ECOLOGICAL OBSERVATIONS ON POLYPLACOPHORA IN A *Halodule wrightii* Ascherson MEADOW AND NEW RECORDS FOR NORTHEAST AND BRAZILIAN COAST (*)

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ABSTRACT

Due to their preferential occurrence on hard substrates and the few studies on specific communities associated with the shoal grass *Halodule wrightii*, investigations addressing chitons in seagrass ecosystems and the ecological relationships between these organisms are scarce. The aim of the present study was to analyze the spatial and temporal distribution of chitons in a *H. wrightii* bed established on a rocky beach and determine the functions of the seagrass for this community. The species *Ischnochiton* sp., *Ischnochiton striolatus*, *Ischnochiton niveus* and *Chaetopleura isabellae* were recorded in this ecosystem. *I. niveus* is recorded for the first time for Brazil and *C. isabellae* is recorded for the first time for the northeastern coast of the country. The irregular distribution of chitons in the ecosystem studied may be related to both the habits of the species and environmental influences. The findings of the present study suggest that chitons have a preference for seagrasses due to the abundant rocky substrates around the meadow for their establishment. The seagrass serves as shelter, feeding and nursery grounds for this community.

Key-words: Seagrass ecology, shoal grass, *Chaetopleura isabellae*, *Ischnochiton niveus* and *Ischnochiton striolatus*.

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RESUMO

Observações ecológicas sobre Polyplacophora em um prado de *Halodule wrightii* Ascherson e novos registros para o Nordeste e costa brasileira – Em função da preferencial ocorrência em substratos duros e dos poucos estudos sobre comunidades específicas associadas a *Halodule wrightii*, estudos sobre quítons em ecossistemas de angiospermas marinhas são escassos, bem como sobre as relações ecológicas entre eles. O objetivo deste estudo foi observar a dinâmica espacial e temporal dos quítons em um banco de *H. wrightii* estabelecido sobre uma praia rochosa, e também observar as funções das plantas em relação a estes animais marinhos. Este estudo registrou as espécies *Ischnochiton* sp., *Ischnochiton striolatus*, *Ischnochiton niveus* e *Chaetopleura isabellae* neste ecossistema, e reportou pela primeira vez as espécies *I. niveus* para a costa brasileira e *C. isabellae* para a costa do nordeste brasileiro. A distribuição dos quítons no ecossistema estudado pode estar relacionada tanto ao hábito das espécies quanto às interferências ambientais. Este estudo sugere a preferência dos quítons pelas plantas, considerando os abundantes substratos rochosos em torno do prado para o seu estabelecimento. As funções de proteção, alimentação e berçário das angiospermas marinhas em relação aos quítons foram observadas.

Palavras-chave: Ecologia de angiospermas marinhas, capim-agulha, *Chaetopleura isabellae*, *Ischnochiton niveus* e *Ischnochiton striolatus*.

INTRODUCTION

Seagrasses promote habitat diversity and accommodate a wide variety of species, influencing the spatial and temporal distribution of the benthic macrofauna (Williams & Heck, 2001; Gambi *et al.*, 1995; Barros & Rocha-Barreira, 2009/2010). On Goiabeiras Beach in the state of Ceará (northeastern Brazil), the seagrass *Halodule wrightii* Ascherson occurs within the intertidal zone on reef rocks and surrounded by diverse banks of macroalgae.

Seagrasses are considered “ecosystem engineers”, as they alter the physicochemical conditions of the environment (Jones *et al.*, 1994). Reef rocks also alter the surrounding physical conditions and exert an influence on the distribution of the macrozoobenthic community (Barros *et al.*, 2001). Reefs offer shelter to a variety of fauna and allow the occurrence of organisms rarely captured in seagrass beds, such as chitons.

Chitons almost exclusively inhabit hard substrates, such as rock fragments, reefs, mollusk shells, shell fragments and manmade debris (i.e. bottles, cans, large pieces of glass, metal, plastic or rubber). These animals are mainly captured in moderately warm water in the low intertidal zone or shallow sublittoral zone, but may be found at depths as far as 7000m (Boyle, 1970; Kaas & Van Belle, 1985; Ríos & Ruiz, 2007; Slieker, 2000; Jörger *et al.*, 2008; Stebbings & Eernisse, 2009; Noseworthy & Kwang-Sik, 2010). In the intertidal zone, these organisms exhibit physical, physiological and behavioral adaptations, such as body temperature similar to the surrounding water temperature (Kenny, 1958), a dorsoventrally flattened body (Kaas & Van Belle, 1985; Slieker, 2000), the ability to create a “vacuum press” with the feet to attach themselves to the substrate (Kaas & Van Belle, 1985; Sirenko, 2006), sublittoral permanence and nocturnal foraging (Glynn, 1970; Boyle, 1977; McMahon & Britton, 1991).

