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Impacts of the seabob shrimp fishery on *Stellifer* spp. (Perciformes, Sciaenidae) assemblage in Armação do Itapocoroy, Penha (SC), Brazil

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Abstract. The low selectivity of trawl nets used in the seabob shrimp fishery is responsible for the bycatch of a variety of organisms of no commercial interest that are therefore discarded. Studies that monitor the main species that compose the bycatch are necessary in order to elaborate management proceedings for sustainable multispecies fisheries. Thus, this study had the objective of evaluating the impact of shrimp trawling on *Stellifer* spp. assemblage, analyzing seasonal and annual fluctuations of $CPUE_W$ data in three different areas of artisanal fishing in Armação do Itapocoroy, estimating the relation between *Stellifer* spp. bycatch and the target species *Xiphopenaeus kroyeri*, relative to temperature and salinity variables. Sampling was performed monthly using double rig trawlers from August 1996 to July 2003 and August 2005 to July 2006. There was great variation in monthly and annual catches. The Redundancy analyses (RDA) indicated a strong relation between *Stellifer* spp. abundances and elevated water temperatures during the summer and an association between salinity and seabob shrimp abundance in the fall.

Key words: ichthyofauna, discards, trawl nets, bycatch, fisheries management, fishes

Resumo. Impactos da pesca do camarão sete-barbas sobre a assembléia de *Stellifer* spp. (Perciformes**,** Sciaenidae**) em Armação do Itapocoroy, Penha (SC), Brasil.** A baixa seletividade das redes de arrasto utilizadas na pesca do camarão sete-barbas é responsável pela captura de uma variedade de organismos que não são aproveitados comercialmente, sendo descartados pelos pescadores. Estudos que monitorem as variações das capturas dos organismos mais frequentes na fauna acompanhante são necessários para que seja possível elaborar técnicas de manejo da prática pesqueira, com vistas à manutenção da integridade do ecossistema marinho. Assim, esse estudo objetivou avaliar o impacto causado pela pesca com redes de arrasto em indivíduos do gênero *Stellifer* spp., analisando variações sazonais e anuais de dados históricos de capturas em três diferentes áreas de pesca artesanal na Armação do Itapocoroy, além de estimar as relações entre as capturas de *Stellifer* spp. *e Xiphopenaeus kroyeri* com as variáveis temperatura e salinidade. As coletas ocorreram mensalmente com o uso de redes de arrasto duplo com portas (Tangones) durante o período de agosto de 1996 a julho de 2003, sendo interrompidas por dois anos e reiniciando em agosto de 2005 e indo até julho de 2006. Houve variações nas capturas das populações estudadas mensalmente e anualmente. A análise de redundância (RDA) demonstrou que os meses de verão são caracterizados por altos valores de captura de *Stellifer* spp. associados a altos valores de temperatura da água, enquanto os de outono, por altos valores de abundância do camarão sete-barbas associados ao aumento de salinidade.

Palavras chave: ictiofauna, descarte, rede de arrasto, fauna acompanhante, manejo pesqueiro, peixes

Introduction

Seabob shrimp *Xiphopenaues kroyeri* (Heller 1862) fisheries occur from North Carolina (USA) to Rio Grande do Sul (Brazil) (D'Incao *et al.* 2002) with an annual brazilian production of 12,184.5 metric tons, being the states of the Bahia (2,943.5 t), São Paulo (1,749.5 t), Alagoas (1,502 t), Sergipe (1,397 t) and Santa Catarina (824 t) exhibit the largest catches (IBAMA 2004). This activity has significant economic, historical, social and cultural values for Brazilian coastal communities (Branco 2005)

The technology employed in this fishery consists of otter trawl nets that capture not only shrimp, but a variety of non target organisms, denominated "bycatch", that compose an important fraction of the total catch (Kotas 1998, Earys 2007). The current estimate of global bycatch production is 7 million metric tons (Kelleher 2004) and much of this animal protein that could be used for human consumption, is lost due to the fishery's routine, obsolete processing technology and lack of governmental incentives. This reality is magnified and especially worrisome in Third World countries, where most fisheries are artisanal (Young *et al*. 1979, Poulter & Trevino 1983, Morais *et al*. 1995).

A quali-quantitative analysis of the bycatch is fundamental for the sustainability of commercial stocks, fisheries' economic cycles and the marine ecosystem (Graça-Lopes *et al.* 2002, Branco & Verani 2006). In addition, it may produce critical information for subsidizing fisheries management.

In Brazil, one of the characteristics of the seabob shrimp fishery is the bycatch of Sciaenidae fishes, especially those of the genus *Stellifer* (Oken 1817) (Coelho *et al*. 1986, Paiva-Filho *et al*. 1987, Giannini & Paiva-Filho 1990, Branco & Verani 2006). Along the South and Southeast coast there are four congeneric species (*Stellifer rastrifer*, *Stellifer stellifer*, *Stellifer brasiliensis* and *Stellifer* spp.) and this elevated abundance may be due to these fishes preference for shallow water habitats over sandy or muddy bottoms (Menezes & Figueiredo 1980), coinciding with the areas explored by the fleet.

The present study evaluated the impact of seabob shrimp fisheries on *Stellifer* spp. assemblage, analyzing monthly and yearly fluctuations in biomass (CPUEw) during an eight year period in three artisanal fishing areas in Armação do Itapocoroy. Moreover, a relation between *Stellifer* spp. and seabob shrimp catches was established and correlated with variations in bottom water temperature and salinity.

Material and Methods

Study area

Municipality of Penha is located in North Central coast of Santa Catarina State, region characterized by mesothermal humid climate with rainfall and average annual temperature of 1,690 mm and 20.2 ºC, respectively (Araújo *et al*. 2006).

