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Research Article

Distribution and feeding habits of three sea robin species (*Bellator brachychir*, *Prionotus nudigula* and *Prionotus punctatus*) in the Campos Basin, southeastern Brazil

Ricardo R.B. de São Clemente[1], Paulo A.S. Costa[1] & Agnaldo S. Martins[2]
[1]Universidade Federal do Estado do Rio de Janeiro, Laboratório de Dinâmica de Populações Marinhas
Departamento de Ecologia e Recursos Marinhos, IBIO, Av. Pasteur, 458 - sala 410, Urca
Rio de Janeiro, RJ, 22290-240, Brazil
[2]Universidade Federal do Espírito Santo, Departamento de Oceanografia e Ecologia
Vitória, 29075-910, ES, Brazil

ABSTRACT. The distribution, size structure, and feeding of three sea robin species belonging to the family Triglidae (*Bellator brachychir, Prionotus nudigula* and *Prionotus punctatus*) were studied based on specimens caught with bottom trawls on the continental shelf of Campos Basin, southeastern Brazil. The two *Prionotus* species were more concentrated in the inner shelf (<50 m), while *B. brachychir* was generally more abundant on the outer shelf (50-100 m). In general, the three species showed a carcinophagous diet, but with small overlap in their main preys. While amphipods was the most important prey to *B. brachychir*, isopods and shrimps were the basic food item found in *P. nudigula* and *P. punctatus* diet, respectively. This reduction in interspecific competition for food was followed by some degree of spatial segregation and thermal preferences for each species.

Keywords: sea robin, Triglidae, distribution, feeding ecology, Campos Basin, southeastern Brazil.

Distribución y hábitos alimentarios de tres especies de rubio (*Bellator brachychir*, *Prionotus nudigula* y *Prionotus punctatus*) en la cuenca de Campos, sureste de Brasil

RESUMEN. La distribución, estructura de tamaños, y la alimentación de tres especies de rubio pertenecientes a la familia Triglidae (*Bellator brachychir, Prionotus nudigula* y *Prionotus punctatus*) se estudiaron sobre la base de ejemplares capturados con redes de arrastre de fondo en la plataforma continental de la cuenca de Campos, en el sureste de Brasil. Las dos especies de *Prionotus* estaban más concentradas en la plataforma interior (<50 m), mientras que *B. brachychir* fue generalmente más abundante en la plataforma exterior (50-100 m). En general, las tres especies mostraron una dieta carcinófaga, pero con pequeño solapamiento en sus principales presas. Los anfípodos fueron la presa más importante de *B. brachychir*, los isópodos y camarones fueron el alimento básico encontrado en la dieta de *P. nudigula* y *P. punctatus*, respectivamente. Esta reducción de la competencia interespecífica por alimentos fue seguida por un cierto grado de segregación espacial y preferencias térmicas para cada especie.

Palabras clave: rubio, Triglidae, distribución, ecología alimentaria, cuenca de Campos, sureste de Brasil.

Corresponding author: Ricardo Raphael Bastos de São Clemente (rrbsc17@hotmail.com)

INTRODUCTION

Family Triglidae, known as sea robins, includes 105 species distributed in 10 genera (Nelson, 2006). The three species that occur in Brazil, *Bellator brachychir* (Regan, 1914), *Prionotus nudigula* (Ginsburg, 1950) and *Prionotus punctatus* (Bloch, 1793) are relatively common in sandy and mudflat continental shelf areas in the southeastern and southern coast (Figueiredo & Menezes, 1980; Fagundes-Netto & Gaelzer, 1991; Haimovici *et al.*, 1994, 1996; Haimovici, 1997).

These species are frequently found in commercial trawls on the shelf, mainly as bycatch (Haimovici *et al.*, 1996; Viana, 1998). Between 2000 and 2010, catches of *P. punctatus* in southern Brazil amounted 3,600 ton year^{-1}, on the average (GEP/UNIVALI, 2007, 2008, 2009, 2010, 2011). The species showed signs of overexploitation and a 15% reduction in fishing effort

have been suggested to increase the cost-benefit ratio (Magro *et al.*, 2000).

Studies on growth, feeding, fishing and ecology of *P. punctatus* primarily developed in southeastern and southern Brazil, mainly due to its growing importance in the fisheries in the 1980's. According to Andrade *et al.* (2006), this was one of the main demersal fisheries motivated by the negative perspectives of catching species usually taken as target.

Prionotus punctatus uses bays and estuaries during part of its life cycle as feeding and breeding areas (Milagre *et al.*, 2002). Soares *et al.* (1994, 1998) studying feeding of *P. punctatus* in southeastern Brazil (23ºS), found its diet based on crustaceans, especially *Callinectes* spp. and *Portunus* spp. Similar results were found by Braga & Braga (1987), with shrimps and crabs as the items most found in the stomachs of *P. punctatus*. Tubino (1999) performed an analysis of the distribution and feeding ecology of the three sea robin species off Cabo Frio (23ºS). *B. brachychir* differed from the other species because it was possible to verify its greater abundance in colder and deeper waters of the studied area.

