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Assemblage of hermit crabs near coastal islands in southeastern Brazil

Assembleia de ermitões nas proximidades de ilhas costeiras do sudeste do Brasil

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Abstract

An assortment of environmental factors may limit the permanence of hermit crabs in the environment, and determination of certain ecological indices can reveal the current conditions of the assemblage. This study evaluated the assemblage of hermit crabs near two islands adjacent to areas with fishing activity. Hermit crabs were collected monthly near Couves and Mar Virado islands on the southeastern coast of Brazil, from January through December 1998. Environmental factors were also recorded monthly. Ecological indices including species richness, diversity, evenness and dominance were calculated. The environmental characteristics differed between the islands, which helps to explain the differences in the composition of hermit crabs between the locations. Hermit crabs were significantly more abundant near Couves Island, where, according to the canonical correspondence analysis (CCA), the environmental parameters varied less. The Monte Carlo test ($P < 0.05$) confirmed the CCA model, indicating a strong correlation between the species of hermit crabs, bottom and surface water temperatures, and sediment organic-matter content. The presence of ovigerous females throughout the year indicates that these areas are favorable for reproduction. These results indicate that the environmental heterogeneity allows the establishment of different species of hermit crabs, influencing species richness and abundance of individuals in the ecosystem. These conditions favor the establishment of diverse benthic communities near the studied islands.

Keywords: Diogenidae, Paguridae, diversity, abundance, multivariate analysis, *Dardanus insignis*, *Loxopagurus loxochelis.*

Resumo

Uma variedade de fatores ambientais pode limitar a permanência de ermitões no ambiente, sendo que alguns índices ecológicos podem revelar as condições da assembleia. Este trabalho avalia a assembleia de ermitões em duas ilhas adjacentes a regiões com atividade pesqueira. Os ermitões foram coletados mensalmente nas ilhas das Couves e do Mar Virado, pertencentes ao litoral sudeste brasileiro, no período de janeiro a dezembro de 1998. Fatores ambientais também foram registrados mensalmente. Índices ecológicos como riqueza, diversidade, equidade e dominância foram calculados. As características ambientais foram diferentes entre as ilhas, o que pode explicar as diferenças na composição de espécies entre os locais. A abundância de indivíduos foi significativamente maior na ilha das Couves, a qual apresenta, segundo a análise de correspondência canônica (CCA), menores oscilações em suas variáveis ambientais. O teste de Monte Carlo ($P < 0.05$) confirmou a robustez da CCA, evidenciando uma forte correspondência entre as espécies de ermitões, temperatura de fundo e superfície e teor de matéria orgânica. A presença de fêmeas ovígeras ao longo do ano também aponta as áreas como propícias à

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reprodução. Desta maneira, os resultados permitem concluir que a heterogeneidade dos ambientes permite o estabelecimento de diferentes espécies de ermitões, influenciando a riqueza de espécies e a abundância de indivíduos no ecossistema local. Tal condição propicia o estabelecimento de comunidades bentônicas distintas nas ilhas estudadas.

Palavras-chave: Diogenidae, Paguridae, diversidade, abundância, análise multivariada, *Dardanus insignis*, *Loxopagurus loxochelis*.

Introduction

The southeastern/southern Brazilian coast is a hydrological and wildlife transition area, with a combination of biological characteristics and associated fauna originating from tropical, subtropical and subantarctic regions (Sumida and Pires-Vanin, 1997). These features increase the species richness in the region, and the composition of the benthic communities has been widely investigated (e.g. Abelló *et al*., 1988; Fransozo *et al*., 1998; De Léo and Pires-Vanin, 2006; Muñoz *et al*., 2008; Bertini *et al.,* 2010), to aid in the development and strengthening of local preservation practices (McNeely *et al*., 1990).

Benthic organisms feed on detritus of both continental and marine origin, and transmit energy to other levels of the food chain. The detritus-feeding habit contributes to nutrient cycling in biogeochemical cycles (Duineveld *et al*., 1997), lending further importance to knowledge of these animals. Hazlett (1981) suggested that hermit crabs represent the best example of benthic detritivorous organisms, since the group has successfully adopted a wide range of feeding habits, reproduction, and shell occupation. Studies of assemblages of hermit crabs may reveal the true state of preservation and possible changes that may occur in the marine environment, since the permanence of these animals in one location is determined by intra and interspecific relationships, as well as by their interaction with environmental factors (Bauer, 1985; Fransozo *et al*., 1998; Meirelles *et al*., 2003; Frameschi *et al.,* 2013a).

