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Epibiotic community of *Tegula viridula* (Gastropoda: Trochidae) in southeastern Brazil

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Abstract

In this investigation, we present data on composition, frequency of occurrence, volume and weight of the epibiotic community on the snail *Tegula viridula* (Gmelin, 1791) from Flexeiras beach, Itacuruçá Island, Rio de Janeiro, Brazil. Epibionts found were algae, bryozoans, barnacles, polyplacophorans, polichaete worm tubes, and oysters. Epibionts were found on 82.17% of *T. viridula* individuals examined, barnacles being the most frequent (64%), followed by polychaetes, algae and oysters. The months of June (2010) and January (2011) had the highest percentages of epibioses recorded: 95.35% and 93.68%, respectively. The percentage of epibionts was positively correlated to the length of the shell. Types of epibionts changed according to length variation of shells. Epibionts also significantly increased the weight and volume of shells.

Keywords: Epibiosis, Incrustation, Mollusca, Sepetiba Bay.

Resumo

Neste trabalho apresentamos dados da composição, frequência de ocorrência, volume e peso da comunidade de epibiontes do caramujo *Tegula viridula* (Gmelin, 1791) na praia das Flexeiras, Ilha de Itacuruçá, Rio de Janeiro, Brasil. Os epibiontes encontrados foram algas, briozoários, cracas, poliplacóforos, poliquetos e ostras. Foram encontrados epibiontes em 82,17% dos indivíduos de *T. viridula* analizados, sendo as cracas os mais frequentes 64%, seguidos por poliquetas, algas e ostras. Os meses de junho (2010) e janeiro (2011) apresentaram os maiores percentuais de epibiose 95,35% e 93,68%, respectivamente. A porcentagem de epibiontes foi positivamente relacionada com o comprimento da concha. Os tipos de epibiontes mudaram de acordo com as classes de comprimento e também aumentaram significativamente o peso e o volume das conchas.

Palavras-chave: Epibiose, Incrustação, Mollusca, baía de Sepetiba.

Introduction

Epibiosis is the spatial association between a substrate organism (‘basebiont’) and a sessile organism (‘epibiont’) attached to the basebiont´s outer surface without trophically depending on it, being an important alternative colonization (Creed 2000, Wahl 2009).

Epibiontic associations have been documented in algae, barnacles, bryozoans, hydroids, polychaetes, oysters and sponges (Buschbaum & Reise 1999, Chan & Chan 2005, Dougherty & Russel 2005, Marin & Belluga 2005, Diederich 2006, Dubois et al. 2006, Thieltges & Buschbaum 2007, Ayres-Peres & Mantelatto 2010, Wernberg et al. 2010).

Depending on the environmental context and the composition and density of the epibiotic assemblage, the effect on the basebiont can be specific or general, weak or strong, direct or indirect, beneficial or detrimental (Wahl 2009). Epibionts can negatively affect their hosts through increased predation pressure as shared doom (Manning & Lindquist 2003), energy expenditure through drag (Donovan et al. 2003) and decreased buoyancy (McAllen & Scott 2000). In contrast, benefits provided by epibionts to their hosts include a decrease in the desiccation rate of intertidal organisms (Penhale & Smith 1977), or, more commonly, decreased host mortality due to reduced predation, including camouflage (Laudien & Wahl 1999, 2004, Marin & Belluga 2005).

The epibionts more often found on molluscs shells are algae, barnacles and oysters (Creed 2000). The marine snail *Tegula viridula* (Gmelin, 1791) has a wide geographical distribution in the Brazilian coast – Ceará to Santa Catarina – also occurring in Panama, Suriname and Venezuela (Rios 2009). This herbivore macrogastropod inhabits rocks in the intertidal, shallow subtidal zones (Rios 2009). It plays an important role in the marine trophic chain being found in the diet of crabs and other gastropods and represents a link between producers (e.g., algae) and carnivorous consumers (e.g., crabs and other snails) (Turra et al. 2005, Santana et al. 2009). Besides that, empty shells of *T. viridula* are commonly used as homes by a variety of hermit crabs (Turra & Leite 2003, Fantucci et al. 2008, Pereira et al. 2009).