Ecological studies on these communities are relatively recent (Bandel & Wedler, 1987; Soliman *et al.*, 1996; Avila & Albergaria, 2002; Ríos & Ruiz, 2007; Jörger *et al.*, 2008; Stebbins & Eernisse, 2009; Dell’Angelo, 2010). Most often, chitons are only investigated in studies on the entire mollusk community (Otway, 1994; Alves & Araújo, 1999; Castriota *et al.*, 2005; Absalão *et al.*, 2006; Boyle, 2010; Noseworthy & Kwang-Sik, 2010). According to Ríos & Ruiz (2007), studies on chitons are scarce due mainly to the absence of commercially important species, critical habits and sampling difficulties.

Few studies address chitons associated with seagrass ecosystems (Bandel & Wedler, 1987; Alves & Araújo, 1999; Rueda & Salas, 2008; Barros & Rocha-Barreira, 2009/2010; Creed & Kinupp, 2011). Furthermore, the ecological relationship between chitons and seagrasses is unknown because of the few studies on specific communities associated with *H. wrightii* (Creed, 2000) and the preferential occurrence of these organisms for hard substrates (Ríos & Ruiz, 2007; Jörger *et al*., 2008). According to Castriota *et al.* (2005), there is a need for investigations on the ecological interactions between chitons and their substrates.

Considering the influence of seagrasses on benthic communities, the aim of the present study was to determine whether *H. wrightii* exerts an influence on the spatial and temporal distribution of chitons and provide information on both chiton ecology and plant-animal interactions.

MATERIAL AND METHODS

The study area was Goiabeiras Beach (03º41'31" S; 038º34'49" W), which is located in the city of Fortaleza in northeastern Brazil (Fig. 1).