A major oceanographic characteristic of the region is the penetration of mass of the South Atlantic Central Water (ACAS) in the bottom layer of the platform mainland during the summer, forming a thermocline at a depth of approximately 10 to 15 m. With the retreat of ACAS during the winter, temperature distribution in the coastal zone becomes homogeneous with water between 20 and 23 ° C and salinity of 35 (Matsuura 1986). Close to the coastal region, predominate the Coastal Water mass which has salinity below 34 and temperature ranging from 19 to 28ºC in winter and summer, respectively (Schettini *et al.*1999). For the majority of the year, winds are predominantly from the northeast, changing periodically to southerly winds with advances of the polar frontal systems, which are more frequent and intense in winter (Schettini *et al*. 1999, Araújo *et al.* 2006. The fishing grounds are composed predominantly of sandy facies varying from very fine to medium sand (Abreu *et al*. 2006), but considerably wide layers of fine sediments (silt and clay) also occur parallel to the coast (Horn Filho 2003)

The seabob shrimp artisanal fleet is based in Armação do Itapocoroy, in three traditional fishing grounds (26°40' - 26°47' S, 48°36' - 48°38' W), from eight to 18 meters in depth (Fig. 1).

Data collection

Monthly sampling campaigns were conducted from period August 1996 to July 2003 and from August 2005 to July 2006. Samples were collected using a double rig trawler, at a speed of two knots, during one hour. Net mesh sizes varied from 3.0 cm at the wings to 2.0 cm between knots at the codend (Branco 2005). Three replicas (20 minutes each) were done in each traditional fishing spot.

The catch was labeled and cooled on ice until later processing. At each area, water samples were collected from the bottom through Van Dorn bottle, enabling them to obtain at the field the values of the temperature and salinity with a manual thermometer (model 9793.16.1.00 Incoterm) and handheld salinity meter, respectively. The species that composed the bycatch were identified in the laboratory using appropriate literature (Menezes & Figueiredo 1980).

The biomass per trawl were registered for seabob shrimp and fishes belonging to the genus *Stellifer* were used to estimate monthly $CPUE_W$ means in biomass (kg/h).

Data analyses

The normality and homogeneity of variances of biotic and abiotic factors were tested using the Bartlet's test (Zar 1999). It was found that most of the data did not meet these requirements, therefore the logarithmic transformation log (x + 1) for the biotic and log (x) for the abiotic data, where log in logarithm base 10, and x is the untransformed value, were used to transform the data. The temporal and spatial differences between mean values of the data were verified using Three-factorial analysis of variance (ANOVA) at a confidence level of 95% ($p < 0.05$). Where significant interactions were observed among factors (sampling area, months and years), variations within each factor were complemented by multiple comparison test of Tuckey-Kramer (Zar 1999).

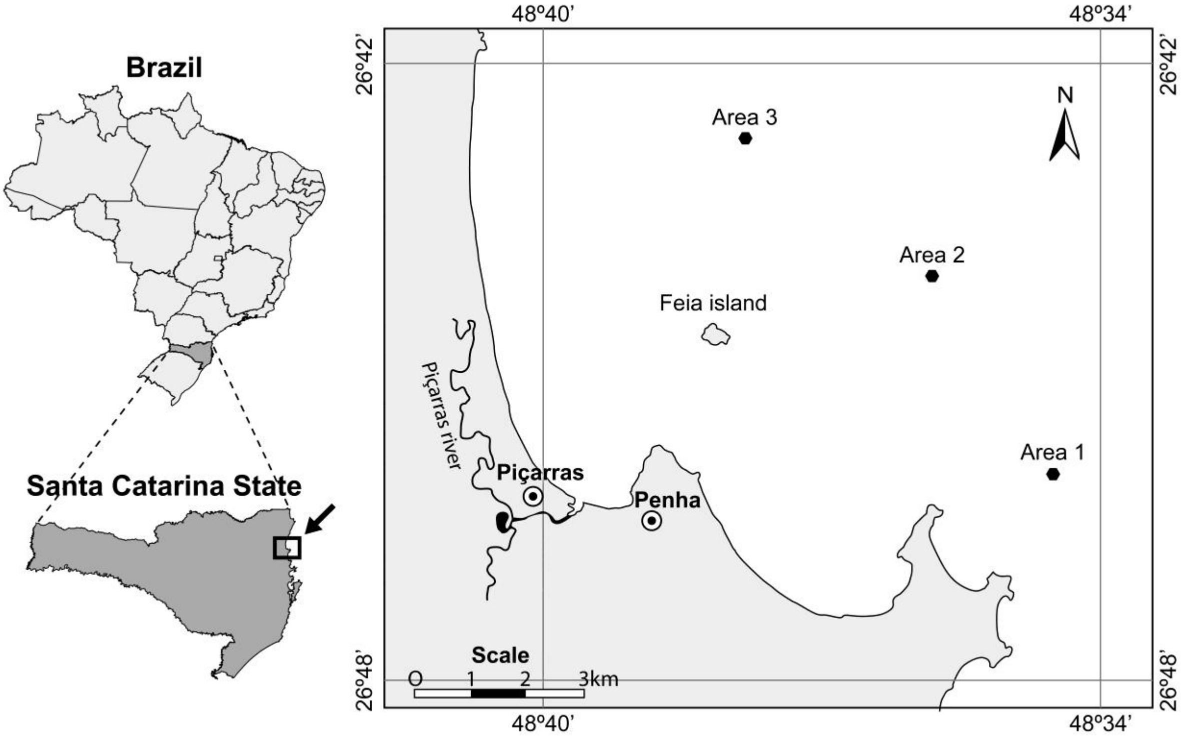

Figure 1. Map of Armação do Itapocoroy, Penha (SC) with the three points of traditional fisheries of seabob shrimp where sampling was conducted.

Multivariate statistics (Redundancy analysis – RDA) were employed, using XLSTAT 7.5.2 computer software, in order to verify the possible influence of abiotic variables of the bottom water on the biomass of *Stellifer* spp. and *X. kroyeri* (Legendre & Legendre 1998). In presenting the results of the RDA, the months and years have been abbreviated and presented in the following model to obtain a better understanding of ordination method: Mar_02 (refers to March 2002).