In this study, we addressed the following questions: (1) What is the composition, frequency and monthly occurrence of epibiotic community on shells of *T. viridula*? (2) Does the size or gender of *T. viridula* affect their epifaunal cover? (3) Do the epibionts increase the volume and weight of *T. viridula*? The answers to these questions has implications for both their life history and habitat strategies.

Material and Methods

Flexeiras beach (22º56'S, 43º54'W) is located in Itacuruçá Island, Sepetiba Bay, Rio de Janeiro state. This beach extends for 350 meters, slopes gently, has low wave action, and can be characterized as a sheltered beach according to the ranking system of McLachlan (1980). The sediment on the beach is mainly sand (medium to coarse grain size), with rock fragments, and sea grass beds of *Halodule wrightii* Asch., 1868 being observed along the beach (Caetano et al. 2008).

The population of *T. viridula* at Flexeiras beach was sampled monthly from April 2010 through March 2011 by three collectors, always at low tide, until no more snails were found. Individual snails were manually collected over a rectangular area measuring aproximately 20 x 10m, situated at one extreme end of the beach where rock fragments occur, in addition to sandy substratum. Shell length was measured in the field with a vernier caliper (0.1mm of accuracy). Length-frequency data were grouped into size classes (intervals of 1 mm). Afterwards, all specimens were returned to the environment, except those utilized for sex determination. In the laboratory, shells were cracked in a vice and the soft parts were removed. Individuals showing creamy gonads were identified as males and individuals with dark green gonads, as females (Righi 1962).

Epibiosis for *T. viridula* was evaluated by: identification of epibionts (epibiont composition), frequency of occurrence of each epibiont type, and determination of volume and weight of epibionts.

Individual shells used for determination of volume and weight had a variation in shell length of 18 to 21 mm, corresponding to length classes more abundant in the population (Fontoura-da-Silva, obs. pers.). The volume of epibionts on individual shells was determined by water displacement in a 250mL graduated cylinder to the nearest 0.1 mL. After removing the epibionts, measurements were repeated, and the difference in water displacement was recorded as epibiont volume. Weight measurements were carried out in the same way after drying snails on a paper towel, using a precision balance calibrated to the nearest 0.01 g.

Simple linear regressions were performed to assess relationships between the percentage of shells with epibiosis and shell length. A Chi-squared test was used to compare the frequency of total epibionts and the frequency of each type of epibiont for male and female snails (Zar 1999). The Mann-Whitney U Test was used for determination of significant difference in volume and Student's t-test was used for the weight comparisons. Cluster analysis was used to aid the interpretation of epibiosis pattern. Similarity values were calculated between length classes using the Euclidean distance. Dendrograms were obtained from the dissimilarity matrix by WPGMA (weighted pair-group).

Results

Epibionts were found covering the outer surface in 82.17% of analyzed shells (n = 1755). They were classified as: algae, bryozoans, barnacles, polyplacophorans, polichaete worm tubes, and oysters (Table 1).

The months of June and January had the highest percentages of epibiosis 95.35% and 93.68% respectively, and April the lowest 33.33% (Figure1).

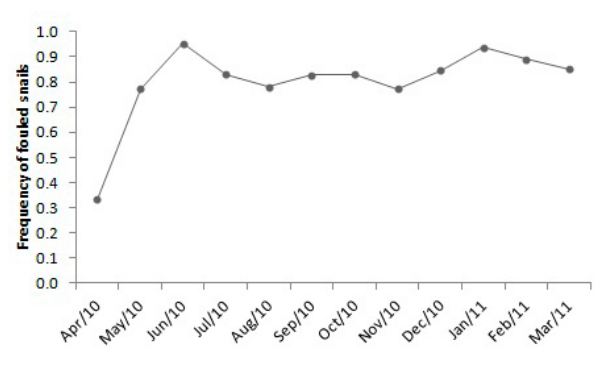

Fig 1 Fouling monthly variation in T. viridula in Flexeiras beach, Itacuruça Island (RJ, Brazil).

