

Feeding habits of the congeneric species *Stellifer rastrifer* and *Stellifer brasiliensis* (Acanthopterygii: Sciaenidae) co-occurring in the coast of the state of Santa Catarina, Brazil

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Abstract

The objective of the present study was to investigate the feeding habits allowing the occurrence of the congeneric species *Stellifer rastrifer* and *Stellifer brasiliensis*, collected on a seasonal basis, in the operating area of the artisanal seabob-shrimp trawl fishery in Porto Belo, an important fishing area on the southern Brazilian coast. Fish were collected seasonally from November 2009 to August 2010, in isobaths of 10, 20 and 30m. Of the 450 stomachs analyzed, 194 belonged to *Stellifer rastrifer* and 242 to *Stellifer brasiliensis*. From the totality of analyzed stomachs 33.49% were empty and 66.52% had some content. Crustacea were the predominant food category in the diet of *S. rastrifer* and *S. brasiliensis*, and the shrimp *Acetes americanus* was the most frequent crustacean in stomachs of both studied species. The overlapping in the diet of the species was high, however when analyzing the overlap in each season it was found that it occurred only during spring and winter. Although the most important items in the diet of these species are the same, the intake of each alternates in time, suggesting a difference in predation pressure, which leads to less direct competition in a given time.

Keywords: competition, fish diet, feeding overlap, shrimp fisheries, *Stellifer*.

Hábitos alimentares das espécies congêneres *Stellifer rastrifer* e *Stellifer brasiliensis* (Acanthopterygii: Sciaenidae) co-ocorrendo na costa do estado de Santa Catarina, Brasil

Resumo

O objetivo do presente estudo foi investigar os hábitos alimentares que possibilitam a ocorrência das espécies congêneres *Stellifer rastrifer* e *Stellifer brasiliensis*, coletados sazonalmente, na área operacional da pesca artesanal do camarão setebaras, em Porto Belo, uma área de pesca importante na costa sul do Brasil. Os peixes foram coletados sazonalmente de novembro de 2009 a agosto de 2010, em isóbatas de 10, 20 e 30m. Dos 450 estômagos analisados, 194 eram de *S. rastrifer* e 242 de *S. brasiliensis*. Da totalidade dos estômagos analisados 33,49% estavam vazios enquanto 66,52% tinham algum conteúdo. Crustacea foi a categoria de alimento predominante na dieta, e o camarão *Acetes americanus* foi o crustáceo mais freqüente nos estômagos de ambas as espécies. A sobreposição na dieta foi alta, porém a cada estação do ano, verificou-se que a sobreposição ocorreu apenas durante a primavera e o inverno. Embora os itens mais importantes na dieta destas espécies sejam os mesmos, o consumo de cada um é alternado no tempo, o que sugere uma diferença na pressão de predação, levando a uma menor competição direta em um determinado momento.

Palavras-chave: competição, dieta, sobreposição alimentar, pesca camaroeira, *Stellifer*.

1. Introduction

Bycatch is defined as the catch of individuals by a fishing gear which is targeting another species. It is a well known and under exploited resource in many countries while it may be overvalued in others (Mathews and Samuel, 1991). As shrimp fisheries are responsible for the largest bycatch among all fishing gears in the world (Keunecke et al.,

2007), a large amount of the catch – composed mainly by immature organisms – is rejected on board and returned to the sea since it has no commercial value, (Vazzoler, 1962), however the study of the discarded species was made necessary, as many of them might have commercial value in the near future.

According to Sheridan et al. (1984), Sciaenidae, Haemulidae, Sparidae, Synodontidae, Serranidae and Paralichthyidae are the families of demersal fish commonly found in the same areas of occurrence of Penaeidae shrimps, such as the seabob-shrimp *Xiphopenaeus kroyeri* (Heller, 1862). The fishes of the Sciaenidae family are most commonly found in shallow waters of the continental shelf, over sandy bottoms or mud (Menezes and Figueiredo, 1980; Souza et al., 2008) and represent the most important fishery resource in estuarine and coastal waters in the world (Chao, 1986). In Brazil this family is represented by 21 genera and 54 marine species (Menezes et al., 2003).

