FISH ALIMENTATION OF THE CARANGIDAE FAMILY OF THE ESTUARINE LAGOON COMPLEX IN CANANÉIA, SÃO PAULO, BRAZIL

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ABSTRACT

Estuaries are areas of great ecological importance owing to their biological productivity, which makes them important providers of fish and crustacean species of high economic value. They are also important for small-scale fishermen.

The objective of this study is to determine the eating habits of fish, which are found in Cananéia, São Paulo, Brazil, through stomach content analysis.

The trophic spectrum analysis of the Carangidae family species studied allows the basic alimentation of crustacean and fish eaters: **Selene setapins, S. vomer, Caranx latus, Oligoplites saliens** and **O. saurus**; crustacean and polychaete eaters for **Chloroscombrus chrysurus** and **Trachinotus goodei**; mollusks, crustaceans and fishes eaters for **Trachinotus carolinus** and mollusks and fishes for **Trachinotus falcatus**.

Key words: Fish alimentation, Ictiology, Cananéia, SP, Carangidae

INTRODUCTION

There are important aspects in studying estuarine areas bordered by swamp areas with mangroves. The pioneer study at São Paulo Shore, by LUDERWALDT (1919), with the characterization of the source area and the living species, showed the possibility of several ecological studies of such nature.

They are great ecological importance areas owing to their high biological productivity, which makes them important providers of fish and crustacean species of high economic value. **YANEZ-ARANCIBIA & SANCHES-GIL (1987)**, they are also important areas for small - scale fishermen (MOURÃO, 1971; RIBEIRO NETO E OLIVEIRA; 1987; GRASSO, 1994).

In natural condition these ecosystems work as the base of a balanced source in biological relation that are vulnerable at men interface (YANES - ARANCIBIA & DAY, 1985; PAIVA FILHO, 1982).

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In the Cananéia region there are few studies about the fishes communities, as RADASEWSKY (1976); SINQUE & YAMANAKA (1982); ZANI - TEIXEIRA (1983) e CORREA (1987). The greatest part of the studies refers to the species biological aspects and/or families, particularly the ones of commercial value, as CARVALHO (1953); MONTES (1953); PINTO (1983); SADOWSKY (1958,1973); RICHARDSON & SADOWSKY (1960); MISHIMA & TANJI (1981,1982); GOMES and cols. (1993,a,b,1990,1992); JORDÃO and cols. (1992); SCORVO FILHO and cols. (1992); GODINHO and cols. (1993); HOFLING and cols. (1997,1998).

Therefore, by the increasing intensity of the human interference (harbours, anchorage, sewerage systems, commercial fishing and recreation fishing) at these ecosystems of high importance for many species surviving, even grows the necessity of more objective and discerning studies about these estuarine areas, above all those related to their conservation.

This work is part of a project about all the species arrested in the estuarine area concerning to their alimentation, reproduction and distribution, that will be published.

MATERIAL AND METHODS

* Characterization of the studied area:

Cananéia estuarine lagoon complex is located in the south of São Paulo state, at 25° 01'S latitude and 47° 55" W longitude since the Ribeira river mouth of discharge until Ararapira Channel with about 110 km of length. It's composed by a system of lagoons and channels, is protected by Comprida and Cardozo Islands, surrounded in the east by Cubatão sea and in the south by Trapandé bay (Camargo, 1982).

According to Teixeira (1969) and Tundisi (1969) the region is considered as an estuarine lagoon complex, owing to the and instability condition estuarine zone characteristics and by the occurrence of coast lagoons in the south by Cananéia and in the north by Icapara. In the north there is a unique channels called Mar Pequeno divided in the south direction in two branches Cananéia sea and Cubatão sea. (Fig 1).

Cananéia Island has 27 Km of length and variable width from 1 to 5 Km. The surrounding channels have variable width from 1 to 3 Km and are about 4m of depth but in some areas they reach 20m of depth. The more shallow areas (below 4m) occupy opposite position to the deepest ones, and so, occur some groups of islands (Pai Matos, Boqueirão, Garça, Furadinho, etc).