In order to visualize possible seasonal patterns in the results obtained from RDA and generate a greater understanding about the temporal variations occurred in the studied area, it was considered that the months were grouped as follows: autumn (April, May, and June), winter (July, August, September), spring (October, November, December) and summer (January, February, March).

Results

Environmental variables

The temperature and salinity differed significantly annual and monthly throughout the study (Three-factorial ANOVA; $p < 0.05$) (Table I and II). There were also differences in internal factors, monthly variation being more evident for temperature and annual variation for salinity. Among the sampling sites, no statistical differences for both variables were observed (Tables I and II). Significant interactions were found between most of the factors, except between Month x Area for temperature.

Table I. Summary of the calculation of the Three-factorial analysis of variance (ANOVA) for temperature according to the areas, months and years of sampling. * statistical significance ($p < 0.05$)

Source of variation	Degrees of freedom	Sum of squares	Mean square	F Values
Year	7,00	2,82	0,40	3,36*
Month	11,00	3,37	0,31	2,55*
Area	2,00	2,62	1,31	10,93*
Year*Month	77,00	5,63	0,07	0,61
Year*Area	14,00	1,22	0,09	0,73
Month*Area	22,00	1,16	0,05	0,44
Year*Month*Area	153,00	8,82	0,06	0,48

Table II. Summary of the calculation of the Three-factorial analysis of variance (ANOVA) for salinity according to the areas, months and years of sampling. * statistical significance ($p < 0.05$)

Source of variation	Degrees of freedom	Sum of squares	Mean square	F Values
Year	7,00	0,033	0,005	99,66*
month	11,00	0,029	0,003	55,04*
Area	2,00	0,000	0,000	0,17
Year*month	77,00	0,090	0,001	24,58*
Year*Area	14,00	0,002	0,000	3,63*
month*Area	22,00	0,003	0,000	3,34*
Year*month*Area	153,00	0,023	0,000	3,12*

During the eight year study period, a seasonal pattern in bottom water temperature was identified in three areas of sample with a total range of 13 ^{o}C in Areas I and III and 12°C in Area II. The greatest values occurred in summer, with a maximum of 28 °C in Areas I (March 1999 and 2000) and II (December/1996, March 1997, 1999 and 2000). In Area III, the March (1997, 1999 and 2000) was the month where occurs the greatest value of 29 °C.

The lowest temperature occurred in winter, with a minimum in July 2000 of 15 °C in Area I and 16 °C in Areas II and III (Fig. 2).

The seasonality of temperature was confirmed by multiple comparison test of Tuckey-Kramer, where the months with higher temperatures (January, February and March) and lower (June, July and August) were significantly different from all others (Table III).

There was inter-annual variation in temperature, such that in 2005-2006 the lowest values were recorded, which differed significantly from those periods where highest temperatures were recorded, 1996-1997, 1997-1998 and 1998-1999, respectively (Fig. 2 and Table III).

The highest salinity (37.0) was registered in April 1998 and 1999 and the lowest values in August and October 1998 and August 1999 (28.0) in the three Areas (Fig. 3).

The multiple comparison test of Tuckey-Kramer showed that the months that had the highest values of salinity were April and May respectively (Table IV).

There were fluctuations in salinity between the years of study, with the highest values being recorded from the period 2001-2002 (Table IV).