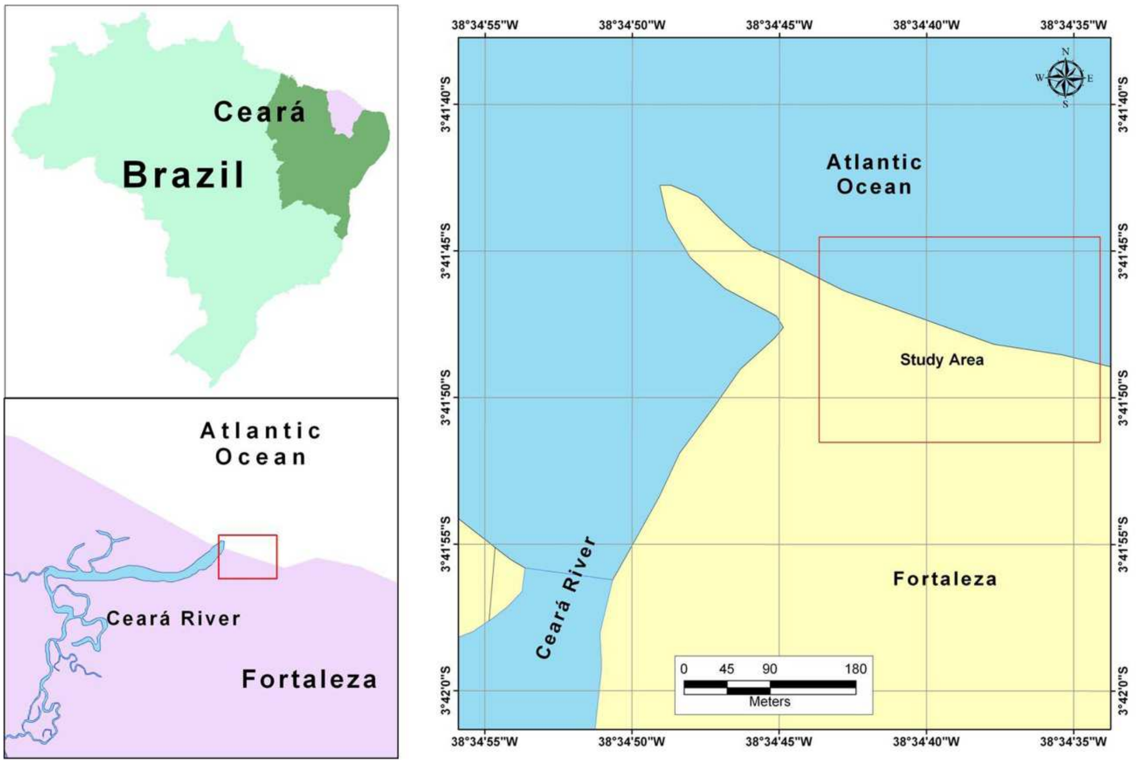

Fig. 1: Study Area – Goiabeiras Beach (Fortaleza, Ceará, northeastern Brazil)

Sampling was performed based on the methods described by Barros & Rocha-Barreira (*In Press*). Chitons were preserved on 70% alcohol and identified at the Malacology Laboratory of the Zoology Museum of the University of Sao Paulo (MZUSP). Frequency of occurrence was determined for both *H. wrightii* strata (aboveground and belowground): F < 10% = Rare; 10% < F < 40% = Infrequent; 40% < F < 70% = Frequent; F > 70% = Very Frequent. Specimens were deposited in the Prof. Henry Ramos Matthews Malacological Collection of the Institute of Marine Sciences, Federal University of Ceará (CMPHRM 3830-3833).

RESULTS

Two hundred thirty mollusk specimens were captured. The class Gastropoda was dominant (73%) and Polyplacophora accounted for 4% of the specimens. Bivalves had the greatest number of species (11 species), followed by gastropods (9 species) and chitons (4 species).

For Polyplacophora, the species identified were *Ischnochiton* sp., *Ischnochiton striolatus* (Gray, 1828), *Ischnochiton niveus* Ferreira, 1987 and *Chaetopleura isabellae* (d'Orbigny, 1841). Chitons were more frequent in belowground, especially *I. niveus*. These species were considered rare in aboveground, but exhibited greater diversity, with at least one specimen of each species occurring in this stratum (Fig. 2).

