Composition and abundance of the caridean prawn species in two estuaries from the northern coast of São Paulo State, Brazil.

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ABSTRACT: Composition and abundance of the caridean prawn species in two estuaries from the northern coast of São Paulo State, Brazil. The aim of this research was to examine the diversity of the caridean prawns in the estuaries of Comprido (23°29'S; 45°10'W) and Ubatumirim Rivers (23°20'S; 44°53'W) in the northern coast of São Paulo State, Brazil. The samplings were carried out monthly in these estuaries from April 2003 to March 2004, during low tide conditions in the morning periods. The sampling procedure used was the capture per unit effort by a person who passed a sieve (approximately 3.0 mm of mesh size) under the bordering vegetation, during 20 minutes in each of the three sites (initial = entrance to the estuaries; intermediate = 800 m; final = 1.200 m towards the continent). The environmental factors sampled were: water temperature, salinity, organic matter content of the water and sediment. The representatives of Palaemonidae and Alpheidae families were obtained, and four species of caridean prawns were found: Palaemon (Palaemon) pandaliformis (Stimpson, 1871), Palaemon (Palaeander) northropi (Rankin, 1898), Macrobrachium acanthurus (Wiegmann, 1836) and Alpheus heterochaelis (Say, 1818). Among the environmental factors analyzed in the Ubatumirim River, none was correlated with the abundance of the species of prawns sampled. In the Comprido River, the water temperature was correlated with P. pandaliformis and A. heterochaelis abundances and the organic matter of the water was correlated with M. acanthurus. Comparing the total abundance between estuaries there was no statistical difference. In both estuaries and among the sampled sites, P. pandaliformis was the species with the highest abundance. These facts suggest that this species could find biotic and environmental conditions which favored its development and population growth.

Key-words: Composition, abundance, caridean prawns, diversity index, estuaries.

RESUMO: Composição e abundancia dos camarões carídeos em dois estuários do Litoral Norte do Estado de São Paulo, Brasil. O objetivo desta pesquisa foi examinar a diversidade de camarões carídeos nos estuários do rio Comprido (23°29'S; 45°10'W) e Ubatumirim (23°20'S; 44°53'W), litoral norte de São Paulo. Os camarões foram coletados mensalmente, de abril/2003 a março/2004, durante a maré baixa no período da manhã. A técnica utilizada foi a do esforço de captura por uma pessoa passando uma peneira (malha de 3,0 mm de tamanho) sob á vegetação marginal, durante 20 minutos em cada um dos três pontos amostrados (início = entrada do estuário; intermediário = 800 metros; final = 1200 metros em direção ao continente). Os fatores ambientais amostrados foram: temperatura da água, salinidade, matéria orgânica da água e do sedimento. As famílias Palaemonidae e Alpheidae foram registradas, sendo representadas por 4 espécies de camarões carídeos: Palaemon (Palaemon) pandaliformis (Stimpson, 1871), Palaemon (Palaeander) northropi (Rankin, 1898), Macrobrachium acanthurus (Wiegmann, 1836) e Alpheus heterochaelis Say, 1818. Entre os fatores ambientais monitorados para o rio Ubatumirim nenhum deles correlacionou-se com a abundância das espécies de camarões amostrados. Paro o rio Comprido, a temperatura da água correlacionou-se com P. pandaliformis e A. heterochaelis e o teor de matéria orgânica da água, com M. acanthurus. Comparando-se a abundância total das espécies entre os estuários não houve diferença estatística. Em ambos estuários e entre os pontos de amostragem, P. pandaliformis foi a espécie mais abundante. Tal fato sugere que esta espécie encontrou condições bióticas e ambientais favoráveis ao seu desenvolvimento e crescimento populacional.

Palavras-chaves: Composição, abundância, camarões Caridea, índice de diversidade, estuário.

Introduction

The knowledge of the biology of the species which live in estuaries is of great importance for studies of ecological purposes, ecosystem dynamics, environmental impact and natural variability of the communities, serving as basis for a more adequate handling at such environment (Teixeira & Falcão, 1992).

According to Schaeffer-Novelli (1995), an estuarine environment is much diversified concerning its animal composition, being composed by mollusks, crustaceans, amphibious, reptiles, fishes and birds. Among these animals, crustaceans are unique, due to its great ecological, economic and social importance, and for being one of the most abundant groups.