In southern Brazil (32ºS), Teixeira & Haimovici (1989) found *P. nudigula* from 30 to 380 m and from 14º to 18ºC. The diet consisted mainly of crustaceans and fish, and reproduction occurs during the spring and early fall.

Campos Basin lies in southeastern Brazil, off the states of Rio de Janeiro and Espírito Santo. According to the Brazilian Petroleum Agency, approximately 71% of national production (~1,600,000 boe day^{-1}) is pumped into this area, mostly by the Brazilian oil and gas company Petrobras (ANP, 2013). For this reason, there is a continuous demand for environmental data to support engineering projects and evaluate the subsequent environmental risk to the coastal ecosystems. In this study we analyze the distribution and feeding of the three sea robin species on the Campos Basin continental shelf, with the objective of discerning the abundance, analyze the trophic level or, in other words, behold the ecological interaction of these species, to better understand in the future the trophic chain of southeastern Brazil.

MATERIALS AND METHODS

The data was obtained during a single 25-day scientific survey aboard the R/V Gyre, in April, 2008. The specimens were collected using a 15 m otter trawl with a 3.1 cm stretch mesh. The net was towed and opened hydro dynamically by spreading the two 7'×14' wooden doors, with a single warp cable. The net was made of a 10.87 m head rope, a 12.60 m ground rope, and 2.08 m of maximum height, resulting in an estimated effective opening of 6.30 m, or 50% of the length of the groundrope, as described in Pauly (1980). All samplings were carried out during the day (06:00 h AM to 06:00 h PM).

After each trawling, the fish were separated from invertebrates and grouped according to species or type, and the number of specimens and the total weight of each taxon were recorded. The samples were packed in plastic drums and fixed in 10% formalin. Subsequently, the samples were transferred to 70% ethanol for preservation.

The number and weight of captured fish were considered by trawling time and converted to relative yields (n h^{-1} and kg h^{-1}), which were used as abundance indicators. These data were used to map the spatial distribution of sea robin's populations in the Campos Basin shelf. In this context, sea robin species occurred in 17 trawling stations made during the survey, at depths ranging from 10 to 100 m (Fig. 1).

In laboratory, the fish were measured and weighted, reproductive data were collected, and analysis of stomach contents was performed. Each individual had its total length (mm) recorded in an ichthyometer and weighted with the aid of a digital balance accurate to 0.01 g. The gonads were analyzed for sexual differentiations, maturation and stomachs were presserved in 70% alcohol for trophic studies. The food items were determined quantitatively to the lowest possible taxonomic level.

The mean trophic level was compared statistically among the considered species, according to Pauly *et al.* (2000) proposal, which allowed items standardization for purposes of comparisons among the analyzed species and even compared to other studies, since this classification is adopted by FishBase. The classification consists of a table with three levels of aggregation encompassing the most common prey types found in dietary studies compiled worldwide. Afterwards these values were attached to the trophic level equation proposed by Cortés (1999) and Ebert & Bizzarro (2007) to calculate the species mean trophic level:

$$\text{Tropic level} = 1 + [\sum (P * TP)]$$

where P is the frequency of prey category in the diet and TP is the trophic position of prey category.

The frequency of occurrence, numerical importance, and weight of the preys were used to quantify their relative importance in the species' diet, according to Hyslop (1980). Subsequently, the Index of Relative Importance (IRI) was calculated as developed by Pinkas *et al.* (1971) according to the equation:

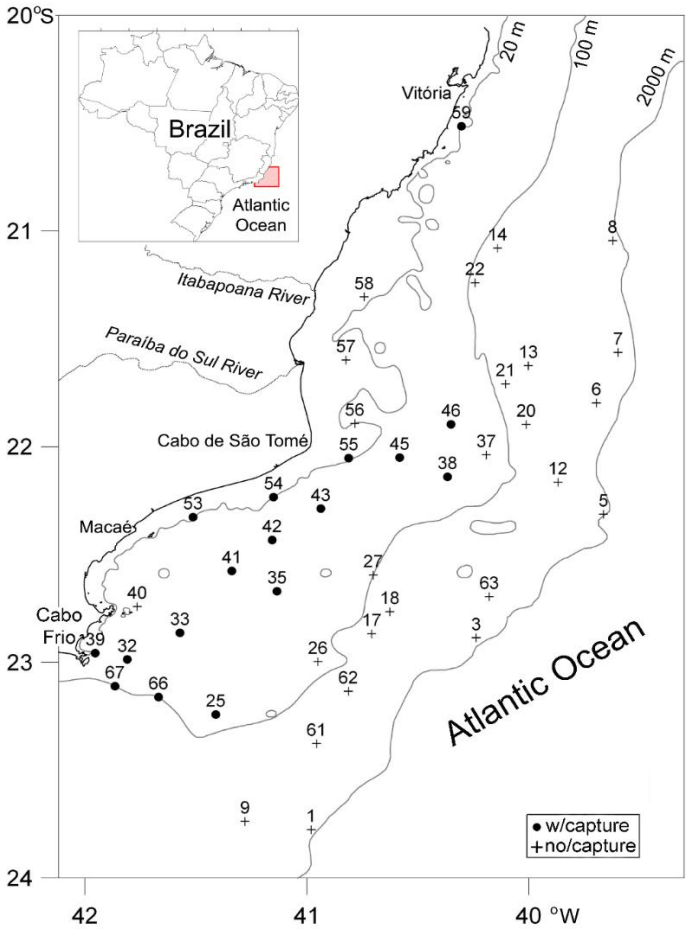

Figure 1. Trawl stations in the area of Campos Basin, southeastern Brazil, used to analyze the distribution and feeding of sea robins species.