Associated to these groups of islands, there are some mangrove areas that grow even at tide channels coast (SUGUIO e cols., 1987).

Studies have demonstrated the existence of sandy bars and owing to their instability many problems to the embarkation flow occur in Cananéia area. These sandy formation are constituted by sand selected by waviness of short wave length and the tops with their concavities turned to the bar indicating an internal regime of low energy and high resistance to draining. (TESSLER and cols., 1987).

Collects were realized at Cananéia Seas (called low estuary) and Cubatão (called high estuary) showing characteristics of high salty concentration beaches and low salty concentration rivers that run into mangrove areas. Seven collects were realized in the period from April 1994 to May 1995, using Albacora boat, of 14 meters of length, belonging to IO/USP.

The specimens were obtained by day capture in five points of bottom dragging (A1 to A5) and fifteen points for net throwing ("picaré"), 3 points (R1 to R3) realized in Taquari River and Itapitangui River and 2 points (B1 and B2) realized at Barra. The other points were distributed along Trapandé Bay, Itapitangui Sea and Cubatão Sea (C1 to C10) Fig.1.

Bottom dragging was realized in the estuary channel during 5 minutes and 2 knots of speed approximately, using a trap of 16,7m of length in a small fishing net (mesh of 30 mm).

Net throwing ("picaré") was realized in the marginal areas and sandbanks using a net of 42,70 m of length, 4,70 m of height and mesh of 12 mm (24 mm extended).

All the stuff collected was conserved in ice and took to the laboratory at Base de Cananéia. A following selection was done, to identify the specimens according to FIGUEIREDO & MENEZES (1978, 1980) and MENEZES & FIGUEREDO (1980, 1985). Then, the fishes were measured and weighed.

