COMPOSITION AND ABUNDANCE OF THE CRABS (DECAPODA, BRACHYURA) OFF UBATUBA AND CARAGUATATUBA, NORTHERN COAST OF SÃO PAULO, BRAZIL

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Abstract

The objective of the present study was to characterize the composition and abundance of the marine brachyuran crabs in non-consolidated sublittoral sediments in two regions, Ubatuba and Caraguatatuba, on the northern coast of São Paulo State, Brazil. In each region, collections were made monthly at seven depths for two years, July 2001 through to June 2003, from a fishing boat equipped with two double-rig nets. A total of 30,231 crabs were caught (13,305 at Ubatuba and 16,926 at Caraguatatuba), representing nine superfamilies (Dromioidea, Homoloidea, Calappoidea, Leucosioidea, Majoidea, Parthenopoidea, Portunoidea, Xanthoidea and Pinnotheroidea), 16 families, 29 genera and 44 species. Among the total species collected, 31 were common to both regions. Caraguatatuba showed higher species richness (42) and a higher H' diversity index (2.93). For both regions, *Callinectes ornatus*, *Hepatus pudibundus* and *Libinia spinosa* were the most abundant brachyurans. The results indicate that the two regions provide favorable environments for brachyurans, resulting in a locally high biodiversity.

Key words: *Composition, Biodiversity, Brachyura.*

Resumo

O objetivo do presente estudo foi caracterizar a composição e a abundância dos caranguejos no infralitoral não-consolidado de duas regiões (Ubatuba e Caraguatatuba) do litoral norte paulista, Brasil. Em cada região foram realizadas coletas mensais em sete profundidades, durante o período de dois anos (Julho/ 2001 a Junho/ 2003), utilizando-se um barco de pesca equipado com duas redes do tipo "double-rig". Obteve-se um total de 30.231 caranguejos (13.305 em Ubatuba e 16.926 em Caraguatatuba), abrangendo nove superfamílias (Dromioidea, Homoloidea, Calappoidea, Leucosioidea, Majoidea, Parthenopoidea, Portunoidea, Xanthoidea e Pinnotheroidea), 16 famílias, 29 gêneros e 44 espécies. Do total de espécies coletadas, 31 foram comuns para as duas regiões. Dentre as duas regiões, Caraguatatuba apresentou a maior riqueza de espécies (42) e o maior índice de diversidade (2,93 bits/inds.). Para ambas regiões, *Callinectes ornatus*, *Hepatus pudibundus* e *Libinia spinosa*, foram os braquiúros mais abundantes. Tais resultados indicam que as duas regiões analisadas apresentam ambientes propícios para o desenvolvimento dos braquiúros, possibilitando uma alta biodiversidade.

Palavras-chave: *Biodiversidade, abundância, checklist, Brachyura.*

2. INTRODUCTION

Studies of the composition of marine invertebrates are fundamentally important for a better understanding of the actual number of species present in benthic communities, in addition to serving as a basis for conserving the biodiversity of this environment.

Biodiversity is the central concept in practical efforts to quantify the ecological position of different biotopes, in order to understand the abundance of species (Izsák & Papp 2000). The biodiversity of a particular community may be affected by the dispersal of the organisms, as communities are composed of permanent, temporary and transitory residents (Myers 1997).

Decapod crustaceans are one of the most common groups of marine organisms. The majority of species occur in tropical and subtropical regions, with a significant decline in species number toward the cold-temperate and cold regions (Boschi 2000). Crabs are a highly important group of marine decapods, with approximately 5,000 species described worldwide. The Brazilian coast is home to 302 species of Brachyura (Melo 1996), of which 188 species occur off the coast of the state of São Paulo (Bertini *et al.* 2004).

The biodiversity of different groups of Decapoda in the region of Ubatuba has been extensively studied, for instance by Fransozo *et al.* (1992 and 1998), Negreiros-Fransozo *et al.* (1992 and 1997), Pires (1992), Cobo *et al.* (1993), Hebling *et al.* (1994), Nakagaki *et al.* (1995), Negreiros-Fransozo & Nakagaki (1998), Costa *et al.* (2000), Mantelatto & Fransozo (2000), Bertini & Fransozo (2004), Bertini *et al.* (2004) and Mantelatto *et al.* (2004). Among the studies treating other parts of the Brazilian coast are those of Souza (1997) off Rio Grande do Sul and Lavrado *et al.* (2000) in Guanabara Bay, Rio de Janeiro.

The literature on the Decapoda of the Brazilian coast frequently treats particular geographical areas. These reports are essential to understanding various aspects of benthic communities, in addition to providing basic knowledge of their bioecology. The purpose of the present study was to characterize the composition and abundance of the Brachyura in non-consolidated sublittoral substrates of the regions of Ubatuba and Caraguatatuba, on the northern coast of the state of São Paulo.

2. MATERIAL AND METHODS

2.1 Study Area

Particular features of the northern coast of São Paulo are the close proximity of the coastal mountaneous range, the Serra do Mar, to the ocean; and the extremely indented coastline with its many bights and bays (Mahiques 1995). These features contribute to forming an environment favorable to the establishment and development of a large biological diversity.

Our study areas, located on this coast, included the regions of Ubatuba and Caraguatatuba. The area sampled at Ubatuba began at Ubatuba bay, which opens to the east. The bay is constricted by outcrops of crystalline base rock that divide it into two parts, the outer part deeper that 10 meters and the much shallower inner part (Mahiques 1995). In the region of Caraguatatuba, the islands of Vitória and Búzios, and principally São Sebastião Island form physical obstacles. This shield from the open sea, together with to the proximity of the São Sebastião Channel, renders the hydrodynamism of the region less intense and favours an area of fine-sediment deposition (Pires-Vanin *et al.* 1993).

2.2 Collection Methods

Brachyurans were collected monthly at Ubatuba and Caraguatatuba, from July 2001 through June 2003. Trawls were made from a fishing boat equipped with two double-rig nets. In each region, samples were taken along seven transects, 5, 10, 15, 20, 25, 30 and 35 meters deep. Along each transect the nets were towed for 30 minutes, corresponding to a distance of about 2 kilometers, covering an area of circal 16,000 m^2 (Figure 1). At the end of each tow the contents of the nets were released onto the deck, and all the specimens were sorted and placed into labeled plastic bags, and stored on shaved ice. In the laboratory, the crabs were identified according to Melo (1996). The greatest carapace width (CW) of each specimen was measured with a caliper (0.1 mm). Higher classification was based on Martin & Davis (2001).

