

FEEDING OF THE WHITEMOUTH CROAKER *Micropogonias furnieri* (SCIAENIDAE; PISCES) IN THE ESTUARY OF THE RIO DE LA PLATA AND ADJACENT URUGUAYAN COASTAL WATERS

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RESUMO

Alimentação da corvina *Micropogonias furnieri* (Sciaenidae; Pisces) no estuário do Rio da Prata e águas costeiras do Uruguai

Estudamos a dieta da corvina (*Micropogonias furnieri*) (Pisces) em distintos regimes de salinidade e tipos de fundo no estuário do Rio da Prata e nas águas costeiras adjacentes do Uruguai. Analisamos 258 conteúdos estomacais de organismos com 6-67 cm de comprimento total (TL) e aplicamos um índice de importância relativa das presas (IA), com base na frequência de ocorrência e biomassa. Análises multivariadas (ANOSIM, MDS) foram usadas para detectar diferenças nas dietas entre sítios amostrais. *Micropogonias furnieri* apresentou uma tendência de especialização em um único tipo de presas, no caso bivalves, embora se alimente secundariamente de outros invertebrados bênticos, como poliquetas e crustáceos. A dieta variou em função do tamanho dos organismos e das áreas amostrais. O bivalvo *Macra isabelleana* foi a presa principal de corvinas maiores do que 10 cm TL (%IA = 96.68), enquanto misidáceos foram a presa principal de corvinas com menos de 10 cm TL (%IA = 85.3). As análises multivariadas definiram três grupos principais de corvinas alimentando-se principalmente de *M. isabelleana* (formas estuarinas e de fundos marinhos lamosos), misidáceos (fundos estuarinos lamosos) e *Artemesia longinaris* (fundos heterogêneos, marinhos ou estuarinos). Os três grupos correspondem às estratégias tróficas de especialização, generalização ou mista. A plasticidade no comportamento de alimentação pode ser um dos fatores responsáveis pela ampla distribuição geográfica da corvina-branca, viabilizada por distintos padrões de exploração das presas.

PALAVRAS CHAVE: Sciaenidae, dieta, macroinvertebrados bentônicos, Atlântico Sul Ocidental

ABSTRACT

Feeding of the whitemouth croaker *micropogonias furnieri* (sciaenidae; pisces) in the Río de la Plata estuary and coastal waters of Uruguay

We studied the diet of the whitemouth croaker (*Micropogonias furnieri*) (Pisces) in the Río de la Plata estuary and adjacent Uruguayan coastal waters. Fish were caught at different salinity ranges and bottom types. We analyzed 258 gut contents of whitemouth croaker (6-67 cm total length, TL) and calculated an index of relative importance of prey (IA) based on frequency of occurrence and biomass. Multivariate analyses were used to detect diet differences between sampling sites (ANOSIM, MDS). *Micropogonias furnieri* showed a tendency to specialization towards one single taxonomic prey type, bivalves, but also including other benthic invertebrates like polychaetes or crustaceans. The diet varied according to the size and area analyzed. The bivalve *Macra isabelleana* was the main prey of croakers > 10 cm TL (%IA = 96.68), while mysids were the main prey of croakers < 10 cm TL (%IA = 85.3). Multivariate analyses defined three main groups of croakers which mainly feed on: *M. isabelleana* (estuarine and marine muddy bottoms), mysids (estuarine muddy bottoms) and *Artemesia longinaris* (marine and estuarine waters, heterogeneous bottoms). These three groups also represented distinct feeding behavior of croakers: specialization, generalization and mixed feeding strategies respectively. This plasticity in the feeding behavior could be one of the factors that allows for the extensive geographical distribution of whitemouth croaker, throughout different prey exploitation patterns.

KEYWORDS: Sciaenidae, diet, benthic macroinvertebrates, southwestern Atlantic

1 – INTRODUCTION

Although estuaries contain a relatively low number of macrobenthic species, it has been observed that the total abundance of organisms and the productivity can be higher than in the adjacent areas, representing important feeding grounds for different species of coastal fishes (Griffiths 1997), specially during the juvenile phase (e. g. Able & Fahay 1998). The Río de la Plata is an extensive and shallow coastal plain estuary on the western South Atlantic coast (35-36°S) (Fig. 1) supporting high biomass of fishes, several of them of commercial value (Cousseau 1985, Mianzan *et al.* 2001). The main environmental characteristics of the Río de la Plata estuary are its large geographic extent and the occurrence of a quasi-permanent salt-wedge regime, which generates a border system (bottom and surface salinity fronts) that plays an important role in the reproductive processes of fishes and where high zooplankton biomass concentrates (Mianzan *et al.* 2001). High benthic biomass and several species assemblages have also been reported (Giberto *et al.* 2004).