The effects of disturbance on marine biodiversity call attention to the need to examine potential impacts on species distribution (Parmesan *et al*., 2005), especially when the changes are caused by predatory fishing, release of toxic chemicals, destruction of physical habitat, eutrophication, and transport of exotic species (Norse, 1993). Costa *et al.* (2005) described the effects on the Brazilian coastal fauna caused by predatory fishing for the shrimp *Xiphopenaeus kroyeri* (Heller, 1862). This affects the entire benthic ecosystem because of the large amounts of bycatch generated by this trawl fishery (Voultsiadou, 2011). The bycatch includes large numbers of hermit crabs and shells, limiting the establishment and development of the hermit crabs (Meireles *et al*., 2003).

According to Sanders (1968), one of the fundamental characteristics of a community is its diversity, namely, the number of species and the numerical composition of these species. The particular characteristics of the environment govern the variety of species, and near islands, the large number of macroenvironments directly influences the composition of the assemblage (Fransozo *et al*., 2012). This study investigated the composition and structure of the assemblage of hermit crabs near two islands in southeastern Brazil, aiming to evaluate the ecological indices of hermit crabs present near the islands and the fishing area, as well as the relative abundance of species associated with the environmental characteristics at each site.

Material and methods

Study area

Data were collected near two islands on the southeastern Brazilian coast: Couves Island (23°24'45"S; 44°51'27"W) in Ubatumirim Bay, and Mar Virado Island (23°33'25"S; 45°09'37") in Mar Virado Bay (Figure 1). Couves Island has a large rocky area and is located in the eastern part of Ubatumirim Bay. Compared to the other islands in the bay it is the largest and the farthest from the coast, exposed to the influence of the open sea (Mahiques, 1995). Mar Virado Island is located west of the estuary entering the bay and south of Anchieta Island, and is sheltered from the action of waves derived from marine currents (Mahiques, 1995). This region is partly affected by water masses coming from the south that enter the channel between the large island of São Sebastião and the mainland. The rapid currents in this channel carry fine sediments to the nearby coast and bays (Furtado *et al.,* 1998).

This part of the subtropical Brazilian coast was recently designated an environmental protection zone (IBAMA, 2008, Normative No. 189). This area is used intensively by local fishermen who employ artisanal gear, i.e., not a destructive fishery. They are allowed to fish during most months of the year except from March through May, the local closed season for shrimping.

Field collections

Hermit crabs were collected monthly from January through December 1998**.** Samples were taken with double-rigged nets, with an aperture of 4.5 m and mesh size of 20 mm in the main body of the net and 15 mm at the cod end. Each sample was taken offshore, and covered an approximate area of 18,000 m^2. The mean water depth was 16.8 ± 1.0 m near Couves

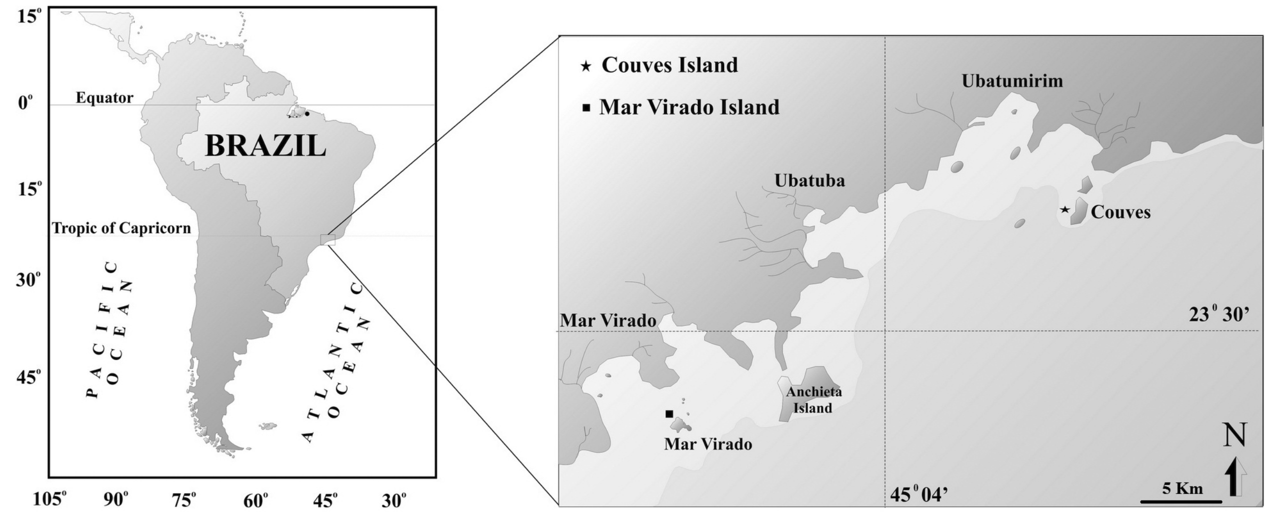

Figure 1. The Ubatuba region, indicating the collection sampling points near Couves and Mar Virado islands, southeastern Brazil.