$$IRI = FO\% * (N\% + W\%),$$

where FO%, N%, and W% are the frequency percentage of occurrence, numerical and weight importance of each prey, respectively.

It was found that the condition of data normality and homoscedasticity could not be confirmed in the statistical comparisons with Shapiro-Wilk test and Levene test (Zar, 2009), reason why the chi-square statistic and nonparametric Mann-Whitney test (Siegel, 1975) were chosen. Yields (CPUE in number and weight), average weight, and average length were compared statistically among depth strata (10-50 m and 50-100 m), temperature (<20°C and >20°C), and sedimentary cover (sand and mud).

RESULTS

Spatial distribution and abundance

The 24 trawls from shelf areas yielded 852 specimens. *Bellator brachychir* was the most abundant (n = 537), while *P. nudigula* (n = 248) and *P.punctatus* (n = 67) occurred in smaller numbers.

Significant values were observed when comparing numerical yields and average weight of *B. brachychir* with depth strata, while temperature and sedimentary cover significantly affect the abundances of *P. nudigula* and *P. punctatus* (Table 1).

Although *B. brachychir* (34-83 mm TL) was the most abundant sea robin species, it showed a more restricted distribution in the surveyed area (Fig. 2). Mean numerical densities were significantly higher (P = 0.004) in the range of 50-100 m (142 ± 81 n h^{-1}), corresponding to 0.6 ± 0.3 kg h^{-1}. Catches occurred exclusively in temperatures below 20°C. *P. nudigula* (54-166 mm TL) was closely associated to inner-shelf stations (10-50 m). Although 91% of the specimens have been recorded between 10 and 50 m, mean numerical densities (113 ± 103 n h^{-1}) and weight (1.5 ± 2.6 kg h^{-1}) were not statistically different (P = 0.200). *P. punctatus* (54-305 mm TL) was the most widely distributed species. Although 84% of the specimens have

Table 1. Mean weight, relative abundance (CPUE) and total length (TL) according to depth and temperature ranges. Significance values (*P*) from non-parametric Mann-Whitney test. In bold are indicated the significant values ($P < 0.05$).

	Depth (m)			Temperature (°C)			Cover		
	10<50	50-100	*P*	<20	>20	*P*	Sand	Mud	*P*
Bellator brachychir									
Weight (g)	4.4	4.3	0.996	4.4	-	-	4.6	4.2	0.700
CPUE (kg h^{-1})	0.02	0.6	**0.004**	0.5	-	-	0.7	0.4	0.350
CPUE (n h^{-1})	26.0	142.0	**0.004**	122.8	-	-	147.3	98.3	0.350
TL (mm)	70.6	69.1	0.880	69.4	-	-	71.1	67.7	0.800
Prionotus nudigula									
Weight (g)	22.5	15.96	0.730	22.9	10.7	0.262	20.0	14.7	0.817
CPUE (kg h^{-1})	1.5	0.11	0.500	1.34	0.03	**0.013**	1.1	0.03	**0.009**
CPUE (n h^{-1})	113.0	12.0	0.287	76.2	5.00	0.064	66.57	3.0	**0.006**
TL (mm)	123.7	110.2	0.730	125.2	98.00	0.521	118.42	108.6	0.417
Prionotus punctatus									
Weight (g)	43.5	116.7	0.191	53.1	82.6	0.998	90.9	23.8	0.600
CPUE (kg h^{-1})	0.4	0.3	0.420	0.1	0.5	**0.009**	0.5	0.06	**0.001**
CPUE (n h^{-1})	23.4	4.2	0.111	2.0	17.7	**0.019**	17.1	2.6	**0.036**
TL (mm)	138.1	210.2	0.190	164.9	171.6	0.800	181.8	129.2	0.416

been recorded from 10 to 50 m, yields did not vary significantly with depth strata ($P = 0.100$). Yields of *Prionotus punctatus* were significantly higher in temperatures above 20°C ($P = 0.019$), while catch rates (kg h^{-1}) of *P. nudigula* were significantly higher ($P = 0.009$) below 20°C (Table 1).

Prionotus nudigula and *P. punctatus* were nearly related to sandy cover, mean numerical densities (66 ± 34 n h^{-1}; 17 ± 13 n h^{-1}, respectively) were significantly higher ($P = 0.006$; $P = 0.036$, respectively) on this sediment. However, *B. brachychir* did not show significant differences ($P = 0.350$) between the sandy and mudflat cover.