The whitemouth croaker *Micropogonias furnieri* is distributed from the Yucatán Peninsula in Mexico (20°N), to the Gulf of San Matías (41°S) in Argentina (Isaac 1988). In the Río de la Plata estuary, it is the dominant species in terms of biomass and a characteristic component of the demersal fish assemblage in the estuary (Jaureguizar *et al.* 2003). It inhabits bottom waters making extensive use of this environment, and supports the main coastal

fisheries of Argentina and Uruguay (Carozza *et al.* 2004). Although adults of *M. furnieri* are also very common in continental shelf waters, the entire life cycle seems to occur within the estuary. They aggregate to spawn close to the bottom salinity front during spring and summer, when they are most abundant (Acha *et al.* 1999). Samborombón Bay, a sheltered environment inside the estuary, is the main nursery ground for juveniles. Individuals of 2 cm in total length inhabit the bay but leave after 2-3 years at about 30 cm in total length (Acha *et al.* 2001). Adults of the species inhabit also the estuary all the year around, specially during winter and summer months (Carozza *et al.* 2004).

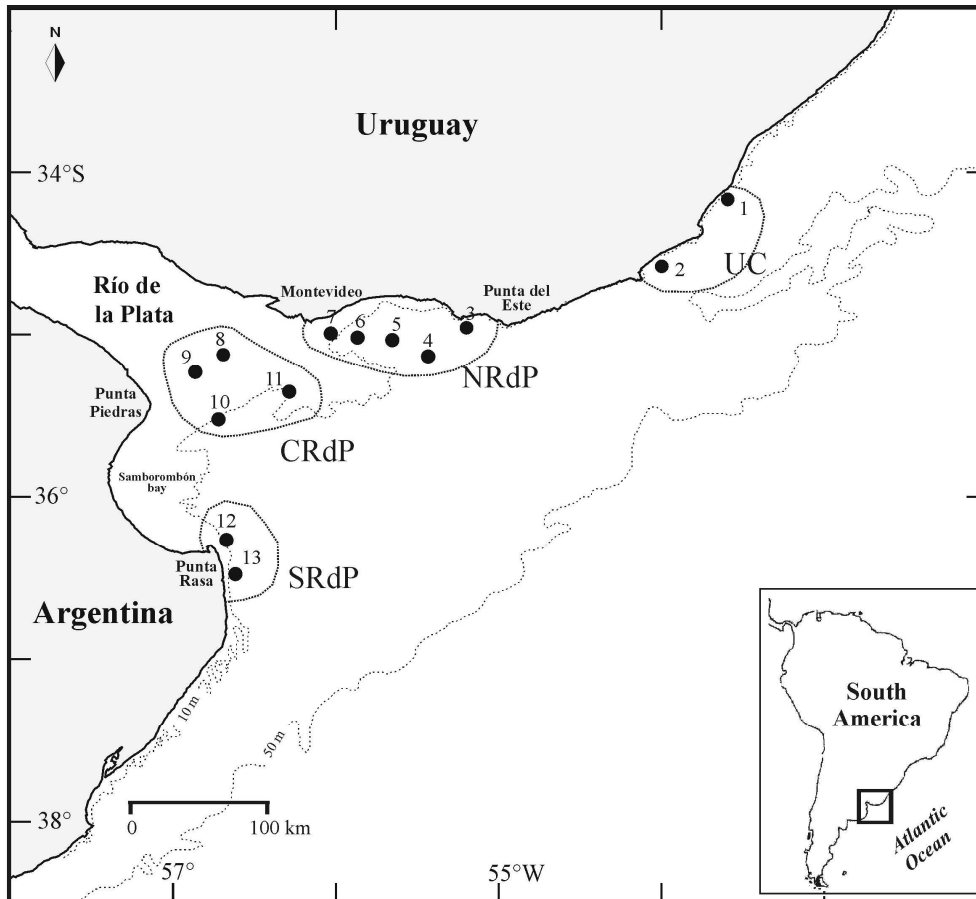


FIGURE 1 – The Río de la Plata (RdP) and Uruguayan shallow shelf. Location of sampling sites of *Micropogonias furnieri* (●) at the Uruguayan coast (UC, n=38), northern margin of RdP (NRdP, n=117), central RdP (CRdP, n=77) and southern margin of RdP (SRdP, n=26). Dotted lines indicate isobaths (m).