Island and 11.1 ± 1.1 m near Mar Virado Island.

Bottom and surface temperature and salinity were recorded monthly, using a mercury thermometer and an optical refractometer, respectively. Sediment samples were collected with a Van Veen grab, sampling a bottom area of 0.06 m^2 to measure the organic-matter content (%). Both the sediment and hermit crabs were kept in thermal boxes on crushed ice until they were transported to the laboratory, and were then refrigerated until analysis.

Laboratory procedures

In the laboratory, the sediment was dried at 70°C for 72 h in an oven. The sediment organic-matter content (%) was obtained through ash-weighing: 3 aliquots of 10 g each per station were placed in porcelain crucibles and incinerated for 3 h at 500°C. The samples were then reweighed and the organic-matter content was calculated from the weight loss. Sediment grain-size composition was analyzed according to Mantelatto and Fransozo (1999), and the sediment remaining after analysis of the organic matter was redried and passed through a series of sieves with graduated mesh sizes, following the Wentworth (1922) scale. All procedures for sediment analysis followed Håkanson and Jansson (1983) and Tucker (1988). Hermit crabs were identified according to Melo (1999), and their sex was determined.

Data analysis

The richness (S') was represented by the number of species present in the sample (Krebs, 1998). The diversity (*H')* of the hermit crabs was estimated through the Shannon-Wiener Index (Pielou, 1975), expressed by the formula: $H' = \Sigma Si = 1(Pi).(ln.Pi)$, taking into account the richness and the relative abundance of the species, where Pi is the result of the number of individuals of species "i" in the sample, divided by the total number of individuals. Evenness was estimated by the equation: $J' = H'/\log_2 s$ indicated by Pielou (1975). Dominance was determined by the Berger-Parker Index (Magurran, 1988).

The degree of similarity between the assemblages was calculated using the Bray-Curtis similarity coefficient, and the unweighted average (UPGMA) was used as the connection method. The data were square-root transformed to emphasize rare species and reduce the dominance of the most abundant ones (Clifford and Stephenson, 1975).

In order to compare the environmental factors, the total abundance of hermit crabs, as well as the abundance of *Dardanus insignis* (Saussure, 1858) between the island areas, we used the PerMANOVA multivariate variance analysis test, with 4999 permutations based on a Bray-Curtis similarity matrix (Anderson, 2001). This same test was used to compare environmental factors and abundance of hermit crabs among the seasons of the year, using the monthly samples in the same season as pseudo-replicates.

The relationship between species abundance and environmental variables was evaluated by a Canonical Correspondence Analysis (CCA). For this analysis, the data were transformed into log(x+1), and then the data matrixes were tracked to outliers. The statistical significance of the eigenvalues and species–environment correlations was evaluated by randomization (Monte Carlo) tests, using 9999 randomized runs for each analysis. In each randomization, sample units in the environmental matrix were shuffled. This destroys the relationship between species and environmental matrices, while preserving the species matrix and the correlation structure of the environmental matrix (Peck, 2010). All multivariate analyses of this study were carried out with the software PC-ORD 6.0 (McCune and Mefford, 2011), adopting a 5% significance level (Zar, 1996).

Results

Of the environmental factors measured, only bottom temperature showed a significant difference between the sites (Table 1). There was no significant difference between the bottom and surface temperatures near Mar Virado Island. On the other hand, near Couves Island, the temperatures differed significantly during the year (Figure 2). The highest salinity values were recorded in summer (Couves: 35.7 ± 0:56; Mar Virado: 35.2 ± 1.60) and the lowest in spring (Couves: 33.9 ± 1.90; Mar Virado: 33.3 ± 1.53). The organic-matter content in the sediment was similar near Couves (4.75 ± 2.63) and Mar Virado (3.17 ± 3.12) (Table 1); however, finer fractions predominated near Mar Virado, while near Couves the sediment contained large proportions of medium and coarse sand (Table 1, Figure 3).

Eight species of hermit crabs were recorded: *Dardanus insignis* (Saussure, 1858*), Petrochirus diogenes* (Linnaeus, 1758*), Paguristes erythrops* (A. Milne Edwards, 1880), *Pagurus exilis* (Benedict, 1892), *Loxopagurus loxochelis* (Moreira, 1901), *Paguristes tortugae* (Schmitt, 1933), *Pagurus criniticornis* (Dana, 1852), and *Paguristes calliopsis* (Forest and Saint Laurent, 1968). *Dardanus insignis, P. diogenes, P. erythrops* and *P. exilis* occurred near both islands, totaling 1116 individuals (Table 2). Near Couves Island, hermit crabs were significantly more abundant (66.2%) than near Mar Virado Island (Table 1).