The genus *Stellifer* (Oken, 1817) comprises 24 species of fish that inhabit the coastal regions of the Atlantic and Pacific along the North, Central and South American coast (Froese and Pauly, 2010). It is distributed from Colombia to southern Brazil, its species usually attaining maximum size of 200mm (Menezes and Figueiredo, 1980) and represent up to 30% of the captured species in the seabob shrimp bycatch in southeastern and southern Brazil (Branco and Verani, 2006; Coelho et al., 1986). Two of these species are *Stellifer rastifer* (Jordan, 1889) and *Stellifer brasiliensis* (Schultz, 1945), commonly known as "Cangoá".

These species occur in abundance in the studied area, as discussed by Rodrigues-Filho (2011), where the overlapping of the reproductive period was observed. In this case, the values of relative condition factor indicated that *Stellifer brasiliensis* more effectively leverages food resources than *S. rastifer*. These results were attributed to different oral structures in each species (Menezes and Figueiredo, 1980), resulting in different feeding strategies (Futuyma, 1998) as found by Frehse (2009) studying *S. rastifer* and *S. brasiliensis* from the Paraná state and from the northern region of the Santa Catarina state.

In this context, this study aims to analyze the natural diet of *S. rastifer* and *S. brasiliensis* attempting to answer the following questions: a) Do changes in the trophic spectra of these species occur seasonally? b) Do species share the same food resources in the study area and, if so, is this sharing associated with changes in the conditions of healthiness?

2. Material and Methods

Samples were collected on a seasonal basis, in the operating area of the artisanal seabob-shrimp trawl fishery in Porto Belo, SC ($27^{\circ} 09'12''$ S and $48^{\circ} 33'43''$ W), from November 2009 to August 2010, in isobaths of 10, 20 and 30m. The main feature of this área is the peninsula of Porto Belo, which presents sandy and rocky beaches, and is mainly composed of muddy sediments which origin of the Tijucas River and bay. Two sweeps were performed with a 15 minutes duration in each isobath, using a whaling ship equipped with two trawl doors, the net with mesh size of 3.0 cm and 2.0 cm in the bagger, navigating with a speed of approximately two knots (Branco et al., 2005). The specimens collected from the two trawls were packed in plastic bags, labeled and kept in coolers with ice until

arrival at the laboratory. Vouchers were deposited in the ichthyological collection of the Biology Laboratory of the Center for Science and Technology, Land and Sea, CTTMar – UNIVALI, Santa Catarina, Brazil.

For every specimen, the standard length (cm) and total weight (g) were recorded. The stomachs were removed, weighed, and classified in five categories, according to a previously established scale, indicated the repletion degree: 1 = empty stomach, 2 = quarter-full stomach, 3 = half-full stomach, 4= three quarters full stomach and 5 = full stomach. They were then open under a stereomicroscope.

Looking for a more cohesive analysis of the trophic spectrum (Hahn and Delariva, 2003) and considering the small size of most items we used the methods of frequency of occurrence (FO) and volumetric points (VP), which consider the relative contribution (percentage) of each item, and the total volume of food in the stomach (Hynes, 1950; Berg, 1979).

In order to evaluate the importance of each food item in the diet of the studied species, the Kawakami and Vazzoler (1980) feeding index was applied, which combines the frequency of occurrence with the points method. Diet similarity between species was calculated by the Morisita similarity index modified by Horn (1966). The values of this ratio vary from 0 to 1, and values above 0.6 are considered indicators of high overlap (Labropoulou and Eleftheriou, 1997).

The condition factor (K) and relative condition factor (Kr) were estimated through the expressions ($K = Wt / Ls^b$) and ($Kr = Wt / We$), respectively, where Wt is the total mass, We expected weight for each fish, Ls is standard length and b is the slope of the weight-length relationship (Vazzoler, 1996). The condition factor was estimated in each length class (range of 1 cm), as done by Rodrigues-Filho et al. (2011), while the relative condition factor was calculated seasonally. The values for each season were compared by the Kruskal-Wallis test (Zar, 1999). The weight-length relationship ($W = aL^b$) was calculated for grouped sexes, from the set of all the individuals collected (Vazzoler, 1996). The t-student test was used in order to determine if $b=3$.

3. Results

Of the 450 samples analyzed, *Stellifer rastifer* was represented by 208 while *S. brasiliensis* by 242 specimens. From the totality of analyzed stomachs 33.49% were empty (repletion degree 1) and 66.52% had some content (repletion degree, 2, 3, 4 and 5) (Table 1).