According to Martin & Davis (2001) and Bauer (2004) the infra-order Caridea presents 2.818 species organized in 36 families. In the Brazilian territory there are 20 families of caridean prawns and at São Paulo State, 5 families are known such as Atyidae, Hippolytidae, Ogyrididae, Alpheidae and Palaemonidae, being the last two families the most common and abundant (Ramos-Porto & Coelho, 1999; Magalhães, 1999; Melo, 2003).

The Palaemonidae family is represented by the Macrobrachium genus (Bate, 1868), in which we can find the giant Malaysian prawn Macrobrachium rosenbergii (De Mann 1879), one of the most known representatives, with great economical interest for the neighboring communities and for aquaculture (Pinheiro & Hebling, 1998).

Beside this genus, the Palaemon genus (Weber, 1795) is also much known in small Rivers fauna. There are little less than 35 species found worldwide. These species present a great capacity to tolerate low salinity, commonly ranging from brackish-water estuaries and bays to freshwater as well (Ramos-Porto & Coelho, 1998; Bauer, 2004). Despite its small size, this genus presents a great ecological importance, as in the cycling of organic nutrients (during feeding and locomotion) and to be part of the alimentary diet of some fish and birds (Coelho, 1964/5).

Studies related to knowledge on the caridean prawn composition, abundance and diversity in the north coast of São Paulo are scarce in the literature. Among them, we can mention publications on the occurrence of caridean prawns and penaeideans together (Costa et al., 2000, Fransozo et al., 2002). Recently, Rocha & Bueno (2004) contributed for a better knowledge about the caridean diversity in the whole São Paulo State.

The aim of this work was to verify the occurrence of prawns in two estuaries in Ubatuba region, northern coast of São Paulo State, with emphasis on the diversity index and some environmental factors.

Material and methods

The study area is composed by the estuaries of Comprido River (23°29'S; 45°10'W) and Ubatumirim River (23°20'S; 44°53'W), both at the northern coast of São Paulo State, Brazil. The vegetation in both estuaries is constituted by a gramineae belonging to Spartina Schreb genus and trees of Avicennia Gaertn. f., Laguncularia (L.) and Rhizophora (L.). Usually, the carideans are found associated to the vegetation roots, in the margin of the Rivers.

The samplings of caridean prawns were carried out monthly from April 2003 to March 2004, at morning low tide and periods. The sampling procedure used was capture per unit effort (CPUE) by a person that passed a sieve (3.0 mm of mesh size) under the bordering vegetation, during 20 minutes in each of the three sites (initial = entrance to the estuaries; intermediate = 800 m; final = 1.200 m towards the continent) (Fig. 1).

The sampled prawns were packed in plastic bags, properly labeled with date and sampling site. After that, they were identified at the laboratory using Melo (2003) and Christoffersen (1984) and kept in alcohol 70% .

The total abundance of the prawns sampled was compared between estuaries by Mann-Whitney test (a=0.05; Zar, 1996). The mean abundance of the each species was compared by t-test (a=0.05; Zar, 1996) between estuaries. Spearman correlation (a=0.05; Zar, 1996) was calculated to determine the existence of a correlation between the absolute abundance of prawns and each environmental factor (salinity, water temperature, organic matter in water and sediment).

The salinity was determined using a specific rephractometer, while the water temperature was measured with a mercury thermometer. Samples of water (600ml) and bottom sediment (200g) from the Rivers were collected seasonally for organic matter content analysis. For determining the quantity of organic material in the water suspension ($mg.l^{-1}$), a gravimetric techniques proposed by Teixeira & Kutner (1962) was used.