To represent the total number of individuals by superfamily of Brachyura, we used the index of abundance: $A = \ln (x + 1)$, where x = the number of individuals and ln = the Neperian logarithm.

Diversity (H') was estimated by the Shannon-Wiener index (Pielou 1966): $H' = \mathbf{S}^{s}_{i=1}$ Pi. $\log_2 P_i$, where "s" is the number of species and " P_i" is the proportion of the i^{th} species. The equitability index (E') was calculated as recommended by García Raso & Fernandez Muñoz (1987): $E' = H' / \log_2 s$. The diversity indices were calculated by the Krebs program (version 0.9) (Krebs 1998).

3. RESULTS

A total of 30,231 individuals crabs were collected. They comprised 44 species, representing nine superfamilies (Dromioidea, Homoloidea, Calappoidea, Leucosioidea, Majoidea, Parthenopoidea, Portunoidea, Xanthoidea and Pinnotheroidea), 16 families and 29 genera.

Table I lists the species recorded and the total number of individuals for each region. In comparison with the data from Ubatuba region, Caraguatatuba region showed the largest number of species and a greater H' diversity index.

Figures 2 A and B show the total number of species and the index of abundance for the superfamilies in each region.

The most species-rich superfamilies in the Ubatuba region were the Xanthoidea (9), Majoidea (8) and Portunoidea (8); in the Caraguatatuba region these were the Majoidea (11), Xanthoidea (10) and Portunoidea (8). The superfamilies with the most individuals at Ubatuba and Caraguatatuba, respectively, were the Portunoidea (9,614 and 8,864) followed by the Calappoidea (1,623 and 4,054) and Majoidea (1,348 and 2,617).

Of the 44 species collected, 31 were common to both regions. *Eucratopsis crassimanus* and *Pinnixa gracilipes* occurred only at Ubatuba; whereas *Hypoconcha arcuata, H. parasitica, Homola barbata, Collodes rostratus, C. trispinosus, Stenorhynchus seticornis, Heterocrypta lapidea, H. tommasii, Mesorhoea sexspinosa, Panopeus americanus* and *Pilumnus dasypodus* were present only at Caraguatatuba.

A list of all species collected is presented below. The size ranges (carapace width) and the geographical distribution according to Melo (1996) and Mantelatto & Dias (1999) are given.

Superfamily Dromioidea de Haan 1833

Family Dromiidae de Haan 1833

- *Cryptodromiopsis antillensis* (Stimpson 1858) Figure 3

Range: CW = 7.7 - 16.0 mm.

Geographic distribution: Occidental Atlantic – North Carolina, Bermuda, Florida, Gulf of Mexico, The West Indies, northern South America, Guianas and Brazil (Amapá to Rio Grande do Sul).

- *Hypoconcha arcuata* Stimpson 1858 Figure 4

Range: CW = 11.0 – 14.2 mm.

Geographic distribution: Occidental Atlantic – North Carolina to Florida, Gulf of Mexico, The West Indies, Guianas and Brazil (Amapá to São Paulo).

- *Hypoconcha parasitica* (Linnaeus 1763) Figure5

Range: CW = 12.4 – 20.6 mm.

Geographic distribution: Occidental Atlantic – North Carolina to Florida, Southern Gulf of Mexico, The West Indies, Venezuela and Brazil (Maranhão to São Paulo).

Superfamily Homoloidea de Haan 1839

Family Homolidae de Haan 1839

- *Homola barbata* (Fabricius 1793) Figure6

Range: CW = 12.2 - 14.7 mm.

Geographic distribution: Occidental Atlantic – Virginia to South of Florida, Southern Gulf of Mexico, The West Indies, Central America, northern South America and Brazil (Rio de Janeiro to Rio Grande do Sul). OrientalEasternEastern Atlantic – Portugal and Africa. Mediterranean Sea.

Superfamily Calappoidea Milne Edwards 1837

Family Hepatidae Stimpson 1871

- *Hepatus pudibundus* (Herbst 1785) Figure7

Range: CW = 2.5 – 81.5 mm.

Geographic distribution: Occidental Atlantic – Georgia, Gulf of Mexico, The West Indies, Venezuela, Guianas and Brazil (Amapá to Rio Grande do Sul). Oriental Atlantic – Guinea to South Africa.

Superfamily Leucosioidea Samouelle 1819

Family Leucosiidae Samouelle 1819

- *Persephona lichtensteinii* Leach 1817 Figure8

Range: CW = 11.5 – 29.5 mm.

Geographic distribution: Occidental Atlantic – Venezuela, Suriname, Guianas and Brazil (Amapá to São Paulo).

- *Persephona mediterranea* (Herbst 1794) Figure9

Range: CW = 10.0 – 44.6 mm.

Geographic distribution: Occidental Atlantic – New Jersey, North and South Carolina, Florida, Gulf of Mexico, The West Indies, Venezuela, Suriname, Guianas and Brazil (Amapá to Rio Grande do Sul) and Uruguay.

- *Persephona punctata* (Linnaeus 1758) Figure10

Range: CW = 10.7 - 42.3 mm.

Geographic distribution: Occidental Atlantic – The West Indies, Colombia, Venezuela, Guianas and Brazil (Amapá to Rio Grande do Sul).

Superfamily Majoidea Samouelle 1819

Family Epialtidae MacLeay 1838

- *Leucippa pentagona* H. Milne Edwards 1833 Figure11

Range: CW = 5.3 - 10.5mm.