The species showed a similar trophic spectrum according to the number of items found with a slight difference in diversity, having *Stellifer rastifer* 20 items ($H' = 1.95$) and *S. brasiliensis* 19 ($H' = 1.83$) (Tables 2 and 3). The Crustacea were the predominant food category in the diet of *S. rastifer* and *S. brasiliensis* with frequency of occurrence of 83.72% and 71.32% respectively, while occupying a relative volume of 78.88% and 78.81%. The shrimp *Acetes americanus* (Ortmann, 1893) was the most

Table 1. Repletion degree of stomachs analyzed of *Stellifer rastrifer* (Sr) and *Stellifer brasiliensis* (Sb) in each season, for specimens collected in Porto Belo, SC (2009/2010).

Repletion Degree	Spring		Summer		Autumn		Winter	
	Sr	Sb	Sr	Sb	Sr	Sb	Sr	Sb
1	14	23	2	20	43	27	10	21
2	28	28	6	36	45	23	7	14
3	11	7	5	12	6	8	7	3
4	0	1	4	6	2	3	5	1
5	3	4	4	3	5	0	1	2
Total	56	63	21	77	101	61	30	41

Table 2. Frequency of occurrence (%), relative volume (%) and feeding index by season, during the study period for each food item consumed by *Stellifer rastrifer*.

Method	Frequency of Ocurrence (%)				Relative Volume (%)				Feeding Index				
	Item	Sp	Su	Au	Wi	Sp	Su	Au	Wi	Sp	Su	Au	Wi
Crustacea													
Malacostraca													
Decapoda un.		17.50		13.64		16.82		15.85		0.089		0.147	
Xiphopenaeus kroyeri				2.27				0.33				0.001	
Acetes americanus		47.50	7.41	25.00	94.44	56.78	6.15	33.48	93.32	0.815	0.021	0.571	0.996
Portunidae				3.70				1.54				0.003	
Xanthidae				3.70	2.27			4.62	2.77			0.008	0.002
Anomura													
Paguroidea			11.11					10.77				0.055	
Megalopa				2.27					1.11			0.076	
Ovas Crustacea				15.91					6.98			0.018	
Isopoda					2.27				0.55			0.001	
Amphipoda				3.70	2.27			3.08	1.11			0.005	0.002
Gammaridae				37.04	2.27			43.08	0.89			0.729	0.001
Caprellidae					2.27				0.22			<0.001	
Maxillopoda													
Copepoda													
Calanoidea		22.50					10.83		0		0.074		
Cyclopoidae		5.00		11.36		5.05		1.77		0.008		0.014	
Echinodermata													
Ophiuroidea					2.27				2.22			0.003	
Annelida													
Polychaeta			7.41	2.27				4.62	9.98			0.016	0.015
Osteichthyes		5.00	14.81	11.36	5.56	9.46	18.46	20.51	6.68	0.014	0.125	0.159	0.004
Scale		2.50	11.11	2.27		1.05	7.69	2.22		0.001	0.039	0.003	
Total		100	100	100	100	100	100	100	100	1	1	1	1

Sp = Spring, Su = summer, Au = autumn and Wi= winter. N=99.

frequent crustacean in stomachs of both studied species however it was consumed in different rates during each season, being most consumed by *S. rastrifer* during the winter, representing 94.44% of occurrence while it was most consumed during the summer by *S. brasiliensis*, with 44.44% of occurrence.

Osteichthyes (bony fish identified remains) was the second most frequent class, occurring in 13.17% of *Stellifer rastrifer* stomachs, in greater abundance during the summer (25.93%), and occurring in 13.23% of *S. brasiliensis* stomachs, peaking in the fall (17.39%).

The volume occupied by this category was 16.60% in *S. rastrifer* and 10.19% in *S. brasiliensis*. Osteichthyes and *Acetes americanus* were the only items present in all samples, in addition to dissolved organic matter.

Polychaetes were identified in stomach contents of *Stellifer rastrifer* captured during summer and autumn, being more abundant in the summer (7.41%), but for *S. brasiliensis* polychaetes were present in stomachs of fish captured during the spring, summer and autumn, being more abundant in autumn (21.74%). Polychaetes of the Nereididae family, were identified only in *S. brasiliensis*

Table 3. Frequency of occurrence (%), relative volume (%) and feeding index by season, during the study period for each food item consumed by *Stellifer brasiliensis*.

