of specimens	4/4	3/4	1/2	1/4	0
Elops lacerta	1	1				
Arius gigas	53	6	9	14	9	15
Gobius sp.	1					1
Epinephelus aeneus	6		1	2	2	1
Caranx latus	10	1	2	2		5
Lutjanus agennes	4	2		1		1
Lutjanus goreenis	20	3	3	2	4	8
Plectorhynchus macrolepsis	5		1	1	1	2
Pomadasys jubelini	72	7	18	10	7	30
Argyrosomus regius	12	1	4	2	2	3
Pseudotolithus senegalensis	24	3	6	8	3	4
Fonticulus. elongatus	753	94	152	199	144	164
Psettias sebae	38	1	1	9	8	19
Sarotherodon melanotheron	8	3	3	1		1
Tilapia guineensis	18	8	1	1	1	7
Liza falcipinnis	1	1				
Mugil cephalus	2	2				
Mugil curema	31	7	9	1	6	8
Sphyraena afra	5		2	3		
Sphyraena guachancho	1			1		
Spyraena sphyraena	1			1		
Polydactylus quadrifilis	76	9	9	14	16	28
Trichiurus lepturus	3			1		2
Cynoglossus senegalensis	1			1		
Dasyatis margarita	3	1	1	1		
Total	1149	150	222	275	203	299
Percentage (%)		13.1	19.3	23.9	17.7	26.0

RESULTS

The species were arranged according to families and similarity of food items found in their stomachs. The results of analysis of stomach contents using the fullness method are shown in Table 1 of the 1149 specimens examined, 299 (26%) were empty stomachs. 150 (13.1%) were fully loaded stomach while 222 (19.3%), 275 (23.9%) and 203 (17.7%) were, ¾, ½ and ¼, respectively. Among the fishes represented by a single specimen, only *Gobius* sp. had empty stomach. Two of the remaining five species, *Elops lacerta* and *Liza facipinnis* had fully loaded stomachs while *Sphyraena guachancho, Sphyraena sphyraena* and *Cynoglossus senegalensis* had their stomachs half full Table 1.

The results of stomach content analysis using the frequency of occurrence method were based on all the species present except for *Gobius* sp. that had a single representation and also had empty stomach Table 2-8. Numerical method was used for all the species, except for *L. falcipinnis, M. cephalus* and *Gobius* sp. Table 2-8. Analysis of stomach contents of the fishes, *E. lacerta, A. gigas, E. aeneus, C. latus, L. agennes, L. goreensis, P. macrolepsis, P. jubelini, A. regius, Pseudotolithus senegalensis, Fonticulus elongatus, P. sebae, S. afra, S. guachancho, S. sphyraena, P. quadrifilis, T. lepturus, C. senegalensis* and *D. margarita* indicate that predatory fishes dominate the species, although some were found to have stomachs containing unidentified plant parts, unidentified fruit seed, dead plant matter while others were bottom (detritus) feeders. Animal

Table 2: Analysis of Food Item Found in the Stomachs of *Elops lacerta*, *Arius gigas* and *Epinephelus aeneus* in the Study Area, Nov. 2004-June 2006

	Elops lacerta				*Arius gigas*				*Epinephelus aeneus*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food items	Frequency	%0	No.	%N	Frequency	%0	No.	%N	Frequency	%0	No.	%N
Unidentified plant parts					1	2.6	4	2.3	2	40	8	36.4
Nematodes (Nematoda)				2	5.2	4	2.3	1	20	1	4.5	
Partially digested polychaete					1	2.6	1	0.6				
Termes flarvipes (wing reproductive termite)					12	31.6	128	73.9				
Lobsters												
Scylarides herklotsii antennae					2	5.2	3					
Scylarides herklotsii					1	2.6	1					
Shrimps												
Glyplus marsupialis	1	100	4	100	3	7.9	3	1.7	1	20	1	4.5
Parapenaeus longirostris mysis					1	2.6	1	0.6				
Parapenaeus longirostris juvenile					3	7.9	3	1.7				
Partially digested shrimps					3	7.9	3	1.7				
True crabs												
Geryon maritae					2	5.2	3	1.7				
Callinectes marginatus									1	20	1	4.5
Partially digested crab					14	36.8	14	8.1				
Mollusca												
Tympanotonus fuscata hell fragments									1	20	2	9.1
Tympanotonus fuscata radula									1	20	1	4.5
Fish												
Partially digested fish					1	2.6	1	0.6				
Fish rib									1	20	3	13.6
Fish scales									1	20	3	13.6
Fish head									1	20	1	4.5
Unidentified animal parts					1	3.1	4	2.3	1	20	1	4.5
Total number examined		1				53				6		
Number of empty stomachs		0				15				1		
Number of non-empty stomachs		1				38				5		