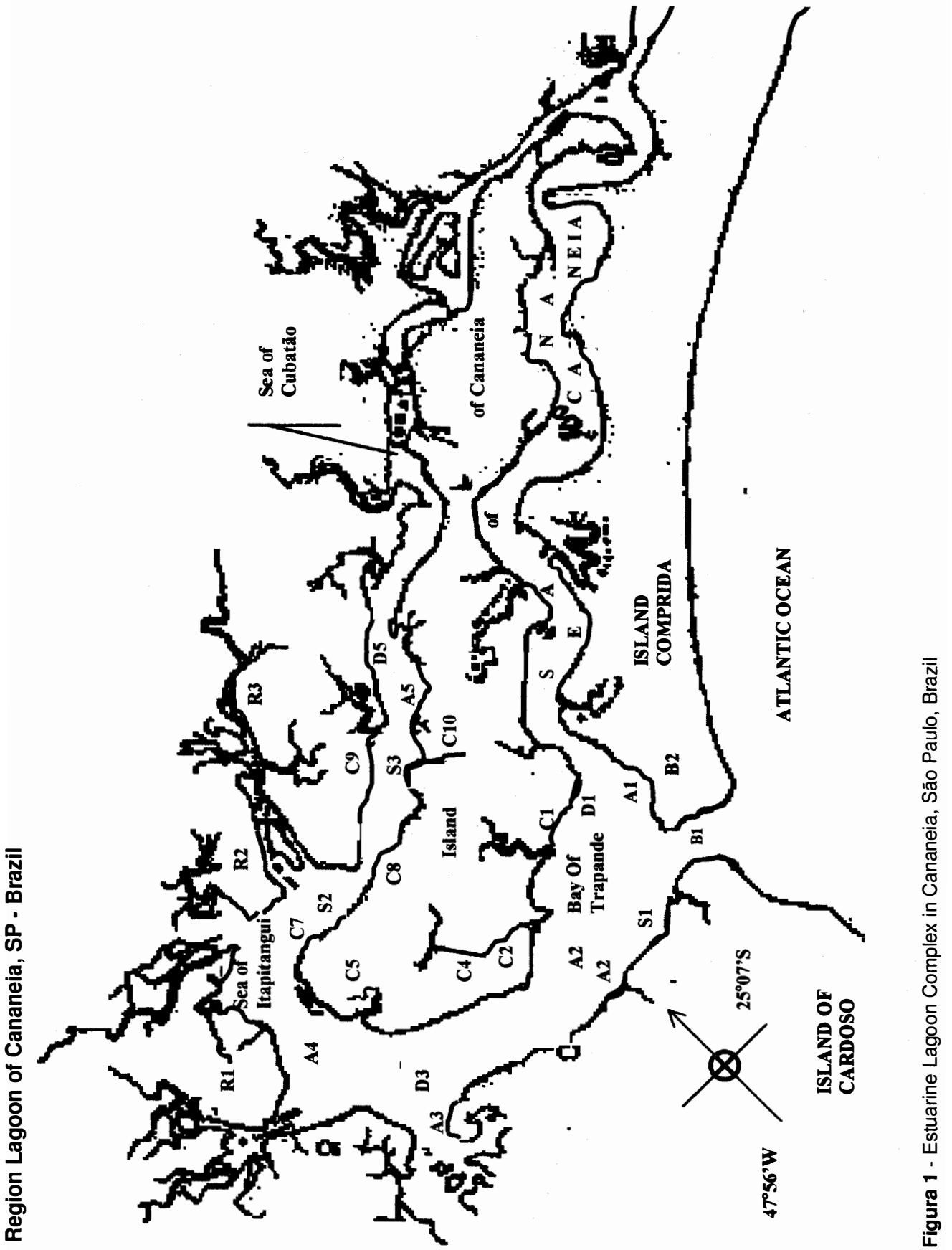

Figura 1 - Estuarine Lagoon Complex in Cananeia, São Paulo, Brazil

For quantitative and qualitative analysis of alimentation contents, stomachs were removed, tied not to lose the contents, and then, they were placed in neutralized formol 10% and took to the laboratory at PUC-Campinas, where they're examined by gravimetric determination of moist weight described by BENVENUTE (1990), that consists in placing the stomach content in a Petri dish , in a uniform way not exceeding 1 mm of thickness.

After, using a millimetred paper over the Petri dish is possible to determine the total area occupied by each item and therefore the weight of each item by direct relation of the total content weight by each item area.

For the identification of alimentation content items, the reference was BARNES (1984) and for each item was determined the occurrence frequency (O.F.) and relative frequency (R.F.) excluding the organic matter not identified (R.F".).

RESULTS AND DISCUSSION

Alimentation spectrum of **Selene setapinis** measuring from 50 to 150mm indicates that its nourishment is based on bentonic crustacean and fish (Tab. I, Fig. 2). RODRIGUES & MEIRA (1988) described for this species nourishment based on crustacean and fish while CARVALHO & SOARES (1997) described a diet based on planctonic fish and crustaceans.

The analysis of stomach contents for **Selene vomer,** measuring from 0 to 150 mm, indicates a nourishment based on crustacean and fish too. (Tab. I, Fig. 3), HUERTA-CRAIG (1986) described for this species a diet based on fish.

According to the alimentation spectrum, **Chloroscrombus chrysurus**, measuring from 50 to 150 mm, the nourishment is based on crustacean and polychaetes (Tab. I, Fig. 4). SOARES and cols. (1995) described for this species, while YANEZ-ARANCIBIA and SANCHES-GIL (1986) described a diet based on polychaetes and planctonic/bentonic crustaceans, FLORENTINO & SOARES(1997) described a diet based on copepods and fish.

For **Caranx latus**, measuring from 0 to 200 mm, the nourishment is based on fish and crustaceans (Tab. I, Fig. 5) HUERTA-CRAIG (1986) described for this species a nourishment based on fish (86%) and crustacean (14%), SAZIMA (1986) described **Caranx latus** as a crustacean eater.

For **Oligoplites saliens**, measuring from 50 to 200 mm, the nourishment is based on crustaceans and fish (Tab. I, Fig. 6) HUERTA-CRAIG (1986), determined a nourishment based on fish.