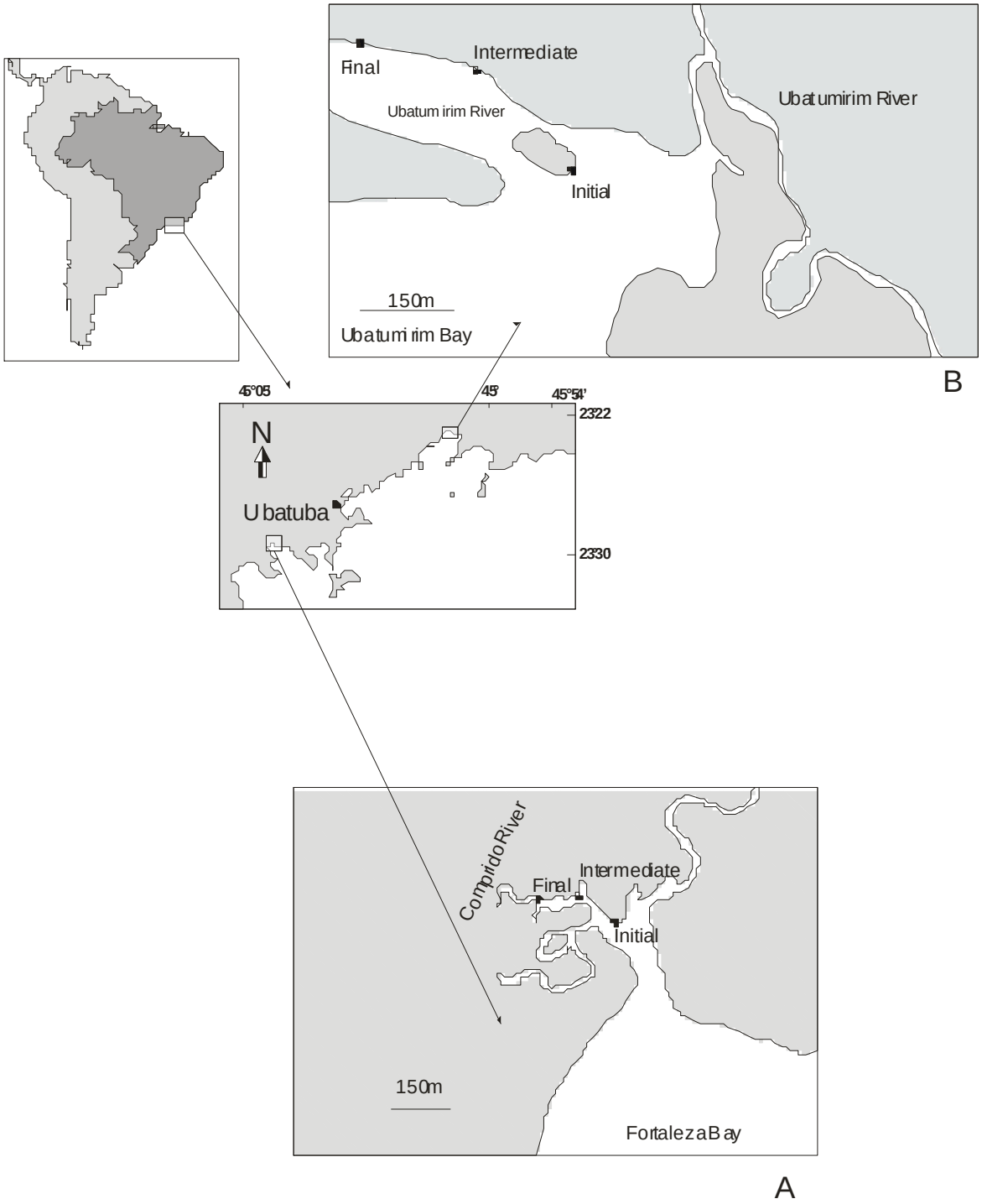

Figure 1: Geographic location the estuaries Comprido (A) and Ubatumirim (B) River, Ubatuba, São Paulo, Brazil.

The organic matter content of the sediment was determined from each site sample. The sediment sample was oven-dried at 60°C for 48hs. For each sample of dried sediment, three sub samples of 10g were placed in an oven at 500°C for 3h and weighed. The organic matter content of samples in terms of percentage was estimated from ash-free dry weight.

The environment factors were compared and analyzed seasonally within estuary through Kruskal-Wallis test ($a=0.05$; Zar, 1996), complemented by Student-Newman-Keuls test ($a=0.05$; Zar, 1996). The comparison of the environmental factors between estuaries was performed by Mann-Whitney test ($a=0.05$; Zar, 1996).

The diversity was estimated through Shannon-Wiener index (H') (Poole, 1974), that has the advantage of joining two components of the diversity: species richness (S') and uniformity (J'). The diversity index (H') was calculated using the logarithm in base 2, and its value was expressed in bits/individual.

Results

A total of 2,687 and 3,518 specimens of caridean prawns was obtained in the Comprido and Ubatumirim Rivers respectively, distributed in 2 families and 4 species (Tab. I).