%0: Percentage of occurrence, %N: Percentage of number

preys which dominated the stomach contents of the dominant predatory fishes based on results of both the occurrence and numerical abundance methods were Insects, Shrimps, Lobsters, Crabs, Fishes, Polychaetes, amphipods, isopods, pagurid decapod, molluscs and nematodes. Other items found in the stomachs of some species were pebbles in *P. jubelini, A. regius, P. senegalensis,*

Table 3: Analysis of food items found in the stomachs of *Caranx lactus, Lutjanus agennes* and *Lutjanus goreensis* in the study area, Nov. 2004-June 2006

	Caranx latus				*Lutjanus agennes*				*Lutjanus goreensis*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food items	Frequency	%0	No.	%N	Frequency	%0	No.	%N	Frequency	%0	No.	%N
Unidentified plant parts					2	66.7	19	44.2	5	41.7	27	42.9
Nematodes (Nematoda)	1	20	1	14.3								
Lobsters												
Scyllarides herklotsii antennae									1	8.3	1	1.6
Shrimps												
Glyplus marsupialis	3	60	4	57.1					1	8.3	1	1.6
Parapenaeus longirostris juvenile	1	20	1	14.3					1	8.3	9	14.3
Penaeus notialis									1	8.3	1	1.6
Partially digested Shrimp									6	50	6	9.5
Shrimp appendages									2	16.7	8	12.7
True crabs												
Geryon maritae												
Goniopsis pelii												
Partially digested Crab					1	33.3	1	2.3				
Crab appendages					1	33.3	9	20.9				
Mollusca												
Tympanotonus fuscata radula					1	33.3	1	2.3				
Fish												
Sardinella maderensis					1	33.3	1	2.3				
Partially digested fish	1	20	1	14.3	2	66.7	2	4.7				
Fish scales					2	66.7	10	23.3	1	8.3	2	3.2
Number of empty stomachs	5				1				80			
Number of non-empty stomachs	5				3				12			
Total number examined	10				4				20			

%0: Percentage ofoccurrence, %N: Percentage of number

P. elongatus and *D. margarita*; sand in *D. margarita* and mud in *P. jubelini, P. sebae* and *D. margarita.*

Shrimps species, represented by *Glyphus marsupialis, Nematopalaemon hastatus, Parapenaeus longirostris, Penaeus notialis* and *Sicyonia* sp. constituted the dominant food items among the food species. They dominated the food items of *E. lacerta* Table 2, *C. latus* and *Lutjanus goreenis* (Table 3), *P. jubelini* (Table 4), *A. regius, Fonticulus elongatus, Pseudotolithus senegalensis* (Table 5).