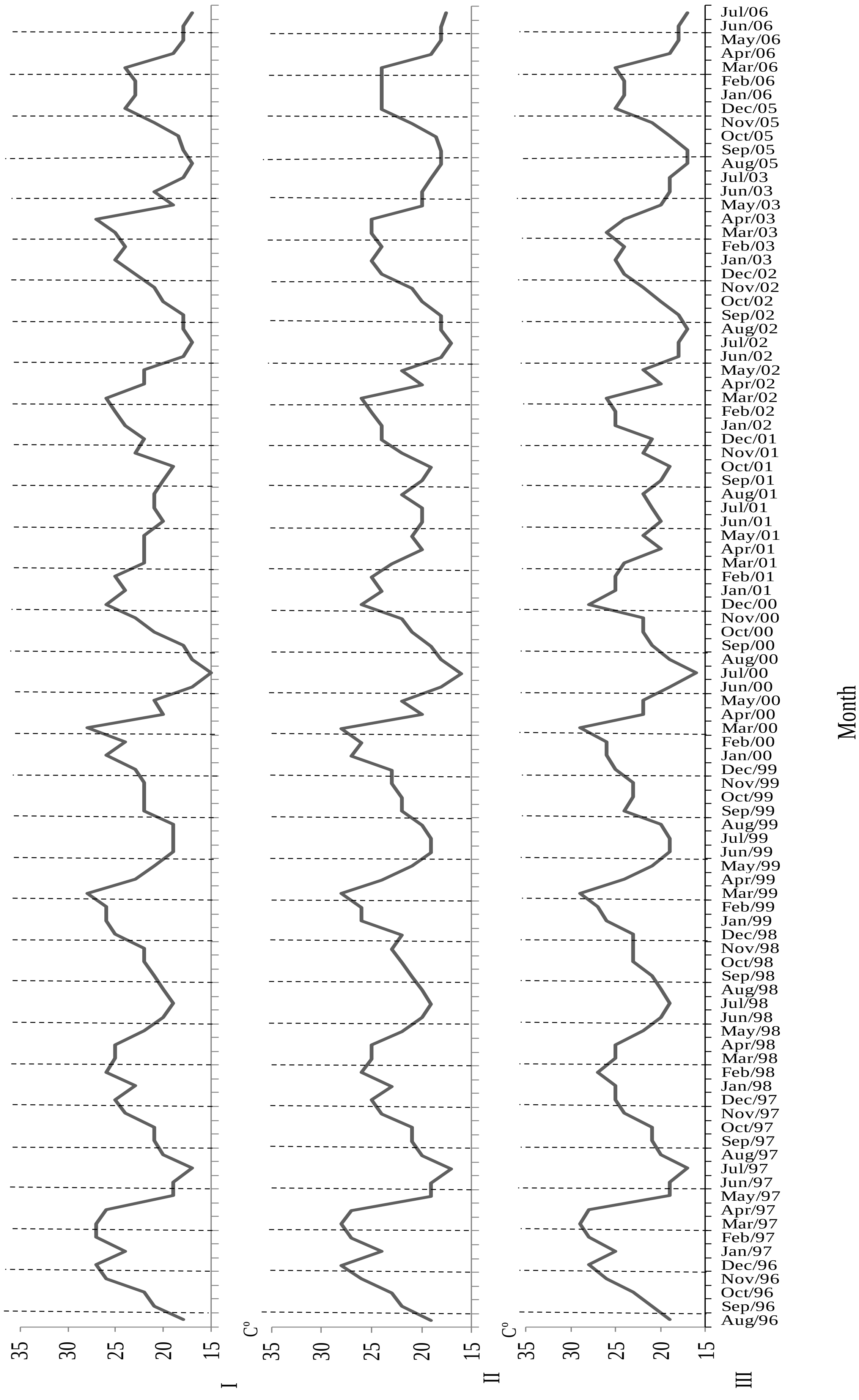

Figure 2. Monthly variation in bottom water temperature recorded in each traditional fishing spot (Area I, II and III) from August 1996 to July 2006. The vertical bar ndicates the seasons.

Table III - Results of multiple comparison test (Tuckey-Kramer) between months and years values of temperature. * statistical significance (p < 0.05); ** statistical significance (p < 0.01); *** statistical significance (p < 0.001).

Diference between months		
Jan	>	Nov*; Apr**; Oct, Sep, Aug, Jul, Jun, May***
Feb	>	Nov, Oct, Sep, Aug, Jul, Jun, May, Apr***
Mar	>	Apr*; Nov, Oct, Sep, Aug, Jul, Jun, May***
Apr	>	May, Oct*; Sep,Aug, Jul, Jun***
May	>	Aug, Jun*; Jul***
Sep	>	Jul***
Oct	>	Aug, Jun**; Jul***
Nov	>	Oct**, Sep,Aug,Jul,Jun,May***
Dec	>	Nov*; Oct,Sep,Aug,Jul,Jun,May***
Diference between years		
96-97	>	05-06**
97-98	>	05-06**
98-99	>	05-06*

Table IV - Results of multiple comparison test (Tuckey-Kramer) between months and years values of salinity. * statistical significance (p < 0.05); ** statistical significance (p < 0.01); *** statistical significance (p < 0.001).

Diference between months		
Mar	>	Oct, Sep*
Apr	>	Aug*; Sep, Oct***
May	>	Oct, Sep**
Jul	>	Oct, Sep*
Diference between years		
97-98	>	96-97,99-00*; 98-99***
01-02	>	00-01*; 96-97, 98-99, 99-00***
05-06	>	96-97, 98-99, 99-00**

Abundance of Stellifer spp e Xiphopenaues kroyeri

The Three-factorial ANOVA applied to biomass values showed differing patterns of variation between the fishery resources (Table V and VI). Samples of *Stellifer* spp. showed significant differences in all factors evaluated (Months, Years and Areas), with no interaction whatsoever between them. In the case of *X. kroyeri*, besides the variation in the factors, year and month, a significant interaction between factors Year x Month and Year x Area was observed (Table VI).

The highest monthly values of biomass of *Stellifer* spp. were recorded in summer and early autumn, in April, with monthly maximum values being registered in February 2000 (Figure 4). In July and August, the lowest biomass catch were recorded, with significant statistics differences being detected (p <0.05) between those months with higher abundances (Table VII).

During the study period, annual biomass of *Stellifer* genus were greater in 1996/1997, followed by 1999/2000 and 2002/2003 (Fig. 4). Mean biomass values in 1996/1997 differed from the 1997/1998, 1998/1999, 2000/2001 and 2001/2002 (Table VII).

Area III was responsible by most of the total biomass catch in this study, followed by Area II and Area I (Fig. 4). The multiple comparison test of Tuckey-Kramer showed a statistically significant difference between the biomass values recorded in Area III with the other Areas (Table VII).

