

## **POLYPLACOPHORA (MOLLUSCA): COMPOSITION, ABUNDANCE AND OCCURRENCE WITH COHABITANTS ON THE WEST COAST OF CEARÁ, BRAZIL**

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DOI: 10.21439/conexoes.v18i0.3390

**Resumo.** The chitons, are marine mollusks found beaches, with morphology adapted for adhering to irregular substrates. This study characterized the chiton assemblage in terms of composition, abundance, and cohabitation on rocky substrates along the western coast of Ceará, Brazil, at Pedra Rachada beach (Paracuru) and Farol beach (Camocim). Three species were identified: *Acanthochitona* sp., *Ischnochiton striolatus*, and *Ischnoplax pectinata*, totaling 697 individuals. *I. striolatus* accounted for 56% of the organisms, followed by *I. pectinata* (33%) and *Acanthochitona* sp. (11%). Paracuru beach showed a higher abundance (488 individuals), while Camocim recorded 209 individuals. The distribution varied according to substrate type: 30 individuals were found on smooth pebble substrates, and 26 on sandstone. Chitons were observed cohabiting with algae, gastropods, oysters, sponges, *polychaetes*, corals, barnacles, and *ascidians*. *I. striolatus* and *I. pectinata* stood out for their abundance and their critical role in the ecological dynamics of consolidated coastal substrates. Understanding their interactions is essential to reveal coexistence patterns that influence biodiversity and the structure of marine ecosystems.

**Palavras-chave:** beachrocks; *callistoplacidae*; *chiton*; *ischnochitonidae*.

## **POLYPLACÓFOROS (MOLLUSCA): COMPOSIÇÃO, ABUNDÂNCIA E OCORRÊNCIA COM COHABITANTES NA COSTA OESTE DO CEARÁ, BRASIL**

**Abstract.** Os quítons são moluscos marinhos encontrados em praias, com morfologia adaptada para aderir a substratos irregulares. Este estudo caracterizou a assembleia de quítons em termos de composição, abundância e coabitação em substratos rochosos ao longo da costa oeste do Ceará, Brasil, na praia da Pedra Rachada (Paracuru) e na praia do Farol (Camocim). Três espécies foram identificadas: *Acanthochitona* sp., *Ischnochiton striolatus* e *Ischnoplax pectinata*, totalizando 697 indivíduos. *I. striolatus* representou 56% dos organismos, seguido por *I. pectinata* (33%) e *Acanthochitona* sp. (11%). A praia de Paracuru apresentou maior abundância (488 indivíduos), enquanto Camocim registrou 209 indivíduos. A distribuição variou de acordo com o tipo de substrato: 30 indivíduos foram encontrados em substratos de seixos lisos e 26 em arenito. *Quítons* foram observados coabitando com algas, gastrópodes, ostras, esponjas, poliquetas, corais, cracas e *ascídias*. *I. striolatus* e *I. pectinata* se destacaram por sua abundância e seu papel crítico na dinâmica ecológica de substratos costeiros consolidados. Entender suas interações é essencial para revelar padrões de coexistência que influenciam a biodiversidade e a estrutura dos ecossistemas marinhos.

**Keywords:** praias rochosas; *callistoplacidae*; *quíton*; *ischnochitonidae*.

## 1 INTRODUCTION

*Polyplacophorans*, also known as chitons, are marine benthic mollusks found in all parts of the world, from coastal areas to the abyssal plains (Eernisse; Clark; Draeger, 1994). Elliptical in shape and dorsoventrally flattened, they have a shell in the dorsal region divided into eight articulated valves, while in the ventral region, there is a large muscular foot associated with mucus glands, facilitating adhesion and movement on consolidated and irregular surfaces (Eernisse; Clark; Draeger, 1994; Okusu *et al.*, 2003).

Thus, intertidal rocky environments are attractive habitats for these organisms, which use them to search for food and protection. This is because chitons are part of the food chain as prey for secondary consumers and also as primary consumers of algae and invertebrates (Jörger; Meyer; Wehrmann, 2008). Additionally, they exhibit negative phototaxis, hiding under rocks or in crevices where the effects of solar radiation and desiccation are minimized (Harper; Williams, 2001).