In most field studies of fish feeding ecology, results have been restricted to descriptions of the diet, without any further analysis of the feeding strategy of the predator (Amundsen *et al.* 1996). This seems to be the case for *M. furnieri*. Descriptions of its diet in the estuary (Puig 1986, Sánchez *et al.* 1991) and in other regions (Isaac 1988 and references therein, Bremec & Lasta 1998, Hozbor & García de la Rosa 2000, Sardiña 2004) stated that this species is a generalist and opportunistic predator, feeding mainly on crustaceans, bivalves and polychaetes. A generalist or opportunistic behavior means acceptance of resources in proportion to their availability (Emlen 1977, Rosenzweig 1981). Because of oceanographic conditions, different benthic assemblages are found in the Río de la Plata estuary and adjacent marine zones (Giberto 2003, Giberto *et al.* 2004), conforming habitats with different trophic offer for *M. furnieri*. However, this fact was not taken into account during previous investigations in the area, where little information on the feeding ecology of *M. furnieri* is available. In this study we present the results of diet studies conducted at different benthic habitats of the Río de la Plata region, we compare our results with available information on the feeding ecology of *M. furnieri* in other regions, and finally we discuss *M. furnieri* feeding behavior.

2 – MATERIALS AND METHODS

Study area: the funnel of the Río de la Plata estuary extends for over 280 km from the head (25 km wide) to the mouth (230 km wide) between Punta Rasa and Punta del Este, and has a mixohaline area of 38,000 km². Depth ranges from 5 to 20 m and salinity ranges between 0 and 33.8. The freshwater discharge (annual mean 22,000 m³ s⁻¹) from the Paraná and Uruguay rivers into the estuary exhibits low seasonality. There are no significant temperature gradients (see Mianzan *et al.* 2001).

Whitemouth croaker sampling: individuals were collected from 13 sampling stations in which this species was the most abundant fish, during summer 1996 by the R/V “Eduardo L. Holmberg” (INIDEP). Fish (n=258) were captured using a bottom trawl performed with an Engel mesh type. Total length (TL) of each specimen was measured to the nearest mm and sex was recorded. Stomachs were preserved on board in formalin 5%. Prey items were identified to the lowest possible taxa, counted and weighted (wet) to the nearest 0.01 g at laboratory.

Data analysis: We assessed the prey importance by percentage frequency of occurrence (%F) and by percentage of biomass (%B). An alimentary index (IA) was calculated for each prey category *i* as the product of %F_{*i*} and %B_{*i*}, and expressed as a percentage, where:

$$\%IA = 100 IA_i / \sum_{i=1}^n IA_i$$

and *n* is the total number of food categories considered at a given taxonomic level (Lauzanne 1975 en Rosecchi y Nouaze 1987, Cortes 1997, Griffiths 1997). Numerical percentage contribution was excluded in this analysis because it is biased towards small prey items (e.g. amphipods and isopods), and because it is difficult to estimate numbers in each category when there is mastication of food items (Hyslop 1980, Griffiths 1997).

We followed Ferry & Cailliet (1996) and used a power analysis technique described by Cohen (1988) to determine if adequate sample sizes were being used to ascertain diet differences between fish groups. We calculated the sample size necessary (ϕ) to detect a significant difference according to:

$$\phi = (Z_{\alpha} + Z_{\beta})^2 \times s^2 / d^2$$

where s^2 is the variance, *d* is the untransformed difference between the proportions being compared, and Z_{α} and Z_{β} are the z-scores for the α and β values set (for $\alpha = 0.05$, $Z_{\alpha} = 1.96$; for $\beta = 0.20$, $Z_{\beta} = 0.85$). Since proportions of several diet items across sites were compared, we selected the largest difference (effect size) presented in %prey biomass between sectors, assuming this would be the easiest difference to detect and the most reliable test of sample size efficiency (Ferry & Cailliet 1996).

In temperate estuaries, availability of preys plays an important role in the distribution patterns of Sciaenidae (Chao & Musick 1977, Griffiths 1997). In our study area, sampling stations could be matched to 4 different feeding grounds (Giberto 2003, Giberto *et al.* 2004): Uruguayan coast (marine waters, bottoms characterized by shell debris and mud-sand fractions, high relative diversity), northern margin of RdP (mixohaline waters, mud-sand fractions, and intermediate diversity), central RdP (mixohaline waters, muddy bottoms, and low diversity) and southern margin of RdP (mixohaline waters, sand medium fraction, and intermediate diversity). Therefore we used non-parametric multivariate analyses (Clarke and Warwick, 2001) based on diet composition to test if the 4 areas are also reflecting differences in the diet of *M. furnieri*, and to define biological grouping of diet sampling stations. The ANOSIM test was used to search for differences in diet composition along the 4 areas (Uruguayan coast, northern, central and southern RdP). This permutation test computes an R statistic under the null hypothesis “no difference between sites”. R falls between -1 and 1, so if R is significant ($p < 0.1\%$) and approximately 0 the null hypothesis is true. The biological grouping of sampling stations was determined by a multi-dimensional scaling (MDS) ordination (The Bray-Curtis similarity measure based on the 4th root transformed %IA of each prey item was used to produce the association matrix). All the analyses were performed using the PRIMER software (Clarke and Warwick, 2001).