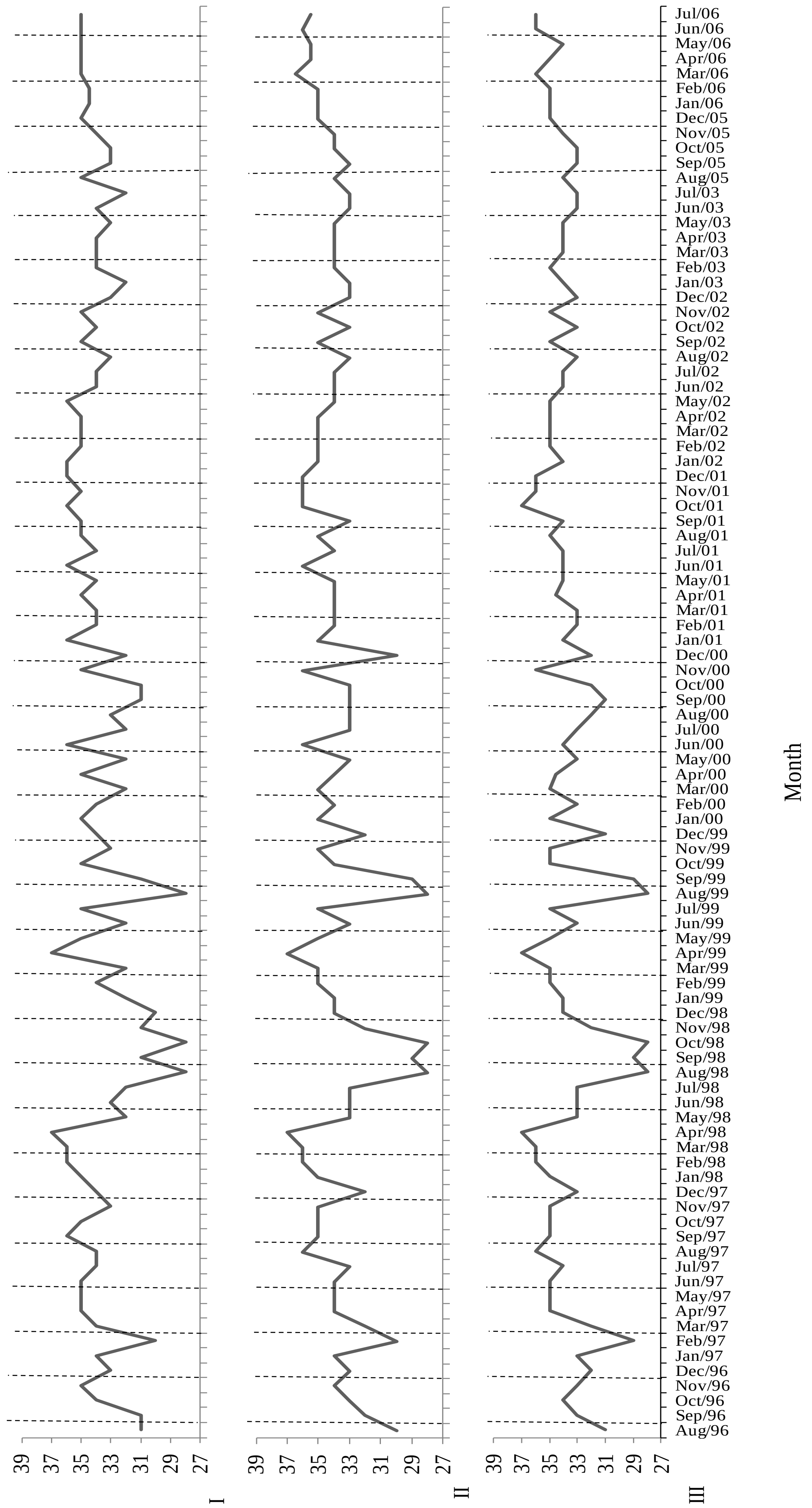

Figure 3. Monthly variation in bottom water salinity recorded in each traditional fishing spot (Area I, II and III), from August 1996 to July 2006. The vertical bar indicates the seasons

Table V. Summary of the calculation of the Three-factorial analysis of variance (ANOVA) for biomass of *Stellifer* spp. according to the areas, months and years of sampling. * statistical significance (p < 0.05)

Source of variation	Degrees of freedom	Sum of squares	Mean square	F Values
Year	7,00	2,82	0,40	3,36*
Month	11,00	3,37	0,31	2,55*
Area	2,00	2,62	1,31	10,93*
Year*Month	77,00	5,63	0,07	0,61
Year*Area	14,00	1,22	0,09	0,73
Month*Area	22,00	1,16	0,05	0,44
Year*Month*Area	153,00	8,82	0,06	0,48

Table VI. Summary of the calculation of the Three-factorial analysis of variance (ANOVA) for biomass of *Xiphopenaeus kroyeri* according to the areas, months and years of sampling. * statistical significance (p < 0.05)

Source of variation	Degrees of freedom	Sum of squares	Mean square	F Values
Year	7,00	1,31	0,19	13,86*
Month	11,00	7,48	0,68	50,38*
Area	2,00	0,10	0,05	3,52
Year*Month	77,00	4,28	0,06	4,12*
Year*Area	14,00	0,54	0,04	2,88*
Month*Area	22,00	0,43	0,02	1,45
Year*Month*Area	154,00	3,16	0,02	1,52

The biomass of *X. kroyeri* was high in the late summer months (February and March), and reaching the highest values in April, May and June respectively (Fig. 5). The multiple comparison test demonstrated that there were multiple strong influence of seasonality in the catches of shrimp, which can be seen by the differences among the months in fall, especially April and May, with all others. (Table VIII).

The biomass of *X. kroyeri* varied between the years of study. The highest values were recorded in 2001-2002 and 1997-1998, respectively (Fig. 5). The period between 2000 and 2001 had the lowest values and differed significantly (p <0.05) in 1997-1998, 1998-1999, 2002-2003, 2005-2006 and 2001-2002 (Table VIII).

Among the areas of sampling, Area I recorded that the largest catch biomass of *X. kroyeri*, followed by Areas II and III (Fig. 9). However, when multiple comparisons was performed, there no significantly statistical difference between the areas (Table VIII).

Table VII. Results of multiple comparison test (Tuckey-Kramer) among months and years values of *Stellifer* spp. * statistical significance (p < 0.05); ** statistical significance (p < 0.01); *** statistical significance (p < 0.001).

	Diference between months	
Jan	>	Jul*
Feb	>	Aug, Jul**
Mar	>	Aug, Jul*
Apr	>	Aug, Jul*
	Diference between years	
96-97	>	99-00*; 97-98**; 01-02, 00-01, 98-99***
	Diference between areas	
Area III	>	Area II, Area I***