Table I: Caridean prawns (mean number of specimens ± sd) species in different sites from each estuaries.

Sites	**Comprido River**				**Ubatumirim River**			
Families/Species	Initial	Intermediate	Final	Total	Initial	Intermediate	Final	Total
PALAEMONIDAE								
Palaemon (Palaemon) pandaliformis (Stimpson, 1871).	36.75±43.51	73.91±33.31	98.16±42.61	2,506	88.75±31.88	86.42±36.67	63.67±30.70	2,878
Palaemon (Palaeander) northropi (Rankin, 1898).	1.58±3.34	0.25±0.87	0.92±3.18	33	47.91±47.17	0.0±0,0	0.0±0.0	575
Macrobrachium acanthurus (Wiegmann, 1836).	4.0±5.01	2.50±1.98	4.92±6.65	137	0.67±2.02	3.08±4.58	1.33±4.03	61
ALPHEIDAE								
Alpheus heterochaelis (Say, 1818).	0.25±4.92	0.50±0.90	0.17±0.39	11	0.0±0.0	0.08±0.29	0.25±0.45	4

In both estuaries, Palaemon (Palaemon) pandaliformis (Stimpson, 1871) was the most abundant species, and the exclusive species found during all the study period. On the other hand, Alpheus heterochaelis (Say, 1818) presented the lowest abundance among the species, being absent during the summer in Comprido River, and spring and summer in Ubatumirim River (Fig. 2).

The Palaemon (Palaeander) northropi species (Wiegmann, 1836) occurred in both studied estuaries during distinct year seasons, becoming absent in summer at both estuaries and in spring at the Comprido River. The highest abundance of Macrobrachium acanthurus (Wiegmann, 1836) occurred at the Comprido River. However, it did not occur in summer at the Comprido and in spring at Ubatumirim River.

The total abundance of caridean prawns between the two estuaries did not show statistical difference (Mann-Whitney, $p>0.05$). Only Palaemon northropi showed a significant difference in its abundance between estuaries (t-test, $p<0.05$).

The salinity in both estuaries ranged from 0 to 16.5‰ and 15.5‰, respectively. There was statistical difference in salinity among seasons for both estuaries (Mann-Whitney, $p<0.05$). The water temperature ranged from 20 to 23°C in the Ubatumirim River and 21 to 22.5°C in the Comprido River. The medium value of the water temperature differed only during autumn between estuaries (Mann-Whitney, $p<0.05$).