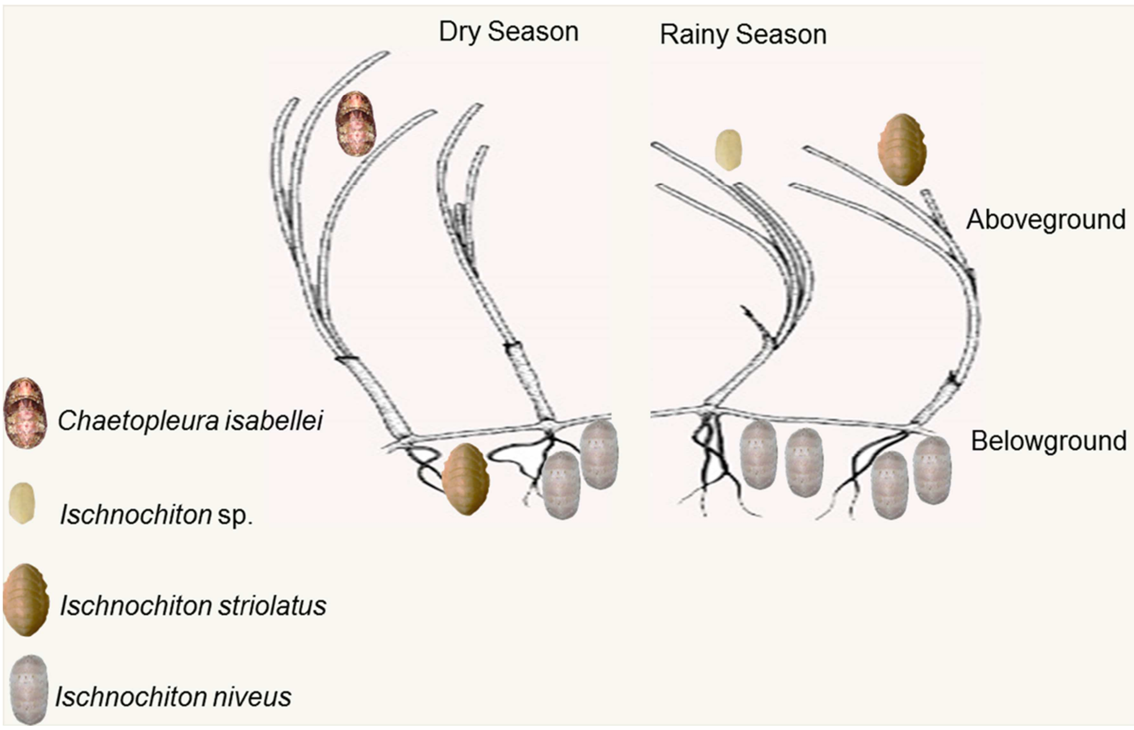

Fig. 2: Spatial and temporal distribution of chitons in *Halodule wrightii* bed off Goiabeiras Beach, northeastern Brazil

SYSTEMATICS AND SPATIOTEMPORAL DISTRIBUTION

FILO MOLLUSCA

CLASS POLYPLACOPHORA Gray, 1821

SUBCLASS LORICATA Shumacher, 1817

ORDER CHITONIDA Thiele, 1910

SUBORDER CHITONINA Thiele, 1910

SUPERFAMILY CHITONOIDEA Rafinesque, 1815

FAMILY CHAETOPLEURIDAE Plate, 1899

Genus *Chaetopleura* Shuttleworth, 1853

Chaetopleura isabellae d'Orbigny, 1841

Description: Animal elongate oval, moderately elevated, valves hardly. Tegmentum orange colored. Girdle dorsally composed of spicules with or without articulation, marginal portion present spicules without articulations and ventral portion with overlapping rectangular scales. Head valve sculptured by marginal nodules; intermediate valves wide, central area sculptured by parallel rows (formed by oval nodules), lateral area sculptured by marginal rounded nodules, apex well development, rounded apophyses; tail valve with anteromucronal area sculptured similarly to central area of intermediate valves, postmucronal area weakly concave, sculptured by marginal rounded nodules, square apophyses.

Geographic distribution: South America coast (Ceará - Brazil to Punta Camarones - Argentina)

In *Halodule wrightii* ecosystem (Goiabeiras Beach, 2006-2007)

Vertical distribution – leaves

Seasonal distribution – rainy season

Frequency of occurrence: Rare

Phase: Juvenile

Specimens: 01

FAMILY ISCHNOCHITONIDAE Dall, 1889

Genus *Ischnochiton* Gray, 1847

Ischnochiton niveus Ferreira, 1987

Description: Elongate oval, moderately elevated, valves not beaked. Head valve semicircular. Intermediate valve, rectangular, lateral area well visible and raised. Tail valve with anteromucronal area convex and postmucronal area concave.

Geographic distribution: North to South American coast (Florida – USA to Ceará – Brazil)

In *Halodule wrightii* ecosystem (Goiabeiras Beach, 2006-2007)

Vertical distribution – roots/rhizomes

Seasonal distribution – dry and rainy seasons

Frequency of occurrence: infrequent

Phase: juvenile and adults

Specimens: 06

Ischnochiton striolatus Gray, 1828

Description: Animal elongate oval, moderately elevated, valves hardly. Tegmentum without standard color. Girdle dorsally composed of scales vertically fissured, marginal portion present longitudinal fissured spicules and ventral portion with overlapping rectangular scales. Head valve sculptured by few deep irregular lines in all valve's surface; intermediate valves wide, central area sculptured by shallow lines, lateral area sculptured by few deep irregular lines, apex well development; tail valve with anteromucronal area sculptured similarly to central area of the intermediate valves, postmucronal area concave, sculptured similarly to head valve.

Geographic distribution: North Carolina (USA) to Santa Catarina (Brazil).

In *Halodule wrightii* ecosystem (Goiabeiras Beach, 2006-2007)

Vertical distribution – leaves and roots/rhizomes

Seasonal distribution – leaves (dry season); roots/rhizomes (rainy season)

Frequency of occurrence – leaves: rare; roots/rhizomes: rare

Phase: Juvenile and adult

Specimens: 02

Ischnochiton sp.

Description: Animal elongate oval; tegument without standard color; valves wide, central and lateral are conspicuous, beak conspicuous; girdle dorsally covered by scales (generally horizontal striated). The juvenile specimen not allowed precise specie identification.