We also analyzed the feeding strategy of the whitemouth croaker with the graphical method proposed by Amundsen *et al.* (1996), who incorporated the prey-specific biomass into the Costello's (1990) analysis. The new parameter P_i is defined as the percentage a prey taxon comprises of all items in only those predators in which the actual prey occurs, or in mathematical terms:

$$P_i = (\Sigma B_i / \Sigma B_{t_i}) \times 100$$

where P_i is the prey-specific biomass of prey i , B_i the stomach content (weight) comprised of prey i , and B_{t_i} the total stomach content in only those predators with prey i in their stomach. Then this value was plotted against the frequency of occurrence on a two dimensional graph and information on feeding strategies in terms of specialization (narrow dietary niche width, upper right corner) and generalization (broad dietary niche width, lower left center) can be inferred.

The analysis was carried out at two levels (preys were classified into trophic groups and into functional groups) and at the 4 sectors of the study area (Uruguayan coast, northern, central and southern RdP). Prey items were assigned into functional groups from specific literature using aspects of life habits related to the possible availability to whitemouth croaker as criteria, like where the animal lives (in tubes, burrows or free living for polychaetes) and mobility (epibenthic of active walk or swim, or infaunal that lives mainly buried in the sediment for crustaceans) (Fauchald & Jumars 1979, Day *et al.* 1989, Boschi *et al.* 1992, Wolff 1992).

3 – RESULTS

The analyzed individuals ($n = 258$) were mostly adults, with a TL average of 31.8 cm (6 to 67 cm). Females ($n = 111$) had a TL average of 38.5 cm (16 to 67 cm), while for males ($n = 86$) it was of 35.2 cm (22 to 54 cm). Individuals whose sex was undetermined ($n = 61$) showed a TL average of 15.0 cm (6 to 18 cm). We found 43 alimentary items, mainly crustaceans, mollusks and polychaetes (Table 1). The bivalve *Mactra isabelleana* reached a percentage IA of more than 96% for the total of analyzed sizes (Table 1). Mysidacea is the main food resource for smaller sizes (< 9 cm TL, %IA = 85.3) of whitemouth croaker. The isopod *Macrochiridotea* sp., polychaetes Nereidiidae and the bivalve *Mytella falcata* were found in the size-class 10-19 cm TL, while largest individuals (> 20 cm TL) mainly preyed upon *Callianasa mirim* and *M. isabelleana* (Figure 2). No differences between sexes were found (females= 96.4% IA and males 96.9% IA for *M. isabelleana*).

TABLE 1 – Stomach contents of *Micropogonias furnieri* at the Río de la Plata estuary, presented as percentage of wet biomass (%B) and frequency of occurrence (%F). % IA is the percentage of the sum of the calculated alimentary index (IA) for each prey taxon.

PREY ITEM	%B	%F	IA	%IA
MOLLUSCA	79.603	67.373	4340.078	96.034
<i>Mactra isabelleana</i>	79.394	54.661	4339.745	96.027
<i>Mytella falcata</i>	0.058	5.085	0.182	0.004
<i>Heleobia australis</i>	0.011	5.085	0.055	0.001
Gastropods remains	0.044	1.271	0.056	0.001
Bivalves remains	0.073	0.424	0.031	0.001
<i>Adrana patagonica</i>	0.023	0.424	0.010	< 0.001
Buccinidae	0.001	0.424	< 0.001	< 0.001
CRUSTACEA	13.766	88.983	156.425	3.461
<i>Artemesia longinaris</i>	4.334	23.729	102.841	2.276
Crustacean remains	4.018	7.627	30.645	0.678
<i>Callianasa mirim</i>	2.938	3.390	9.959	0.220
<i>Cyrtograpsus angulatus</i>	1.295	7.203	9.328	0.206
<i>Peisos petrunkevitchi</i>	0.428	2.542	1.088	0.024
<i>Macrochiridotea</i> sp.	0.048	12.288	0.587	0.013