P. guadrifilis and *T. lepturus* (Table 7) by both the occurrence and numerical abundance. They occurred either partially as whole juvenile, parts or partially digested form or in

Table 4: Analysis of Food Items Found in the Stomachs of *Plectorhynchus macrolepsis* and *Pomadasys jubelini* in the Study Area, Nov. 2004-June 2006

	Plectorhynchus macrolepsis				*Pomadasys jubelini*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food items	Frequency	%0	No.	%N	Frequency	%0	No.	%N
Unidentified plant parts	1	33.3	4	19	2	4.8	13	10.9
Nematodes (Nematoda)	1	33.3	1	4.8	2	4.8	2	1.7
Polychaeta								
Harmothoe corralophila					1	2.4	6	5
Diptera larvae								
Chironomus transvalensis	1	33.3	1	4.8	1	2.4	1	0.8
Chryptochironomus sp.	1	33.3	1	4.8				
Polypedilum sp.	1	33.3	4	19				
Palpomyia sp.	1	33.3	1	4.8				
Lobsters								
Scyllarides herklotsii antenna	1	33.3	2	9.5	1	2.4	2	1.7
Scyllarides herklotsii					6	14.3	6	5
Shrimps								
Glyphus marsupialis					12	28.6	19	15.9
Nematopalaemon hastatus juvenile	1	33.3	2	9.5	2	4.8	2	1.7
Penaeus notialis					1	2.4	1	0.8
Parapenaeus longirostis juvenile					2	4.8	4	3.4
Partially digested shrimp					5	11.9	5	4.2
Shrimp appendages					1	2.4	12	10.1
True crabs								
Geryon maritae	1	33.3	2	9.5				
Partially digested crab					3	7.1	3	2.5
Crab appendages/parts					1	2.4	34	28.6
Fish								
Partially digested fish					3	7.1	3	2.5
Fish scales					1	2.4	1	0.8
Unidentified animal parts	1	33.3	3	14.3	1	2.4	2	1.7
Pebbles					2	4.8	3	2.5
Mud					1	2.4	0	
Number of empty stomachs	2				30			
Number of non-empty stomachs	3				42			
Total number examined	5				72			

%0: Percentage ofoccurrence, %N: Percentage of number

mysis form for *N. hastatus* and *P. longirostris*. *P. longirostris* mysis occurred in *A. gigas* Table 2, *Fonticulus elongatus* and *T. lepturus* while *N. hastatus* mysis occurred in *Fonticulus elongatus, Pseudotolithus senegalensis, P. quadrifilis* and *T. lepturus*. These mysis forms are planktonic while the juvenile forms and adults are benthic. *Penaeus notialis* were scanty and were found in only *A. regius* and *L. goreensis*. *Sicyonia* sp. was found only as a single individual in *S. melanotheron* (Table 8).

The Lobster, *Scyllarides herklotsii* was another food item which was always found in the stomach contents of *A. gigas, L. goreenis, P. macrolepsis, P. jubelini, A. regius, Fonticulus*

Table 5: Analysis of food items found in the Stomachs of *Argyrosomus regius, Pseudotolithus (Pseudotolithus) senegalensis* and *Pseudotolithus (Fonticulus) elongatus* in the study area, Nov. 2004-June 2006

	Argyrosomus regius				*Pseudotolithus senegalensis*				*Pseudotolithus elongatus*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food Items	Frequency	%0	No.	%N	Frequency	%0	No.	%N	Frequency	%0	No.	%N
Dead plant parts									2	0.3	4	0.3
Unidentified plant parts					2	10	5	3.2	21	3.6	80	5.2
Nematodes (Nematoda)					10	50	76	48.1	159	26.9	340	22.2
Partially digested polychaete									2	0.3	2	0.1
Amphipoda												
Ampelisca brevicornis									1	0.2	1	0.1
Argissa hamatipes									1	0.2	2	0.1
Isopoda												
Gnorimosphaeroma sp.									18	3.1	23	1.5
Ligia sp.									1	0.2	1	0.1
Pagurid decapod												
Clibernarius sp. (Hermit Crab)									1	0.2	1	0.1
Lobsters												
Scyllarides herklotsii antennae	1	11.1	1	3	6	30	12	7.6	92	15.6	188	12.3
Scyllarides herklotsii									131	22.2	161	10.5
Shrimps												
Glyplus marsupialis	1	11.1	1	3					84	14.3	98	6.4
Nematopalaemon hastatus mysis					1	5	7	4.4	13	2.2	73	4.8
Nematopalaemon hastatus juvenile					2	10	2	1.3	21	3.6	27	1.8
Parapenaeus longirostris mysis									16	2.7	46	3
Parapenaeus longirostris juvenile	1	11.1	2	6.1	5	25	10	6.3	92	15.6	111	7.3
Penaeus notialis	1	11.1	1	3								
Partially digested shrimps	2	22.2	2	6.1	2	10	3	1.9	59	10	60	3.9
Shrimp appendages	1	11.1	12	36.4					3	0.5	7	0.5
True crabs												
Callinectes marginatus	1	11.1	1	3					6	1	7	0.5
Geryon maritae	4	44.4	5	15.2	3	15	4	2.5	21	3.6	23	1.5
Goniopsis pelii	1	11.1	1	3					3	0.5	4	0.3
Sesarma angolense	1	11.1	1	3					1	0.2	1	0.1
Partially digested crab	1	11.1	1	3					34	5.8	35	2.3
Crab appendages/parts									3	0.5	11	0.7
Fish												
Partially digested fish	1	11.1	1	3	9	45	12	7.6	73	12.4	82	5.4

