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Observations on the ecology of the hermit crabs *Propagurus gaudichaudii* Milne-Edwards (Decapoda: Paguridae) and *Dardanus insignis* Saussure (Decapoda: Diogenidae) in the outer Uruguayan shelf

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Abstract. *Dardanus insignis* occurs in the northernmost portion of the Uruguayan shelf, whereas *Propagurus gaudichaudii* characterized the southern area. This can be associated with inter-specific differences in the patterns of shell utilization.

Key words: benthic communities, gastropods, shell use, continental shelf, Uruguay.

Resumen. Observaciones sobre la ecología de los cangrejos ermitaños *Propagurus gaudichaudii* (Decapoda: Paguridae) y *Dardanus insignis* (Decapoda: Diogenidae) en la plataforma continental externa uruguaya. *Dardanus insignis* se encontró al norte del área de la plataforma continental uruguaya, mientras que *Propagurus gaudichaudii* caracterizó la porción sur. Esto puede estar asociado con diferencias en el uso de caparazones entre especies.

Palabras clave: comunidades bentónicas, gasterópodos, uso de caparazones, plataforma continental, Uruguay.

Introduction

In the Uruguayan shelf, the hermit crabs *Propagurus gaudichaudii* Milne-Edwards, 1836 and *Dardanus insignis* (Saussure, 1858) commonly occur as by-catch in the trawl fisheries (F. Scarabino, pers. obs). *Propagurus gaudichaudii* is an endemic hermit crab from the coast of South America, extending its Atlantic distribution from Uruguay to Magallanes strait, from the subtidal to a depth of 150 m (Scelzo 1973, Boschi & Gavio 2005, Vinuesa 2005). In contrast, *D. insignis* occurs from the eastern United States, Gulf of Mexico, Antilles, Brazil, Uruguay and Argentina south to Chubut (43ºS) in depths from 1.5 to 500 m[1] (Scelzo 1973, Spivak 1997). Thus, both species overlaps its distribution ranges from 36ºS to 43ºS. The biology of these species is poorly known, the latter being somewhat better studied. Fernandes-Góes (1997) investigated the spatial and temporal distribution of *D. insignis* in Ubatuba Bay (São Paulo State, Brazil) while population biology and growth were examined by Branco *et al.* (2002). Available data for *P. gaudichaudii* for the study area are restricted to species description and distribution (Forest & de Saint Laurent 1968).

In this vein, this study aimed to advance knowledge on the spatial distribution and patterns of shell use of *D. insignis* and *P. gaudichaudii* at the Uruguayan continental shelf; a key area where the presence of contrasting water masses over the outer shelf determines a biogeographic boundary for the benthic fauna (e.g. Carranza *et al*. 2007, Carranza *et al.* 2008). This work report observations carried onboard research vessel "Aldebarán" of the DINARA (National Direction of Aquatic Resources), during an experimental cruise during July 2006 directed to the evaluation of the stock and by-catch of *Merluccius hubsii* Marini, 1933. The fishing gear used for the evaluation consisted in an

[1] The depth mentioned by Scelzo (1973) for R/V "Walther Herwigh" station Nº 246, 36º48'S-54º03'W seems to be incorrect based on the faunal composition of the sample provided in Olivier & Scarabino (1972), e.g. presence of the shallow water species *Mytilus edulis.*

Engel type bottom trawl net with a 24 m horizontal opening and a 100 mm stretched mesh in the cod ends. A total of 36 stations were allocated based on a stratified design based on the biological features of the target species between 59 and 233 m depth (Figure 1). In each station, 30 minutes tows were performed, depth was noticed and a CTD cast (SBE-19) profiled the water column for temperature and conductivity from the surface to the bottom. The exact location of the stations was determined by Global Positioning System (GPS).

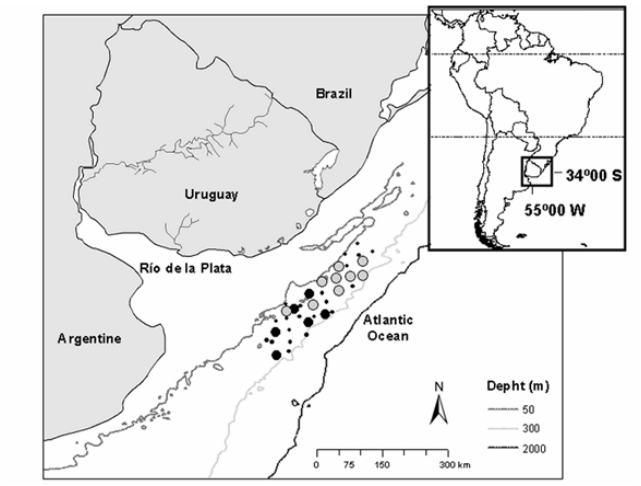

Figure 1. Distribution of the surveyed stations (●) and collection sites for the species of hermit crabs *Propagurus gaudichaudii* (●) and *Dardanus insignis* (●) at the Uruguayan shelf. Both species were never collected in the same trawl.

Observations on by-catch of benthic species were registered. In this sense, all hermit crabs and its gastropod shell hosts were collected and determined onboard. Voucher material for each crab and associated gastropod shells is deposited at the National Museum of Natural History, Montevideo (MNHNM). Environmental conditions associated with the records of each species were described in terms of the range and standard deviation for all the measured environmental parameters, and a Student's t-test was then used to evaluate the statistical significance of the observed differences using species as the grouping variable. Frequencies of occurrence (as total occurrences/number of stations) and by-catch per unit effort (BPUE, as individuals/30') were calculated for both species. The species of gastropods utilized as refuges by the hermit crabs were identified *in situ*, registering also measures of it shells (Shell length, SL, from apex to distal end) to the nearest 0.1 cm.