For **Oligoplites saurus**, measuring from 50 to 200 mm , the nourishment is based on crustaceans and fish (Tab. I, Fig. 7) AUSTIN & AUSTIN (1971), determined for individuals measuring less then 50 mm a diet based on planctonic crustaceans. SAZIMA described the nourish habit for this species as a scale eater when younger and fish and crustacean eater when adult. RANDALL (1967) BEEBE and TEE-VAN (1928) and SPRINGER and WOODBURN (1960), described for this species an alimentation based on fish while CARR & ADAMS (1973) affirm that initially it's a plankton eater, copepods and misidaceae correspond 96% of the stomach contents for individuals measuring from 21 to 25 mm, fish and scale (58 – 67%) for individuals measuring from 26 to 40 mm and a diet based on fish for individuals measuring from 61 to 101 mm, indicating a possible reduction in the filtrating activity for bigger specimens. Our results obtained are in accord to the results obtained by the mentioned authors.

The alimentation spectrum for **Trachinotus carolinus** measuring from to 0 to 150mm, indicates nourishment based on mollusks, crustacean and fish (Tab. I fig 8) ARMITAGE & ALEVIZON (1980) described for the youngster a diet of bivalves and crustacean and for the adults a diet of bivalves, while HUERTA-CRAIG (1986) described a diet based on gastropods.

According to GOBERNA (1987), DE LANCEY (1989), MONTEIRO Y RODRIGUES (1990) in DANEMANN (1993) the species for **Trachinotus** gender the nourishment is based on zooplanktonic organisms as copepods, decapods, polychaetes, bivalves and fish larva.

For **Trachinotus falcatus**, measuring from 0 to 250mm the nourishment is based on mollusks and fish (Tab. I, Fig. 9). Qualitative studies about this species alimentation indicate bentonic invertebrates including worms, mollusks, crustacean and eventually echinoderms. (HILDEBRAND & SCHROEDER 1928; LINGLEY & HILDEBRAND, 1941; SPRINGER & WOODBURN, 1960; FINUCANE, 1969). AUSTIN & AUSTIN (1971) described a diet based on mollusks and crustacean while CARR & ADAMS (op cit.) affirm that youngsters measuring from 15 to 20mm, probably eat plankton, individuals measuring from 26 to 35mm eat coast fish and bigger individuals eat bentonic invertebrates as gastropods and crabs. According to SAZIMA (op. cit.) **Trachinotus falcatus** eat bottom organisms and live in small groups.

Table 1 - The trophic spectrum of Carangidae species from the Estuarine Lagoon Complex in Cananeia - SP - Brazil, OF = Occurence Frequency; FR" Relative Frequency excluding the organic matter and sand.

Species	*Selene setapinis*			*Selene vomer*			*C. chrysusrus*			*Caranx latus*			*Oligoplitis saliens*		
Trophic category/ measure	05 a 15 cm			0 a 15 cm			05 a 15 cm			0 a 20 cm			05 a 20 cm		
	FO	FR	FR"	FO	FR	FR"	FO	FR	FR"	FO	FR	FR"	FO	FR	FR"
filamentous algae	12,50	0,93	1,15												
Diatoms	12,50	1,87	2,31	8,33	1,66	1,83	8,57	0,06	0,17						
Vegetable matter				8,33	8,33	9,18	8,57	0,45	1,26	9,09	0,06	0,07	6,45	0,61	0,96
polichaeta							14,28	3,63	10,15						
Copepoda				8,33	5,16	5,69	51,42	28,41	79,45	18,18	1,58	1,91	29,03	16,75	26,40
Ostracoda							8,57	0,10	0,28						
Isopoda				16,66	1,83	2,02	5,61	0,06	0,17						
Tanaidacea				75,00	46,52	51,28							3,22	0,40	0,63
Decapoda	75,00	74,87	92,52				11,42	2,89	8,08	63,63	38,75	46,85	41,93	10,76	16,96
Amphipoda							2,85	0,01	0,02				3,22	0,04	0,06
Gastropoda															
Bivalves				33,33	25,00	27,56	2,85	0,01	0,03						
Fish	25,00	3,25	4,20	8,33	1,66	1,83				45,45	42,32	51,17	9,67	8,73	3,60
scale							2,85	0,03	0,08				16,12	7,49	11,81
Mematode							2,85	0,06	0,17				6,45	0,22	0,35
Platyhelminthes							2,85	0,04	0,11						
Insects				33,33	9,25								51,51	35,29	
Organic matter	25,00	17,81					85,71	54,50		18,18	17,27		3,22	1,96	
Sand	12,50	1,25		8,83	0,55	0,61	34,28	9,73							
Inorganic matter													12,90	12,90	20,33
fish egg													9,67	5,64	8,89
Chaetognatha															