PREY ITEM	%B	%F	IA	%IA
Mysidacea	0.041	12.712	0.518	0.011
Cirripedia	0.118	4.237	0.500	0.011
Brachyurans remains	0.221	1.695	0.375	0.008
<i>Cyrtograpsus altimanus</i>	0.158	2.119	0.335	0.007
Grapsidae	0.045	2.542	0.115	0.003
<i>Pagurus comptus</i>	0.086	0.847	0.073	0.002
Gammaridae	0.017	2.966	0.052	0.001
<i>Diastylis</i> sp.	0.007	0.424	0.003	< 0.001
Ostracoda	0.001	2.542	0.002	< 0.001
Cirolanidae	0.006	0.424	0.002	< 0.001
Idoteidae	0.001	0.847	0.001	< 0.001
Asellota	0.002	0.424	0.001	< 0.001
<i>Pinnixa brevipollex</i>	0.002	0.424	0.001	< 0.001
ANNELIDA (Polychaeta)	2.213	23.729	10.356	0.229
Onuphiidae	0.959	5.508	5.285	0.117
Capitellidae	0.395	2.542	1.005	0.022
Polychaetes remains	0.681	5.085	3.461	0.077
Nereidiidae	0.100	5.085	0.507	0.011
<i>Travisia</i> sp.	0.045	1.695	0.076	0.002
Opheliidae	0.011	0.847	0.009	< 0.001
Glyceridae	0.003	1.695	0.005	< 0.001
Maldanidae	0.014	0.424	0.006	< 0.001
<i>Onuphis</i> sp.	0.004	0.424	0.002	< 0.001
Spionidae	0.001	0.424	< 0.001	< 0.001
TELEOSTEI	2.440	8.898	12.406	0.275
Teleosts unidentified	1.663	7.203	11.981	0.265
<i>Anchoa marinii</i>	0.225	0.847	0.191	0.004
<i>Paralanchurus brasiliensis</i>	0.356	0.424	0.151	0.003
Engraulidae	0.196	0.424	0.083	0.002
CHAETOGNATA	< 0.001	0.424	< 0.001	< 0.001
FORAMINIFERA	< 0.001	0.847	< 0.001	< 0.001
ANTHOZOA	1.978	0.424	0.033	< 0.001
Actiniaria	1.978	0.424	0.033	< 0.001

The sample size necessary (ϕ) to detect a significant difference in diet between sectors varied according to the prey considered ($\phi= 203$ for *M. isabelleana*, $\phi= 113$ for *A. longinaris*, $\phi= 102$ for *C. mirim*, and so on), but overall the n sampled in this study was enough to detect diet differences.

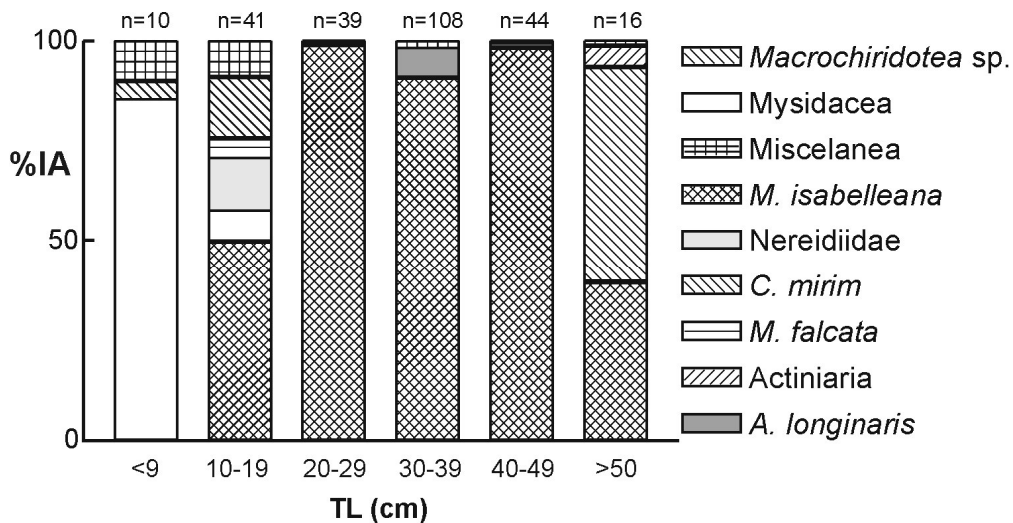


FIGURE 2 – Percentage of alimentary index (%IA) of prey taxa > 5%, for different size-classes of *Micropogonias furnieri* in the Río de la Plata estuary and Uruguayan shallow shelf. n = fish number.

The results of the global test of the ANOSIM ($R= 0.08$, significance level of sample statistic: 30.1%) showed no differences in croaker diet among the 4 previously defined areas. Indeed, the MDS ordination (Figure 3) revealed three distinct groups of natural sampling sites. These groups (group I: sites 2, 6, 7, 10-13, group II: sites 8, 9 and group III: sites 1, 3-5) were related with the main prey ingested instead to the previously defined areas: *M. isabelleana* (estuarine and marine muddy bottoms), mysids and *Macrochiridotea* sp. (estuarine muddy bottoms) and *Artemesia longinaris* (marine and estuarine waters, heterogeneous bottoms) in groups I, II and III respectively (Figure 3 and 4).