The most abundant species near both islands (Couves: $F = 3.438$; Mar Virado: $F = 5.725$, $P < 0.001$ for both locations) was *D. insignis*. This species was significantly more abundant near Couves than near Mar Virado, mainly during autumn and winter (Table 1). Other abundant species were *P. diogenes* and *P. erythrops*. Ovigerous females were found year-round near both islands (Table 2). The PerMANOVA indicated no differences between the ecological indices for the islands (Diversity: $F = 1.40$, $P = 0.18$; Evenness: $F = 1.35$, $P = 0.19$; Dominance: $F = 4.05$, $P = 0.06$). According to the index values by season, the greatest similarity between the islands was during the winter (Table 2).

Two groups were determined, through similarity, for Couves. Group A is represented by the most abundant species, which showed only 10% similarity with the species of group B (Figure 4). For Mar Virado Island, the similarity test indicated three groups, with a single species, *D. insignis,* composing group A, because it was the most abundant species at this location. The similarity of group A to the other groups was less than 10%. Groups B and C had slightly over 60% similarity, and were represented by less-abundant species (Figure 4).

The Monte Carlo test ($P < 0.05$) confirmed the robustness of the canonical correspondence analysis, showing a strong correlation between the species of hermit crabs and environmental variables with the axes. Environmental factors explained 27.6% of the variations in the structure of the hermit-crab assemblage (Table 3). The coefficient results of the CCA values were low ($r < 0.60$), with no cross-correlation between the environmental factors. From the species dispersed in the canonical space (Figure 5a), *D. insignis*, *P. diogenes* and *L. loxochelis* were grouped next to the arrow representing the organic-matter content, showing a positive relationship between the species and this variable (Table 3). The relationship between environmental variables and the season for each site revealed that the points relating to Mar Virado Island were the farthest from the center of the canonical axis, which indicates that environmental variations were greater at this site than near Couves Island, especially during spring and summer (Figure 5b).

Discussion

The variations of the environmental factors directly affected the benthic communities. Local changes observed in this study are explained by the influence of the incursion of the South Atlantic Central Water (SACW), as reported in other studies in the region (e.g. Bertini and Fransozo, 2004; Costa *et al.,* 2005; Fransozo *et al.,* 2008; Almeida *et al.,* 2011). This water mass is characterized by low temperatures and salinity ($T < 18^{o}C$ and $S < 36$), in addition to carrying nutrients such as nitrogen and phosphorus (Castro Filho *et al.,* 1987). The instability of the temperature during spring and summer resulted in the formation of a thermocline near Couves Island, with cold water coming from the South Atlantic, as previously reported by Pires-Vanin and Matsura (1993) for the entire Ubatuba region. At Mar Virado, the temperature variation was minimal, which indicates a smaller effect of the SACW near this island, because of the protection provided by São Sebastião Island.

According to Mahiques *et al.* (1998), sites with low hydrodynamics tend to have finer sediments, as near Mar Virado Island. Particle size influences the percentage of organic matter, which is higher in locations where silt and clay predominate (Burone *et al.*, 2003). These environmental factors may directly affect the distribution of hermit crabs, as confirmed by Mantelatto *et al.* (2004) and Fransozo *et al*. (2008). According to Negreiros-Fransozo *et al*. (1997), the sediment texture and associated organic-matter content are crucial for the establishment of these crustaceans, and favor species that feed primarily on organic matter (see Caine, 1975; Bertini and Fransozo, 1999; Branco *et al.*, 2002), such as *D. insignis*, *P. diogenes* and *L. loxochelis*. The last species, an endemic of the South Atlantic, occurred only near Mar Virado Island, which concords with the pattern of effluents and fine particles transported by currents from

Table 1. PerMANOVA for abundance of hermit crabs and environmental variables near Couves and Mar Virado islands on the coast of southeastern Brazil. *significant differences.