Barnacles were the most frequent epibiont in all months, followed by polychaetes, algae, and oysters, except in October, when polychaetes were the most frequent. The largest proportion of barnacles was recorded in January with the concomitant decline of most epibionts. Bryozoan and polyplacophorans were the epibionts having the lowest occurance frequency in all months (Figure 2).

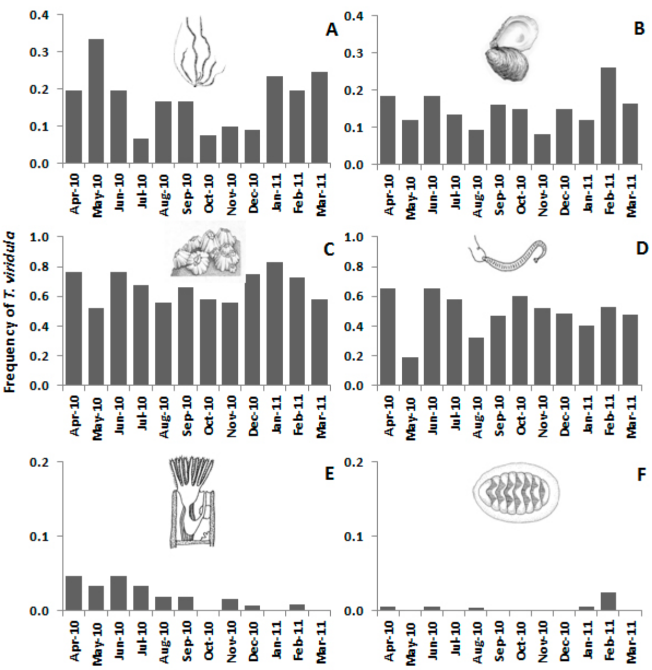

Fig 2 Monthly variation of epibionts on over *T. viridula* shell in Flexeiras beach, Itacuruça Island (RJ, Brazil). A. Algae; B. Oyster; C. Barnacle; D. Polychaete; E. Bryozoan; F. Polyplacophora.

The percentage of shells with epibionts was positively correlated to length of the shells ($y = -0.027 + 0.0552x$; $R^2 = 0.92$; $p < 0.05$) (Figure 3).

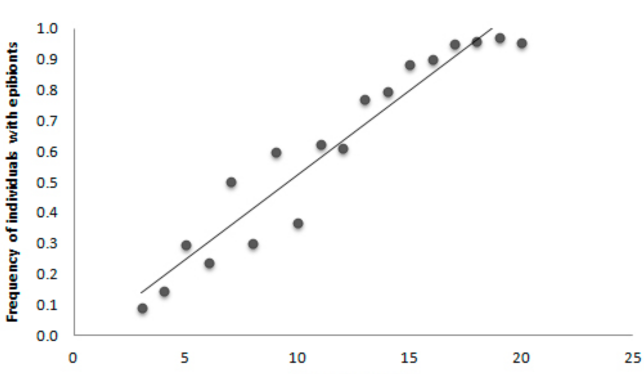

Fig 3 Linear regression between mean shell length and percentage of individuals with epibionts.

Epibionts prevalent on smaller shells were briozoans and polychaetes, while on the largest shells barnacles were more prevalent. Polychaetes and barnacles occurred in almost all length classes and oysters began to appear on individuals of 14mm (Figure 4).

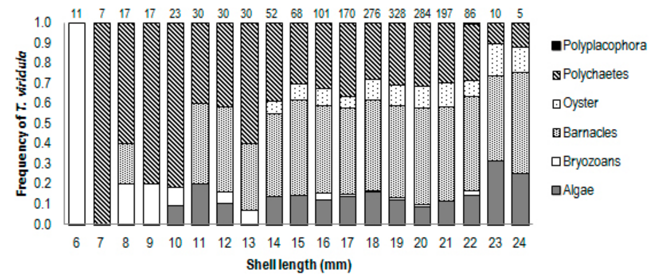

Fig 4 Distribution of epibionts by length classes. Numbers above the vertical bars are absolute frequencies.

