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Ontogenetic Variation in the Diet of *Chrysichthys nigrodigitatus* (Lacepede, 1803) in a Tropical Estuarine Ecosystem in Nigeria

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ABSTRACT

The ontogenetic variation in the diet of *Chrysichthys nigrodigitatus* (Lacepede, 1803) was investigated. The study was carried out for a period of 15 months (Feb.-Sept. 1996 and March-Sept. 1997) based on 660 specimens of the fish. It was aimed at a detailed analysis of the diet composition of *C. nigrodigitatus* and the variation in diet with size class. The diet composition was analysed using the occurrence, numerical and gravimetric methods. These were combined into a composite Index of Relative Importance (IRI) which formed the basis of determining the importance of each food category. *C. nigrodigitatus* is a benthic omnivorous feeder subsisting on a variety of benthic food items, with significant ontogenetic shifts in diet composition. The size classes 0-30.00 and 31-60.00 cm adult had preference for plankton, 61-90.00 cm preferred fish and crabs while 91-120.00 cm had preferential diet of shrimps. Index of Relative Importance (IRI) was as follows: fish-31.8%, Crustaceans-23.6%, bivalves-10.61%, as major food items. The minor food items included plankton, polychaetes, palm fruits, plant materials and detritus. Variation of Condition Factor (CF) with fish length was studied with highest CF value of 1.86 for size group 10-19 cm and lowest CF value of 0.71 for size group 40-49 cm. This study has not only identified *C. nigrodigitatus* as a benthic predator in the estuary, but has also provided data that can make significant inputs into the trophic modeling and multispecies management of the estuary.

Key words: *Chrysichthys nigrodigitatus*, index of relative importance, gravimetric, numerical, frequency of occurrence, condition factor

INTRODUCTION

The study of fish diet is a major topic in the area of fish biology. It forms the basis of establishing the ecological status of a given fish and determining the direction of energy flow within an ecosystem (Hyslop, 1980). Given the shift in emphasis in fisheries science, from single species management to multispecies approaches (Christensen and Pauly, 1993; Christensen, 1995), the study of fish diet provides the most reliable method of determining the nature of biological interactions among the species (Caddy and Sharp, 1986). The estuarine Catfish, *Chrysichthys nigrodigitatus* (Lacepede, 1803), of the family Bagridae, occurs commonly in West Africa. It contributes substantially to the fisheries of the river, lakes and lagoon in Nigeria (Fagade and Adebisi, 1979). Fagade and Olaniyan (1973), reported that the food of *C. nigrodigitatus* in Lagos lagoon consists of bivalve (84% mainly *Aloides*) and gastropod (mainly *Nerita* sp. 14%). Reliable information of the food and feeding ecology of fish is based on the analysis of gut contents of fish obtained from their natural habitat. Hence, this study examines a detail

analysis of the ontogenetic variation in the diet composition of *C. nigrodigitatus*, its trophic status and its biological interaction with other organisms in the Cross River estuary.

MATERIALS AND METHODS

The cross river estuary is a coastal plain estuary (Pritchard, 1967) occupying a total of 54,000 km² (Akpan and Offerm, 1991). *C. nigrodigitatus* constitutes 42% of the trawl landings in cross river estuary. Sampling was done between February and September 1996 and between March and September 1997 on a monthly basis. A total of six hundred and sixty fresh specimens of *C. nigrodigitatus* comprising of all size groups were obtained from artisanal gill net and hook and line fishers at Nsidung Beach, Calcemco Jetty and from traders at the "Volvo fish market" all in Cross River state. The freshly non-damaged specimens were transported in portable cooler containing ice blocks to reduce the rate of food digestion or autolysis in the stomach prior to their examination (Cadwellader, 1975). Also large samples which could not be bought due to high cost were dissected on the spot with the permission from the prospective buyers and their guts included in the container brought to the fisheries and Aquaculture laboratory, Institute of oceanography for analysis. The total length (from the tip of the snout to the tip of the caudal fin). According to Powell (1979) were taken with the aid of a measuring board and the weight of the 660 fish specimens were taken with the aid of 3 weighing devices. All measurement was taken to the nearest 0.1 cm and 0.1 g, respectively. Fish specimens were dissected and gutted and the guts preserved in 4% formaldehyde solution for 3 days prior to analysis, according to the method used by Marioghae (1982). The various diets components were identified and enumerate by the aid of a hand lens, a Carl zeiss JURGEN phase contrast microscope: Model 475002-02. Identification keys and texts were employed such as Edmondson and Ward (1959) and Newell and Newell (1977) for plankton, Powell (1983) for shrimps, Schneider (1990) for fishes. Three methods of stomach content analysis namely frequency of occurrence, numerical abundance and gravimetric methods were employed in this work (Hyslop, 1980). Fulton's Condition Factor (CF) was estimated for individual fish specimen using the formula (Pauly, 1984):