Source variation	d.f.	Sum Square	Mean Square	Pseudo-F	P	Source variation	d.f.	Sum Square	Mean Square	Pseudo-F	P
Total abundance						Surface temperature					
Islands	1	0.374	0.375	3.587	0.039*	Islands	1	0.422	0.422	0.164	0.983
Residual	22	2.296	0.104			Residual	22	0.563	0.256		
Total	23	2.671				Total	23	0.563			
Season	7	1.398	0.199	2.509	0.022*	Season	7	0.372	0.532	4.461	0.560
Residual	16	1.273	0.796			Residual	16	0.190	0.119		
Total	23	2.671				Total	23	0.563			
Species abundance						Bottom salinity					
Couves	3	1.984	0.661	5.725	0.001*	Islands	1	0.842	0.842	2.295	0.148
Residual	12	1.386	0.116			Residual	22	0.807	0.367		
Total	15	3.370				Total	23	0.892			
Mar Virado	3	1.910	0.637	3.438	0.002*	Season	7	0.397	0.566	1.831	0.133
Residual	8	1.481	0.185			Residual	16	0.495	0.309		
Total	11	3.391				Total	23	0.892			
D. insignis abundance						Organic matter					
Islands	1	0.459	0.459	4.617	0.013*	Islands	1	0.119	0.11970	1.058	0.311
Residual	22	2.189	0.995			Residual	22	0.678	0.11309		
Total	23	2.649				Total	23	0.798			
Season	7	1.560	0.223	3.274	0.004*	Fractions					
Residual	16	1.089	0.680			Islands	1	0.168	0.168	1.350	0.029*
Total	23	2.649				Residual	22	0.748	0.124		
Bottom temperature						Total	23	0.169			
Islands	1	0.101	0.101	4.861	0.034*	Bottom vs. Surface temperature					
Residual	22	0.458	0.208			Couves	7	0.503	0.718	3.40	0.017*
Total	23	0.559				Residual	16	0.337	0.210		
Season	7	0.306	0.437	2.760	0.036*	Total	23	0.840			
Residual	16	0.253	0.158			Mar Virado	7	0.159	0.291	9.83	0.152
Total	23	0.559				Residual	16	0.085	0.136		
						Total	23	0.250			

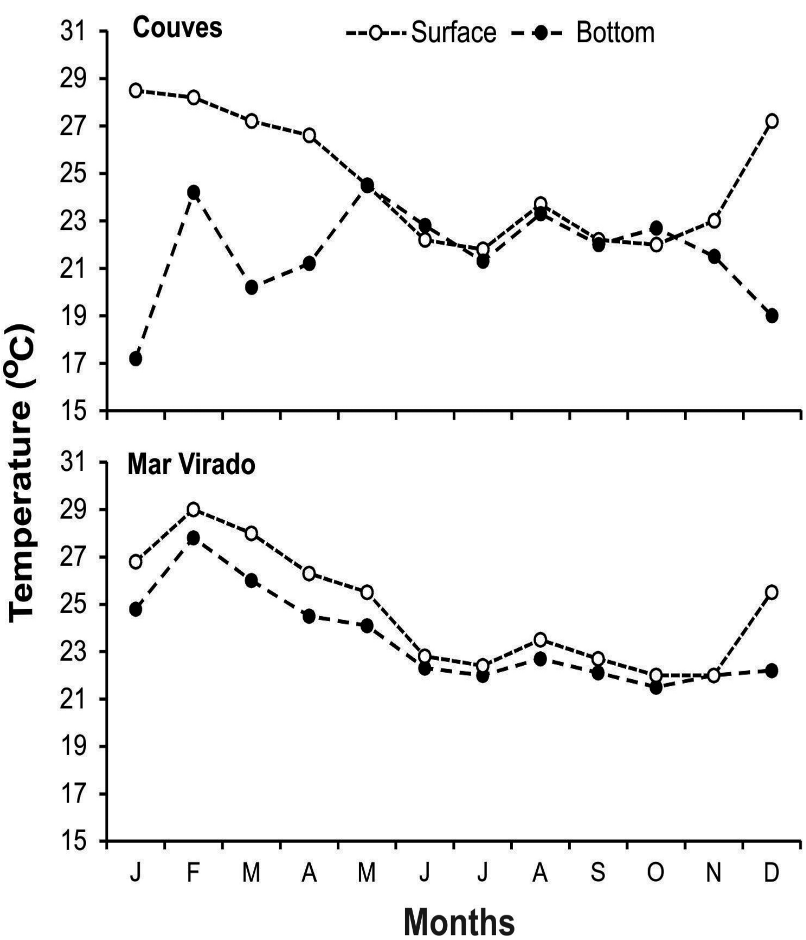

Figure 2. Monthly surface and bottom temperatures near Couves and Mar Virado islands, southeastern Brazil.