Method	Frequency of Occurrence (%)				Relative Volume (%)				Feeding Index			
	Item	Sp	Su	Au	Wi	Sp	Su	Au	Wi	Sp	Su	Au
Crustacea												
Malacostraca												
Decapoda unidentified	24.39	20.63	26.09		16.06	19.31	27.53		0.197	0.142	0.404	
Pleoticus muelleri					11.11				21.74			0.126
Litopenaeus schmitti					11.11				26.40			0.153
Xiphopenaeus kroyeri				4.35				1.404				0.003
Acetes americanus	31.71	44.44	17.39	33.33	40.14	49.93	14.33	30.12	0.641	0.788	0.140	0.523
Pinnotheridae				8.70				23.88				0.117
Pinnixa sp.	4.88	7.94			10.39	10.81			0.026	0.030		
Portunidae												
Callinectes sp.					22.22				12.42			0.144
Amphipoda	2.44				11.11	2.36			3.11	0.003		0.018
Gammaridae		4.76					3.24				0.005	
Caprellidae	2.44				1.77				0.002			
Maxillopoda												
Copepoda												
Calanoidea	2.44		4.35		0.59		2.25		<0.001		0.006	
Annelida												
Polychaeta	9.76	3.17	21.74		7.08	2.16	24.16		0.035	0.002	0.296	
Nereidae		3.17				2.88				0.003		
Bivalvia	7.32	4.76			6.26	2.74			0.023	0.005		
Osteichthyes	9.76	7.94	13.04	11.11	13.93	8.07	3.65	6.21	0.068	0.023	0.027	0.036
Scale	4.88	3.17	4.35		1.42	0.86	2.81		0.003	<0.001	0.007	
Total	100	100	100	100	100	100	100	100	1	1	1	1

Sp = Spring, Su = summer, Au = autumn and Wi= winter. N=117.

stomachs during the summer. Bivalves were found in six stomachs of *S. brasiliensis* during the spring (7.32%) and summer (4.76%). Stomachs of *S. rastrifer* did not contain any bivalves, however in the stomach of those captured in the fall, ophiuroids were present (2.77%) (Tables 2 and 3).

Amongst the Crustacea, Isopoda, *Xiphopenaeus kroyeri*, caprellids and crustacean larvae (Megalopa) and eggs were food items present only during the fall in the stomachs of *Stellifer rastrifer*, while Portunidae crabs and hermit crabs (Paguraoidea) were present during the summer and Calanoid copepods during the spring. All other items occurred in two or more seasons. *Xiphopenaeus kroyeri* was also found in the stomachs of *S. brasiliensis* during the fall, while the red shrimp, *Pleoticus muelleri* (Bate, 1888), and white shrimp, *Litopenaeus schmitti* (Burkenroad, 1936), were found only during the winter, as well as crabs of the genus *Callinectes*. The Gammaridae amphipods were identified in stomachs of specimens collected in the summer, while representatives of the Caprellidae family were found in the spring.

The unidentified particulate organic matter as well as sand were disregarded in calculation of the Feeding Index (IAI), however it had a high frequency of occurrence and occupied significant volume in the stomachs of *Stellifer rastrifer* (28.27% in total volume) and *S. brasiliensis*

(36.63% in total volume). The food item with the highest value of IAI was *Acetes americanus*, with a value of 0.996 in winter and 0.815 in spring for *S. rastrifer*. For *S. brasiliensis* the values of IAI for this item were 0.788 in summer and 0.641 in spring. For other items the value was much lower (Figure 1).

In general, the overlapping in the diet of the species was high, with a value of 0.97 (Morisita-Horn index), however when analyzing the overlap in each season it was found that it occurred only during spring (0.95) and winter (0.79) whereas in summer and autumn the overlap was less than 50% (0.04 and 0.45 respectively).

