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Foods of the mudskipper (*Periophthalmus barbarus*) from New Calabar River, Nigeria

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Abstract: *A study on the food intake of Periophthalmus barbarus in New Calabar River was carried out for a period of twelve months using standard methods. A total of four hundred and fifty (450) samples were examined, the study showed that the a length range was 4.1-14,2cm and weight of 0.70-39.62g.twenty two food items were observed in the stomachs of the fish consisting of both plant and animal tissues. The dominant items were fish scale (23.20%) and crab parts (6.7%). There were several unidentified crabs, insects and plants. The most important food item observed was fish scale which scored 23.20% in the index of food significance (IFS). There was an increase in the incidence of empty stomachs in the rainy season.*
Key words; *Food, Feeding, mudskipper, Periophthalmus.*

I. Introduction

Feeding and searching for food regulate or at least influence the distribution, migration and growth of fish. Fish can change their behavior according to food availability. Various forms of feeding and food items are found among fishes. According to Lagler (1977) the search for and feeding methods in fishes vary from species to species. The various forms of feeding found in fishes include filter feeding, carnivores, and herbivores. Osman and Mohmoud (2009) reported that various methods have been developed for the quantitative estimation of diet composition in fishes. Among these, the estimation of abundance and occurrence of different food items are the most popular. Research on transparent goby, *Aphia minuta* by Hesthagen (1971) and Miller (1986) revealed that copepods, cirripeds and mysid larvae were the main componenet of its diet. The food of *Gobius cobitis* as reported by Miller (1986) includes green algae, crustaceans, polychaetes and insects. This tends to portray the gobies as omnivores. Studies by Khoo (1980) on *Periophthalmus barbarus* revealed plant and animal materials in the diet of the species. Detritus, terrestrial insects, chironomids and crabs made up the diet of the species in Buguma River in the study of Edema (1985).While Emmauel and Ajibola (2010) reported crustaceans, pisces and bivalves as the three major food of the frillfin goby *Bathygobius soporator.* This study is intended to provide baseline information on the food and feeding habit of the species, which could serve as guide for aquaculturists and fisheries resource managers.

II. Materials And Method

The samples were collected from the New Calabar River which lies within 4^0 15^1 N and 4^0 45^1 N, and 6^0 57^1 and 7^0 04^1E. The river flows from the hinterland and empties into the Atlantic Ocean. It is one of the tributaries of the River Niger. Its banks are surrounded by the red and white mangroves (*Avicennia sp* and *Rhizophora* sp). Irving (1962) reported that the depth of the river varies from 8 metres to 4. 5 meters, and width varies from 5.08km to 2.54km. Samples were collected bi-weekly for each month from February 2008 to January 2009.The fish was caught using traps made from bamboo. They were 30cm long and had a diameter of 5cm. The traps were buried in the mud flat at low tide with smashed *Uca tangeri* (West African fiddler crab) sprinkled around it to attract the mudskippers. Three traps were used and positioned about 30 meters apart, and left for about one hour. Samples from the stations were pooled together and preserved in 10% formaldehyde solution.

The stomach of each *P. barbarus* was dissected, and its degree of fullness estimated by an arbitrary 0 - 20 point scale: thus 0, 2.5, 5, 10, and 20 points were allotted to empty , trace, quarter-full, half-full, three quarter full and fully distended stomachs. Stomach contents were sorted into categories and analyzed using relative frequency (RF) and point method (Hynes, 1950; Hyslop, 1980). In the RF, the frequency of a particular food item in all stomachs was expressed as a percentage of the frequency of all food items. For the point's scheme (PP), each stomach was allotted 20 points regardless of the fish size. These were shared amongst the various contents, taking into account their relative proportion by volume. The points gained by each food in all stomachs examined were computed and expressed as a percentage of the total points of all food items. The point's scheme gave an indication of bulk contribution of each food category to the diet composition. %RF and %PP were then used to determine the index of food significance (IFS) as follows:

$$IFS = \frac{\%RF \times \%PP}{} \times l00$$

Σ%RF x %PP (Ezenwaji and Offiah, 2003)..