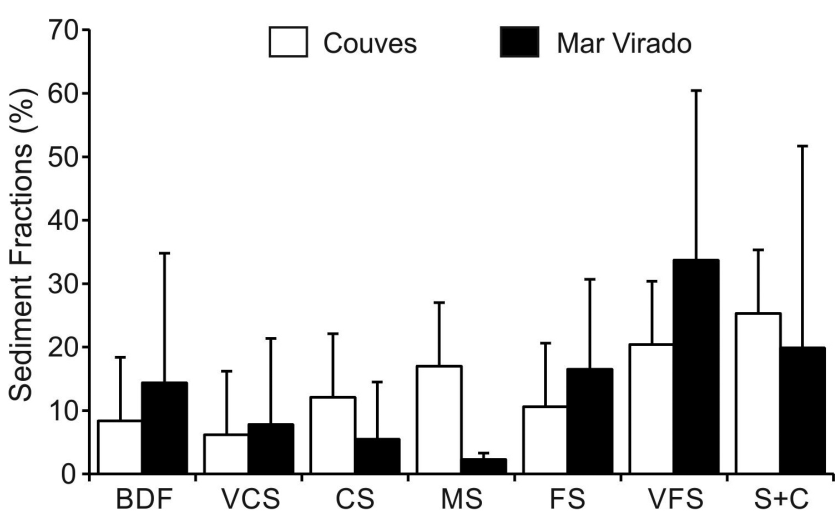

Figure 3. Sediment texture near Couves and Mar Virado islands southeastern Brazil. BDF = biodetritic fragments; CS = coarse sand; FS = fine sand; MS = medium sand; S+C = silt+clay; VCS = very coarse sand; VFS = very fine sand.

the São Sebastião Channel (Furtado, 1995) reaching the bay and Mar Virado Island, providing a favorable habitat for this filter-feeding species (Bertini *et al.,* 2004; Mantelatto *et al.,* 2004). Similarly, Bertini *et al.* (2010) found that brachyuran species that prefer finer sediment, such as *Hepatus pudibundus* (Herbst, 1785), *Libinia ferreirae* (Brito Capello, 1871) and *Libinia spinosa* (H. Milne Edwards, 1834), were more abundant in Mar Virado than in Ubatumirim Bay.

In addition to the sediment granulometry, changes in bottom temperature and salinity may also influence the distribution of hermit crabs, since species have different preferences in relation to these variables, mainly during ontogenetic development (Biggs and McDermott, 1973; Imazu and Asakura, 1994; Ayres-Peres and Mantelatto, 2008). This pattern was also observed in the present study, especially for *P. erythrops,* which showed strong correlations with the bottom and surface temperature and the organic-matter content. Observations reported by other investigators (i.e. Mantelatto and Garcia, 2002; Meireles *et al*., 2006) support the hypothesis that these factors are decisive for the distribution of these species.

The high diversity of crustaceans in protected areas or off nearby islands is due to the heterogeneity of the environment, which offers different types of habitat. According to Hendrickx (1996), these different habitats allow the establishment of various species, allowing an increase in local abundance. These characteristics accounted for the similar variation of evenness and diversity, whose indices are directly affected by dominant species, in this case *D. insignis.* According to Le Hir and Hily (2005), due to the protection provided, the abundance of crabs at these sites is directly affected by intra and interspecific relationships such as predation, and the availability of and competition for shells, which control the establishment of hermit crabs (Fransozo *et al.,* 2008).

Table 2. Abundance and ecological indices for the assemblages of hermit crab near Couves and Mar Virado islands, southeastern Brazil, by season during 1998. (Co = Couves; Mv = Mar Virado; N = number of individuals; * = presence of ovigerous females.)

Hermit crabs	N		Summer		Autumn		Winter		Spring	
	Co	Mv	Co	Mv	Co	Mv	Co	Mv	Co	Mv
Diogenidae										
D. insignis	633*	263*	79*	96*	191	84	272*	65*	91	18*
P. diogenes	96*	14*	9	5*	14	5	48	3	25	1
P. erythrops	7	55*	0	21*	2	33	4	0	1	0
L. loxochelis	-	39*	-	2	-	11*	-	21*	0	5*
P. calliopsis	-	3	-	0	-	2	-	0	-	0
P. tortugae	2	-	2	0	0	-	0	-	0	-
Paguridae										
P. criniticornis	1	-	1	-	0	-	0	-	0	-
P. exilis	1	4*	0	0	1	1	0	2	0	1*
Ecological index										
Diversity (*H'*)	0.69	1.4	0.59	0.79	0.41	0.93	0.68	0.61	0.80	0.70
Evenness (*J'*)	0.27	0.55	0.50	0.59	0.30	0.64	0.51	0.40	0.70	0.69
Dominance (*D'*)	0.86	0.70	0.86	0.80	0.92	0.70	0.84	0.82	0.78	0.71