Table 1 - Continuity - The trophic spectrum of Carangidae species from the Estuarine Lagoom Complex in Cananeia - SP - Brazil, OF = Occurence Frequency; FR" Relative Frequency excluding the organic matter and sand.

Species	*Oligoplitis saurus*			*T. carolinus*			*T. falcatus*			*T. goodei*		
Trophic category/ measure	05 a 20 cm			0 a 15 cm			05 a 15 cm			0 a 20 cm		
	FO	FR	FR"	FO	FR	FR"	FO	FR	FR"	FO	FR	FR"
filamentous algae	5,55	0,75	1,14	13,83	1,18	2,08	7,69	0,38	0,62			
Diatoms										14,30	0,07	0,30
Vegetable matter				6,67	0,14	0,25						
polichaeta	5,55	0,39	0,59	3,33	0,02	0,04				14,50	0,71	3,00
Copepoda										14,30	0,11	0,46
Ostracoda												
Isopoda										14,30	1,57	8,09
Tanaidacea												
Decapoda	33,33	18,29	27,69	13,33	3,94	6,95				14,30	0,23	0,97
Amphipoda										14,30	2,14	9,03
Gastropoda				36,67	12,13	21,39	7,69	2,31	3,75			
Bivalves				70,00	35,97	63,43	6,23	43,42	70,52			
Fish	33,33	21,02	31,82	3,33	3,33	5,87	15,38	15,38	24,98			
scale	38,89	25,55	38,68							14,30	0,71	3,00
Nematode	5,55	0,06	0,09				7,69	0,08	0,13			
Platyhelminthes										42,80	1,73	7,30
Insects										42,80	12,13	51,20
Organic matter	50,00	30,20		76,67	42,78		84,61	40,48		100,00	76,26	
Sand	5,55	3,72		20,00	0,48					42,80	4,29	
Inorganic matter												
fish egg												
Chaetognatha												