The two *Prionotus* species showed little or no spatial overlap, co-occurring in a single trawl (station 38). Only in this case, a single *P. nudigula* specimen occurred against four ones of *P. punctatus* (Fig. 3).

Sexual variability and length-weight relationship

For the three analyzed species, a greater proportion of females relative to males were observed, ranging by 1.5:1 for *P. nudigula*, 2:1 for *P. punctatus*, and 4:1 for *B. brachychir*. The proportions were significantly different only for *B. brachychir* ($P < 0.0001$) and *P. punctatus* ($P = 0.0006$), when compared by chi-square test. The relationship between total weight (g) and total length (mm) was obtained by regression analysis using the least-square method fitted to the potential function for both sexes (Fig. 4). No significant differences (chi-square test) were found among the total lengths and weights between sexes of the same species. The CI 95% relative to the total length ranged 0.18 for *B. brachychir*, 0.44 for *P. nudigula* and 1.22 for *P. punctatus*.

Feeding

Stomachs of *B. brachychir* specimens (44-84 mm TL), *P. nudigula* (73-141 mm TL), and *P. punctatus* (62-166 mm TL) were analyzed. The frequency of stomachs with contents was 63%, 86% and 45% respectively.

In general, the three species presented a diet consisting primarily of crustaceans and other invertebrates from the benthic macrofauna, although the relative importance of the main preys changed according to the species (Table 2). The most frequent items in the diet (excluding unidentified items) of *B. brachychir* were amphipods (38%), while isopods (39%) and cumaceans (22%) were more frequent in *P. nudigula* and *P. punctatus*.

Based on the Index of Relative Importance (IRI), which integrates frequency, numbers and weight of preys, it was observed that *B. brachychir* fed preferentially on amphipods (IRI = 459). isopods (IRI = 1252) and tanaidaceans (IRI = 1209) were more important to *P. nudigula*, while shrimps (IRI = 335) and cumaceans (IRI = 280) to *P. punctatus*. No significant differences were registered in the composition of food items of *Prionotus* in relation to its sizes. Moreover, the diet of *B. brachychir* varied significantly ($P = 0.033$) with the predator size.

