Global Science Research Journals

ISSN: 2408-5464 Vol. 5 (2), pp. 425-429, February, 2017.

http://www.globalscienceresearchjournals.org/

Global Journal of Fisheries and Aquaculture

Full Length Research Paper

Abundance of natural foods needed by Mugil cephalus in the Elechi Creek Niger Delta

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Accepted 27 January, 2016

The present study is aimed to provide information on the abundance of natural foods needed by *Mugil cephalus* in the Elechi Creek. The natural food of *M. cephalus* in the Elechi Creek was studied from stomach contents of the fish. The stomach contents were analyzed using two methods; the frequency of occurrence and numerical methods. Plant materials, diatoms, algae and dinoflagellates constituted its main food. Plant materials were found to be the most preferable food where it occurred in 67.0% of the examined fish. Annelids, fish larva, fish parts, insect parts and crustaceans comprised the food of animal origin. Sand/mud and organic matter occurred in about 11.0 and 73.0% of the examined stomachs respectively. These results indicate that *M. cephalus* is omnivorous plant materials were the most abundant food items by numerical and occurrence methods in the gut of the fish species.

Key words: Algae, food items, frequency of occurrence, numerical method, stomach content.

INTRODUCTION

The study of the food and feeding habit is useful and fundamental to understand the functional role of the fish within its ecosystem. The family Mugilidae is among the commercially important fishes occurring in Elechi Creek, Rivers State. They consist of seventeen genera and eighty species which are widely distributed along the brackish estuaries and coastal lagoons. They are popular, well accepted and form a large proportion of the diets of the rural communities in coastal areas in Nigeria. *Mugil cephalus* occurs worldwide from approximately 42° N to 42° S Latitude (Bok, 1979; Render et al., 1995), where it inhabits estuarine intertidal freshwater and coastal marine habitats. In the western Atlantic Ocean, *M. cephalus* ranges from Cape Cod to Brazil, including the Gulf of Mexico, Caribbean, and West Indies (Fagade and Olaniyan, 1998). Adults and juveniles of grey mullets are hardy, euryhaline, eurythermal and not competitor for food among its species. School occurs in shallow coastal waters; they enter lagoons and estuaries to feed (Rheman et al., 2002). In estuarine waters, they feed on detritus, diatoms, algae and microscopic invertebrates (McDonough and Wenner, 2003). Bishop and Miglarese (1978) found that the principal food sources of adult mullet are detritus and epiphytic algae. However, they also observed *M. cephalus* feeding opportunistically on swarming polychaetes of the *Nereis* genus. The species is heterotrophic, adults feed primarily on detritus. Mullets constitute a large proportion of the catches by artisanal

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Table 1. Analysis of food items stomach of *M. cephalus* by numerical and frequency of occurrence.

Food items	Numerical method		Occurrence method	
	No	%	No	%
Algae	179	19.40	45	15.68
Diatoms	229	24.81	23	8.01
Plant materials	281	30.44	67	23.35
Crustaceans	39	4.23	14	4.88
Fish parts	16	1.73	9	3.14
Insect parts	9	0.97	7	2.44
Annelids	3	0.32	2	0.70
Sand / mud	-	-	11	3.83
Organic matter	-	-	73	25.44
Dinoflagellates	163	17.65	33	11.50
Fish larva	4	0.43	3	1.05

and subsistence fishermen in lagoons and rivers and generate a high market value in demand because of their taste. This paper describes the diet and feeding habits of *M. cephalus* based on the examination of stomachs collected.

MATERIALS AND METHODS

Study area

The Elechi Creek also known as Elechi, Omo Ema Creek is located in Rivers State, Niger Delta Nigeria. The creek lies between longitude 6° 45″E and 7° 20″N and latitude 4° 38″N and 5° 5″E South-West of Port Harcourt. The creek is tide dominated embayment with little fresh water input and is characterized by extensive mangrove swamps, tidal flats, influenced by semi-diurnal tidal regime (NEDECO, 1961).

The vegetation consists of mangrove forest dominated by the red mangrove *Rhizophora racemosa* and *Rhizophora mangle.* In some areas, the white mangrove *Avicennia africana* is interspersed with *Nypa fructicans.* Its vegetation provides logs of wood for domestic and building purposes. The low inter-tidal zone is usually bare of vegetation, with clay, peat and sand deposit. The area is surrounded by numerous water fronts' residential houses. The surrounding terrestrial environment is marked by various human activities such as saw milling of timber.

Sampling procedure

The food and feeding habits of *M. cephalus* was studied by examining the stomach contents. Fish samples were collected with gill and cast nets. The nets used were between 30 and 60 mm mesh size. Specimens of *M. cephalus* were collected fortnightly from the artisanal fishermen. Fish specimens were transported to the University of Port Harcourt, Faculty of Agriculture laboratory to investigate the food and feeding habits.