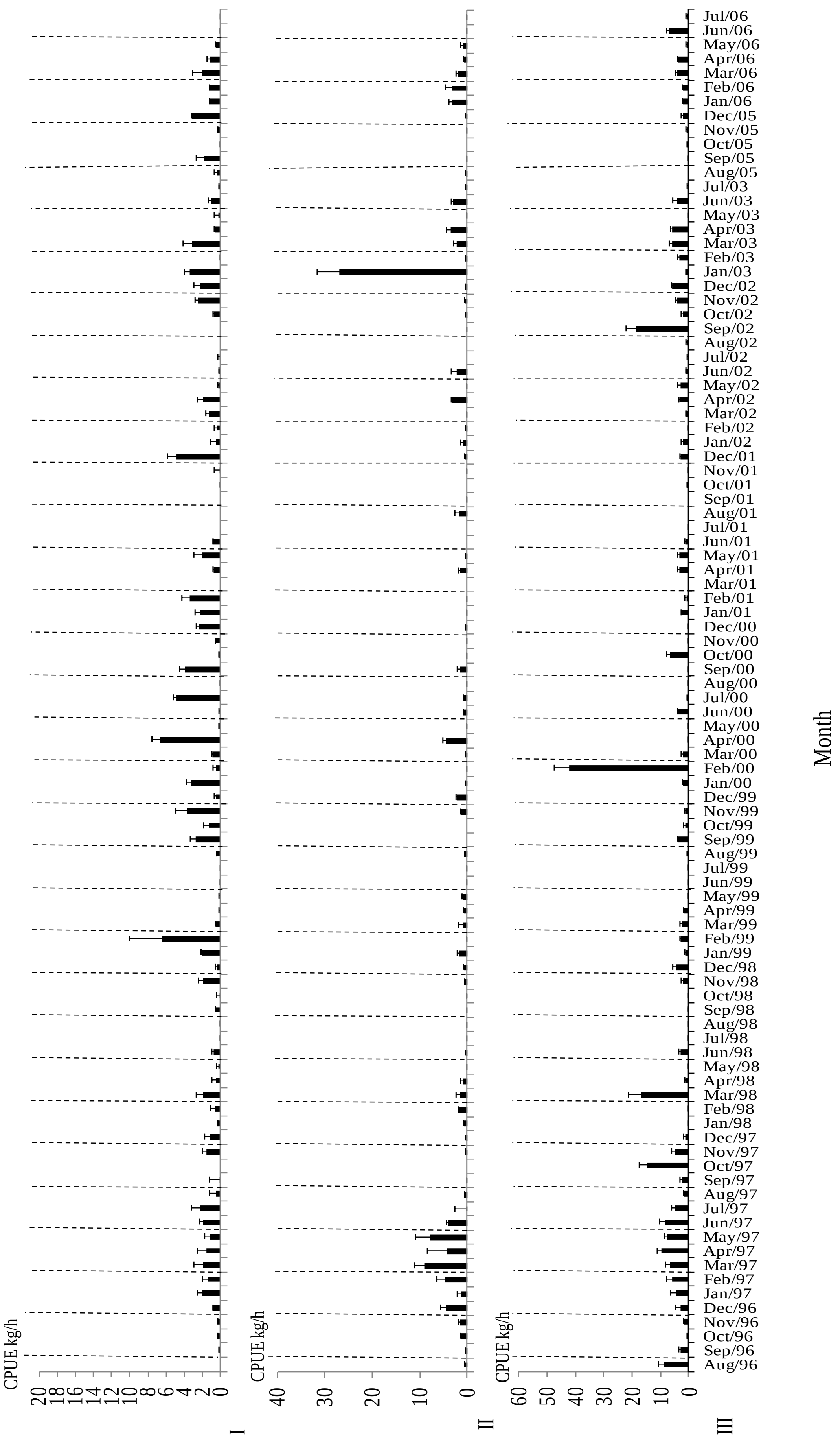

Figure 4. Mean of $CPUE_W$ (kg/h) and stand error of *Stellifer* spp. in Areas I, II and III, from August 1996 to July 2006. The dotted bar indicates the seasons

Table VIII. Results of multiple comparison test (Tuckey-Kramer) between months and years values of *Xiphopenaeus kroyeri*. * statistical significance (p < 0.05); ** statistical significance (p < 0.01); *** statistical significance (p < 0.001)**.**

	Diference between months	
Jan	>	Dec, Nov*
Feb	>	Oct**; Dec, Nov ***
Mar	>	Sep*; Dec,Nov, Oct Aug***
Apr	>	Jun, Mar *; Feb**; Dec, Nov , Oct, Sep, Aug, Jul, Jan***
May	>	Mar *; Feb**; Dec, Nov , Oct, Sep, Aug, Jul, Jan***
Jun	>	Aug*; Dec, Nov, Oct, Sep***
Jul	>	Dec*
	Diference between years	
97-98	>	00-01*
01-02	>	00-01**
02-03	>	00-01*
05-06	>	00-01*

The RDA explaining 91. 90 % of the total variance, composed a plot with axis I and II with respective eigenvalues of 0.61 and 0.107. It is therefore possible to infer that increasing water temperatures in summer months directly influence *Stellifer* spp. biomass (Fig. 6). During spring, however, both water temperatures and *Stellifer* spp. biomass decrease, reaching their lowest points in winter, thus corroborating the association between the two parameters. Similarly, an elevated salinity occurs in late summer (March), extending to the autumn months (April and May), being related with a greater seabob shrimp biomass. The seasonal component in these data is clearly illustrated though the months' disposition in the plot.

Discussion

The results of Three-factorial ANOVA showed a significantly spatiotemporal variations indicating that the interaction between the factors influenced the fluctuations in the abundance of *Xiphopenaeus kroyeri* and in the temperature and salinity values, don't being such variables understood by a single source of variation. In the case of biomass of the genus *Stellifer*, due the fact there isn't interaction between the factors, the variations ocurred in this study were by the isolated action of each of the factors analyzed.

The temperature fluctuations recorded here are expected for the area (Matsuura 1986), a similar pattern was recorded by Branco *et al*. (1999) and Almeida & Branco (2002). The salinity fluctuations recorded here are not expected for the area (Matsuura 1986). Such oscillations usually characterize costal zones and, in this case, are probably a reflection of rainfall patterns and the influence of the Itajaí-Açu river delta, located 20 km from the study site (Branco *et al*. 1999).