A total of 36 hermit crabs and their respective shell hosts were examined. Hermit crabs were observed on the 78% of the 36 stations surveyed. From these, *D. insignis* was numerically dominant, adding to the 80% of the collected specimens. Differences on latitudinal distribution were also observed, being *D. insignis* observed between 35°08'S and 36°03'S, whereas *P. gaudichaudii* occurred from 35°41` to 36°57`S, at depths ranging from 60 to 206 m and 63 to 147 m respectively. BPUE of *D. insignis* ranged from 0 to 10 specimens, averaging 0.78 ± 1.86 (ind/30´± SE) while *P. gaudichaudii* averaged 0.22 ± 0.6. Species did not differ statistically in mean depth of occurrence (Student's t-test; t =0.24, p=0.69) or salinity (t =1.06, p=0.29). In contrast, there were differences in mean sea bottom temperatures (t =2.56, p<0.05), being *P. gaudichaudii* associated with cooler waters. *Dardanus insignis* was found occupying shells of the gastropods *Tonna galea* (Linnaeus, 1758; Tonnidae), *Trophon patagonicus* (d'orbigny, 1839; Muricidae), *Odontocymbiola magellanica* (Gmelin, 1791), *Adelomelon ancilla* (Solander in Lightfoot, 1786) and *Zidona dufresnei* (Donovan 1823; Volutidae) whereas shells of *Fusitriton magellanicus* (Röding, 1798; Ranellidae), *A. ancilla* and *O. magellanica* were utilized by *P. gaudichaudii* (Table I).

Findings show that at the Uruguayan continental shelf, there is a spatial segregation of both species, with *D. insignis* occurring in the northernmost portion of the study area, whereas *P. gaudichaudii* characterized the southern area (below 36º00´S). This is coincident with the idea of the study area as biogeographic limit for decapod crustaceans: Holthuis (1952) already recognized the mouth of the Río the la Plata as the northern boundary of the antiboreal zone in the Atlantic (see references in Gorny 1999). At this area, there is little noticeable effect of the freshwater discharge in the benthic environment, which affects mainly coastal, shallower areas (Ortega & Martínez 2007). Some other environmental factors like the amount of organic matter and texture of sediment may also affect the spatial and seasonal distribution of hermit crabs (Mantelatto *et al.* 2004; Meireles *et al.* 2006) especially at local spatial scales. Although there is a remarkably lack of fine-grained data on sediment features, sandy-muddy bottoms seems to be evenly distributed in the trawlable bottoms of Uruguayan shelf here analysed (Correia *et al.* 1996), and are thus presumably of lesser importance on the distribution patterns of the species here studied at this geographic scale.

Recently, Riestra *et al.* (2006) mentioned *P. gaudichaudii* occurring as by catch in the *Z. dufresnei* fishery at the Uruguayan shelf, between 34º 20'S- 35º 22'S, but these records are probably

Table I. Observed shell host species and number of observations categorized by hermit crab. Mean (± standard deviation, cm) shell length (SL) are provided for each shell species.

SHELL HOSTS	***Dardanus insignis*** **n** (Mean±SD)	***Propagurus gaudichaudii*** **n** (Mean±SD)
Tonna galea	**20** (12.35±1.02)	-
Trophon patagonicus	**4** (4.50±3.14)	-
Adelomelon ancilla	**2** (13±5.65)	**2** (17.50±0.07)
Odontocymbiola magellanica	**1**(11)	**5** (16.3±0.57)
Zidona dufresnei	**1**(15.00)	-
Fusitriton magellanicus	-	**1** (7.00)

based on misidentifications, as mentioned therein, and should be assigned to *D. insignis*. Most likely, this species is restricted to coastal, shallower waters south of Río de la Plata, while *P. gaudichaudii* is restricted to deeper waters at this latitude, following subantartic waters until reaching its range endpoint near 36ºS, a phenomenon already documented for bathyal gastropods (Carranza *et al*. 2007). Conversely, *D. insignis* inhabits deeper waters northward, and has been reported from off Arroyo Chuy, (34º 40'S) in 350 m depth (Rieger 1997), thus reinforcing this idea.

Between 35º 42'S and 36º 04'S, both hermit crab species coexists, thus overlapping in the shell hosts: at this latitudinal range, *D. insignis* was found in *O. magellanica, A. ancilla* and *T. varians*. These gastropod species are reported for the first time as host of *D. insignis*, in addition to *Pachycymbiola brasiliana* (Lamarck, 1811), *Buccinanops gradatus* (Deshayes, 1844) [= *cochlidium* (Dillwyn, 1817)] and *Olivancillaria urceus* (Röding, 1798) (Rieger 1997). Within this latitudinal range, both species also overlapped in its bathymetric distribution, coexisting at the 60-90 m fringe.

However, both species were never found in the same trawl, suggesting that biological interactions (i.e. competence for shell or other resources) may be affecting the observed distribution patterns. It is necessary to take into consideration, nevertheless, the relatively low fishing effort and the lack of replicates as putative factors affecting the observed pattern. Differences in hermit crab distribution may also be explained by differences in the physical habitat, since sea bottom temperature was in average lower at the stations were *P. gaudichaudii* was registered. Thus, the mechanism generating the pattern may involve both resource and habitat partitioning (Vance 1972). However, the low BPUE observed may be due either to a low population density or to low efficiency of the fishing gear. In summary, findings show shelf areas with different shell-availability, leading to different patterns of shell utilization not suggesting shell limitation, but some kind of negative biological interaction operating at a limited geographical range. This suggests that species boundaries for these species may be reflecting both responses to biotic and abiotic environmental features. Further studies are encouraged to analyse the consistency of the patterns here depicted and explore the causal mechanisms.

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