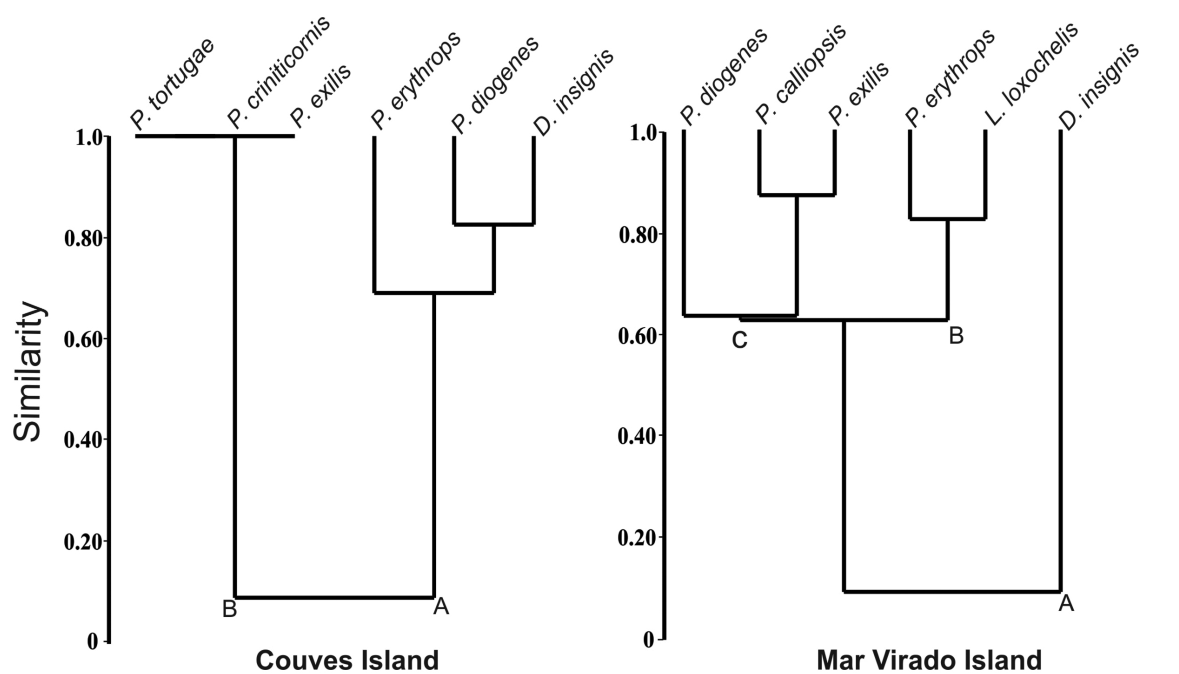

Figure 4. Grouping dendrogram (UPGMA; Bray-Curtis) for species of hermit crabs near Couves and Mar Virado islands, southeastern Brazil.

The hermit crab *D. insignis* is the most abundant species along the Brazilian southeastern/southern coast (see Hebling *et al.*, 1994; Negreiros-Fransozo *et al.*, 1997; Ayres-Peres *et al.*, 2008; Fransozo *et al.*, 1998, 2008, 2011), as found in the present study. The seasonality of this species together with *P. diogenes,* is responsible for the variation of the ecological indices of the system, since the structure of the assemblage is determined by the abundance of these species. The coexistence of the two species also indicates possible sharing of habitats, influencing local richness. Records of assemblages of hermit crabs in coves (Negreiros-Fransozo and Nakagaki, 1998; Negreiros-Fransozo *et al.*, 1997; Fransozo *et al.,* 1998, 2011) reveal lower species richness than near islands, which in some areas is up to six times higher. This is explained by the proximity of sampling points to rocky shores, which also shelter species of hermit crabs that are best adapted to consolidated bottoms (Fransozo

Table 3. CCA results for the four most abundant species of hermit crabs near Couves and Mar Virado islands, southeastern Brazil, and temporal variations in relation to the environmental variables.

	Axis		P
	1	2	(Monte–Carlo)
Statistics of ordination axes			
Eigenvalue (total inertia = 0.8557)	0.170	0.066	0.03
Cumulative % of variance explained	19.9	27.6	0.04
Correlation (T) (Species and Environmental Var.)	0.74	0.45	
Axis intraset correlation coeffcient of environmental variables (coefficient ≥ ±0.4 are considered ecologically relevant, see Rakocinski *et al.*, 1996)			
Bottom temperature	**0.847**	0.078	
Surface temperature	**0.613**	**0.504**	
Bottom salinity	-0.102	**0.932**	
Organic matter	**-0.502**	**0.411**	