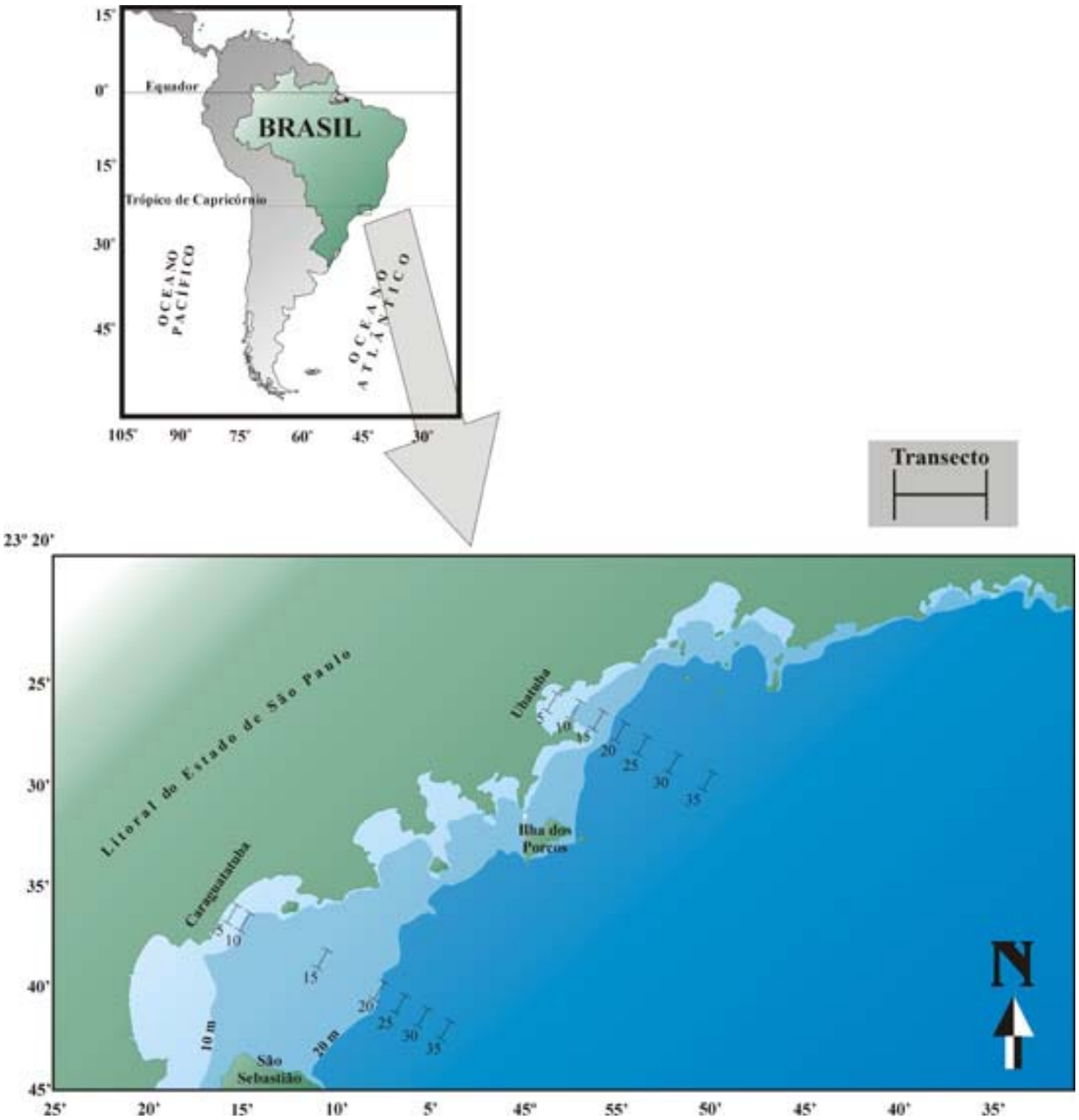

Figure 1. Map showing study areas of Ubatuba and Caraguatatuba.