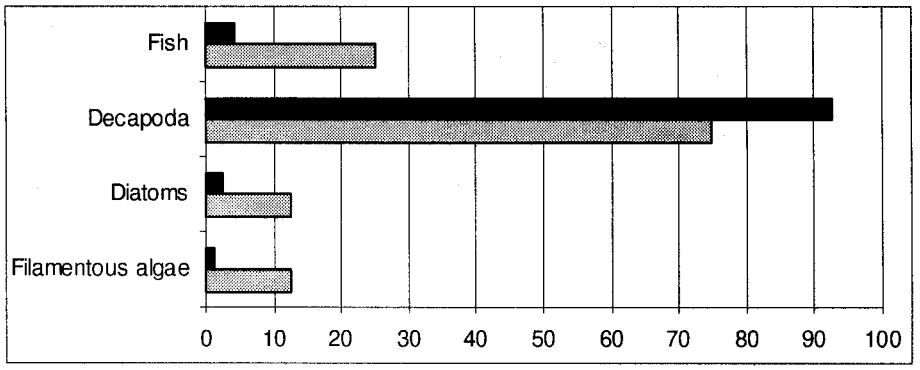

Figura 2 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Selene setapinis

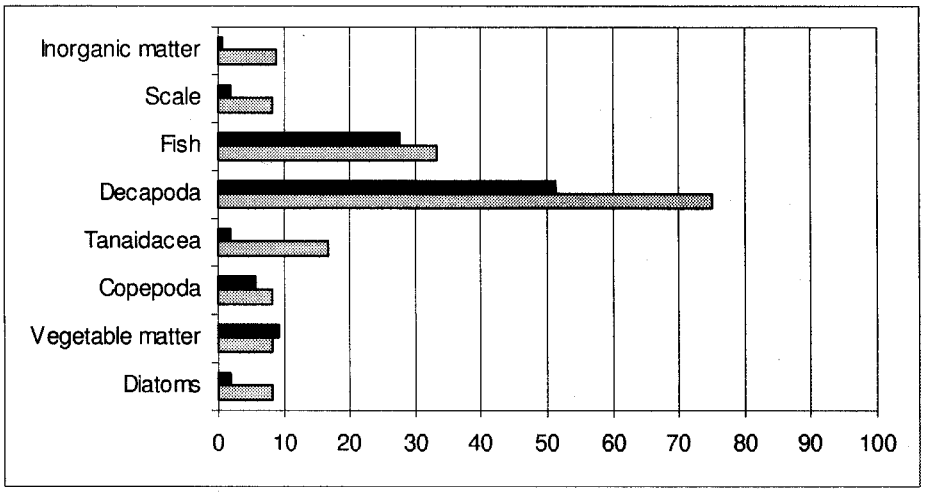

Figura 3 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Selene vomer

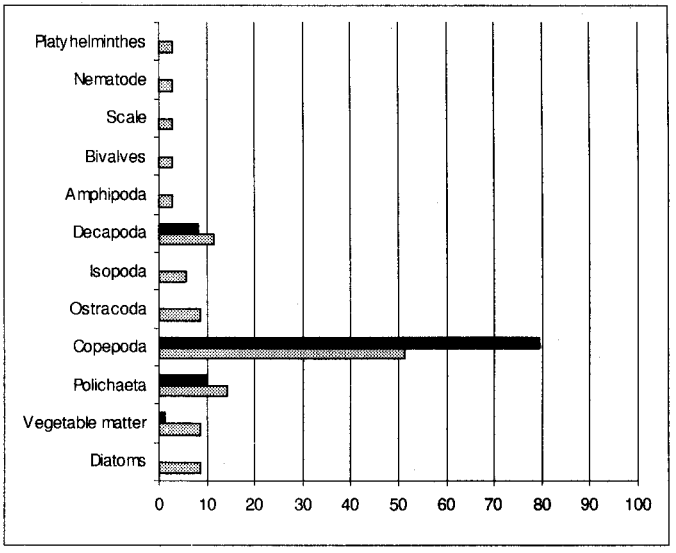

Figura 4 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Chloroscombrus chrysurus