The fish samples were preserved in 10% formalin solution to avoid deterioration. Each fish specimen collected was given a registration number which indicates date of capture, weight and length. Standard and total lengths (in centimeter) were measured using a measuring board while the weights (in grammes) were taken to the nearest gram using a sensitive electrical balance, MP 2003 model. The stomachs were removed intact by cutting above the cardiac and below the pyloric sphincters and preserved in a vial with 4% formalin. Dissection entailed making an incision above the longitudinal axis of the stomach and intestine. The stomach contents were emptied into a Petri dish and identified to the lowest taxonomic level. Identification entailed first sorting by eye for larger food substances. Secondly the stomach contents were dropped on the slides with the aid of a dropping pipette and observed under a light microscope (with variable magnifications up to X 40) examinations.

Food was regarded as total ingested matter and was analysed using the frequency of occurrence and the numerical methods (Bagenal, 1978; Hyslop, 1980). In the frequency of occurrence each food item was used to indicate the proportion of fishes eating a particular food item. The merits and limitations of these methods have been discussed by Dunn (1954), Crips (1963) and Fagade and Olaniyan (1972).

Frequency of occurrence = X/Y x 100%

Where, X = number of stomach where each food item is present, Y = number of stomachs for the experiments.

In numerical methods, the number of individual in each category is recorded for all stomachs and the total is expressed as a proportion.

RESULTS

Food composition

Table 1 show the list of food items found in the stomach of *M. cephalus,* while the summary of the items are illustrated in Figure 1. The relative contributions of the food items are expressed by frequency of occurrence and numerical methods. A total of 100 stomachs were randomly examined. Eleven major items constituted the diet of *M. cephalus,* four forming the dominant stomach content.

Food composition for juvenile's *M. cephalus*

In the numerical analysis plant materials were dominant

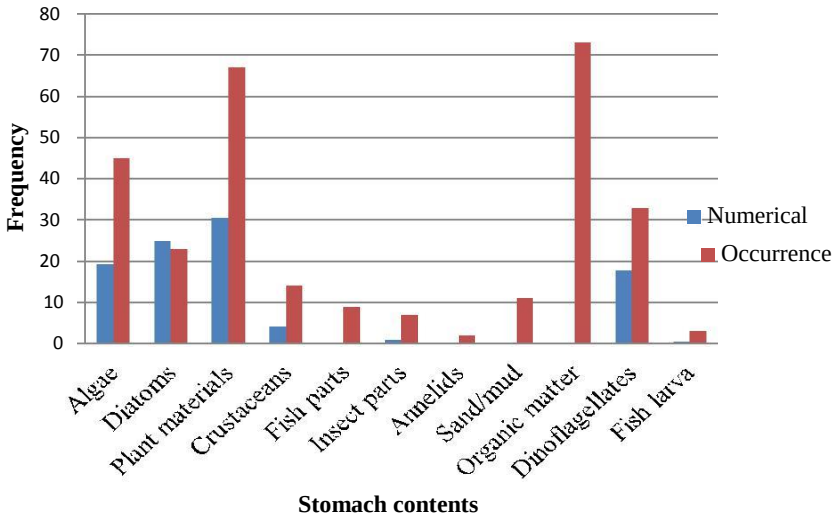

Figure 1. Summary of the stomach contents of *M. cephalus* from the Elechi Creek.

and composed of 30.44% of the items in the stomach, diatoms made up 24.81%, while algae made up 19.40%, dinoflagellates 17.65%, crustaceans 4.23%, fish parts and insect parts 1.73 and 0.97%. Fish larva and annelids were the least with 0.43 and 0.32% respectively.

Food items were contained in one hundred stomachs and organic matter (detritus) and sand particles were present in 25.44%, plant materials were contained in 23.35% of the stomach, algae 15.68%, dinoflagellates 11.50%, diatoms 8.01%, crustaceans 4.88%, fish and insect parts had 3.14 and 2.44%. The least food items of 1.05 and 0.70% were found in fish larva and annelids respectively.

The result of the stomach content of the various size groups is presented in Table 2. Plant materials constituted the most consumed food items fed on in the three size groups both by numerical method (30.91, 33.84 and 25.0) and by frequency of occurrence (33.33, 33.84 and 17.89) methods. Detritus (organic matter) constituted the most occurring item in the stomachs of the three size groups of *M. cephalus* from the Elechi Creek by occurrence (37.17, 24.32, and 17.89). Plant materials were the next in occurrence to the detritus in number of stomach where they are found in the three size groups. The medium size groups consumed more food items than the other size groups.

Variation in empty stomach by size group (Table 3) indicated that the small size group of *M. cephalus* had the highest number of empty stomachs (8.51%), while the medium sized group had (6.25%) and the large sized group had no empty stomach.