Food with IFS 3% was regarded as primary, 0.1 to <3% as secondary, whereas food with < 0.1% was regarded as incidental.

Food richness was defined as the number of food items in the diet with IFS 0.1%. Food composition for rainy and dry seasons was tested for variation by t-test.

III. Results

A total of 450 stomachs were dissected to study the food and feeding habits of *P. barbarous*. The samples studied had length range of 4.1cm-
14.2cm, and weighed from 0.70g to 39.62g. The mean length of samples was 8.64±1.27cm and the mean weight was 11.16±7.29g. The modal class was 7-9cm. The organism feeds on a wide range of food items which include crabs, shrimps, insects, annelids, nematodes, plants, other organic matter and sand grains. Of the 22 food items observed, only 3 varied significantly in the consumption level between the seasons namely unidentified crab parts, *Penaeus* sp, and annelids/ nematode worms (Tables 2 and 3).The major food items consumed by the species were unidentified crabs, fish scale and unidentified insects (Table 1).

There was increase in number of empty stomachs observed in the rainy season, following prolonged periods of flood tide. During the dry season an increased activity was observed on the mud by the fish.

Table 1.Mean Annual Values of Food items by Point and Relative Frequency (RF) of Occurrence .

Food item	RF	Point	RF*Point	%RE*Point
*Sesarmaangolense*23	67	1541	2.17	
*Ocypoda*sp	24	60	1440	2.03
Parts of Crabs	61	79	4819	6.78
Unidentified Crabs	71	99	7029	6.78
Shrimp				
Penaeussp	16	37	592	0.88
Gastropod				
*Pachymelania*sp	29	57	1653	2.32
*Neritina*sp	23	47	1081	1.52
*Assiminia*sp	22	53	11.66	1.64
Bivalve				
*Tellina*sp	21	64	1344	1.89
Fish				
Fish scale	131	126	16506	23.20
Insects				
Coleoptera	45	67	3015	4.24
Tricoptera	41	50	2050	2.88
Hemiptera	24	51	1224	1.72
Inseect larvae	34	44	1496	2.10
Unidentified insects	87	110	9570	1346
Annelids/Nematods	28	37	1036	1.47
Unidentified worms	48	65	3120	4.39
Plants				
Algae	30	42	1260	1.77
Macrophytes	38	49	1862	2.62
Unidentified plants	59	73	4307	6.06
Organic matter	47	52	2444	3.44
Sand grains	69	37	2553	3.59
Total	971	1366	71108	100.00

Table 2. Monthly Index of Food Significance of P. barbarous

Food item Crustacea	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.
Sesarmaangolense	1.55	--	0.76	3.96	1.45	--	4.26	--	1.53	3.27	2.73	
Ocypodesp	0.64	2.71	1.90	3.08	--	4.98	2.56	4.95	1.14	1.90	1.94	0.82
Parts of crabs	2.19	9.04	5.32	9.25	3.38	9.97	10.44	16.50	9.47	6.80	--	0.55
Unidentified crabs	15.46	14.18	3.42	10.57	7.79	13.43	13.43	7.92	7.53	6.53	4.99	9.84
Shrimp												
Penaeussp	1.55	3.01	--	--	--	--	--	1.32	1.14	3.27	1.94	3.28
Mollusca	**Gatropoda**											
Pachymelaniasp	6.44	2.71	--	4.63	1.61	3.12	5.12	1.98	3.03	1.63	0.55	0.55
Neritinasp	1.93	--	1.90	4.41	0.64	0.62	1.22	1.32	2.27	0.54	0.83	6.56
Assiminiasp	0.77	4.52	0.76	0.66	0.64	0.62	1.49	2.64	4.55	0.69	0.55	3.28
Bivalvia												
Tellinasp	1.80	4.22	0.95	5.29	0.97	2.34	2.56	--	1.14	3.27	--	2.73
Piscea												
Fish scale	7.73	12.65	10.65	15.42	30.11	34.89	25.59	15.84	21.21	23.13	23.27	45.08
Insecta												
Coleopterasp	3.87	3.61	2.85	3.96	3.22	2.49	2.56	4.95	13.64	5.99	2.49	1.64
Tricopterasp	7.73	--	1.52	2.64	6.76	1.25	1.71	1.98	1.14	5.71	3.88	0.82
Hemipterasp	1.93	--	4.56	1.10	2.42	--	2.56	1.32	--	2.18	6.65	2.19
Insect larvae	3.09	3.61	7.98	0.66	5.34	--	--	7.92	--	2.86	0.83	0.55
Unidentified insects	12.76	18.07	25.10	9.91	22.54	2.80	5.97	3.96	4.55	11.43	32.96	6.56
Annelida/Nematoda												
Annelids/nematodes	4.51	3.16	3.04	1.98	0.48	--	0.43	--	0.76	4.08	2.08	--
Unidentified worms	6.19	2.41	2.64	0.32	0.32	3.12	4.48	3.96	10.61	3.81	4.43	4.10
Plant												
Algae	1.55	--	2.28	6.17	1.93	2.80	0.64	6.60	1.52	1.63	--	1.64
Macrophytes	4.12	2.26	6.84	0.88	0.97	1.25	3.41	3.96	1.52	2.18	1.11	1.09
Unidentified plants	5.41	6.33	7.60	4.41	9.02	5.45	5.97	4.95	6.82	3.27	3.32	3.28
Organic matter	4.12	3.01	2.28	4.41	1.61	8.72	1.28	3.96	3.03	2.04	0.55	0.55
Sand grains	4.64	2.11	2.28	3.96	2.42	4.67	4.26	3.96	3.03	3.81	2.49	2.19
% Empty stomachs	5	13	20	30	37	32	40	40	30	13	10	5