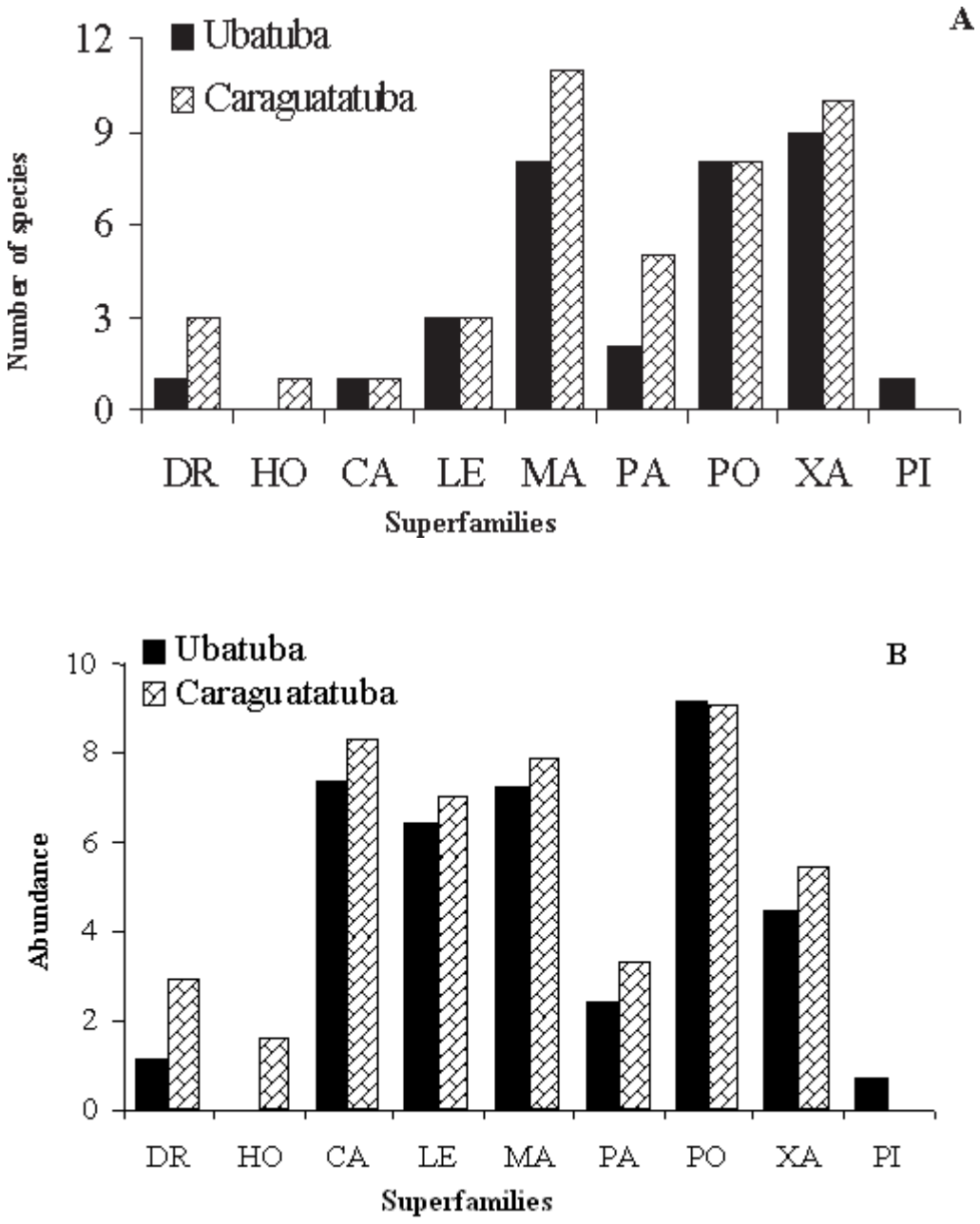

Figure 2. Total numbers of species of Brachyura (A) and abundance: ln (x + 1) of individuals (B) by superfamilies, in the two study areas (DR – Dromioidea; HO - Homoloidea; CA - Calappoidea; LE - Leucosioidea; MA - Majoidea; PA - Parthenopoidea; PO - Portunoidea ; XA – Xanthoidea; PI - Pinnotheroidea).