Cluster analysis revealed that epibiont coverage changed according to increasing age. The smaller shells (group A) were covered with bryozoans and the highest frequency of polychaetes. Medium shells (group B) were covered with algae, polyplacophorans, the highest frequencies of barnacles, and polychaetes. The largest shells (group C) were covered with algae, polychaetes, and highest frequencies of barnacle and oysters (Figure 5).

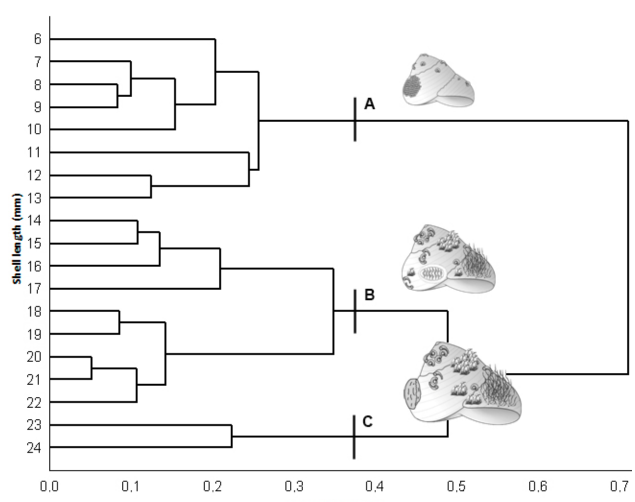

Fig 5 Cluster analysis between distribution of epibionts along length classes (6-24mm).

In groups B and C, a gradual decrease of polychaetes frequency was verified. In most shells, polychaetes were associated with barnacles. Shells without the presence of either of barnacles or polychaetes, had a low occurance rate (Figure 6).

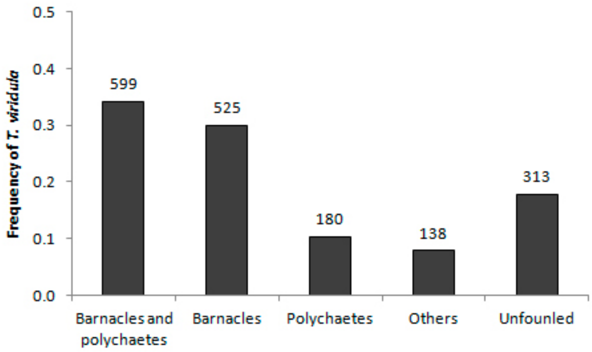

Fig 6 Percentage of individuals of *T. viridula* with the presence of barnacles associates with polychaetes, only with barnacles, only with polychaetes, with others epibionts and unfouled. Numbers above vertical bars representing absolute frequencies.

No significant difference (Chi-squared test; p>0.05) was observed between the sexes of the snails and coverage or lack of shell coverage with epibionts or frequency of epibont types (Figures 7A, 7B).

