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Evidence of non-drilling predation by a naticid gastropod in bivalves on Camocim Beach, Ceará, northeastern Brazil

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ABSTRACT. Marine gastropods of the family Naticidae are worldwide distributed and known for their unusual predatory habits. Due to their wide distribution, the naticids are worldwide studied and known like predators of intertidal bivalves. The present study demonstrates the predation of the naticid gastropod *Natica marochiensis* on the bivalve *Donax striatus* in the northeastern region of Brazil.

Keyword: mollusks; Naticidae; *Natica marochiensis*; *Donax striatus*.

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Introduction

Marine gastropods of the family Naticidae have a worldwide distribution and are known for their unusual predatory habits (Vermeij, 1980; Carriker, 1981; Dietl & Kelley, 2006). Predation by naticids on bivalves can occur through the perforation of the shell (Carriker, 1981; Das, Hutchings & Herbert, 2013; Mallick, Bardhan, Das, Paul, & Goswami, 2014; Paul & Herbert, 2014 Chattopadhyay, & Chattopadhyay, 2015), which is achieved by the radula which is able to dissolve the calcium carbonate of the prey shell. In addition to shell perforation, studies suggest suffocation (or asphyxiation) of the prey via engulfing by the mantle of predator gastropod as an alternative methodology (Hughes, 1985; Ansell & Morton, 1987; Visaggi, Dietl, & Kelley, 2013).

In Brazil there are four genera and 17 species of naticids (Rios, 2009), among them *Natica marochiensis* (Gmelin, 1791), which inhabits beaches with sandy substrates in Florida, West Africa, the West Indies, Surinam and Brazil. *N. marochiensis* has a shell of approximately 30x17 mm and a bright brown color with the first rounds of blue-black tonality, showing dark zigzag spots, white umbilical callus and white operculum with irregular yellow spots (Rios, 2009). The present work had the objective of evidencing of non-drilling predation of the *N. marochiensis* gastropod on the bivalve *Donax striatus* Linnaeus, 1767.

Material and methods

The occurrence of *N. marochiensis* predation over *D. striatus* occurred in the intertidal zone of Camocim beach (2°51'53.41"S, 40°54'11.20"W), located on the coast of the state of Ceará, northeastern Brazil.

Evidence of the predation of *N. marochiensis* occurred during low tide in April 2011. Along the beach, several gastropods were found foraging on bivalves. At each evidence of predation, mollusks were observed throughout predatory encounter and we recorded images and videos for further descriptions of the events.

Results and discussion

The predation of *N. marochiensis* on *D. striatus* represents three different stages: (1) prey detection, probably by smell or sediment movements, as proposed by Hughes (1985), (2) manipulation of the prey using the extensive mantle of the naticids which is able to cover their prey and immobilize them for an indeterminate time and (3) burial of the predatory gastropod in the sand with its prey for consumption of the visceral mass of the bivalve (Figures 1A-H). Suffocation may be used to immobilize the prey and gain access to the visceral mass of the bivalve without the energetic expenditure needed for shell perforation. This

hypothesis is supported by the evidence of innumerable gastropods foraging on *D. striatus* without the need for perforation in the shell, a finding demonstrated by the detection of traces of adductor muscle in the bivalve leaflets after consumption of the visceral mass (Figure 1I).

It is clear that even though there was no evidence of perforation of *D. striatus*, naticids are still active predators. Naticids, considered one of the largest and oldest groups of shell borers, can negatively influence community structure and species diversity in the coastal regions (Wiltse, 1980; Pruss, Stevenson, & Duffey, 2011; Chiba & Sato, 2013; Pahari et al., 2016; Chagas et al., 2020). Because of this they are often considered pests (Hancock, 1960). Interestingly, the perforations characteristic of the predation by naticids make them identifiable predators and have allowed their study through the use of shells of fossil mollusks (Aronowsky & Leighton, 2003; Dietl & Kelly, 2006; Kelley & Hansen, 2006; Stafford & Leighton, 2011; Chattopadhyay, Sarkar, Dutta, & Prasanjit, 2014). A survey of world predation by naticids has not previously included occurrences on the Brazilian coast (Mondal, Hutchings, & Herbert, 2014; Chagas et al., 2020). Even presenting a diversity of naticids, only Henckes and Cunha (2007) recorded the predation of *N. marochiensis* on *D. striatus* in the state of Piauí, in the year 2005.