The hard substrate provided by other organisms, such as mollusk shells (Lopes; Silva; Martins, 2019) or marine angiosperms (Barros; Rocha-Barreira, 2009; Barros; Jardim; Rocha-Barreira, 2013), can also be used, establishing ecological relationships such as inquilinism or epibiosis. However, there is limited information about the occurrence of *polyplacophorans* in coastal ecosystems (Correia *et al.*, 2015), as studies on this group are generally restricted to malacofauna inventories.

Among the first compilations of data on chitons in Brazil, the work of Mattheus e Kempf (1970) stands out, as it aimed to reorganize the knowledge obtained until then about the malacofauna present in the north and northeast of the country, also highlighting the Archipelago of Fernando de Noronha and Atol das Rocas. Subsequent works, such as those by Kaas e Belle (1985), contributed to the taxonomy of the group through an informative manual of organisms for cataloging, showing their worldwide occurrences.

In the state of Ceará, northeastern Brazil, there are few records of the class *Polyplacophora*. Noteworthy studies include those by Barros e Rocha-Barreira (2009), Barros, Jardim e Rocha-Barreira (2013), which documented the presence of the species *Ischnochiton* sp., *Ischnochiton striolatus* (Gray, 1828), *Ischnochiton niveus* Ferreira, 1987, and *Chaetopleura isabellei* (d'Orbigny, 1841) in the marine angiosperm *Halodule wrightii* Ascherson at Goiabeiras Beach in the municipality of Fortaleza, CE, Brazil. Veras *et al.* (2013) and Souza e Matthews-Cascon (2019) Souza and Matthews-Cascon (2019) observed specimens of *Isch-*

*nochiton striolatus* and *Ischnoplax pectinata* (G. B. Sowerby II, 1840) on the rocky substrate of the intertidal region of Pacheco Beach in Caucaia. Lopes *et al.* (2019) reported the occurrence of *Ischnochiton striolatus* on the gastropod *Turbinella laevigata* Anton, 1838, at Picos Beach in Icapuí.

Also in the state, on the west coast, at Pedra Rachada Beach, in the city of Paracuru, Jardim *et al.* (2021) recorded the presence of *Stenoplax kempfi* (Righi, 1971), Nascimento *et al.* (2022) documented *Callistochiton righii* Kaas e Belle (1994), and finally, Lima *et al.* (2021) studied the color patterns of *Ischnochiton striolatus* Gray (1828) at Farol Beach in Camocim.

In this context, the aim of the present study was to characterize the chiton assemblage in terms of composition, abundance, and occurrence with cohabitants on consolidated substrate beaches on the west coast of Ceará, Brazil.