Figure 3. Cryptodromiopsis antillensis *(Stimpson 1858)*

Figure 4. Hypoconcha arcuata *Stimpson 1858*

Figure 5. Hypoconcha parasitica *(Linnaeus 1763)*

Figure 6. Homola barbata *(Fabricius 1793)*

Figure7. Hepatus pudibundus *(Herbst 1785)*

Figure 8. Persephona lichtensteinii *Leach 1817*

Figure 9. Persephona mediterranea *(Herbst 1794)*

Figure 10. Persephona punctata *(Linnaeus 1758)*

Figure 11. Leucippa pentagona *H. Milne Edwards 1833*

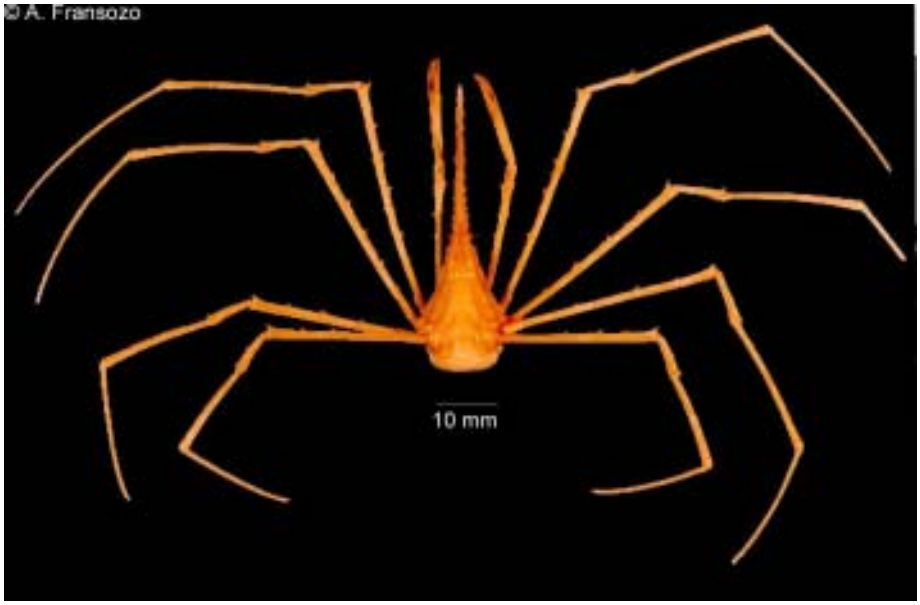

Figure 12. Stenorhynchus seticornis *(Herbst 1788)*

Figure 13. Collodes rostratus *A. Milne Edwards 1878*

Figure 14. Collodes trispinosus *Stimpson 1871*

Figure 15. Leurocyclus tuberculosus *(H. Milne Edwards e Lucas 1843)*

Figure 16. Pyromaia tuberculata *(Lockington 1876)*

Figure 17. Microphrys bicornutus *(Latreille 1825)*

Figure 18. Libinia ferreirae *Brito Capello 1871*

Figure 19. Libinia spinosa *H. Milne Edwards 1834*

Figure 20. Pelia rotunda *A. Milne Edwards 1875*

Figure 21. Rochinia gracilipes *A. Milne Edwards 1875*

Figure 22. Heterocrypta lapidea *Rathbun 1901*

Figure 23. Heterocrypta tommasii *Rodrigues da Costa 1959*

Figure 24. Mesorhoea sexspinosa *Stimpson 1871*

Figure 25. Parthenope (Platylambrus) fraterculus *(Stimpson 1871)*

Figure 26. Parthenope (Platylambrus) pourtalesii *(Stimpson 1871)*

Figure 27. Arenaeus cribrarius *(Lamarck 1818)*

Figure 28. Callinectes danae *Smith 1869*

Figure 29. Callinectes ornatus *Ordway 1863*

Figure 30. Charybdis hellerii *(A. Milne-Edwards 1867)*

Figure 31. Cronius ruber *(Lamarck 1818)*

Figure 32. Portunus ordwayi *(Stimpson 1860)*

Figure 33. Portunus spinicarpus *(Stimpson 1871)*

Figure 34. Portunus spinimanus *Latreille 1819*

Figure 35. Eucratopsis crassimanus *(Dana 1852)*

Figure 36. Hexapanopeus paulensis *Rathbun 1930*

Figure 37. Hexapanopeus schmitti *Rathbun 1930*

Figure 38. Panopeus americanus *Saussure 1857*

Figure 39. Panopeus occidentalis *Saussure 1857*

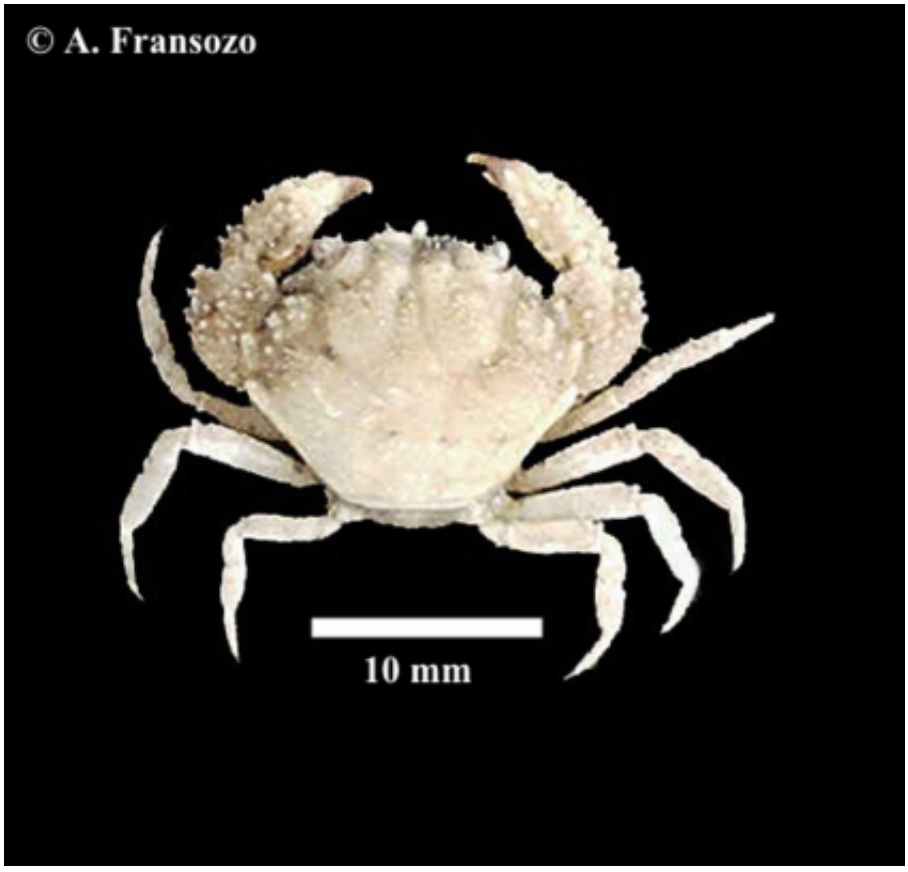

Figure 40. Pilumnoides coelhoi *Guinot e Macpherson 1987*

Figure 41. Pilumnoides hassleri *A. Milne Edwards 1880*

Figure 42. Pilumnus dasypodus *Kingsley 1879*

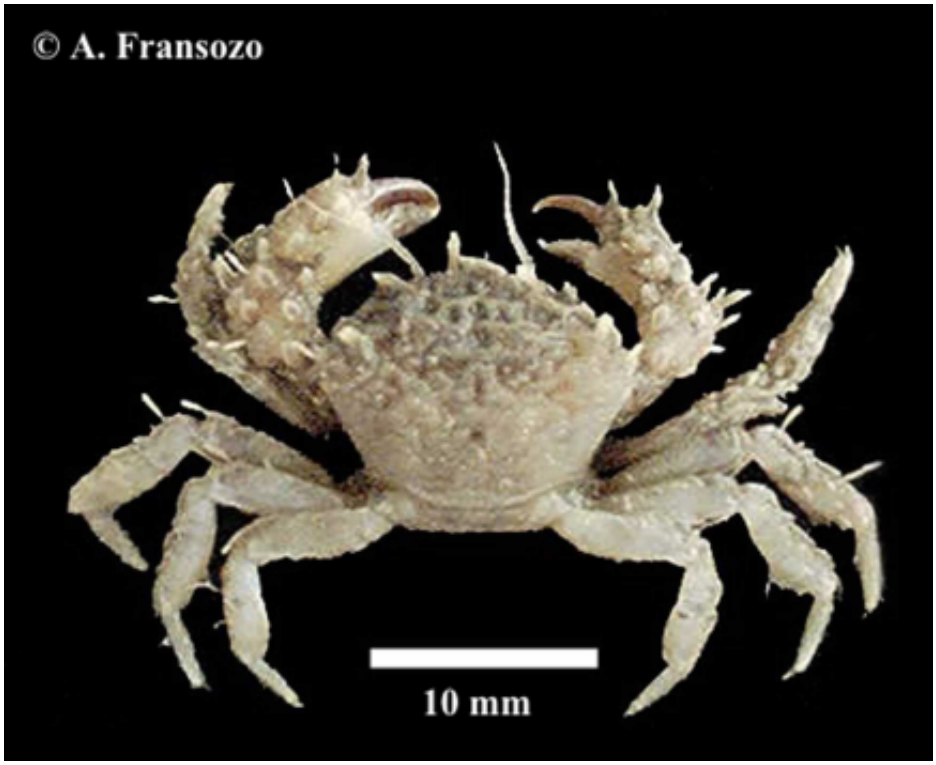

Figure 43. Pilumnus reticulatus *Stimpson 1860*

Figure 44. Pilumnus spinosissimus *Rathbun 1898*

Figure 45. Cataleptodius floridanus *(Gibbes 1850)*

Figure 46. Pinnixa gracilipes *Coelho 1997*

Table I. Species and numbers of individuals of brachyurans collected from July 2001 to June 2003 in the areas of Ubatuba and Caraguatatuba.