Seasonal alterations in environmental conditions lead to quantitative and qualitative variations in the shrimp fishery bycatch (Carranza Fraser & Grande 1982, Paiva-Filho & Schimegelow 1986, Graça- Lopes *et al*. 2002, Branco & Verani 2006). In this study, the summer was the period more abundant, but in others regions, like on the coast of São Paulo and Paraná, fish of genus *Stellifer* are more abundant in spring and summer (Coelho *et al*. 1986) and in autumn (Chaves & Vendel 1997), respectively.

The greater Sciaenidae catches in cost of São Paulo occurred in autumn (Giannini & Paiva-Filho 1990) and in winter (Souza *et al*. 2008), while in the coast of Rio Grande do Sul, larger catches alternated between spring and autumn in Rio Grande do Sul (Haimovici *et al.* 1996). Prior studies in Armação do Itapocoroy registered the greatest fish bycatch in spring and summer (Branco & Verani 2006).The fishes of this family occur as dominant in accompanying fauna in artisanal seabob shrimp fishery along Brazilian coast (Ruffino & Castello 1992/93, Chaves *et al*. 2003, Vianna & Almeida 2005, Branco & Verani 2006, Gomes & Chaves 2006, Schwarz Jr *et al*. 2007, Souza *et al*. 2008, Moraes *et al.* 2009).

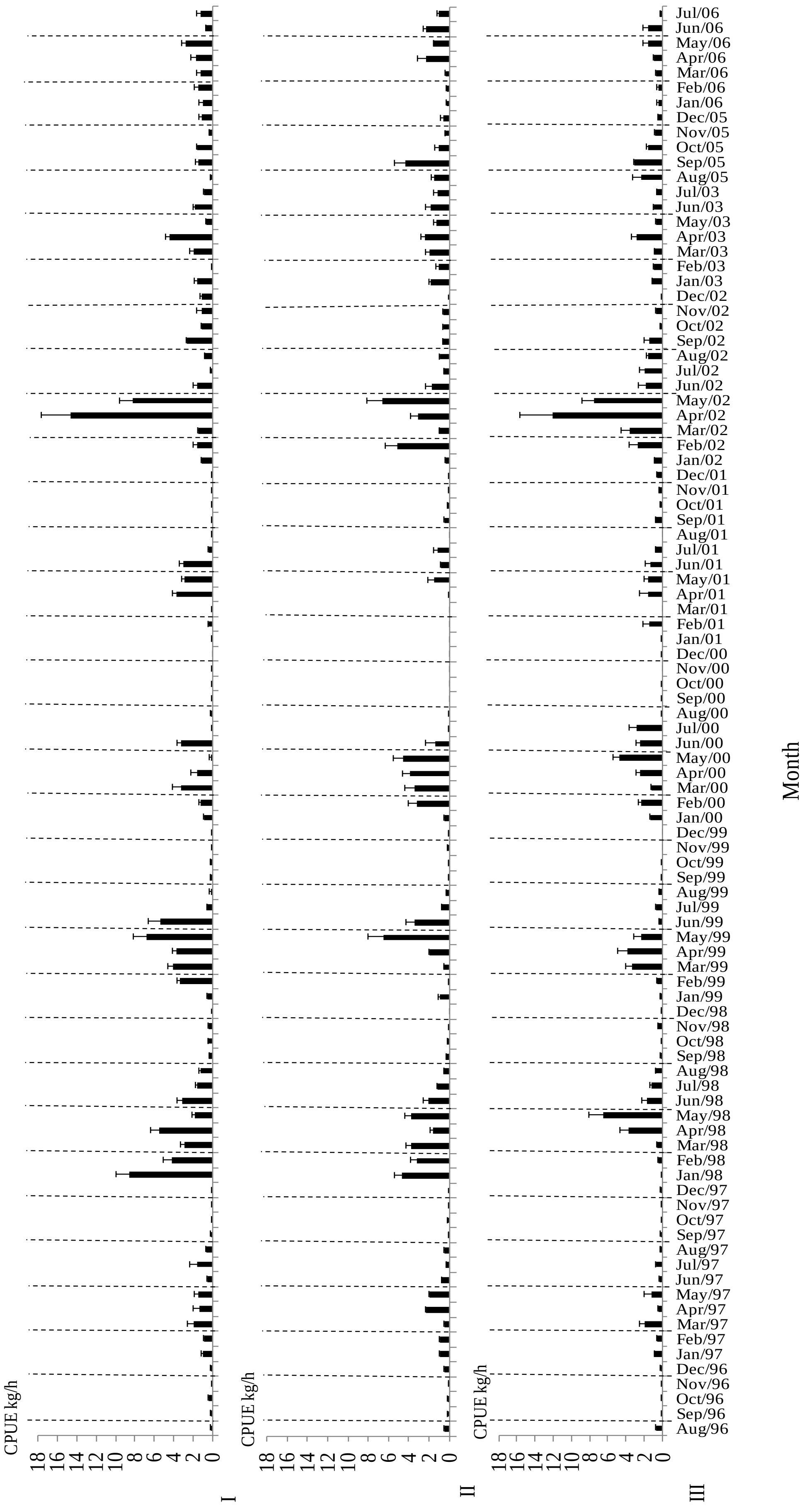

Figure 5. Mean of $CPUE_W$ (kg/h) and stand error of of *Xiphopenaeus kroyeri* in Areas I, II and III, from August 1996 to July 2006. The dotted bar indicates the seasons.