Table 5: Continued

	Argyrosomus regius				*Pseudotolithus senegalensis*				*Pseudotolithus elongatus*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food Items	Frequency	%0	No.	%N	Frequency	%0	No.	%N	Frequency	%0	No.	%N
Fish scales	1	11.1	2	6.1	1	5	4	2.5	11	1.9	44	2.9
Fish ossicles					3	15	7	4.4	1	0.2	1	0.1
Fish eggs					4	20	10	6.3	8	1.4	10	0.7
Fish gills									1	0.2	1	0.1
Fish ribs									11	1.9	15	0.9
Fish vertebral column					2	10	2	1.3	23	3.9	23	1.5
Unidentified animal parts									14	2.4	29	1.9
Pebbles of number	1	11.1	2	6.1	2	10	4	2.5	8	1.4	19	1.2
Number of empty stomachs	3		4						164			
Number of non-empty stomachs	9		20						589			
Total number examined	12		24						753			

%0: Percentage ofoccurrence, %N: Percentage of number

elongatus, Pseudotolithus senegalensis and *P. quadrifilis,* particularly at times when shrimps were scarce.

True Crabs, represented by the dominant *Geryon maritae, Goniospsis pelii, Sesarma angolense* and *Callinectes marginatus* occurring as larvae, juveniles, parts or partially digested form, constituted the dominant food items of *Arius gigas* (Table 2) by the occurrence method. They also occurred in the stomach contents of *L. agennes, E. aeneus, P. macrolepsis, P. jubelini, A. regius, Fonticulus elongatus. Pseudotolithus senegalensis, P. quadrifilis, D. margarita* and *S. melanotheron.*

Extraneous insects, wing reproductive termite, *Termes flavipes* which occurred in the water at a period of nuptial flight was found in large number in the stomach content of *A. gigas* (Table 2) and *P. sebae* (Table 6). Extraneous hymenopteran nymph was also found in the stomach content of *S. melanotheron* (Table 8). Diptera larvae, represented by *Chironomus transvalensis, Cryptochiromomus* sp. *Polypedilum* sp. and *Palpomyia* sp. dominated the stomach content of *P. macrolepsis* (Table 4). The Trichopteran, *Oxyethira* sp. was also found in the stomach content of Sarotherodon melanotheron.

Isopods (*Gnorimosphaeroma* sp. and *Ligia* sp.) and nematodes dominated the food items of *D. margarita* Table 7. *Gnorimosphaeroma* sp. and *Ligia* sp. were also found in *Fonticulus elongatus.* Nematodes which were most abundant in *Fonticulus elongatus* were also found in *A. gigas, E. aeneus, C. latus, P. macrolepsis, P. jubelini, Pseudotolithus senegalensis, P. sebae, S. afra, P. quadrafilis, T. lepturus* and *D. margarita.* Amphipods, represented by *Argissa* and *Ampelisca brevicornis* were also found in *Fonticulus elongatus.* Also found in *Fonticulus elongatus* was the pagurid decapod, *Clibernarius* sp. (Hermit Crab) (Table 5).