$$CF = \frac{W}{L^3} \times 100$$

RESULTS AND DISCUSSION

The Condition Factor (CF) calculated for the individual fish specimens were pooled into 10 cm size class: 10-19 to 110-119 cm. The variations of CF with fish length for the two years are presented in Fig. 1. The highest CF of 1.86 was obtained for the size group 10-19 cm and the lowest CF of 0.71 was obtained for size group 40-49 cm. The condition factor appears to be highest in the smallest size classes, then reduced rapidly to intermediate values in the adult size classes. The lowest condition factor for fish specimens of 30-50 cm total length may be associated with first maturity in the fish as they develop sex organs for reproduction (Lagler, 1977). The percentage of occurrence, number and weight of various food categories are presented in Table 1. Based on the percentage index of relative importance (%IRI), it is clear that fish constituted the most important food category with a total of 31.8%. Shrimps formed the next most important food category (%IRI-23.6%). A plethora of other food items were obtained: Phytoplankton (%IRI-20.67%), bivalves (%IRI-10.61%), crabs (%IRI-2.93%), zooplankton (%IRI-5.79%), mysids, insects, gastropod, polychaetes, detritus, plant materials and even palm fruits. *C. nigrodigitatus* is omnivorous, feeding on a wide variety of benthic food organism and materials. The significant amount of plankton indicates that it is not entirely benthic in its feeding habit, but

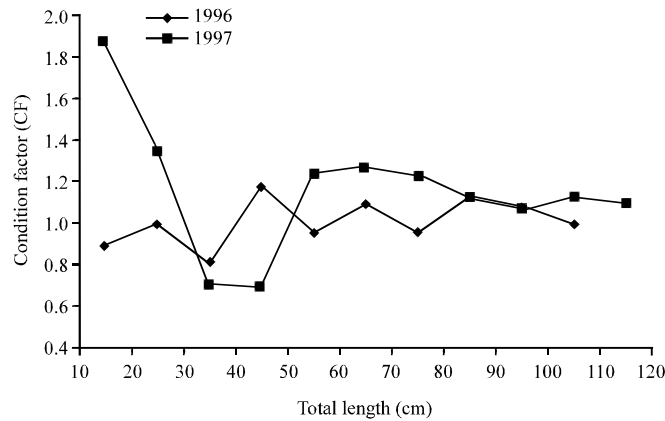


Fig. 1: Variation of condition factor with fish length of *C. nigrodigitatus*

Table 1: The food composition of *C. nigrodigitatus* from 1996-1997 combined

Food items	Occurrence		Numerical		Gravimetric		IRI	IRI %
	No.	%	No.	%	Weight (g)	%		
Fish								
<i>Pseudotolithus elongatus</i>	76	14.3	129	0.1	934.04	8.4	120.61	4.25
<i>Gobioides ansorgii</i>	106	19.9	431	0.2	3732.13	33.4	670.91	23.62
<i>Eleotris</i> sp.	10	1.9	13	++	32.63	0.3	0.56	0.02
Miscellaneous fish	65	12.2	483	0.3	20.43	0.2	5.38	0.19
Fish remains	109	20.5	294	0.2	554.48	5.0	105.11	3.70
Crabs								
<i>Callinectes amnicola</i>	69	13.0	147	0.1	199.12	1.8	24.12	0.85
<i>Ocypode africana</i>	47	8.8	97	0.1	199.12	1.8	24.12	0.85
Other crabs	5	0.9	43	++	2.58	++	0.04	0.001
Crabs remains	151	28.4	768	0.4	173.20	1.6	55.91	1.97
Shrimps								
<i>Palaemonetes africanus</i>	61	11.5	365	0.2	93.53	0.8	11.93	0.42
<i>Alpheus pontederia</i>	22	4.1	99	0.1	9.70	0.1	0.58	0.02
<i>Macrobrachium macrobrachion</i>	127	23.9	406	0.2	490.86	4.4	110.28	3.88
<i>Macrobrachium vollenhovenii</i>	116	21.8	315	0.2	2347.66	21.0	462.38	16.28
<i>Penaeus notialis</i>	107	20.1	1795	1.0	100.49	0.9	37.81	1.33
Shrimp remains	139	26.1	514	0.3	170.80	1.5	47.30	1.67
Bivalvia								
<i>Iphigenia</i> larvae	89	16.7	12437	6.8	1216.32	10.9	296.12	10.43
Bivalve remains	41	7.7	462	0.3	44.95	0.4	5.01	0.18
Diatoms								
<i>Actinocyclus</i> sp.	52	9.8	67258	36.8	-	-	359.44	12.66
<i>Coscinodiscus</i> sp.	24	4.5	3250	1.8	-	-	8.03	0.28
<i>Navicula</i> sp.	23	4.3	8452	4.6	-	-	19.96	0.70
<i>Melosira</i> sp.	20	3.8	9296	5.1	-	-	19.14	0.67
<i>Nitzschia</i> sp.	24	4.5	3650	2.0	-	-	9.02	0.32
<i>Gyrosigma</i> sp.	27	5.1	11630	6.4	-	-	32.31	1.14
<i>Aulacodiscus</i> sp.	52	9.8	25664	14.0	-	-	137.17	4.83
<i>Surirella</i> sp.	5	0.9	4000	2.2	-	-	2.06	0.07