The mean values of the relative condition factor (Figure 2) in each species, when compared by the Kruskal-Wallis test indicated no significant differences between them, with mean values of approximately 1 in all seasons for *Stellifer rastrifer* while *S. brasiliensis* had the same pattern except in the autumn when the mean relative condition factor was 0.67. The weight-length curves of both species were grouped graphical representation as they showed the same weight-length patterns (Figure 3), where for the majority of individuals the length range was small, and for both species the t-student test indicated significant differences from the values of b and 3 (*S. rastrifer*: $t=4.061$, $g.l.=302$ $p<0.001$; *S. brasiliensis*: $t=2.109$, $g.l.=$

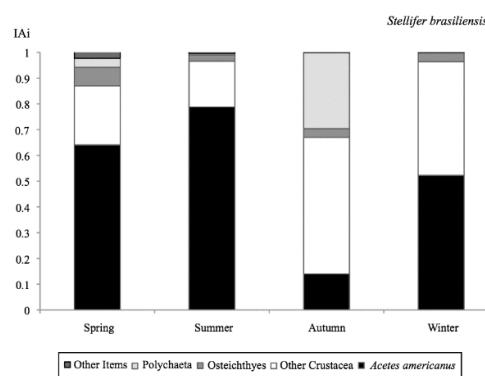
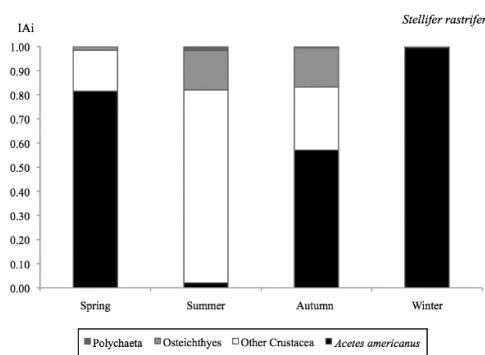


Figure 1. Kawakami and Vazzoler (1980) feeding index (IAi) for the main food items consumed by *Stellifer rastrifer* and *S. brasiliensis* collected in spring, summer, autumn and winter (2009/2010) in Porto Belo, Santa Catarina.

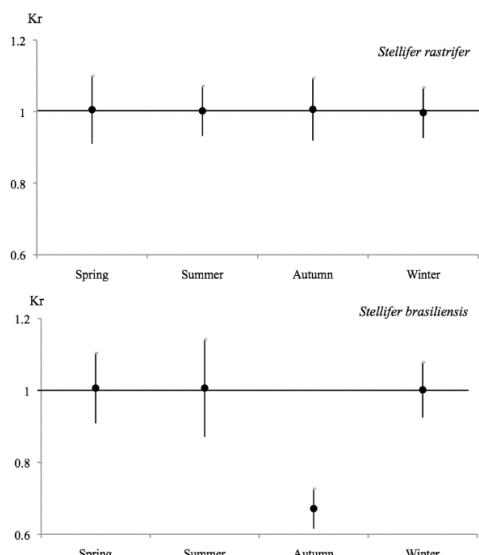


Figure 2. Relative condition factor (Kr) of *Stellifer brasiliensis* and *S. rastrifer* for specimens collected in spring, summer, autumn and winter (2009/2010) in Porto Belo, Santa Catarina.

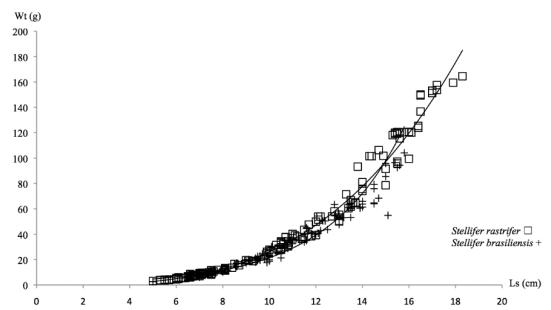


Figure 3. Weight-length curve for *Stellifer rastrifer* ($Wt = 0.0151Ls^{3.2379}$) and *S. brasiliensis* ($Wt = 0.0198Ls^{3.0798}$) and for specimens collected in spring, summer, autumn and winter (2009/2010) in Porto Belo, Santa Catarina.

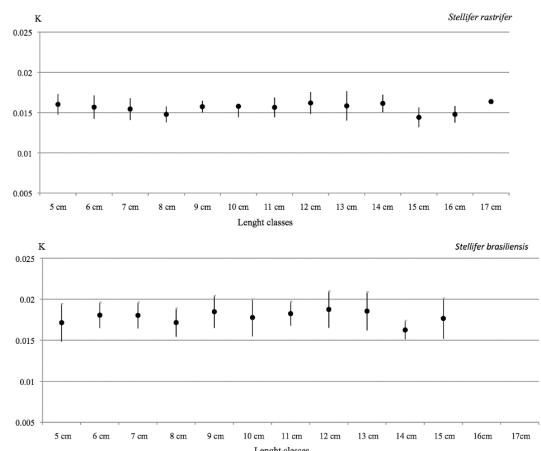


Figure 4. Condition factor (K) by length classes (cm) of *Stellifer rastrifer* and *S. brasiliensis* for all specimens collected in Porto Belo, SC (2009/2010).