Table 6: Analysis of Food Items Found in the Stomachs Of *Psettias sebae, Sphyraena afra, Sphyraena guachancho* and *Sphyraena sphyraena* in the Study Area, Nov. 2004-June 2006

	Psettias sebae				*Sphyraena afra*				*Sphyraena guachancho*				*Sphyraena sphyraena*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food items	Frequency	%0	No.	%N	Frequency	%0	No.	%N	Frequency	%0	No.	%N	Frequency	%0	No.	%N
Unidentified plant parts	7	36.8	38	28.8									1	100	17	8.9
Dead plant parts	1	5.3	1	0.8												
Nematodes (Nematoda)	4	21.1	8	6.1	2	40	3	16.7								
Diptera larvae																
Palpomyia sp.	1	5.3	1	0.8												
Isoptera																
Termes Flavipes (*Wing reproductive termite*)	1	5.3	60	45.5												
Shrimps																
Glyphus marsupialis	3	15.8	3	2.3												
Parapenaeus longirostris	2	7.7	4	3												
Shrimp appendages	1	5.3	1	0.8									1	100	1	0.5
Fish																
Psettias sebae					1	20	1	5.6								
Polydactylus quadrifilis					1	20	1	5.6								
Partially digested fish					3	600	3	16.7	1	100	1	4.8	1	100	1	0.5
Fish scales	1	5.3	2	1.5	1	20	6	33.3	1	100	20	95.2	1	100	105	54.7
Fish ribs	1	5.3	3	2.3									1	100	65	33.9
Fish eggs					1	20	2	11.1					1	100	3	1.6
Fish ossicles					1	20	2	11.1								
Partially digested crab	1	5.3	1	0.8												
Unidentified animal parts	3	15.8	10	7.6												
Mud	2	7.7														
Number of empty stomachs	19				0				0				0			
Number of non-empty stomachs	19				5				1				1			
Total number examined	38				5				1				1			

%0: Percentage of occurrence, %N: Percentage of number

Table 7: Analysis of food items found in the stomachs of *Polydactylus quadrifilis, Trichiurus lepturus, Cynoglossus senegalensis* and *Dasyatis margarita* in the study area, Nov. 2004 -June 2006

	Polydactylus quadrifilis				*Trichiurus lepturus*				*Cynoglossus senegalensis*				*Dasyatis margarita*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food items	Frequency	%	Numbers	%N	Frequency	%	Numbers	%N	Frequency	%	Numbers	%N	Frequency	%	Numbers	%N
Unidentified plant parts									1		100	18	94.7			
Nematodes (Nematoda)	13	27.1	54	41.2	1	100	6	66.7					2	66.7	17	15.5
Isopoda																
Gnorimosphaeroma sp.													1	33.3	1	0.9
Ligia sp.													1	33.3	1	0.9
Lobsters																
Scyllarides herklotsii antennae	3	6.3	3	2.3												
Scyllarides herklotsii	2	4.2	2	1.5												
Shrimps																
Glyphus marsupialis	18	37.5	23	17.6	1	100	1	11.1	1	100	1	5.3	1	33.3	1	0.9
Nematopalaemon hastatus mysis	1	2.1	3	2.3	1	100	1	11.1								
Nematopalaemon hastatus juvenile	1	2.1	3	2.3												
Parapenaeus longirostris mysis					1	100	1	11.1								
Parapenaeus longirostris juvenile	6	12.5	13	9.9												
Partially digested shrimp	10	20.8	10	7.6												
True crabs																
Callinectes marginatus	3	6.3	4	3.1												
Geryon maritae	3	6.3	3	2.3												
Goniopsis pelii	1	2.1	1	0.8												
Partially digested crab	4	8.3	4	3.1	1	33.3	2	1.8								