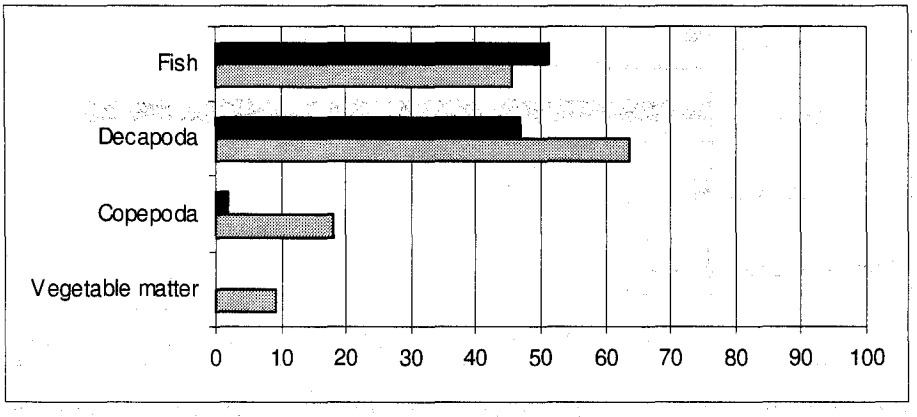

Figura 5 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Caranx latus

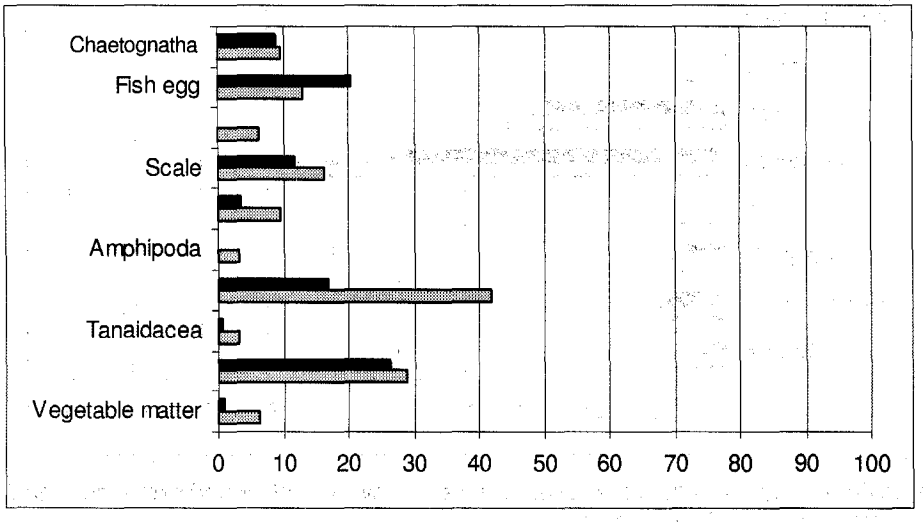

Figura 6 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Oligoplitis saliens

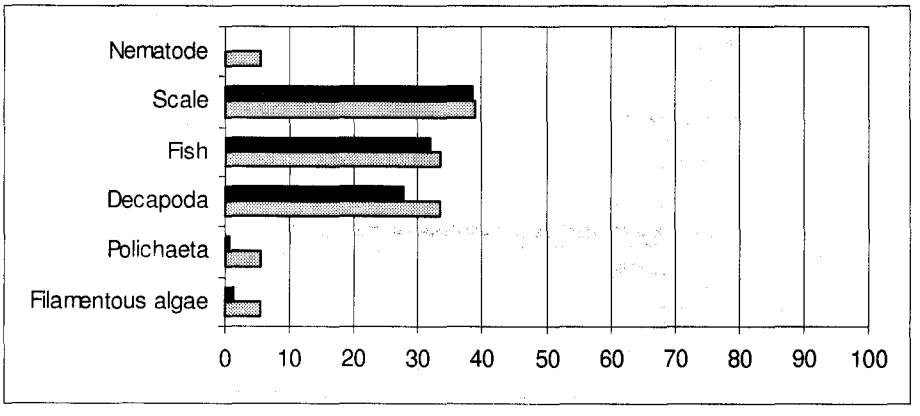

Figura 7 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Oligoplitis saurus

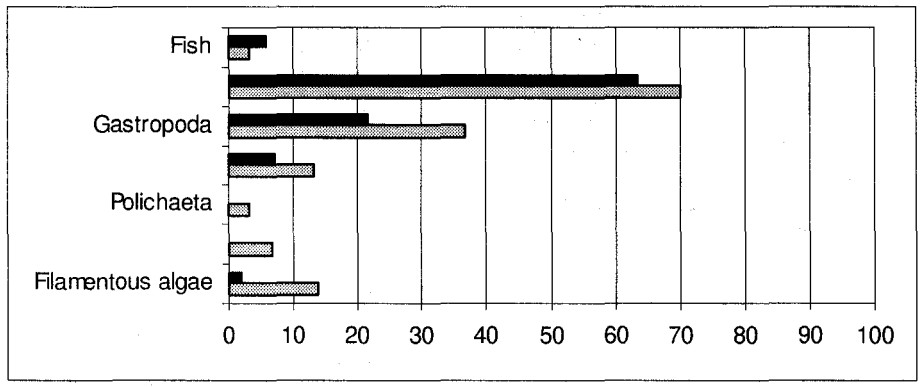

Figura 8 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Trachinotus carolinus