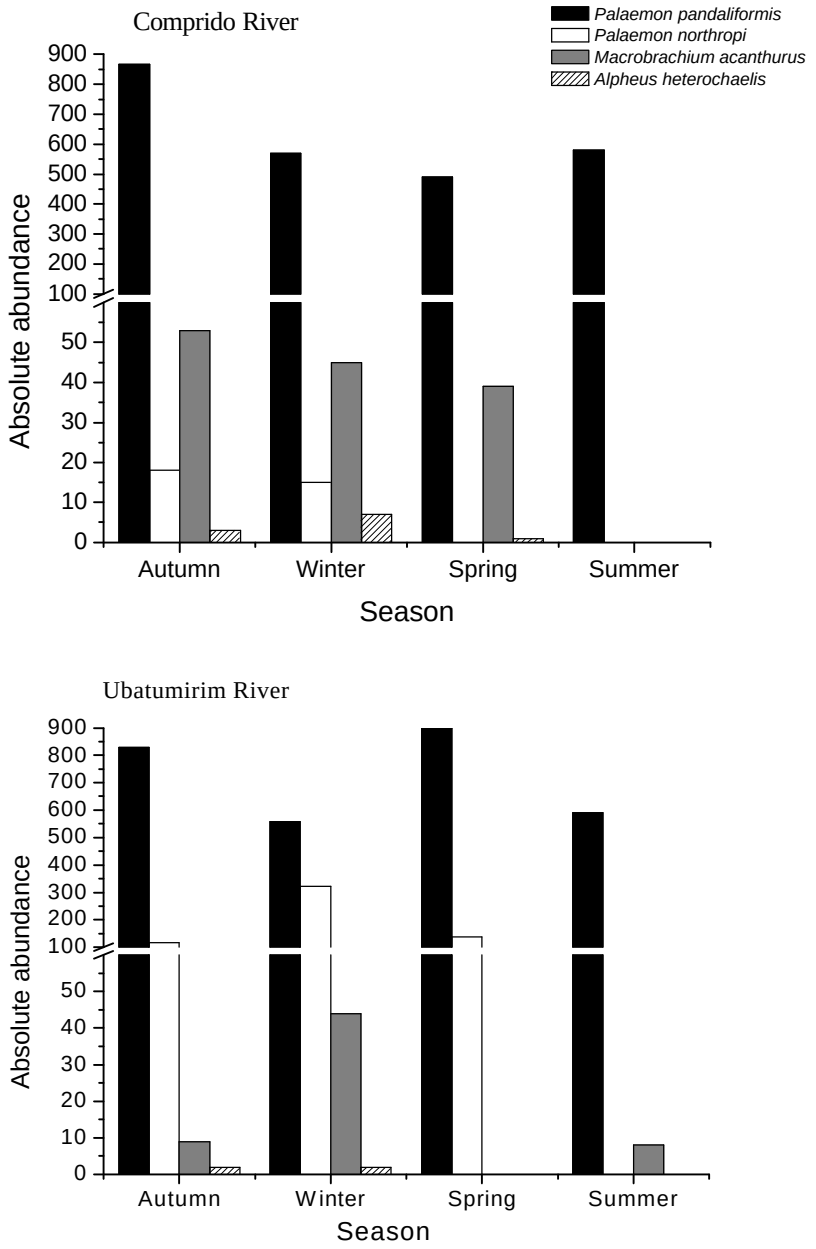

Figure 2: Absolute abundance of the caridean sampled in each season in the studied estuaries.

The comparisons performed between estuaries showed that the organic matter of the water did not present statistical difference among seasons (Mann-Whitney, $p>0.05$). With reference to the organic matter of the sediment, only the winter and summer values did not present statistical difference between estuaries (Mann-Whitney, $p>0.05$).

The results of the environmental factors comparisons within each estuary are shown in Fig. 3.

The correlation analyses performed between the environmental factors and the absolute abundance of the species in Ubatumirim River showed no significant statistical correlations (Spearman correlation, $p>0.05$). Concerning to the Comprido River, P. pandaliformis and A. heterochaelis species presented a positive correlation with the temperature ($p<0.05$ and $r = 0.61$; $p<0.05$ and $r = 0.64$, respectively), while M. acanthurus was correlated to the organic matter of the water ($p<0.05$; $r = 0.59$). The P. northropi species did not show significant correlation with any analyzed environmental factor in the Comprido River ($p>0.05$).

The diversity index and uniformity by months were represented in figure 4 and the results obtained in each estuary are shown at Tab. II. It can be observed that the values of diversity and uniformity presented a slightly variation between estuaries.