In *Halodule wrightii* ecosystem (Goiabeiras Beach, 2006-2007)

Vertical distribution – leaves

Temporal distribution – dry season

Frequency of occurrence: rare

Phase: Juvenile

Specimens: 01

DISCUSSION

In addition to the influence exerted on the physicochemical conditions of the environment, the biodiversity found in seagrass ecosystems is related to their influence on the sediment and surrounding area, adding to the variety of habitats for associated organisms. According to Williams & Heck (2001), the structural complexity of the aboveground seagrass stratum is related to the reproduction of leaves and stems as well as the biomass of algae and epiphytes, while the complexity of the belowground stratum is related to rhizomes and roots, which stabilize and protect the sediment from erosion. According to Gambi *et al.* (1995), the greater diversity of species in the belowground stratum may be also associated with its fewer seasonal variations in comparison to the aboveground stratum.

Chitons rarely occur in seagrasses or soft algae beds. Seagrass leaves may provide a suitable hard substrate in environments in which consolidated substrates are rare or absent, but may be considered ephemeral (Creed, 2000). Although the site studied herein has reefs, the presence of *H. wrightii* on these rocks may provide shelter from the hydrodynamics of the environment, which can have abrasive effects (Ríos & Ruiz, 2007) and lead to gill congestion in chitons (Hyman, 1967). This plant may also shelter chitons from exposure to sun and air, which is frequent in the reef studied during low spring tides, when the specimens of the present investigation were captured.

Furthermore, seagrasses may provide a source of food, as the leaves carry periphyton and the species identified belong to grazer-scraper genera (Peterson & Heck Jr, 2001; Rodrigues & Absalão, 2005). Records of juveniles throughout the year of all species captured confirm the role seagrasses play as nurseries. Although seagrasses are not common substrates for chitons, the findings of the present study suggest that *H. wrightii* serves as a substrate for these organisms due to the surrounding available rocky substrate for fixation and feeding.

The chitons captured in the present study were more abundant in the belowground stratum and in the rainy season. Besides the influence of seagrass, Barros & Rocha-Barreira (2009/2010) found that the habits of the species and/or environmental factors may exert a considerable influence on the vertical distribution of the macrofauna in this ecosystem. The increase in abundance of chitons in both strata in the rainy season is likely due to the increase in the biomass of *H. wrightii* in this period (Barros & Rocha-Barreira, *In Press*). Supporting this hypothesis, Mukai (1976) recorded an increase in the density of mollusks along with the increase in the biomass of the macroalgae *Sargassum serratifolium* C. Agardh.

Among the species identified, this paper offers the first reports of *Ischnochiton niveus* for Brazilian coast and *Chaetopleura isabellae* for the northeastern coast of the country (*cf.* Simone & Jardim, 2009). *I. niveus* was the most abundant chiton species and occurred only in the belowground stratum.

The species *I. striolatus* has previously been reported for other seagrass beds (Bandel & Wedler, 1987; Alves & Araújo, 1999). Bandel & Wedler (1987) identified *I. striolatus* in meadows of *Syringodium filiforme* Kützing and *Thalassia testudinum* Banks & Sol. in the Caribbean Sea. In Brazil, Alves & Araújo (1999) report the sporadic occurrence of *I. striolatus*, with only one specimen in *H. wrightii* meadows off Itamaracá Island (northeastern Brazil). Studying mollusk fauna associated with *H. wrightii* in Cabo Frio (state of Rio de Janeiro), Creed & Kinupp (2011) report the occurrence of *I. striolatus* and *Stenoplax* **cf.** *purpurascens* (C.B. Adams, 1845), both with low densities and frequencies.

Rueda & Salas (2008) identified only one specimen of chiton among 2396 mollusks associated with the seagrass *Zostera marina* Linnaeus in Cañuelo Bay, Spain, but the authors did not identify the species. Thus, considering the findings described in these studies, the abundance of chitons in the seagrass meadow studied herein may be considered important. While no studies report a great abundance of chitons in seagrass ecosystems, these environments are recognized as important shelters and nursery grounds for a large number of species.

In summary, the distribution of chitons in the ecosystem studied herein was affected by the influence of the seagrass *Halodule wrightii* on the sediment, although other environmental influences should also be considered. The findings of the present study also suggest the preference of chitons for seagrasses, even with the abundant presence of rocky substrates at the site. Seagrasses may function as shelter and both feeding and nursery grounds for these marine species. However, information on the relationship between *H. wrightii* and chitons remains incipient and further studies are needed to obtain a better understanding regarding interactions among the environment, seagrass and fauna.

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