## 2 MATERIAL AND METHODS

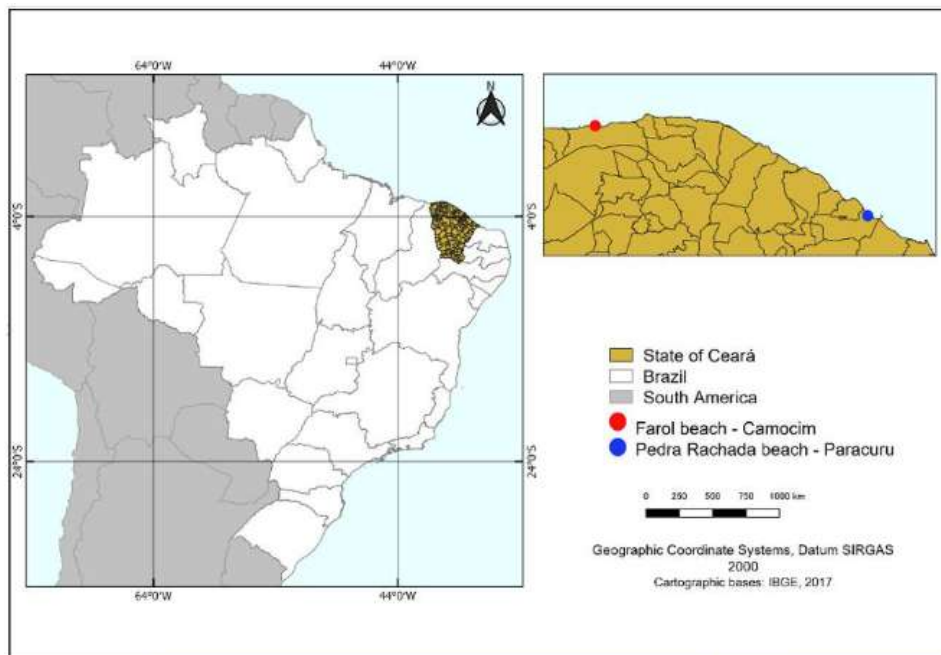
### 2.1 Study area

The study was conducted at two locations on the western coast of the state of Ceará, Northeast Brazil: Pedra Rachada Beach (S 03°23.955', W 039°00.768'), situated in the municipality of Paracuru, approximately 90 km from Fortaleza, and Farol do Trapiá Beach (S 02°52.125', W 040°51.435'), located in the municipality of Camocim, 355 km from the capital. The sampled areas are 302.3 km apart (Figure 1)

The coast of Ceará is characterized by a semi-arid tropical climate, with an average temperature of 29 °C and an annual average rainfall of 900 mm. There are two well-defined seasons: a rainy period, from January to June, and a dry period, from July to December (FUNCEME, 2022).

Pedra Rachada Beach, directly influenced by the sea, features an extensive rocky formation composed of sandstone reefs and small loose stones, which provide shelter and food for various benthic organisms (Matthews-Cascon; Lotufo, 2006). Farol Beach, in Camocim, has an intertidal zone formed by sandstone reefs and loose stones, with estuarine influence from the Coreau River, offering a variety of habitats for benthic fauna (Lima; Maia; Jardim, 2024). Both areas form tide pools, which are irregular depressions that retain water during low tide, serving as refuges for many organisms (Legrand *et al.*, 2018).

Figure 1: Map of the sampling locations on the west coast of Ceará, Brazil. Red point: Farol Beach; Blue point: Pedra Rachada Beach.



Source: Authorial.

## 2.2 Method

Sampling was carried out in January 2017, during neap low tides in tide pools. The sampled area at each beach was approximately 30 m<sup>2</sup>. The collection of individuals was conducted through active and manual searching, with a sampling effort of 20 people for three hours at each beach, working perpendicular to the waterline. The occurrence substrates were documented through photographs.

For the analysis of the chiton assemblage, specimens were identified, counted, and photographed on their substrates. After the photographs were taken, the organisms were returned to their habitat, except for those whose identification could not be confirmed in the field. These specimens were preserved in 70% alcohol and later identified with the aid of a *stereomicroscope*, according to Kaas e Belle (1990) and Lyons (1988). The identified specimens were cataloged and incorporated into the malacology collection of the Institute of Marine Sciences (MPHRM), including *Ischnochiton striolatus* (Sowerby, 1832), MPHRM 5144; *Acanth* sp., CMPHRM 5145; and *Ischnoplax pectinata* (Sowerby, 1840), CMPHRM 5143.

The same procedure was applied to the cohabitants,

which were counted and classified into major taxonomic groups, following Brusca, Moore e Shuster (2018). No additional collection was performed, and all individuals were returned to their environment. The graphical representation of chiton abundance data, as well as the characterization of cohabitants, was generated using R Studio software.

## 3 RESULTS

Fifty photographs were analyzed. Pedra Rachada and Farol beaches were represented by three species of *Polyplacophora* included in three families: *Ischnochitonidae*, represented by *Ischnochiton striolatus* (Gray, 1828) (Figure 2A); *Acanthochitonidae*, represented by *Acanthochitona* sp., (Figure 2B); and *Callistoplacidae*, represented by *Ischnoplax pectinata* (Sowerby, 1840), (Figure 2C).