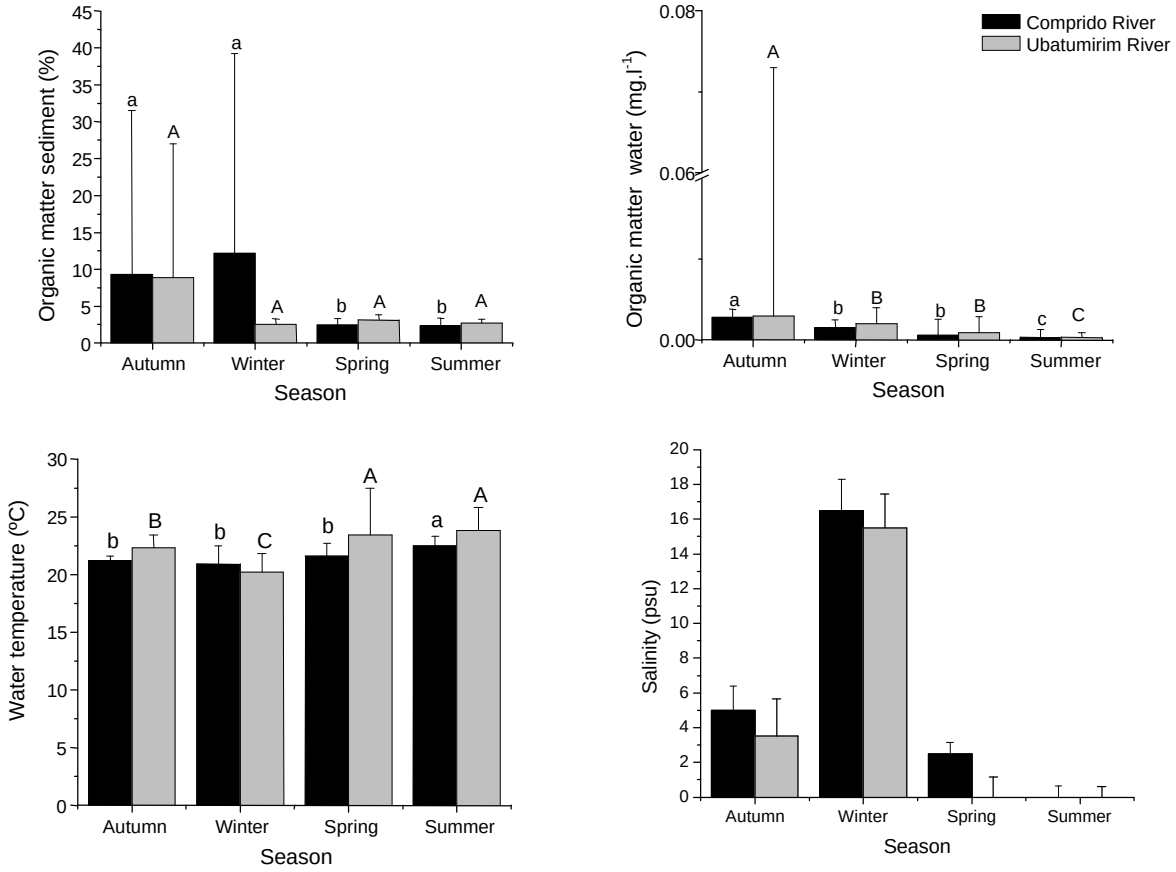

Figure 3: The environmental factor in median values (± sd): Comprido River (small letter) and Ubatumirim River (capital letter) in each season. The statistical comparisons were performed for each season between sites (Kruskal-Wallis, p›0.05). White bars with at least one some letter in common did not differ statistically.

Table II: Comparative diversity index (Shannon-Wiener) for the species of Carideans in the studied estuaries.

Estuaries	N	S	H´	Var (H´)	J´	Var (J´)
Ubatumirim River	3.518	4	0.776	0.160	0.118	0.005
Comprido River	2.687	4	0.423	0.070	0.046	0.001

N = Total number of prawns; S = Total number of species; H´ = Diversity index calculated; Var (H´) = Diversity index variance; J´ = Uniformity; Var (J´) = Uniformity variance.

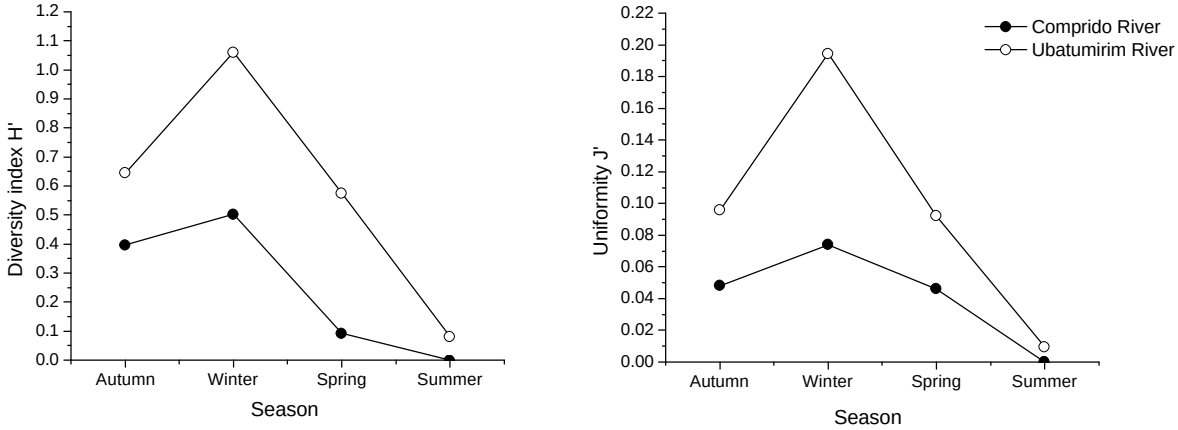

Figure 4: Temporal distribution of the diversity index Shannon-Wiener (H´) and uniformity (J'), during the study period in each estuary.