Table 1: Continue

Food items	Occurrence		Numerical		Gravimetric		IRI	IRI %
	No.	%	No.	%	Weight (g)	%		
Zooplankton								
<i>Nauplius</i>	13	2.4	1650	0.9	-	-	2.20	0.08
Ostracoda	15	2.9	2000	1.1	-	-	3.07	0.11
Cladocera	36	6.8	6000	3.3	-	-	22.21	0.78
Harpacticoida	72	13.5	18500	10.1	-	-	136.92	4.82
Mysidae	78	14.7	744	0.4	20.78	0.2	8.80	0.31
Euphausiidae	4	0.8	21	++	0.21	++	0.01	0.00
Insecta (<i>Campanotus acropinensis</i>)	4	0.8	28	++	0.16	++	0.02	0.001
Amphipoda	32	6.0	361	0.2	2.67	++	1.32	0.05
Gastropoda (<i>Neritina glabrata</i>)	34	6.4	231	0.1	14.85	0.1	1.66	0.06
Polychaetes	36	6.8	294	0.2	5.90	0.1	1.42	0.05
Plant materials	102	19.2	258	0.1	37.32	0.3	9.01	0.32
Palm fruits	67	12.6	200	0.1	896.37	8.0	102.48	3.61
Sand/pebbles	12	2.3	205	0.1	1.75	++	0.29	0.01
Detritus/mud	176	33.1	-	-	21.67	0.2	6.29	0.22
Unidentified materials	4	0.8	304	0.2	0.68	++	0.14	0.01
Total			182794	99.98	11159.59	99.98		

++: Percentage composition less than 0.05

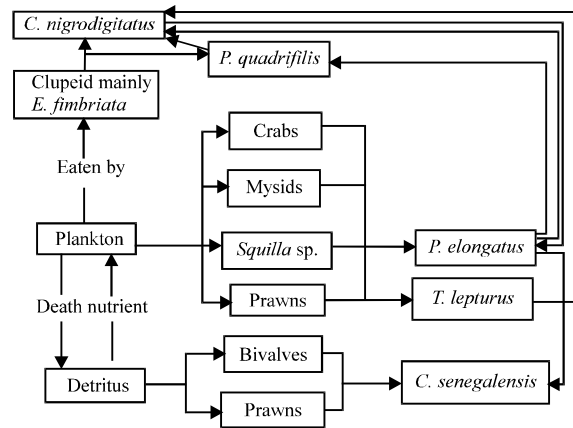


Fig. 2: A trophic model indicating interrelationship of *C. nigrodigitatus* with other organisms in the Cross River estuary

this may be associated with the shallow nature of the estuary. It takes advantage of the abundant species of fish, shrimps, molluscs and other organisms and materials in the estuary. The presence of large fish in the stomach betrays *C. nigrodigitatus* as a top predator in the estuary. There were significant differences in the diet of *C. nigrodigitatus* obtained in this study and those obtained by Ikusemiju and Olaniyan (1977), from Lekki Lagoon. Fish and shrimps were the most important categories in the diet of this in Cross River estuary but in Lekki Lagoon, the fish depended more on mollusc, insects, cladocera, copepods, ostracods and mysids. A diagrammatic representation of the feeding interrelationship between *C. nigrodigitatus* with other fishes and other organisms in the estuary is presented in Fig. 2, based on the results of this study and other reports (Nawa, 1982). It is clear from the model that *C. nigrodigitatus* is a top benthic predator in the estuary. This study

has not only placed *C. nigrodigitatus* as a top benthic predator in the estuary but has also provided data on the biological interactions (predation and competition) between fishes in the estuary.

CONCLUSION

Information obtained from this study will serve as a guide to sustainable ecosystem management based on the knowledge of multi species interaction.

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