Table 7: Continued

	Polydactylus quadrifilis				*Trichiurus lepturus*				*Cynoglossus senegalensis*				*Dasyatis margarita*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method	
Food items	Frequency	%0	Numbers	%N	Frequency	%0	Numbers	%N	Frequency	%0	Numbers	%N	Frequency	%0	Numbers	%N
Mollusca																
Crucibranchaea sp.													1	2.1	1	0.8
Unidentified shell parts													1	33.3	1	0.9
Fish																
Psettias sebae																
Partialy digested fish	5	10.4	5	3.8												
Fish vertebral column	1	2.1	1	0.8												
Unidentified animal parts	1	2.1	1	0.8												
Mud													2	66.7	0	
Pebbles													1	33.3	12	10.9
Sand													2	66.7	75	68.2
Number of empty stomachs	26			2					0				0			
Number of non-empty stomachs	48			1					1				3			
Total number examined	76			3					1				3			

%0: Percentage of occurrence, %N: Percentage of number

Table 8: Analysis of food items found in the Stomachs of *Sarotherodon melanotheron, Tilapia guineensis, Liza falcipinnis, Mugil cephalus* and *Mugil curema* in the study area, Nov.2004-June. 2006

	Sarotherodon melanotheron				*Tilapia giuineensis*				*Liza falcipinnis*		*Mugil cephalus*		*Mugil curema*			
	Frequency of occurrence method		Numerical method		Frequency of occurrence method		Numerical method		Frequency of occurrence method		Frequency of occurrence method		Frequency of occurrence method		Numerical method.	
Food items	Frequency	%0	Numbers	%N	Frequency	%0	Numbers	%N	Frequency	%0	Frequency	%0	Frequency	%0	Numbers	%N
Mud	3	42.9			11	100			1	100	2	100	23	100		
Unidentified plant parts	2	28.6	50	66.7									6	26	10	90.9
Unidentified fruit seed	1	14.3	16	21.3									1	4.3	1	9.1
Unidentified animal parts	1	14.3	3	4												
Oxyethira sp (Trichoptera)	1	14.3	1	1.3												
Hymenopteran nymph	1	14.3	1	1.3												
Shrimps																
Parapenaeus longirostris	2	28.6	2	2.7												
Sicyonia sp	1	14.3	1	1.3												
Partially disgested shrimp	1	14.3	1	1.3												
Crab parts					1	9.1	2	100								
Number of empty stomachs	1				7				0		0		8			
Number of non-empty stomachs	7				11				1		2		23			
Total number examined	8				18				1		2		31			

%0: Percentage of occurrence, %N: Percentage of number

Polychaetes in partially digested form were found in *Arius gigas*. The species, *Harmothoe* sp. was found in *Pomadasys jubelini* Table 4. Molluscs represented by *Tympanotonus fuscatus fuscatus* and *Tympanotonus fuscatus radula* were found in the stomach contents of *E. aeneus* and *L. agennes*. The planktonic *Crucibranchaea* sp. was found in *Polydactylus quadrafilis*. Unidentified shell parts were found in *D. margarita*.

Unidentified animal parts were found in *E. aeneus, P. quadrifilis, L. agennes, L. goreenis, P. jubelini, P. macrolepsis, P. elongatus* and *M. curema*.

Unidentified plants parts were found in *A. gigas, C. senegalensis, P. sebae, L. agennes, L. goreensis, Fonticulus elongatus, Pseudotolithus senegalensis, P. macrolepsis, E. aeneus* and *P. jubelini*. Dead plant matter was also found in *P. sebae* and *Fonticulus elongatus*. Unidentified fruit seeds were found in *S. melanotheron*. Pebbles were found in *P. jubelini, A. regius, Fonticulus elongatus, Pseudotolithus senegalensis* and *D. margarita*. Sand was also found in *D. margarita*.

Mud was found in *P. jubelini, P. sebae* and *D. margarita*. Mud was the dominant food item in the stomach contents of the bottom feeders, *S. melanotheron, T. guineensis, L. falcipinnis, M. cephalus* and *M. curema*.