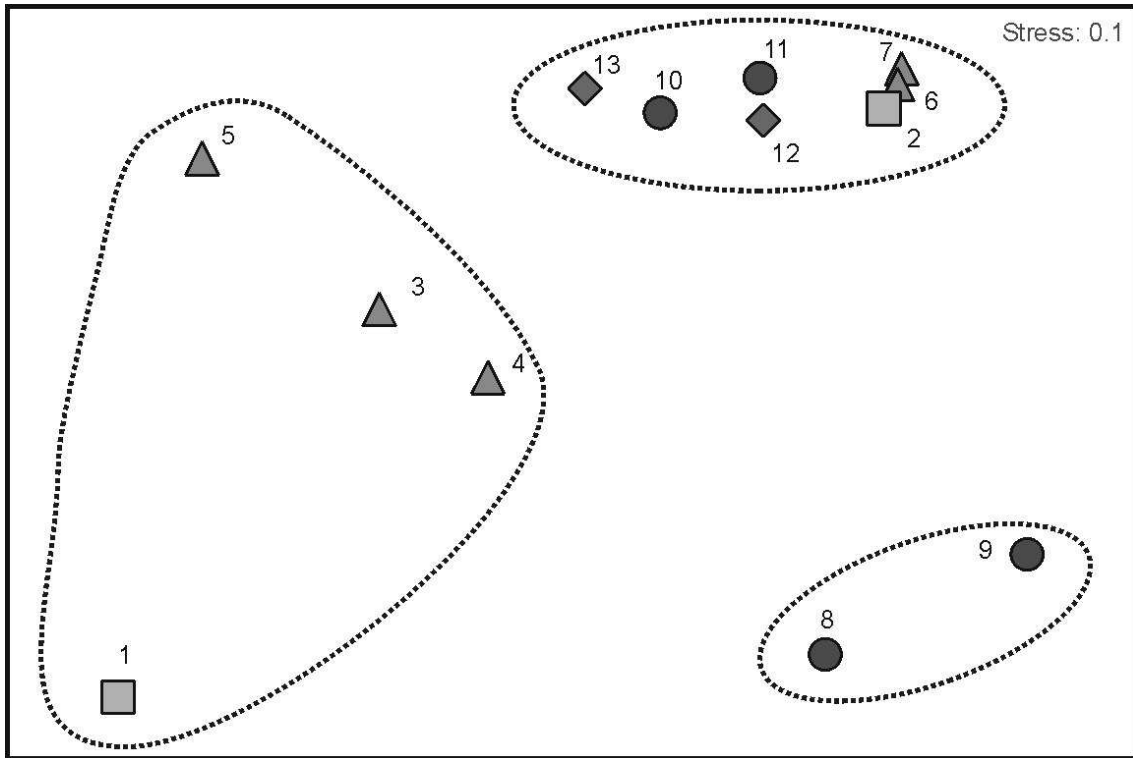


FIGURE 3 – MDS ordination of sampling stations (1-13) using percentage of alimentary index (%IA) of prey items of *M. furnieri* for the Uruguayan coast (□), northern margin of RdP (▲), central RdP (●) and southern margin of RdP (◆). Dotted lines indicate natural groups of sampling sites after the ordination: group I (2, 6, 7, 10-13), group II (8, 9) and group III (1, 3-5).

The feeding strategy plots indicated a tendency of fish specialization towards bivalves and, to a lower degree, crustaceans, while other items were eaten sporadically (Fig. 4). However, the general pattern varied according to the fish size and area analyzed. Fish from Group I (RdP and adjacent Uruguayan coastal area) displayed a specialization strategy, while fish from Group II (inner RdP, mostly of smaller sizes) displayed a generalist feeding behavior. Finally, fish from Group III (mainly northern RdP and one site of the Uruguayan coastal area) adopted a mixed feeding strategy.