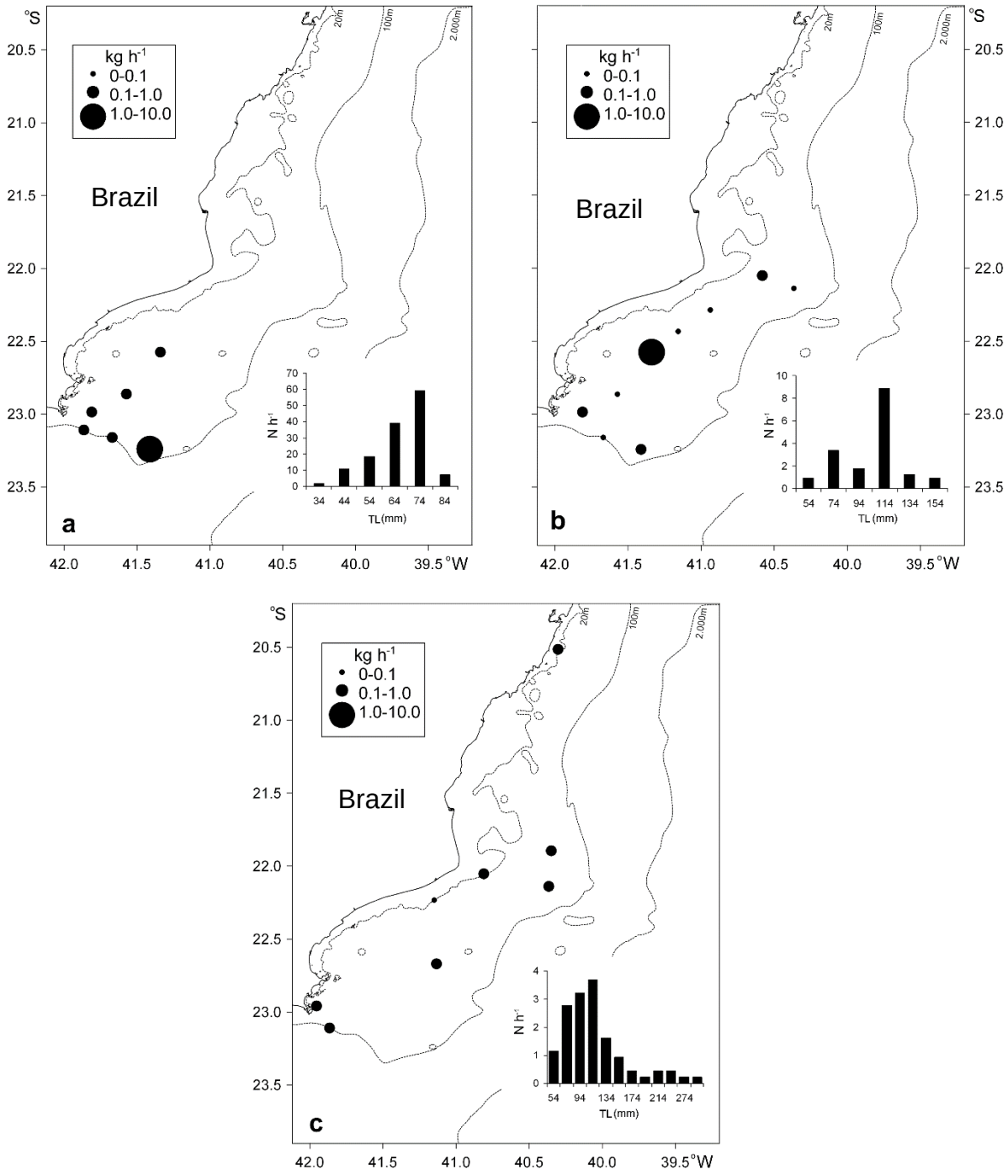

Figure 2. Relative abundance (CPUE kg h^{-1}) of a) *B. brachychir*, b) *P. nudigula*, and c) *P. punctatus*. Histograms represent densities (n h^{-1}) recorded by total length (TL mm).

The three studied sea robin species showed very similar values concerning their trophic levels (Fig. 5), ranging between 3.0 and 3.4.

However, these values were considered signify-cantly different (P = 0.004) according to Kruskal-Wallis test when comparing the diet of *B. brachychir* and *P. punctatus*. This can be explained by the higher consumption of fish by *Prionotus* species (IRI = 114) compared with *Bellator* (IRI = 9.7).

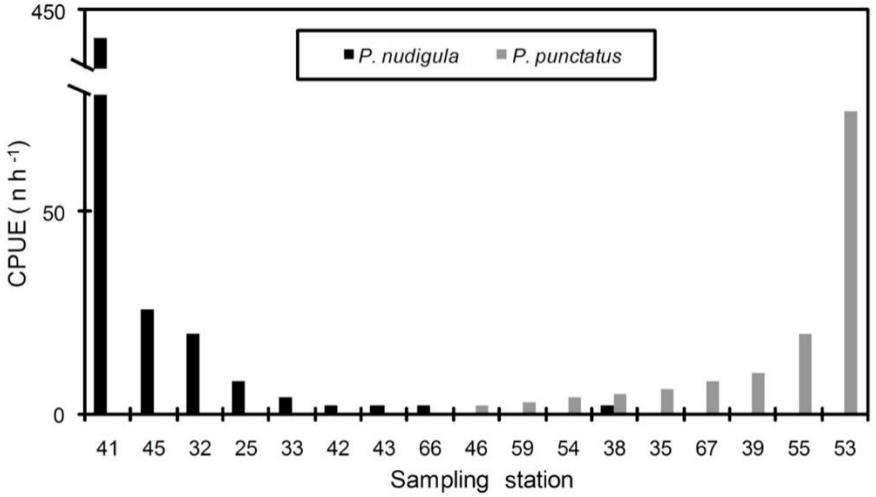

Figure 3. Inverse relative abundance (CPUE) of *Prionotus* species in Campos Basin, southeastern Brazil.

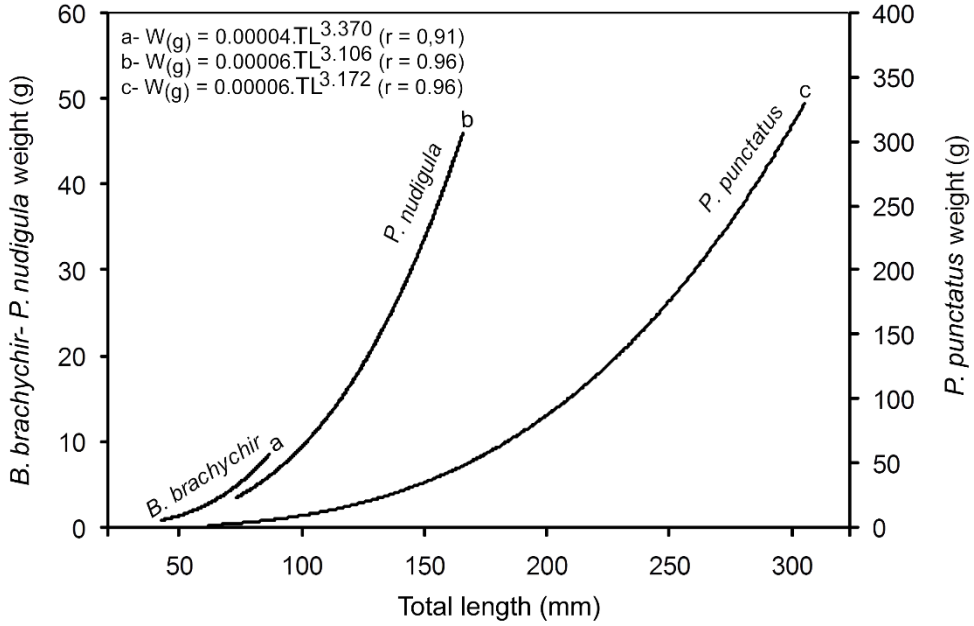

Figure 4. Length-weight relationship, with sexes combined, of the three Brazilian sea robin species.