A. gigas, Fonticulus elongatus, Pseudotolithus senegalensis, T. lepturus, P. quadrifilis, S. afra, S. guachancho and *S. sphyraena* were benthopelagic feeders while *C. latus, C. senegalensis, D. margarita, E. lacerta, P. macrolepsis, P. jubelini, L. agennes, L. goreensis, P. sebae, A. regius* and *E. aeneus* were benthic feeders and all were predominantly predatory.

DISCUSSION

The food items in the stomachs of Buguma creek fish species indicated that they were euryphagous, i.e., feeding on a wide range of organisms (Olojo *et al.*, 2003), except for bottom feeders in the families Cichlidae (*S. melanotheron* and *T. guineesis*) and Mugilidae (*L. falcipinnis, M. cephalus* and *M. curema*). The food of the predatory feeders were highly dominated by benthic and planktonic species.

Any seasonal changes in the composition of the stomach contents probably reflected the abundance and availability of each item recorded (Beumer, 1978).

Comparison with finding of Fagade and Olaniyan (1973) on Lagos lagoon species reveals a minor shift in food items. *M. sebae, L. goreensis, P. elongatus* and *P. jubelini* which they considered non-piscivorous predators in their study were found to be piscivorous predators in this study. This could be attributed to differences in habitats, relative abundance of prey organism and individual species food habitat (Sarker *et al.*, 1980; Alfred-Ockiya, 2000). But their finding that *E. lacerta, E. aeneus, C. hippos, Sphyraena* spp. and *P. quadrifilis* are piscivorous predators conforms with this study. Other piscivorous predators in this study were *L. agennes* in which whole *Sardinella maderensis* and fish parts were found, *Pseudotolithus senegalensis* and *A. regius*.

Apart from the bottom feeders and the piscivorous *Sphyraena* spp., the overall picture of the diet that emerged from the fishes of Buguma Creek is that of species which are largely unspecialised in their feeding habits. This is further confirmed by the feeding on the extraneous wing reproductive termites, *Termes flavipes* by *A. gigas* and the extraneous hymenopteran nymph by *S. melanotheron*. Unspecialised flexible dietary habits are an optimal strategy for survival in habitats where food sources are subject to fluctuation (Welcomme, 1979; Olojo *et al.*, 2003). Similarly, the inclusion of large amount of mud (detritus) in the diet of *D. margarita* (*Dasyatidae*) is of survival value. It is abundant always in the creek.

Shrimps juveniles and mysis were the dominant food items of the predatory fishes. The abundance of these shrimps could be attributed to the fact that unlike penaeid adults that live offshore and spawn in deeper waters, the juvenile forms inhabit estuaries (Khan *et al*., 2001). The predators also feed on the lobster, *Scyllarides herklotsii*. This serves as dominant food item at periods when shrimps were not available.

The occurrence of the planktonic Shrimp mysis in the diet of *A. gigas*, *Fonticulus elongatus*, *Pseudotolithus senegalensis*, *T. lepturus* and *P. quadrifilis* which was also observed to feed on the planktonic *Crucibranchaea* sp. is an indication that they are benthopelagic. The predatory fishes of Buguma creek were either benthopelagic or benthic feeders.

Stomach content analysis based on fullness method revealed that out of 1149 number of fishes examined, only 299(26%) had empty stomach. This could be attributed to the fact that predatory fishes have irregular feeding habit and tend to take a large meal when their prey is available (Corbet, 1961; Thomas, 1966; Munro, 1967; Fagade and Olaniyan, 1973). Odum and Anuta (2001) attributed high empty stomach in *Phractolaemus ansogii* to intermittent feeding. On the other hand, the mud containing detritus was always available for the bottom feeders.

Frequency of occurrence method was not used for *Gobius* sp. because only one individual was examined. The numerical method was not used for *L. falcipinnis*, *M. cephalus* and *T. giuneensis* because only mud was found in their stomachs.

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