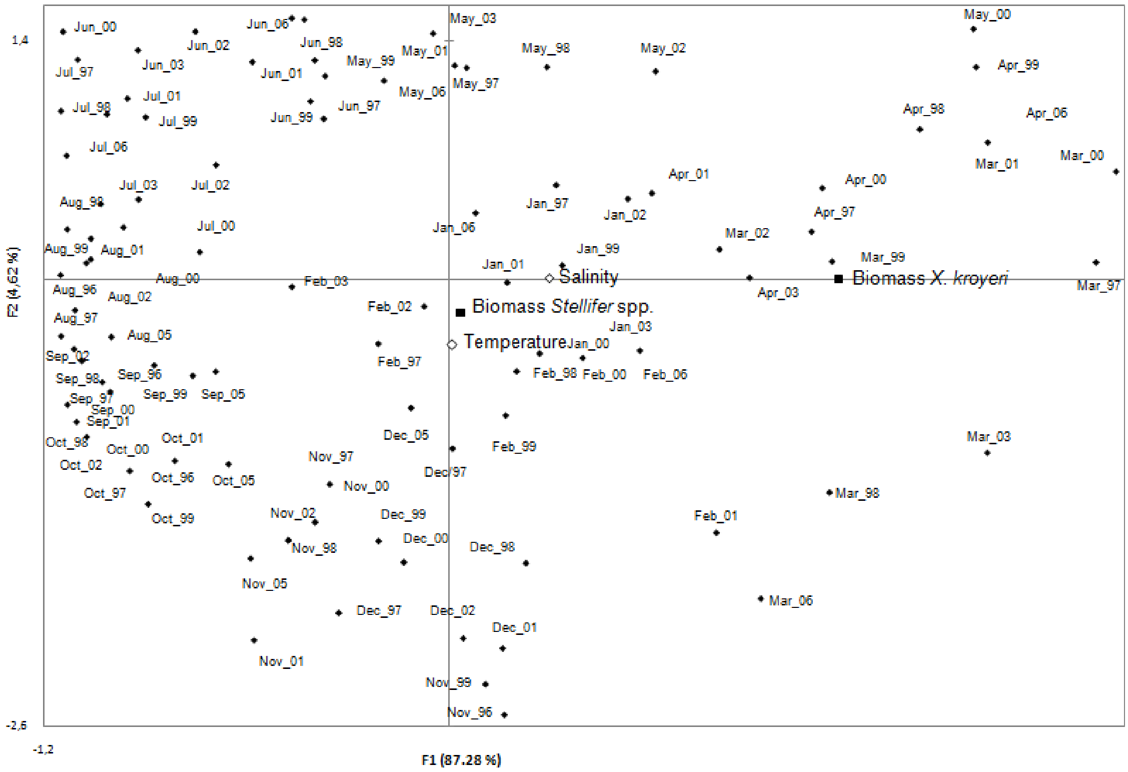

Figure 6. Redundancy analysis (RDA) plot based on values of *Stellifer* spp. and *Xiphopenaeus kroyeri* biomass, and measures of bottom water temperature and salinity from 1996 to 2006.

Reproductive strategies and juvenile recruitment, especially during summer months, may alter catch values throughout the years (Vazzoler 1996, Almeida & Branco 2002) fact that can be observed in this study. $CPUE_W$ fluctuations may be associated with population stratification, where larger specimens inhabit deeper areas within the fishing grounds (Coelho *et al*. 1987). Longhurst & Pauly (2007) argue that as fish penetrate deeper and colder waters, there is a reduction in their metabolism and the consequent exceeding energy can be invested in growth. This theory supports the hypothesis that *Stellifer* spp. tend to migrate to deeper waters as they grow.

The monthly variations of biomass of *X. kroyeri* were accentuated. The results showed that the months of highest capture (autumn) differed from the others. Still, it was noted that the summer months recorded higher biomass and distinguish themselves from the months of low fishing productivity, corroborating the results of Epagri / Ibama (1995) indicating that the months of peak production of shrimps in the Santa Catarina coast extends February to April.

Despite some oscillation in yearly averages of biomass, a general tendency of decreasing catches was not observed for *Stellifer* spp and *X. kroyeri*. Therefore, there is no indication that this fishery is posing a deleterious threat for these stocks in Armação do Itapocoroy. This fact was corroborated by statistical analysis, which showed no significant differences between the biomass sampled in the last year (2005 - 2006) of the present study with the periods of greatest abundance of the stocks (1996-1997 for *Stellifer* spp. and 2001-2002 for *X . kroyeri*).

The RDA expresses how much of the variance in one set of variables can be explained by the other (Legendre & Legendre 1998). In this study, was noted that this analysis was very effective in expressing the variation of biomass of the *Stellifer* spp. and *X. kroyeri* of the populations studied as a function of fluctuations in abiotic variables, indicating that temperature and salinity influence catch abundances either directly. Plavan *et al*. (2010), by using the same methodology to test the environmental influences on the community of an estuary, reported that the temperature and salinity were the most important variables in the abundance of fish species.

Therefore, these abiotic variables play an important role in the distribution, population structure and development of the referred organisms. This relation has been demonstrated for individuals of the gender *Stellifer* spp. on the coast of São Paulo state, where higher abundances were associated with salinity levels of 34 and 29 and temperatures around 23.0 to 25.0 °C (Giannini & Paiva-Filho 1995). Smaller specimens were more frequently captured in warm shallow waters (Giannini & Paiva-Filho 1990).

The bycatch of numerous species of commercial interest in the seabob shrimp fishery reinforce the necessity for the elaboration of management plans in order to maintain these stocks. Evidently, biological and ecological aspects of the species at hand are essential and cannot be excluded from these efforts. Although *Stellifer* spp. stocks are not yet exploited, their potential depletion would alter local biocenosis leading to changes in specific composition and, consequently, affect the target species.

The present results follow a general tendency of larger bycatch biomass compared to target organisms (Slavin 1983, Conolly 1986, Coelho *et al*. 1987, Alverson *et al*. 1994, Graça-Lopes *et al*. 2002, Vianna & Almeida 2005, Branco & Verani 2006, Souza *et al*. 2008) and highlight the environmental and social problematic consequences of shrimp trawl fisheries. A reduction in this fishery's bycatch would certainly diminish its impact on accessory species, aiding in the maintenance of biodiversity and community resilience. There are numerous management mechanisms (Brewer *et al*. 1998, Eyars 2007), some at low cost, but there are few economic resources for fishermen and a lack of governmental incentive, especially in regards to artisanal fisheries. Therefore, an adequate management of these activities is still a goal to be attained.

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