328 p<0.001). Grouping all the collected specimens of each species, the condition factor was calculated for each length class, being a relative constant in all length classes, ranging from 0.016 to 0.014 in *S. rastrifer* and 0.018 to 0.016 in *S. brasiliensis* (Figure 4). The lowest K values for *S. rastrifer* occurred in 8cm and again in 14 cm, while in *S. brasiliensis* the same rise and fall pattern is seen in the 8cm, 10cm and again in 14 cm.

4. Discussion

The diet of *Stellifer brasiliensis* and *S. rastrifer* in Porto Belo has a similar pattern to what is described in the literature (Chaves and Vendel, 1998; Frehse, 2009; Magalhães, 1993; Menezes and Figueiredo, 1980 Micheletti and Uieda, 1996; Pombo, 2010; Rodrigues and Meira, 1988), consisting of a few dominant items, most of them decapods. However a temporal analysis of diet showed seasonal variations with the appearance of a few items in some seasons, disappearing in others.

The predominant frequency of occurrence of the Sergestidae from the genus *Acetes* is related to the fact that they occupy the epipelagic or the mesopelagic zones

(Simões et al., 2012), being widely consumed also by the seabob-shrimp *Xiphopenaeus kroyeri* (Branco 2005). Xiao and Greenwood (1993) studying the biology of *Acetes*, observed a clustering behavior in various spatial and temporal scales. Such behavior appears to be linked to pre-spawning activities such as mating and egg production, but also is closely associated with low temperatures present throughout the year in the sampled area due to the Falklands Current, from the Antarctic region (Gordon, 1989; Olson et al., 1988), fact that may contribute to the predominance of this food item in stomachs of fishes of the genus *Stellifer*. In the present study, *Acetes americanus* was the main food item for *S. rastrifer* in the winter, whereas in the summer it was the least consumed, however, *Acetes* was most consumed by *S. brasiliensis* in the summer, indicating that these congener species occupy the same area probably due to resource partitioning. *Acetes* was also the predominant food item for *S. rastrifer* and *S. brasiliensis* collected in Santos (Rodrigues and Meira, 1988) and Ubatuba (Magalhães, 1993) São Paulo state.

The preferential intake of crustaceans has been found by other authors who have studied the genus *Stellifer* (Höfling et al., 1997; Magalhães, 1993; Menezes and Figueiredo, 1980; Micheletti and Uieda, 1996; Rodrigues and Meira, 1988). Despite this preference, and being the most abundant fish amongst the bycatch, *Xiphopenaeus kroyeri* does not appear to be an important food item in the diet for species of the genus *Stellifer*. In this study *X. kroyeri* appears only during the autumn in one stomach of each studied species, however some unidentified decapods may be the seabob shrimp. A similar result was found by Rodrigues and Meira (1988), with the presence of the seabob shrimp in only 22 of the 77 analyzed stomachs of *S. rastrifer* and 2 of the 36 analyzed stomachs of *S. brasiliensis*. It is known that penaeid shrimps are benthic and burry themselves in the sediment (Castilho et al., 2008; Simões et al., 2012), and therefore are available in a smaller scale for benthopelagic consumers, such as *S. rastrifer* and *S. brasiliensis* (Wakabara et al., 1993). Even if juveniles of *X. kroyeri*, are available in the pelagic zones for these fishes, they may be choosing to consume shrimp from the genus *Acetes* not only for their abundance in the studied environment, but for their short and blunt rostrum, that are of easier consumption than the sea-bob's rostrum with five teeth near the base and slightly curved upwards.