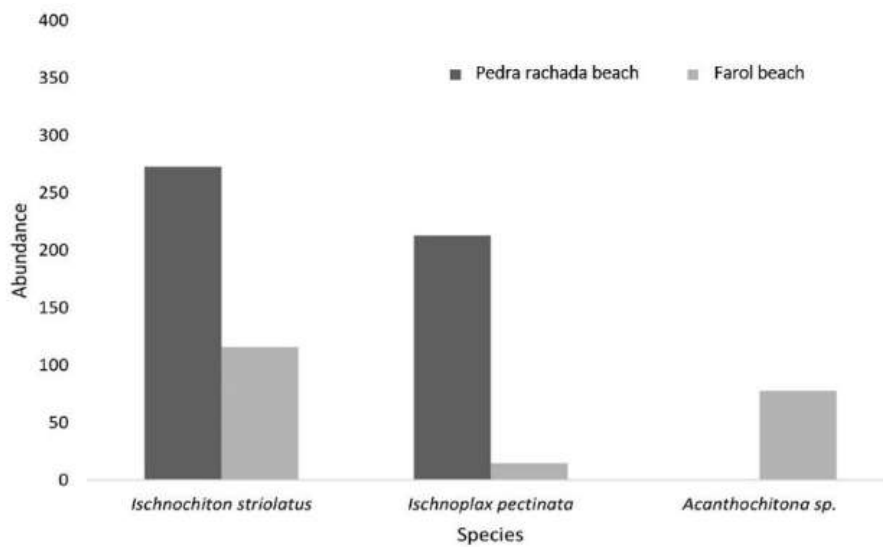
At the research site, 697 organisms observed, of which 56% belonged to the species *I. striolatus*, followed by *I. pectinata* with 33%, and *Acanthochitona* sp. with 11%. When comparing the two sampled areas, Pedra Rachada beach had an abundance of 488 individuals, while Farol beach had an abundance of 209 individuals (Figure 3).

**Figure 2:** Species of *Polyplacophora*: A - *Ischnochiton striolatus*, B - *Acanthochitona* sp., C - *Ischnoplax pectinata*. Specimens collected from Farol and Pedra Rachada beaches, west coast of Ceará, Brazil.



Source: Authorial.

**Figure 3:** Abundance of chitons at Farol beach and Pedra beach Rachada, west coast of Ceará state, Brazil.



Source: Authorial.

A total of 30 individuals were found only on a hard substrate (without cohabiting organisms) composed of pebbles, belonging to the species *I. pectinata*, *Acanthochitona* sp., and *I. striolatus*. Twenty-six individuals were found on a smooth substrate composed of sandstone, belonging to the species *I. pectinata* and *I. striolatus*. The remaining organisms were observed cohabiting on the hard substrate with macroalgae, snails (*Mollusca: Gastropoda*), oysters (*Mollusca: Bivalvia*), sponges (*Porifera*), polychaetes (*Annelida: Polychaeta*), corals (*Cnidaria: Anthozoa*), barnacles (*Crustacea: Cirripedia*), and ascidians (*Ascidacea*) (Figure 4). These associations included: algae and sponges, algae and polychaetes, algae and snails, sponges and ascidians, sponges and polychaetes, snails and polychaetes, and oysters and barnacles.

#### 4 DISCUSSION

In this study, *Ischnochiton striolatus* and *Ischnoplax pectinata* were the most abundant species. Correia *et al.* (2015) found these species in coral reefs associated with algae in the coastal region of Maceió, Alagoas. Veras *et al.* (2013) also observed *I. striolatus* in greater abundance than *I. pectinata* in the infralittoral sandstone reefs of Ceará. Previous studies have shown that these species are commonly found in this region and, as herbivores, rely on algae communities associated with consolidated substrates for feeding (Rodrigues; Absalão, 2005; Veras *et al.*, 2013; Souza; Matthews-Cascon, 2019; Denadai; Amaral, 1999) and Amaral, Rizzo e Arruda (2006) consider these species typical of consolidated environments characterized by high salinity and elevated temperatures. Both *I. striolatus* and *I. pectinata* are reported in environments with extreme salinity variations (Lima; Maia; Jardim, 2024).

In addition to being common in consolidated environments, *I. striolatus* has also been collected in seagrass meadows (Barros; Jardim; Rocha-Barreira, 2013), associated with macroalgae (Correia *et al.*, 2015), and found ecologically related to gastropods (Lopes; Silva; Martins, 2019) in studies conducted in the Northeast of Brazil. It has also been recorded at Praia da Pedra Rachada by Souza e Matthews-Cascon (2019) and at Praia do Farol in places with low salinity by Lima, Maia e Jardim (2024).

Species of the genus *Acanthochitona* have also been recorded in Ceará, though there is limited data on their occurrence. Matthews e Rios (1974) reported the presence of *Acanthochitona spiculosa* (Reeve, 1847) on Meireles beach, while other unidentified species of the genus were recorded at Bitupitá beach (Menezes, 2019).