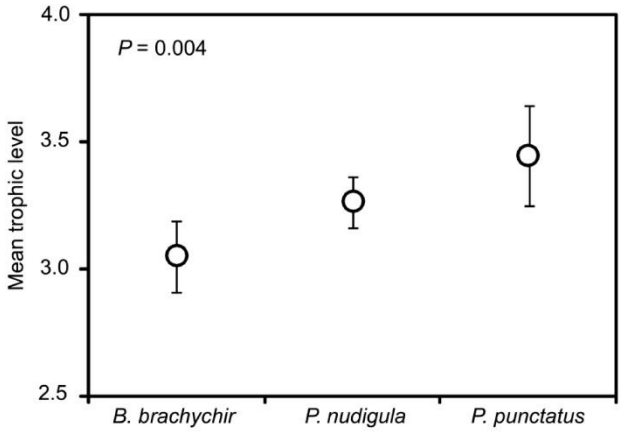

Figure 5. Mean trophic level of sea robin species according to the food items found in their stomachs. The vertical bars show the confidence interval (95%).

Table 2. Frequency of occurrence (FO), number (N), weight (g), and Index of Relative Importance (IRI) of food items found in stomachs contents of Brazilian sea robins (*B. brachychir*, *P. nudigula*, and *P. punctatus*) on Campos Basin continental shelf.

	FO	%	n	%	W(g)	%	IRI
Bellator brachychir (n = 97)							
Amphipoda	16	16.5	54	21.3	0.10	6.5	459.3
Dendrobranchiata	7	7.2	26	10.3	0.16	8.2	133.2
Anomura	6	6.2	20	7.9	0.06	3.7	72.0
Cumacea	3	3.1	31	12.3	0.14	8.6	64.5
Brachyura	3	3.1	10	4.0	0.12	7.3	34.7
Teleostei	4	4.1	4	1.6	0.01	0.8	9.7
Tanaidacea	2	2.1	5	2.0	0.01	0.8	5.8
Isopoda	1	1.0	1	0.4	0.001	0.1	0.5
Unidentified	55	56.7	102	40.3	1.06	64.0	5915.9
Prionotus nudigula (n = 61)							
Isopoda	19	31.1	120	23.2	0.55	17.0	1252.2
Tanaidacea	9	14.8	311	60.2	0.71	21.9	1209.9
Amphipoda	12	19.7	58	11.2	0.50	15.4	523.1
Dendrobranchiata	4	6.6	14	2.7	0.19	5.8	56.0
Brachyura	2	3.3	5	1.0	0.14	4.4	17.7
Anomura	1	1.6	1	0.2	0.09	2.8	5.0
Polichaeta	1	1.6	3	0.6	0.03	1.1	2.6
Unidentified	13	21.3	5	1.0	1.00	31.6	694.1
Prionotus punctatus (n = 25)							
Dendrobranchiata	3	12.0	5	9.1	0.29	18.8	335.0
Cumacea	4	16.0	8	14.5	0.04	3.0	280.2
Brachyura	2	8.0	5	9.1	0.22	14.5	188.8
Isopoda	2	8.0	6	10.9	0.11	7.5	147.1
Amphipoda	3	12.0	5	9.1	0.01	0.9	119.9
Teleostei	3	12.0	5	9.1	0.007	0.5	114.5
Stomatopoda	1	4.0	1	1.8	0.10	6.9	34.9
Unidentified	7	28.0	20	36.4	0.74	48.0	2361.3

DISCUSSION

Although the three studied sea robin species have been recorded over the continental shelf of the Campos Basin, their distribution in the trawls suggest a possible spatial segregation that can be explained by preferences for their bathymetric and thermal distribution and also in response to the food preferences. Possibly, this mechanism is related to a reduction in interspecific competition, a frequent strategy in co-generic species, or exploitation of comparable niches in the same area.

Tubino (1999), in an extensive regional study on the sea robins in the upwelling area of Cabo Frio, suggest that Triglidae species use basically the same food resources, but in different environmental situations. He found the same sea robin species occurring throughout the year, but concentrated in specific depth ranges. These results resemble largely those found on the Campos Basin shelf, where *B. brachychir* was concentrated between 50-100 m depth and temperatures below 20ºC, while both *Prionotus* species prevailed between 10-50 m, in a wider temperature range. Fagundes-Netto & Gaelzer (1991) and Teixeira & Haimovici (1989) have reported the distribution of the three sea robin species throughout the year in comparable depths and thermic ranges as reported in the present study.

A less intense deviation in the ratio among females and males was observed for the *Prionotus* species in the southernmost regions, with 2:1 (Andrade, 2004) and 1.2:1 (Teixeira & Haimovici, 1989), which suggest that populations change their structure in the sex proportions latitudinally.