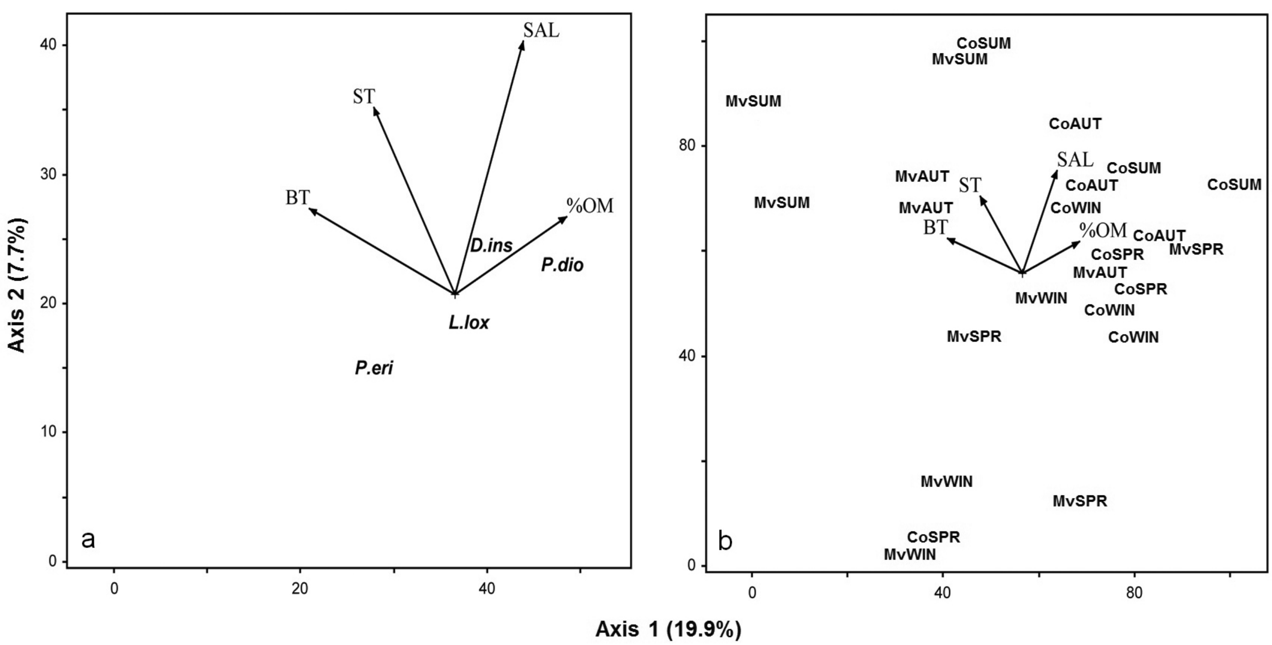

Figure 5. Biplot of hermit crab species in relation to the environmental variables (a) and seasonal variation for Couves and Mar Virado islands, southeastern Brazil, for variables entered in the CCA (b). AUT = autumn; BT = bottom temperature; Co = Couves; *D.ins = D. insignis*; *L.lox = L. loxochelis*; Mv = Mar Virado; %OM = organic matter; *P.dio = P. diogenes*; *P.ery = P. erythrops*; SAL = Salinity; SPR = spring; ST = surface temperature; SUM = summer; WIN = winter.

et al., 2012; Frameschi *et al.,* 2013b). This affirmation is also supported by the small catches of *P. brevidactylus, P. criniticornis* and *P. calliopsis,* species that are characteristic of consolidated sediments and found on rocky shores and in seaweed beds, but share practically the same resources (Mantelatto *et al.,* 2005, 2007). The occurrences of these species reaffirm the existence of a rich local marine fauna and flora.

According to Mantelatto and Garcia (2002), the availability of resources such as shelter, food and shells favors the occurrence of hermit crabs. These resources are abundant near the islands, and explain the occurrence of ovigerous females of *D. insignis*, *P. diogenes*, *P. erythrops*, *L. loxochelis* and *P. exilis*, since good availability of resources favors the reproduction of these species (Fransozo *et al.,* 2012). The higher frequency of ovigerous females during spring and summer may also be related to the incursion of South Atlantic Central Water (SACW) in the region, which increases the amount of food for larvae because of the increase in primary productivity (De Léo and Pires-Vanin, 2006).

According to Dugan and Davis (1993), areas that function as a source of recruits due to the presence of shelters positively affect fisheries resources in nearby areas. As stated by Norse

(1993), such areas are fundamentally important for the conservation of all local biodiversity. Studies such as this, with a focus on conservation, are extremely important to support the creation of protection and conservation areas for marine biodiversity. The studies of the NEBECC research group, which has operated in the Brazilian southeast region for over 20 years, have provided supporting information for the implementation of Marine Protected Areas (MPA) such as the creation of the Cunhambebe sector on the northern São Paulo coast, in 2008 (proclamation No. 53525, October 8, 2008), a site that is still the object of studies on biodiversity. Although differing as to location and the consequent intensity with which the environmental factors oscillate, the richness of hermit crabs was similar near both islands, with higher abundance near Couves, possibly because of its larger area of rocky substrate. The analysis of environmental differences between the regions also revealed the preference of some species for certain habitats, such as occurred with *L. loxochelis*. The record of endemic species in these locations indicates the need for preservation of small islands, since these environments can shelter a high diversity of species through structuring of the local habitat.

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