The *polyplacophorans* in this study were found in pebble and sandstone substrates, characteristic of the studied region, co-occurring with other benthic species. *I. striolatus* was the species that showed the most co-occurrence with other organisms. This species, in addition, to having been found together with *I. pectinata* along the estuarine coast of Camocim city, exhibits color polymorphism in its valves, and its abundance in substrates may be strongly linked to the community's protection against visual predators (Amaral; Rizzo; Arruda, 2006; Rios, 1994; Lima *et al.*, 2021; Lima; Maia; Jardim, 2024).

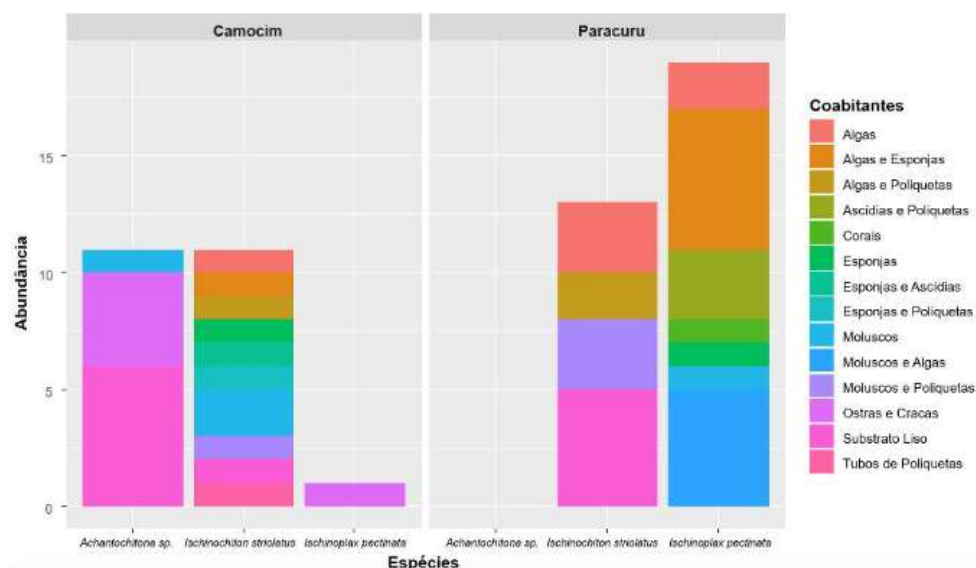
In studies on marine mollusks, selective visual predation is often suggested as a contributing factor to maintaining polymorphism. However, this species occurs on various substrates, often without camouflage, standing out in the environment (Whiteley; Owen; Smith, 1997; Ekendahl, 1998; Amaral; Rizzo; Arruda, 2006). It is likely that visual predators do not significantly influence prey with negative phototaxis, such as *I. striolatus* (Rodrigues; Absalão, 2005; Lima *et al.*, 2021).

In general, chitons are found on various consolidated substrates, including rocks and shells, and are often associated with other mollusks. *I. striolatus*, for example, has been found living in symbiosis with the gastropod *Turbinella laevigata*, and has also been occasionally observed with *Pugilina tupiniquim* (Abbate; Simone, 2015), *Anomalocardia flexuosa* (Linnaeus, 1767), *Voluta ebraea* (Linnaeus, 1758), and *Crasostrea* sp. (Lopes; Silva; Martins, 2019).

#### 5 CONCLUSION

This study demonstrated that *Ischnochiton striolatus* and *Ischnoplax pectinata* are consistently the most abundant species in the investigated areas. The diversity of substrate types and forms, as well as the cohabitation with other benthic organisms, suggesting that these species play a significant role in the local ecological balance. The presence of *I. striolatus* in various substrates and its associations with multiple organisms highlights its adaptability and relevance in the marine ecosystem of the analyzed regions. However, a better understanding of these organisms' behavior in relation to substrates, as well as possible color variations related to the presence of cohabitants and their interactions, is needed. Additional information on the specific ecological relationships of chitons with their habitats could provide valuable data on the dynamics and resilience of these ecosystems in response to environmental pressures and climate change.

**Figure 4:** Abundance of chitons found cohabiting with other organisms in hard substrates. Individuals collected at Farol beach and Pedra beach Rachada, west coast of Ceará state, Brazil.



Source: Authorial.

## 6 ACKNOWLEDGMENTS

To Conselho Nacional de Desenvolvimento Científico e Tecnológico (Cnpq) and Instituto Federal do Ceará for financial and logistical support. To Laboratório de Ecologia de Manguezais (ECOMANGUE) and your staff for providing the structure and human resources.

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