Superfamilies	Species	Ubatuba	Caraguatatuba	Total
Dromioidea	*Cryptodromiopsis antillensis*	2	13	15
	Hypoconcha arcuata		2	2
	Hypoconcha parasitica		3	3
Homoloidea	*Homola barbata*		4	4
Calappoidea	*Hepatus pudibundus*	1,623	4,054	5,677
Leucosioidea	*Persephona lichtensteinii*	29	43	72
	Persephona mediterranea	540	922	1,462
	Persephona punctata	53	147	200
Majoidea	*Leucippa pentagona*	17	19	36
	Stenorhynchus seticornis		1	1
	Collodes rostratus		4	4
	Collodes trispinosus		1	1
	Leurocyclus tuberculosus	764	822	1,586
	Pyromaia tuberculata	39	72	111
	Microphrys bicornutus	1	1	2
	Libinia ferreirae	55	13	68
	Libinia spinosa	457	1,655	2,112
	Pelia rotunda	12	17	29
	Rochinia gracilipes	3	12	15
Parthenopoidea	*Heterocrypta lapidea*		1	1
	Heterocrypta tommasii		1	1
	Mesorhoea sexspinosa		1	1
	Parthenope (Platylambrus) fraterculus	2	10	12
	Parthenope (Platylambrus) pourtalesii	8	14	22
Portunoidea	*Arenaeus cribrarius*	210	506	716
	Callinectes danae	552	108	660
	Callinectes ornatus	6,580	3,694	10,274
	Charybdis hellerii	1	1	2
	Cronius ruber	1	1	2
	Portunus ordwayi	6	3	9
	Portunus spinicarpus	1,337	3,830	5,167
	Portunus spinimanus	927	721	1,648
Xanthoidea	*Eucratopsis crassimanus*	1		1
	Hexapanopeus paulensis	51	76	127
	Hexapanopeus schmitti	10	72	82
	Panopeus americanus		1	1
	Panopeus occidentalis	1	7	8
	Pilumnoides coelhoi	2	24	26
	Pilumnoides hassleri	14	39	53
	Pilumnus dasypodus		7	7
	Pilumnus reticulatus	1	1	2
	Pilumnus spinosissimus	2	1	3
	Cataleptodius floridanus	3	2	5
Pinnotheroidea	*Pinnixa gracilipes*	1		1
	Total individuals	13,305	16,926	30,231
	Total species	33	42	44
	Diversity	2.56	2.93	2.87
	Equitability	0.51	0.54	0.53

Geographic distribution: Occidental Atlantic – Brazil (Rio de Janeiro and São Paulo), Uruguay and Argentina. Oriental Pacific – California, Mexico and Chile.

Family Inachidae MacLeay, 1838

- *Stenorhynchus seticornis* (Herbst 1788) Figure12

Range: CW = 8.3mm.

Geographic distribution: Occidental Atlantic – North Carolina, Florida, Gulf of Mexico, The West Indies, Colombia, Venezuela, Guianas, Brazil (Amapá to Rio Grande do Sul), Uruguay and Argentina.

Family Inachoididae Dana 1851

- *Collodes rostratus* A. Milne Edwards 1878 Figure13

Range: CW = 6.5 – 12.6mm.

Geographic distribution: Occidental Atlantic – Brazil (Espírito Santo to Rio Grande do Sul), Argentina (including Patagonia).

- *Collodes trispinosus* Stimpson 1871 Figure14

Range: CW = 15.0 mm.

Geographic distribution: Occidental Atlantic – North Carolina to Florida, Gulf of Mexico and Brazil (Amapá, Rio de Janeiro and São Paulo).

- *Leurocyclus tuberculosus* (H. Milne Edwards and Lucas 1843) Figure15

Range: CW = 5.4 - 39.1mm.

Geographic distribution: Occidental Atlantic – Brazil (Rio de Janeiro to Rio Grande do Sul), Uruguay and Argentina (including Patagonia). Oriental Pacific – Chile.

- *Pyromaia tuberculata* (Lockington 1876) Figure16

Range: CW = 3.7 - 15.8 mm.

Geographic distribution: Occidental Atlantic – Brazil (Rio de Janeiro to Paraná) and Argentina. Oriental Pacific – California, Central America to Chile. Indo Pacific – Japan.

Family Mithracidae Balss 1929

- *Microphrys bicornutus* (Latreille 1825) Figure17

Range: CW = 3.5 - 5.0 mm.

Geographic distribution: Occidental Atlantic – North Carolina to South Florida, Bermuda, Gulf of Mexico, The West Indies, Central America, Venezuela and Brazil (Maranhão to Rio Grande do Sul; Fernando de Noronha).

Family Pisidae Dana 1851

- *Libinia ferreirae* Brito Capello 1871 Figure18

Range: CW = 5.7 – 60.5 mm.

Geographic distribution: Occidental Atlantic – Venezuela and Brazil (Pará to Santa Catarina).

- *Libinia spinosa* H. Milne Edwards 1834 Figure19

Range: CW = 4.3 – 84.0 mm.

Geographic distribution: Occidental Atlantic – Brazil (Espírito Santo to Rio Grande do Sul), Uruguay and Argentina. Oriental Atlantic – Senegal to Angola, Cape Verde Island. Pacific – South of California to North of Chile, Galapagos Islands and Hawaii.

- *Pelia rotunda* A. Milne Edwards 1875 Figure20

Range: CW = 6.2 – 6.8 mm.

Geographic distribution: Occidental Atlantic – Brazil (Pará to Rio Grande do Sul), Uruguay and Argentina.

-*Rochinia gracilipes* A. Milne Edwards 1875 Figure21

Range: CW = 3.3 - 12.0 mm.

Geographic distribution: Occidental Atlantic – Brazil (Rio de Janeiro to Rio Grande do Sul), Uruguay, Argentina and Antarctica.

Superfamily Parthenopoidea MacLeay 1838

Family Parthenopidae MacLeay 1838

- *Heterocrypta lapidea* Rathbun 1901 Figure22

Range: CW = 9.6 mm.

Geographic distribution: Occidental Atlantic – The West Indies and Brazil (Pará to Rio Grande do Sul).

- *Heterocrypta tommasii* Rodrigues da Costa 1959 Figure23

Range: CW = 11.2 – 17.6 mm.

Geographic distribution: Occidental Atlantic – Central America, Guianas and Brazil (Ceará to Rio Grande do Sul).

- *Mesorhoea sexspinosa* Stimpson 1871 Figure24

Range: CW = 11.2 mm.

Geographic distribution: Occidental Atlantic – North Carolina, Florida, Gulf of Mexico, Antilhas and Brazil (Pará to Rio Grande do Sul).

- *Parthenope (Platylambrus) fraterculus* (Stimpson 1871) Figure25

Range: CW = 13.0 – 18.3 mm

Geographic distribution: Occidental Atlantic – North Carolina to Florida, Gulf of Mexico, The West Indies, Suriname and Brazil (Amapá to Rio Grande do Sul).

- *Parthenope (Platylambrus) pourtalesii* (Stimpson 1871) Figure26

Range: CW = 12.7 – 27.0 mm.

Geographic distribution: Occidental Atlantic – New Jersey to South Florida, Gulf of Mexico, The West Indies and Brazil (Amapá to Rio Grande do Sul).