Teixeira & Hamovici (1989), studying the feeding of the two *Prionotus* (*P. punctatus and P. nudigula*) species in southern Brazil (32ºS), reported that the diet of sea robins was composed mainly by crustaceans and fish, with variations on prey's composition, according to the considered species. Similarly, Tubino (1999) found crustaceans, fish, and euphausiids as the main

food sources for sea robins in the region of Cabo Frio (23ºS). This suggest that the diet of sea robins showed little variation regarding latitude or depth, but vary significantly from the preferences in diet composition among the three species.

CONCLUSIONS

According to the data analyzed, it can be concluded that the two *Prionotus* species were spread preferentially on sandy bottoms at depths between 10 and 50 m. However, while *P. nudigula* occurred preferentially at lower temperatures (<20ºC), *P. punctatus* preferred warmer waters (>20ºC), whereas *B. brachychir* was distributed between 50 and 100 m in cooler waters (<20°C). It is noteworthy that the co-generic species belonging to the *Prionotus* genus showed little or no spatial superposition, co-occurring only in a single trawl.

Basically, sea robins at Campos Basin presented a carcinophagous diet, but with small overlap in their main preys. While amphipods was the most frequent prey (excluding unidentified items) to *B. brachychir* (38%), isopods (39%) and cumaceans (22%) were the basic food item found in *P.nudigula* and *P. punctatus* diet, respectively. This reduction in interspecific competition is followed by spatial segregation and thermal preferences for each species.

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REFERENCES

Agência Nacional do Petróleo (ANP). 2013. Boletim da Produção de Petróleo e Gás Natural. Superintendência de Desenvolvimento e Produção. homepage, http://www.anp.gov.br.

Andrade, H.A. 2004. Age and growth of the sea robin (*Prionotus punctatus*) in Brazilian waters. Bull. Mar. Sci., 75(1): 1-9.

Andrade, H.A., S.H.B. Lucato, L.R. Almeida & E. Cerchiari. 2006. Diagnóstico do estoque e orientações para o ordenamento da pesca de *Prionotus punctatus* (Bloch, 1793). In: C.L.D.B. Rossi-Wongtschowski, A.O. Ávila-da-Silva & M.C. Cergole (eds.). Análise das principais pescarias comerciais da região Sudeste-Sul do Brasil: dinâmica populacional das espécies em explotação-II. São Paulo, pp.139-144.

Braga, F.M.S. & M.A.A.S. Braga. 1987. Estudo do hábito alimentar de *Prionotus punctatus* (Bloch, 1797) (Teleostei, Triglidae) na região da Ilha de Anchieta, Estado de São Paulo, Brasil. Rev. Bras. Biol., 42(1/2): 31-36.

Cortés, E. 1999. Standardized diet compositions and trophic levels of sharks. ICES J. Mar. Sci., 56: 707-717.

Ebert, D.A. & J.J. Bizarro. 2007. Standardized diet compositions and trophic levels of skates (Chondrichthyes: Rajiformes: Rajoidei). Environ. Biol. Fish., 80: 221-237.

Fagundes-Netto, E.B. & L.R. Gaelzer. 1991. Associações de peixes bentônicos e demersais na região de Cabo Frio-RJ, Brasil. Nerítica, Curitiba, 6(1-2): 139-156.

Figueiredo, J.L. & N.A. Menezes. 1980. Manual de peixes marinhos do Sudeste do Brasil. III Teleostei (2). Museu de Zoologia. Universidade de São Paulo, São Paulo, 96 pp.

Grupo de Estudos Pesqueiros/Universidade do Vale do Itajaí (GEP/UNIVALI). 2007. Boletim estatístico da pesca industrial de Santa Catarina-Ano de 2005 e Panorama 2001-2005: Programa de monitoramento e avaliação da atividade pesqueira industrial no sudeste e sul do Brasil. Universidade do Vale do Itajaí, Itajaí, SC, 80 pp.

Grupo de Estudos Pesqueiros/Universidade do Vale do Itajaí (GEP/UNIVALI). 2007. Boletim estatístico da pesca industrial de Santa Catarina-Ano de 2006: Programa de monitoramento e avaliação da atividade pesqueira industrial no sudeste e sul do Brasil. Universidade do Vale do Itajaí, Itajaí, SC, 80 pp.

Grupo de Estudos Pesqueiros/Universidade do Vale do Itajaí (GEP/UNIVALI). 2008. Boletim estatístico da pesca industrial de Santa Catarina-Ano de 2007: Programa de monitoramento e avaliação da atividade pesqueira industrial no sudeste e sul do Brasil. Universidade do Vale do Itajaí, Itajaí, SC, 71 pp.

Grupo de Estudos Pesqueiros/Universidade do Vale do Itajaí (GEP/UNIVALI). 2009. Boletim estatístico da pesca industrial de Santa Catarina-Ano de 2008: Programa de monitoramento e avaliação da atividade pesqueira industrial no sudeste e sul do Brasil. Universidade do Vale do Itajaí, Itajaí, SC, 73 pp.