Discussion

The Palaemonidae family, represented by prawns, is commonly found in largest number of species inhabiting freshwater, estuaries and sea (Gomes-Corrêa, 1977; Ramos-Porto & Coelho, 1999). In the State of São Paulo, 17 species occur according to Magalhães (1999), from which only three species were obtained during this study: Macrobrachium acanthurus, Palaemon pandaliformis and Palaemon northropi.

The presence of the Palaemonidae prawns in the studied estuaries is possibly related to their life cycle (Bauer, 2004). Many species of caridean prawns live in the estuaries because they depend on the estuarine water at least in one of their developmental phases to complete their reproductive cycle (Choudhury, 1970; Bueno & Rodrigues, 1995).

Rocha & Bueno (2004) mentioned that the species of Macrobrachium genus present distinct reproductive strategies. According to these authors, some species depend on the estuarine waters to complete their development; on the other hand, some of them do not need salinity variation to develop. The presence of M. acanthurus species in the estuaries of Comprido and Ubatumirim Rivers can be explained by the necessity of reproducing in the estuaries, fact also observed in M. rosenbergii (De Mann, 1879) by Raman (1967), in M. carcinus (Linnaeus, 1758) by Choudhury (1971), in M. olfersi (Wiegmann, 1836) by Anger & Moreira (1998) and in M. nipponense (de Haan) by Mashiko (2000).

For both estuaries, P. pandaliformis is a well established species and the most abundant in such environments. Gamba (1998) demonstrated that P. pandaliformis larvae could be obtained either in freshwater and salt water. So, this species has a high capacity to support high salinity variations that occurs daily in estuaries (Bond-Buckup & Buckup, 1989; Rocha & Bueno, 2004). Teixeira & Falcão (1992) and Teixeira & Sá (1998) in Lagunar Complex Mundaú/ Manguaba, Alagoas State also mentioned this fact by P. pandaliformis.

The occurrence of P. northropi in the studied estuaries confirms the proposition by Corey & Reid (1991) and Anger & Moreira (1998) that this species lives near the mangrove region in the estuarine environment. However, Ramos-Porto & Coelho (1999) assumed that this species establishes itself in marine sandbank and in a coast deeply rocky. This way, P. northropi could be included in the pattern proposed by Lacerda (1999): it is a marine species that spend most of its life cycle in estuarine environment, except ovigerous females (Pralon & Negreiros-Fransozo, 2006).

The low density of A. heterochaelis could be related to the fact that this species does not inhabit areas with high quantity of Spartina (Almeida et al. 2006). Therefore the presence of the species confirms the proposition of Christoffersen (1984) and Martinez-Iglesias et al. (1996/7), i.e., the occurrence of this species in an estuarine environment, a place where it could find an adequate flora to feed, to protection, opposition and agonistic possible predation.

The results obtained between environmental factors in the estuaries of Comprido and Ubatumirim Rivers were similar. However, a study performed in such area demonstrated that each estuary showed distinct physiographic features. According to Miranda et al. (2000), the changes that estuarine environments present are directly related to their geomorphology and hydrodynamics difference, which causes constant alterations in the water temperature, salinity and organic matter particulate and/or dissolved (Schaeffer-Novelli, 1995).

The obtained value of the diversity index and uniformity was low in both estuaries, because of the fact that Shannon-Wiener index considers the uniformity (relative abundance of each species) and richness (Margalef, 1982; Poole, 1974; Krebs, 1989). The absence of P. northropi, M. acanthurus and A. heterochaelis during some seasons (spring and summer) in the samples may cause the low values of diversity. Possibly the sampling procedure or collection time were not adequate to obtain such species.

The value of the diversity index found for the present studied group and environment are low when compared to other decapods and nearby environments. Pinheiro et al. (1997) and Negreiros-Fransozo & Nakagaki (1998) found elevated diversity index values for decapods from Sabellariidae worm reefs and brachyurans from marine shallow waters, respectively.

It can be verified that the estuarine environment offers conditions favorable to the establishment and development of

many species of caridean prawns. Therefore, further studies of characterization from the caridean population in other estuaries of São Paulo States are still necessary, for a better understanding of the life cycle of these organisms.

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