Superfamily Portunoidea Rafinesque 1815

Family Portunidae Rafinesque 1815

- *Arenaeus cribrarius* (Lamarck 1818) Figure27

Range: CW = 22.8 - 100.2 mm.

Geographic distribution: Occidental Atlantic – Massachusetts to North Carolina, Bermuda, Florida, Gulf of Mexico, The West Indies, Colombia, Venezuela, Brazil (Ceará to Rio Grande do Sul), Uruguay (Maldonado) and Argentina (Mar del Plata).

- *Callinectes danae* Smith 1869 Figure28

Range: CW = 30.0 – 92.7 mm.

Geographic distribution: Occidental Atlantic – Bermuda, Florida, Southern Gulf of Mexico, The West Indies, Colombia, Venezuela and Brazil (Paraíba to Rio Grande do Sul).

- *Callinectes ornatus* Ordway 1863 Figure29

Range: CW = 9.4 – 99.3 mm.

Geographic distribution: Occidental Atlantic – Virginia, North Carolina to Florida, Gulf of Mexico, The West Indies, Colombia, Venezuela, Guianas and Brazil (Amapá to Rio Grande do Sul).

-*Charybdis hellerii* (A. Milne-Edwards 1867) Figure30

Range: CW = 36.2 – 47.0 mm.

Geographic distribution: Occidental Atlantic – eastern Florida, Cuba, Colombia, Venezuela and Brazil (Alagoas to Santa Catarina). Oriental Atlantic – eastern Mediterranean: Israel and Egypt. Indo Pacific – Japan, Philippines, New Caledonia, Australia, Hawaii, and throughout the Indian Ocean, including the Red Sea.

- *Cronius ruber* (Lamarck 1818) Figure31

Range: CW = 6.3 – 7.3 mm.

Geographic distribution: Occidental Atlantic – North Carolina to South Florida, Gulf of Mexico, The West Indies, Central America, northern South America, Guianas and Brazil (Amapá to Rio Grande do Sul). Oriental Atlantic – Senegal to Angola. Oriental Pacific – California to Peru and Galapagos.

- *Portunus ordwayi* (Stimpson 1860) Figure32

Range: CW = 6.1 – 10.6 mm.

Geographic distribution: Occidental Atlantic – Massachusetts to Florida, Gulf of Mexico, The West Indies, Venezuela, Guianas and Brazil (Amapá to Rio Grande do Sul, Fernando de Noronha).

- *Portunus spinicarpus* (Stimpson 1871) Figure33

Range: CW = 5.5 – 42.9 mm.

Geographic distribution: Occidental Atlantic – North and South Carolina, Florida, Gulf of Mexico, The West Indies, Colombia, Venezuela, Guianas and Brazil (Amapá to Rio Grande do Sul) and Uruguay (Maldonado).

- *Portunus spinimanus* Latreille 1819 Figure34

Range: CW = 14.5 – 91.9 mm.

Geographic distribution: Occidental Atlantic – New Jersey to South Florida, Bermuda, Gulf of Mexico, The West Indies, Venezuela, Guianas and Brazil (Pernambuco to Rio Grande do Sul).

Superfamily Xanthoidea MacLeay 1838

Família Eriphiidae MacLeay 1838

- *Eucratopsis crassimanus* (Dana 1852) Figure35

Range: CW = 15.0 mm

Geographic distribution: Occidental Atlantic – Florida, Gulf of Mexico, Antilhas and Brazil (Alagoas to Rio Grande do Sul).

Família Hexapodidae Miers 1886

- *Hexapanopeus paulensis* Rathbun 1930 Figure36

Range: CW = 2.0 - 12.4 mm.

Geographic distribution: Occidental Atlantic – South Carolina, Florida, Gulf of Mexico, Brazil (Pará to Santa Catarina) and Uruguay (Maldonado and Rocha).

- *Hexapanopeus schmitti* Rathbun 1930 Figure37

Range: CW = 2.0 - 8.0 mm.

Geographic distribution: Occidental Atlantic – Brazil (Ceará to Santa Catarina) and Uruguay.

- *Panopeus americanus* Saussure 1857 Figure38

Range: CW = 10.6 mm.

Geographic distribution: Occidental Atlantic – Florida, Gulf of Mexico, The West Indies, Colombia, Venezuela and Brazil (Maranhão to Santa Catarina).

- *Panopeus occidentalis* Saussure 1857 Figure39

Range: CW = 4.7 - 14.5 mm.

Geographic distribution: Occidental Atlantic – North Carolina to Florida, Southern Gulf of Mexico, Central America, The West Indies, northern South America, Guianas and Brazil (Ceará to Santa Catarina).

Family Pilumnidae Samouelle 1819

- *Pilumnoides coelhoi* Guinot and Macpherson 1987 Figure40

Range: CW = 5.3 – 7.5 mm.

Geographic distribution: Occidental Atlantic – Brazil (Bahia to Santa Catarina).

-*Pilumnoides hassleri* A. Milne Edwards 1880 Figure41

Range: CW = 4.0 – 7.7 mm.

Geographic distribution: Occidental Atlantic – Brazil (Rio de Janeiro to Rio Grande do Sul), Uruguay and Argentina to Strait of Magellan.

- *Pilumnus dasypodus* Kingsley 1879 Figure42

Range: CW = 3.1 - 9.4 mm.

Geographic distribution: Occidental Atlantic – North and South Carolina, Florida, Gulf of Mexico, The West Indies, northern South America and Brazil (Paraíba to Santa Catarina).

- *Pilumnus reticulatus* Stimpson 1860 Figure43

Range: CW = 4.0 – 7.2 mm.

Geographic distribution: Occidental Atlantic – The West Indies, Central America, northern South America, Brazil (Pará to Rio Grande do Sul), Uruguay and Argentina. Oriental Pacific – Southern California to Panama.

- *Pilumnus spinosissimus* Rathbun 1898 Figure44

Range: CW = 2.6 - 25.1mm.

Geographic distribution: Occidental Atlantic – Florida, Southern Gulf of Mexico, The West Indies and Brazil (Rio Grande do Norte to Santa Catarina).

Família Xanthidae MacLeay 1838

- *Cataleptodius floridanus* (Gibbes 1850) Figure45

Range: CW = 10.0 - 12.2 mm.