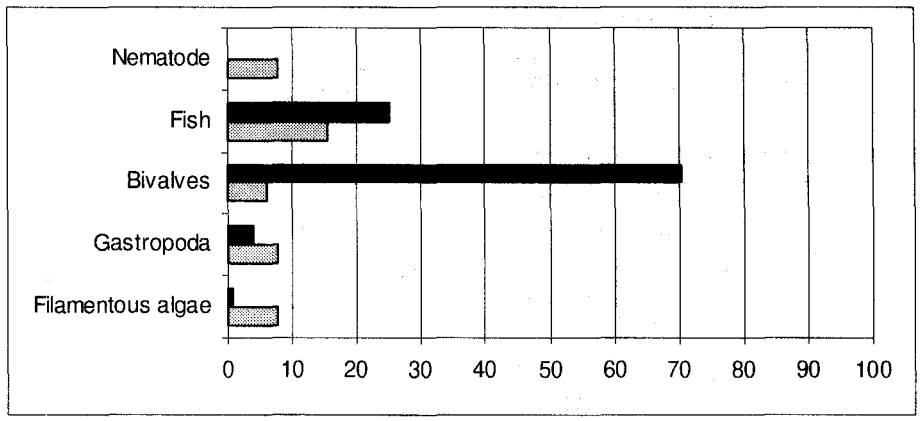

Figura 9 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Trachinotus falcatus

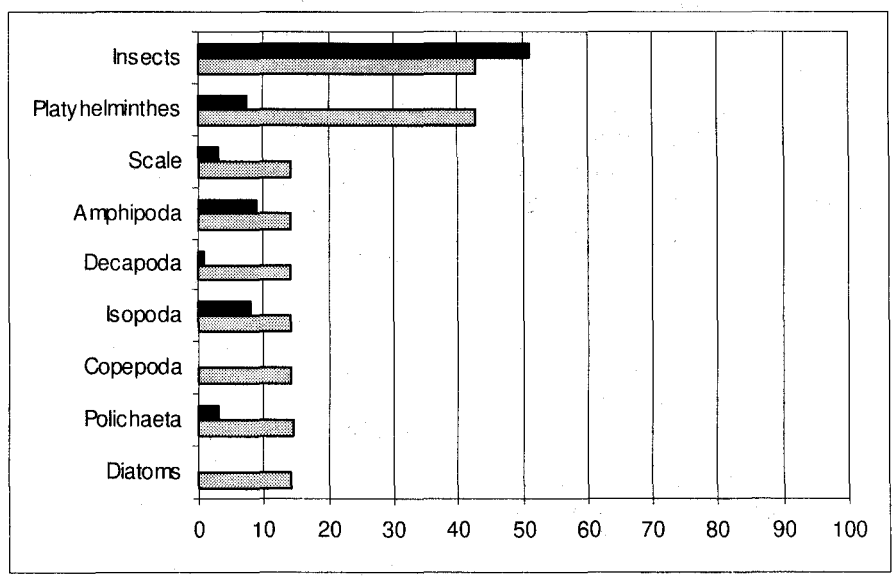

Figura 10 - Occurence Frequency (OF-grey bar) and Relative Frequency (RF" - black bar) excluding organic matter and sand from the alimentation for Trachinotus goodei

For **Trachinotus goodei** measuring from 50 to 200mm, the diet is based on insects, bentonic invertebrates (Tab. I fig. 10).

Items as **Emerita** spp, **Donax** spp and a variety of mollusks are part of **T. falcatus**, **T. carolinus** and **T. goodei** food habits. (FINUCANE, 1970; BELLINGER & AVAULT, 1971; ARMITAGE & ALEVISON, op. cit.; HELMER and cols., 1982).

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