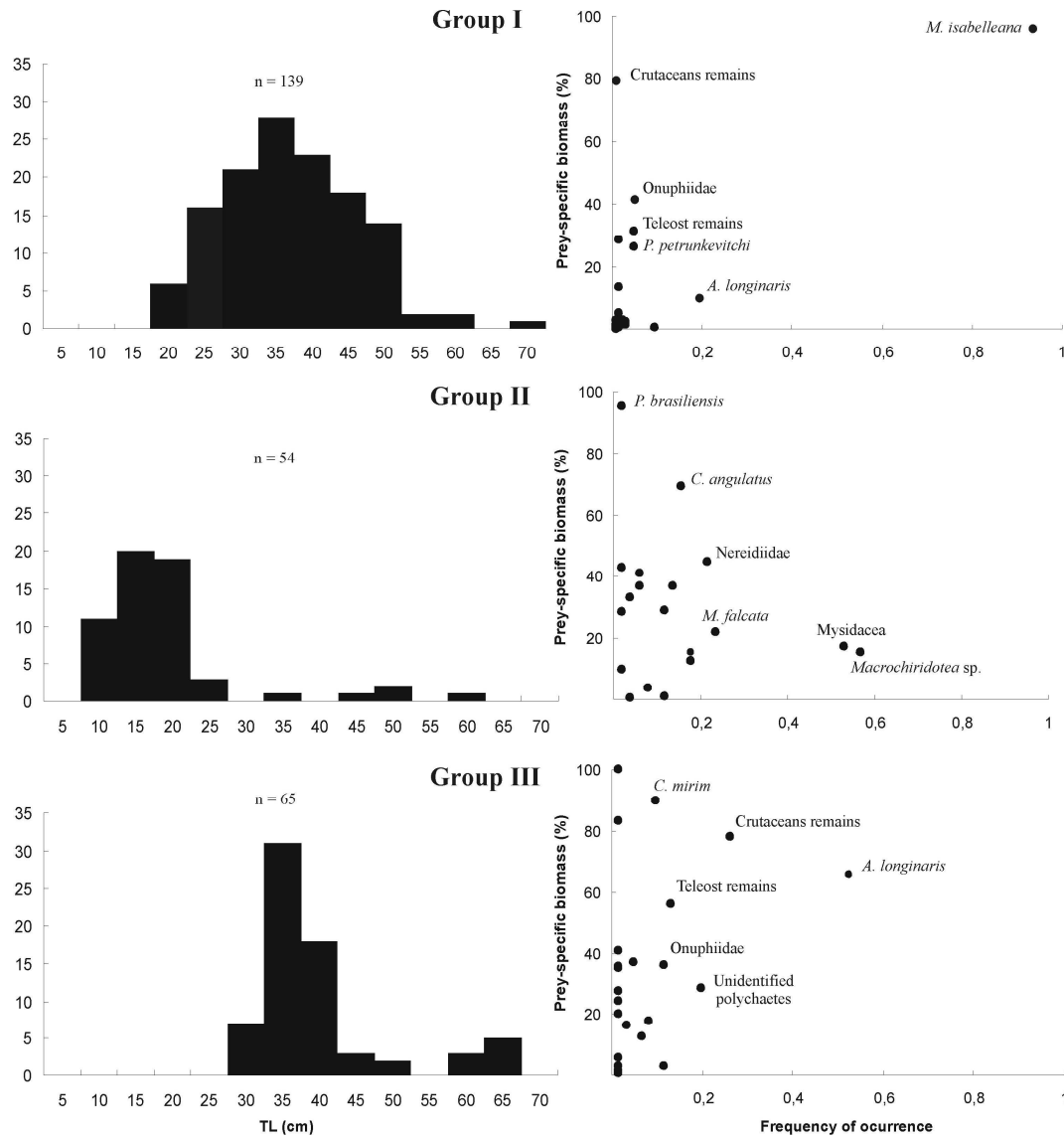


FIGURE 4 – Total length (TL) frequency distribution and contribution of prey taxa expressed as percentage of prey specific biomass and frequency of occurrence for the three groups of stations clustered together in ordination analysis: group I (sites 2, 6, 7, 10-13), group II (sites 8, 9) and group III (sites 1, 3-5).

Regarding trophic groups, the whitemouth croaker fed mostly on deposit feeders in sites of group I, while fish of groups II and III fed mainly on omnivores (Table 2). When considered functional groups, bivalves were the main preys in group I, while in the other two groups epibenthic crustaceans were the main preferred functional prey (Table 3).

TABLE 2 – Percentage contribution (range of %IA) of main trophic groups to the diet of *Micropogonias furnieri* at the groups I-III in the study area.

TROPHIC GROUP	SECTORS		
	I	II	III
Deposit-feeders	56.5-99.99	1.1-6.2	0.2-7.3
Carnivores/scavengers	0-18.7	1.9-25.5	<0.01-7.1
Suspension/filter-feeders	-	0.9-3.7	0-1.4
Omnivores	<0.01-24.5	39.3-95.1	37.3-97.1

TABLE 3 – Percentage contribution (range of %IA) of main functional groups to the diet of *Micropogonias furnieri* at the groups I-III in the study area.