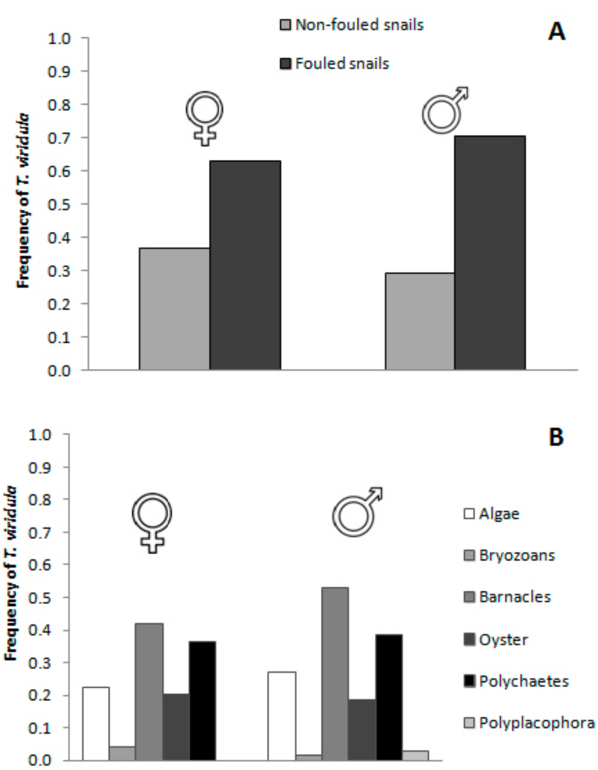

Fig. 7. (A) Percentage of fouled and non-foulded snails by gender. (B) Percentage of types of epibionts by the gender of the snails.

Epibionts significantly increased the weight (fouled: mean±SD = 5.52±0.85; unfouled: mean±SD = 4.93±0.72; *t*-Test = 3.37, df = 80, p = 0.001) and volume (fouled: mean±SD = 2.84±0.60; unfouled: mean±SD = 2.05±0.54; Mann-Whitney U = 244.50, n_1 = 41, n_2 = 41, p = 0.000) of *T. viridula*.

Discussion

In our study, epibionts of *T. viridula* were mainly barnacles and shell boring polychaetes. Of snails studied, 34% were fouled by barnacles and shell boring polychaetes so it is likely that positive interaction occurs between shell boring polychaetes and barnacle epibionts. At Flexeiras beach the higher abundance of barnacles and polychaetes covering *T. viridula* was probably a consequence of the higher incidence of these epibionts at the location. Barnacle epibionts and shell boring polychaetes strongly facilitate each other (see Thieltges & Buschbaum 2007).

Polyplacophorans are negatively phototaxic (Rodrigues & Absalão 2005) and in this study *Ischnochiton striolatus* was always found attached to the ventral side of *T. viridula* shells. The lower frequency of this observation can be correlated with their mobility.

Seasonal epibiotic communities are common (Chiavelli et al. 1993, Davis & White 1994, Fernandez et al. 1998, Dougherty & Russell 2005) and may be related to reproductive cycles of the epibionts (Creed 2000). In this study epibionts also showed a distinct temporal pattern. The algae epibionts were more abundant in May, polychaetes/bryozoans in July, barnacles in January, oysters/polyplacophorans in February.

The declines of the epibiotic community in April and November could be related to an observed increase in the *T. viridula* population (Fontoura-da-Silva, obs. pers.). As a consequence of this increase, a higher proportion of smaller individuals were in the population in these months. Since the frequency of epibionts was positively related to shell length and the peaks of epibionts occurred two months after (June and January) with the length increase of *T. viridula*, months with a high proportion of small shells also have a smaller epibiotic community.

Heavy incrustations were found only in larger shells, while in smaller shells only light incrustations were found such as bryozoans and polychaetes. Generally, older individuals or older parts (apex of the shell) of an individual tend to be more heavily covered by epibionts (Maldonado & Uriz 1992, Warner 1997, Fernandez et al. 1998, Dougherty & Russel 2005).

Composition of epibiosis can differ between sexes within a species (Maldonado & Uriz 1992, Patil & Anil 2000) but in *T. viridula* no difference was observed.

Epibionts can modify the three-dimensional substratum structure, movement pattern, and speed of the animal. It can also have a negative effect on gonad development and reduce the ability of the snail to turn over after being disturbed, which can makes life difficult for some snails (Buschbaum & Reise 1999, Chan & Chan 2005).

In the study area, *T. viridula* displayed a heterogeneous and seasonal epibiotic community. Epibiont coverage changed according to the size of the shell, but didn't change between the sexes. Epibionts increased the weight and volume of the shell. High frequency of epibiosis in *T. viridula* could cause positive and negative effects that were not evaluated in this study. Further studies might evaluate the positive (e.g. camouflage, chemical defense, protection to desiccation) and negative (e.g. locomotion, balance) effects of epibiosis on *T. viridula* and epibiotic composition in different microhabitats.

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