Grupo de Estudos Pesqueiros/Universidade do Vale do Itajaí (GEP/UNIVALI). 2010. Boletim estatístico da pesca industrial de Santa Catarina-Ano de 2009 e Panorama 2000-2009: Programa de monitoramento e avaliação da atividade pesqueira industrial no sudeste e sul do Brasil. Universidade do Vale do Itajaí, Itajaí, SC, 97 pp.

Grupo de Estudos Pesqueiros/Universidade do Vale do Itajaí (GEP/UNIVALI). 2011. Boletim Estatístico da Pesca Industrial de Santa Catarina-Ano de 2010: Programa de monitoramento e avaliação da atividade pesqueira industrial no sudeste e sul do Brasil. Universidade do Vale do Itajaí, Itajaí, SC, 59 pp.

Hyslop, E.J. 1980. Stomach contents analysis - a review of methods and their application. J. Fish Biol., 17: 411-429.

Haimovici, M. 1997. Recursos pesqueiros demersais da Região Sul. Programa REVIZEE/MMA/CIRM, 80 pp.

Haimovici, M. & J.T. Mendonça. 1996. Descartes da fauna acompanhante na pesca de arrasto de tangones dirigida aos linguados e camarões na plataforma continental do sul do Brasil. Atlântica, 18: 161-177.

Haimovici, M., A.S. Martins & P.C. Vieira. 1996. Distribuição e abundância de teleósteos demersais sobre a plataforma continental do sul do Brasil. Rev. Brasil. Biol., 56(1): 27-50.

Haimovici, M., A.S. Martins, J.L. Figueiredo & P.C. Vieira. 1994. Demersal bony fish of the outer shelf and upper slope of the southern Brazil subtropical convergence ecosystem. Mar. Ecol. Prog. Ser., 108: 59-77.

Magro, M., M.C. Cergole & C.L.D.B. Rossi-Wongtschowski. 2000. Síntese de conhecimentos dos principais recursos pesqueiros costeiros potencialmente explotáveis na costa sudeste-sul do Brasil: peixes. Programa REVIZEE/MMA/CIRM, 143 pp.

Milagre, R.R., M.C.C. Azevedo & F.G. Araújo. 2002. Distribuição, reprodução e hábitos alimentares de *Prionotus punctatus* (Scorpaeniformes: Triglidae) na baía de Sepetiba, RJ. Acta Biol. Leopoldensia, 24(2): 173-184.

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Nelson, J.S. 2006. Fishes of the world. John Wiley & Sons, New York, 600 pp.

Pauly, D**.** 1980. A selection of simple methods for the assessment of tropical fish stocks. FAO Fish. Circ., 729: 54 pp.

Pauly, D., R. Froese & P.S. Sa-a. 2000. TrophLab Manual. ICLARM, Manila, 185 pp.

Pinkas, L., M.S. Oliphant & I.L.K. Iverson. 1971. Food habits of albacore, bluefin tuna, and bonito in California waters. Calif. Fish. & Game, Fish Bull., 152: 1-105.

Siegel, S. 1975. Estatística não-paramétrica para as ciências do comportamento. McGraw-Hill, São Paulo, 350 pp.

Soares, L.S.H. & R. Apelbaum. 1994. Atividade alimentar diária da cabrinha *Prionotus punctatus* (Teleostei: Triglidae) do litoral de Ubatuba, Brasil. Bolm. Inst. Oceanogr., São Paulo, 42(1/2): 85-98.

Soares, L.S.H., A. Jarre-Teichmann & C.L.D.B. Rossi-Wongtschowski. 1998. Field estimates of food consumption of the sea robin *Prionotus punctatus* (Bloch, 1797) on the continental shelf off Ubatuba, southeastern Brazil. Rev. Brasil. Oceanogr., 46(1): 45-60.

Teixeira, R.L. & M. Haimovici. 1989. Distribuição, reprodução e hábitos alimentares de *Prionotus punctatus* e *P. nudigula* (Pisces,Triglidae) entre Solidão (30º43'S) e Chuí (33º45'S). Atlântica, 11(1): 13-45.

Tubino, R.A. 1999. Distribuição e ecologia alimentar de três espécies de peixes demersais da Família Triglidae*: Prionotus punctatus, Prionotus nudigula e Bellator brachychir* na região de ressurgência de Cabo Frio, Rio de Janeiro, Brasil. Dissertação de Mestrado, Programa de Pós Graduação em Biologia Marinha, UFF, Niterói, 81 pp.

Vianna, M. 1998. Análise de populações de peixes teleósteos acompanhantes da pesca de arrasto do camarão-rosa (*Penaeus brasiliensis* e *P. paulensis*), em Ubatuba, SP: captura, crescimento e mortalidade. Tese de Doutorado, Universidade de São Carlos, São Paulo, 114 pp.

Zar, J.H. 1999. Biostatistical analysis. Prentice Hall, New Jersey, 663 pp.