FUNCTIONAL GROUP	SECTORS		
	I	II	III
<i>Polychaetes</i>			
Burrowers	0-0.02	0-0.04	0-0.5
Motile	0-22.9	0-12.5	0-8.7
Sessile	0.02	-	-
<i>Molluscs</i>			
Bivalves	56.5-99.99	1.2-9.1	0-7.3
Gastropods	<0.01	0-0.07	-
<i>Crustaceans</i>			
Epibenthic with motility	<0.01	33.02-94.9	0.8-2.5
Epibenthic swimmers	<0.01-20.2	0.26-19.5	0-84.7
Infaunal	<0.01-0.02	<0.01	0-97.1
Sessile	-	0.74-0.77	0-1.4

4 – DISCUSSION

Micropogonias furnieri in the Río de la Plata estuary and adjacent shallow Uruguayan shelf showed a tendency to specialization towards one single taxonomic prey type, bivalves, but also consumed other benthic invertebrates like polychaetes or crustaceans. The general pattern varied according to the size and area considered. While individuals >10 cm TL preyed mainly on *Mactra isabelleana*, smaller juveniles preyed mostly on Mysidacea. Ontogenetic changes in the diet of some fish species are very well documented (Langton & Watling 1990), but the observed diet variation must be confirmed, because of lower representativity of class length <10 cm. Sanchez *et al.* (1991) (Samborombón Bay), Puig (1986) (Río de la Plata estuary) and Sardiña (2004) (Bahía Blanca estuary) found a diet variation with increasing predator length. These authors found mainly a carcinophagous and annelidophagous diet. On the contrary, our results show a diet mainly based on bivalves, in a similar way to the results of El Rincón (40°30'S), where bivalves *Mytilus edulis platensis* and *Atrina seminuda* were the main items of croakers between 36 cm and 63 cm (Bremec & Lasta 1998). When considering the functional prey groups, larger whitemouth croakers generally fed on slow motile deposit-feeders invertebrates, bivalves mostly, displaying a common pattern of dietary habits at all the habitats. Smaller croakers of estuarine sites adopted also a mixed strategy, feeding on several prey types (Figure 4). This is in coincidence with previous studies in the region, in where early juveniles (< 10 cm TL) fed mainly on epibenthic preys and larger adults on slow motile invertebrates (Sanchez *et al.* 1991, Puig 1986, Bremec & Lasta 1998, Sardiña 2004). The findings of our work are in accordance to results from southern and southeastern Brazil, where the whitemouth croaker had a diet based mostly on invertebrate preys like polychaetes, crustaceans and bivalves, but with different proportions depending of differential availability of preys (Vazzoler 1991, Gonçalves 1997, Figueredo & Vieira 1998, 2005, Soares & Vazzoler 2001).

The croaker diet was similar at the four areas defined previously according to possible distinct prey availabilities (three sectors in the estuary and other in the Uruguayan shallow shelf). Natural biological grouping using multivariate ordination resulted in sampling sites of the Uruguayan coast clustered with the Río de la Plata estuarine sites. Group I clustered sites characterized by a dominance of *M. isabelleana* in the diet. This bivalve is generally dominant in the muddy assemblages of the Río de la Plata estuary and adjacent marine waters, including some sectors of the Uruguayan coast (Giberto 2003, Giberto *et al.* 2004). Group II included smaller croakers feeding on Mysidacea, which are very abundant at the inner sector of the estuary (Schariti *et al.* 2006). Finally,

group III corresponded to croakers feeding on *A. longinaris*, a common shrimp found all over the study area (Giberto 2003, Giberto *et al.* 2004). In the three groups, croakers displayed distinct feeding strategies, varying from a specialization or generalist strategies in muddy bottoms (both marine and estuarine) to a mixed feeding strategy in the heterogeneous marine bottoms. Therefore, croakers adjust their niche width specializing in distinct resource types between individuals or utilizing many resource types simultaneously by the same individual. This general pattern, which must be considered with caution because of the limitation of the data set, reflects the ability of *M. furnieri* to exploit different functional preys when they are very abundant. Mianzan *et al.* (1996) reported ctenophores in the diet of whitemouth croaker, associated to temporal blooms of these preys in the estuary. In a similar way, Acha *et al.* (2002) reported cannibalism on planktonic eggs by *M. furnieri*. This species is usually found at turbid waters, but it also has the ability to detect faster motile animals like *A. longinaris* or teleosts when they could see their prey. For example, Puig (1986) found that presence of fish in the diet increased during midday (higher luminosity), reaching 45% in the diet of some individuals, and Figuereido & Vieira (2005) found an increase in feeding intensity during daylight hours. Therefore, *M. furnieri* seems to have the potential for plasticity in its feeding behavior, and it could be one of the factors that allows for the extensive geographical distribution of this species, throughout different prey exploitation patterns.

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