DISCUSSION

The food composition of the species in Elechi Creek shows a high food richness as the specimens showed high trophic flexibility by the wide variety of food items consumed. *M. cephalus* is diurnal feeder, consuming mainly zooplanktons, dead plant matter and detritus. In this study *M. cephalus* foods varied from microscopic items such as diatoms to macroscopic ones such as annelids and fish parts. This is an indication that it has advantages of using large aquatic resource to its advantage. This high trophic flexibility ensures a constant energy source which is necessary for its large population (King, 1988). Its occurrence maybe due to this reason; the fish was able to shift from one form of food to another depending on the seasons and availability of the foods. Availability of food organisms are often cyclic and maybe due to their life histories, climate, or environmental conditions. During this study, empty stomach was recorded between the months of August (12.5%) and September (5.0%).

Presence of plants presumed the species as an herbivore, while the availability of invertebrates showed it as a carnivore, fish parts as a part of its diet was an indication of its piscivorous ability. Presence of organic matter and sand/mud in reasonable number mean the species was both detritus and benthic feeder food is ingested from bottom substrate.

In relation to size, the trend among the three size groups of the stripped mullets from the Elechi Creek changes. The juveniles fed mainly on plant materials, algae, dinoflagellates, diatoms and crustaceans, while the adults predominantly fed on plant materials, algae, dinoflagellates, diatoms, crustaceans, annelids, fish parts, insect parts, sand/mud and organic matter. The high dietary importance of sand/mud and detritus may be due to the marginal mangrove vegetation growing on water-logged deposits of soft mud and clay-silt sediment.

The decomposing leaves and other biogenic materials

Table 2. Stomach contents of *M. cephalus* by size groups from Elechi Creek.

Stomach contents	Small-sized (11.2-13.cm)				Medium-sized (13.7-18.5cm)				Large-sized (18.6-24.7cm)			
	Numerical method		Occurrence method		Numerical method		Occurrence method		Numerical method		Occurrence method	
	No	%	No	%	No	%	No	%	No	%	No	%
Algae	42	24.6	11	14.1	83	18.4	21	18.9	54	18.0	13	13.7
Diatoms	26	15.2	3	3.9	118	26.1	11	9.9	85	28.3	9	9.5
Plant materials	53	30.9	26	33.3	153	33.8	24	21.6	75	25.0	17	17.9
Crustaceans	9	5.3	2	2.6	18	4.0	7	6.3	12	4.0	5	5.3
Fish parts	-	-	-	-	5	1.1	3	2.7	11	3.7	6	6.3
Insect parts	-	-	-	-	2	0.4	1	0.9	7	2.3	6	6.3
Annelids	-	-	-	-	1	0.2	1	0.9	2	0.7	1	1.1
Unidentified items	-	-	-	-	-	-	3	2.7	-	-	8	8.4
Organic matter	-	-	29	37.2	-	-	27	24.3	-	-	17	17.9
Dinoflagellates	41	24.0	7	9.0	71	15.7	15	13.5	51	17	11	11.6
Fish larva	-	-	-	-	1	0.2	1	0.9	3	1	2	2.1

Table 3. Variation in empty stomach by size of *M. cephalus* from Elechi Creek.

Size/standard length (cm)	Number examined	Number with empty stomach	% Empty stomach
Small-sized (11.2 - 13.6)	47	4	8.51
Medium-sized (13.7 - 18.5)	32	2	6.25
Large-sized fish (18.6 - 24.7)	21	-	-

washed into the swamp ensure a constantly enriched nutrient pool for algae often seen growing extensively on the exposed mud surfaces.

The adults had more of sand/mud and organic matter in their stomach because they become benthic feeder as they grow. This change in diet with growth not only offers a wider range of food resources to the species but also reduces possible competition between the adults and juveniles to some extent. Seasonally variation in the feeding habit was not recorded as the study was carried out only in the rainy season. The success of mullets according to Kurian (1975) and Payne (1976) also lies in their feeding habits and the abundance of their food. Presence of detritus and sand/mud in large quantities in the stomach of the fish does not presume that these items were nutritional better than other food items that appeared in lesser number. Sand/mud has no nutritional property but they might have been picked up along with other food items. Its presence in the gizzard like stomach may assist the fish in digestion process.

In comparison with other studies, this result confirmed to the study on food and feeding habits with reviews from Akpan and Ubak (2005) and Lawson and Jimoh (2010), on the diets of mullets. However, from the study, major food of *M. cephalus* in the Elechi Creek where diatoms, algae, plant materials, dinoflagellates, sand/mud, organic matter, crustaceans, insect parts, fish parts and annelids.

Conflict of Interest

The authors have not declared any conflict of interest.

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