Geographic distribution: Occidental Atlantic – Florida, Gulf of Mexico, Bermuda, Antilhas, Central América, northern South América and Brazil (Rocas, Fernando de Noronha and Ceará to Rio Grande do Sul). Oriental Atlantic – Africa (Guiné to Gabão).

Superfamily Pinnotheroidea de Haan 1833

Family Pinnotheridae de Haan 1833

- *Pinnixa gracilipes* Coelho 1997 Figure46

Range: CW = 9.8 - 11.6 mm.

Geographic distribution: Occidental Atlantic – Brazil (Pará, Pernambuco and São Paulo).

4. DISCUSSION

The study areas, Ubatuba and Caraguatatuba, are small in comparison to the vast extent of the Brazilian coast. Nevertheless, the faunistic sampling carried out up to the present have been of great importance for studies on the structuring of marine benthic communities, also serving as a basis for understanding and preserving biodiversity and the sustainable use of natural resources.

According to Melo (1990), the south and southeastern littoral of Brazil is an area of hydrological and faunal transition, and consequently species of various origins are present in addition to the local endemics. This region harbors a mixture of faunas originating from tropical, subtropical and subantarctic regions (Sumida & Pires-Vanin 1997). This was evident in the present study by the occurrence of *Leurocyclus tuberculosus* and *Portunus spinicarpus*, which occur more abundantly between Rio Grande do Sul in southern Brazil and Patagonia in Argentina (Pires 1992 and Melo 1996).

Observations of environmental factors in this region by Costa *et al.* (2000) and Bertini *et al.* (2001) revealed the existence of a seasonal thermal variation which is directly related to depth, with a thermocline present during the spring and summer months. Sumida & Pires-Vanin (1997) reported that the changes in the benthic fauna of Ubatuba clearly follow the depth gradients, and are probably linked to the changes in the sediment and the physical stability of the water masses present in the region. Pires (1992) noted that between 10 and

40 meters depth, the predominant factor in the distribution of the fauna off Ubatuba is the type of sediment, which varies from silty to sandy; above 40 m, temperature is the principal factor responsible for structuring the communities.

The species composition changed gradually, principally from the 25-meter depth. In both regions, *Callinectes ornatus* predominated in inner shallower areas and *Portunus spinicarpus* in the outer deeper areas. This occurred mainly during summer, when the South Atlantic Central Water (SACW) dominates, as also observed by Pires (1992) and Bertini *et al.* (2004), in other areas from northern coast of São Paulo State, indicating that the studied species are essential to the benthic communities in the sampled areas.

Higher diversity, in terms both of number of species (92.1%) and individuals (56%), was recorded at Caraguatatuba. This high diversity may be related to the presence of Vitória, Búzios and São Sebastião islands. According to Bertini *et al.* (2004), the islands are of prime importance for the maintenance of many brachyuran species, because they form a transition area, incorporating the species from the open sea, and the species which are resident in the bays and possibly migrate to deeper water. In the Ubatuba region, 33 species were found, with the highest richness recorded in the inner part of the bay (down to 20 meters). Mantelatto & Fransozo (2000) and Bertini *et al.* (2004), in their studies of Ubatuba bay, recorded 50 species of Brachyura. These larger totals than in our study can be explained by their studies having included collections near the coastline, where more heterogeneous sediments are present that offer favorable environments for additional species.

Among the nine superfamilies of Brachyura collected, the most abundant were the Portunoidea, Calappoidea and Majoidea, for each the most abundant species being *Callinectes ornatus*, *Hepatus pudibundus* and *Libinia spinosa*, respectively. Mantelatto & Fransozo (1999) also found that *C. ornatus* was present in high abundance and suggested that this is probably related to this species high fecundity and its multiple annual reproductive cycles. The same appears to be the case for *H. pudibundus* and *L. spinosa*, indicating that these regions provide favorable conditions for these species.

The geographical distribution patterns of many of the species caught during the present study were described by Melo (1985 and 1990), Souza (1997) and Nucci & Melo (2000). From a latitudinal provincial point of view, Argentine species (examples: *Collodes rostratus*, *Leurocyclus tuberculosus*, *Libinia spinosa*, *Rochinia gracilipes* and *Pilumnoides hassleri*), Central-South American species (*Pelia rotunda* and *Hexapanopeus schmitti*), continuous Carolinian species (*Cryptodromiopsis antillensis*, *Microphrys bicornutus*, *Stenorhynchus seticornis*, *Mesorhoea sexspinosa*, *Callinectes danae*, *Portunus spinicarpus* and *Hexapanopeus paulensis*), and continuous Virginian species (*Persephona mediterranea*, *Parthenope pourtalesii*, *Arenaeus cribrarius*, *Callinectes ornatus* and *Portunus spinimanus*) are present. From a longitudinal perspective Amphi-American species (*Pyromaia tuberculata* and *Pilumnus reticulatus*), Amphi-Atlantic species (*Homola barbata* and *Hepatus pudibundus*) as well as Circumtropical species (*Cronius ruber*) are present.

According to Melo (1985), Indo-Pacific species are rarely found off southeastern Brazil. However, Negreiros-Fransozo (1996) collected several specimens of the Indo-Pacific *Charybdis hellerii*, extending its known distribution to the coast of São Paulo. Since then, several studies off the Brazilian coast, including ours, have recorded this species: Negreiros-Fransozo *et al.* (1999), Mantelatto & Dias (1999), Lavrado *et al.* (2000), Mantelatto & Fransozo (2000), Bertini & Fransozo (2004) and Bertini *et al.* (2004). Apparently this exotic species has found favorable conditions in the region.

Certain species were present in low numbers, in contrast to others which were abundant. The species found in low numbers may have been migrating, or else they occupy very restricted locations, making their collection difficult, or are perhaps naturally rare. The higher abundances recorded for other species may indicate that they complete all or part of their life cycles locally.

Our data indicate that Ubatuba and Caraguatatuba are areas of great importance for the establishment and maintenance of many species of brachyurans, probably because of the numerous bays and islands that help form favorable macro-environments. This study can serve as a basis for future environmental monitoring in the region, and to establish procedures for conservation and maintenance of the marine biodiversity of the northern coast of São Paulo.

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