Micheletti and Uieda (1996) described and compared the diet of the ten most abundant sciaenids in Flamengo Bay, Ubatuba, and crustaceans and fish were the main food items consumed by *Stellifer brasiliensis* and *S. rastrifer*. A similar result was found by Höfling et al. (1997) studying the diet of sciaenids in the estuarine complex of Cananeia, with the predominant intake of crustaceans, yet Chaves and Vendel (1998), dealing specifically with the diet of *S. rastrifer* in a mangrove area in Guaratuba, Paraná state, identified polychaetes and "shrimps" (non-brachyuran decapods) as major food items with a marked difference in composition at each season. The predominance of polychaetes in this case may be due to the sampled location, as usually estuary sediment is rich in organic matter, which favors for the

development of this type of organisms. Thus, differences in food items may be a consequence of the characteristics of each study area.

According to Lucena et al. (2000), without seasonal variation in diet, both intra-and inter-specific competition will be favored, which may end up causing negative impacts in one or more species. However Colwell and Futuyma (1971) assert that diets with high similarity do not necessarily indicate competition as food resources can be abundant and shared between different species resulting in dietary overlap.

Regarding the analysis of dietary overlap between the two species of fish in question, although the composition of their diets has been shown to be similar in this and other studies, authors do not usually attest strong dietary overlap between them, although the composition of the diets has shown to be recurrently similar. Magalhães (1993) observed a significant difference between the diets of *Stellifer rastrifer* and *S. brasiliensis* while Frehse (2009) found no evidence of strong dietary overlap between them. Micheletti and Uieda (1996) found less than 40% similarity and yet Pombo (2010) found no similarity percentage lower than 60%.

A more detailed analysis on overlap shows differences in the proportions of ingested items. According to Zaret and Rand (1971), even when these differences are small there is no reason to suppose that similarities in diet indicate direct competition when other factors, such as spatiotemporal environmental differences are not analyzed simultaneously. According to Hynes (1950), when a food item is exploited by two or more fish species, their relative significance to each of these species is generally different, as observed during the summer and autumn in Porto Belo studied area. Although the most important items in the diet of these species are the same, the intake of each alternates in time, suggesting a difference in predation pressure, which leads to less direct competition in a given time. The coexistence of similar species within the same ecosystem may occur owing to different resource use, as resource partitioning includes food, habitat and/or time segregation (Pianka, 1973; Schoener, 1974), and seasonal fluctuations in food resource availability have been shown to modify resource partitioning among sympatric fish species (Jepsen et al., 1997).

The distribution of the allometric condition factor by length classes for all captured individuals of each species shows a decline in the value of K in the first length classes, raising again in 9cm and decreasing again in 14cm for *Stellifer rastrifer* and *S. brasiliensis*, however the variation was so low that overall the species condition remained constant. As seasonal changes direct effect on condition factors, which have been shown to be correlated with gonad cycles, rate of feeding, etc (Le Cren, 1951), it is likely that the lower relative condition factor value found during the fall for *S. brasiliensis* is a result of the sampling of young individuals with smaller lengths.

Despite no significant differences between seasons indicated by the Kruskal-Wallis test, the value of 0.67 for the condition factor reflects a greater abundance of

specimens with standard length ranging from 5 to 8 cm. A similar length distribution for the congener species *Stellifer stellifer* was found by Almeida and Branco (2002), in Penha, a county in Santa Catarina State, located only a few miles from Porto Belo, when in the fall of 1997 64.5% of the sample were represented by individuals shorter than 8 cm. A larger number of sampled juveniles was also found by Rodrigues-Filho et al. (2011) in the same area. This can be explained by the low selectivity in bottom trawls used in shrimp fisheries (Coelho et al., 1985, 1987; Giannini and Paiva Filho, 1990, 1995), and therefore very subtle variations in the values of Kr for the two species throughout the year, leads us to disregard any significant seasonal variation in the feeding composition, so that these variations would not be a result of food shortages or changes of abiotic factors, but reflect the changing age structure of the population, since it is influenced by the entry of new individuals periodically, whether small or bigger (youth and adults).

Our results therefore enable us to answer the previously made questions. Very subtle changes occur seasonally in the trophic spectra for both studied species, and as they share the same food resources with the intake of each item occurring in different moments, a difference in predation pressure becomes evident, with less direct competition in a given time. This is reflected in stable values of the allometric condition factor and the relative condition factor, that in association with the weight-length relationship for both species, lets us assess that their high nutritional condition, that may be due to abundant food items present in the studied environment, despite the constant exploitation by the seabob-shrimp fisheries.

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