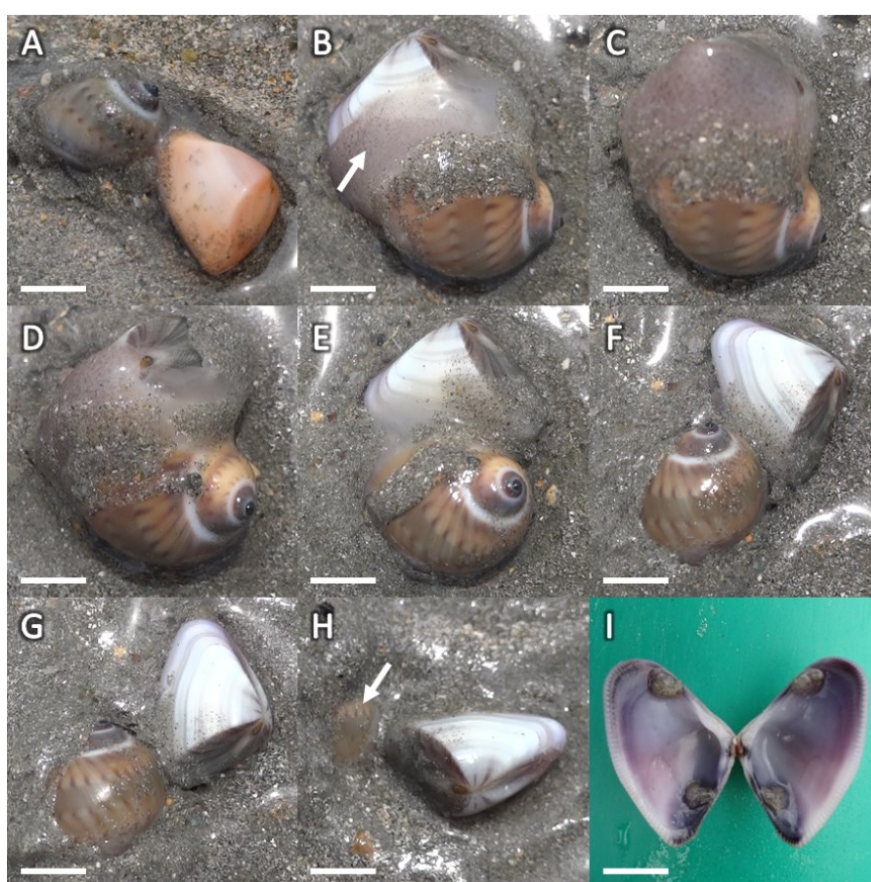


Figure 1. Sequence of images showing the predation of the gastropod *Natica marochiensis* on the bivalve *Donax striatus* in the intertidal zone of the beach of Camocim, where the naticid gastropod consumed the bivalve through the attachment of the radula to the soft body of the prey (A). *Natica marochiensis* carries the prey to a location where predation begins due to engulfing with the mantle (indicated by the arrow) which is able to encompass the entire bivalve (B, C, D and E). Due to the failure of the attack on the substrate, the gastropod buries itself (indicated by the arrow) a few centimeters into the sand where predation commences (F, G and H). Evidence of death due without perforations in the shell as well as the presence of traces of adductor muscles (indicated by the arrow) is observed (I). Scale: 6 mm (B, C, D, E and I), 7 mm (F, G and H) and 8 mm (A).

Conclusion

It should be emphasized that the importance of studies on the predatory relationship of naticid gastropods on the Brazilian coast because of the diversity of bivalves that inhabit the intermareal region. Additional work should include (1) the characterization of predator and prey densities, (2) the prey types used, (3) the relationship between the size of the predator and the prey bivalves, and (4) possible impacts on bivalve populations or other organisms inhabiting the intertidal zone due to predation by naticids.

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