Table 3. Seasonal Index of Food Significance for P. barbarus

Food Item	Rainy Season	Dry Season	P^c
Crab			
Sesarmaangolense2.35	3.27	0.911 ns	
*Ocyypodas*p	2.75	2.07	1.02 ns
Parts of Crabs	8.42	5.60	1.03 ns
Unidentified Crabs	7.53	13.49	2.56 p≥0.1
Shrimp			
*Penaeus*sp	0.13	3.09	4.45 p≥0.1
Gastropod			
*Pachymelania*sp	2.69	3.42	1.04 ns
*Neritina*sp	1.59	2.00	0.95 ns
*Assiminia*sp	1.00	2.51	1.79 ns
Bivalve			
*Tellina*sp	2.06	2.87	1.08 ns
Fish			
Fish scale	23.38	25.55	0.87 ns
Insects			
Coeoptera	3.18	5.74	1.67 ns
Tricoptera	2.79	4.94	1.424 ns
Hemipetera	1.99	3.16	1.05 ns
Insect larvae	3.45	2.80	0.99 ns
Unidentified insects	12.44	20.97	1.48 ns
Annelids/Nematodes	1.00	3.74	2.89 P≥0.025
Uidentified worms	3.62	5.34	0.95 ns
Plants			
Macrophytes	3.08	1.24	1.52 ns
Unidentified plants	2.72	2.87	1.32 ns
Organic matter	6.43	5.89	0.67 ns
Sand grains	3.85	2.94	1.05 ns
%Empty stomachs	3.55	3.96	0.78 ns

ns = not significant. P^c =significance level of difference.

IV. Disscussion

The stomach content of *P. barbarus* was of both plant and animal materials with dominance of food items such as crabs, fish scales and insects. This is similar to results obtained by Skora and Rzeznik (2001) with the gobiid, *Neogobius melanostomus*. This type of feeding shows some degree of selectivity in the species; as such it can be regarded as an opportunistic feeder. This result is also similar to findings by Kowtun *et al.,* (1974) in his report on *Neogobius melanostomus,* considering the wide range of food items found in the stomachs. This behaviour is critical in the survival and the well being of the species, especially when any of the food items is in short supply or not available. Furthermore, this attribute makes the species a good candidate for aquaculture as any available food item would likely be accepted.

The increase in number of empty stomachs during the rainy season could be attributed to the short feeding periods observed at this time due to the reduced low tide duration. This fish is found to be much active on the mud flats at low tide. Studies by McGregor (1999) showed this period of activity is important in the feeding, mating and other biological activities of the fish.

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