

Scavenger gastropod devouring a common lamellibranch bivalve in an estuary of Northeast Brazil

Evandro Cosmo Tomaz Abreu¹ and Silvio Felipe Barbosa Lima^{2,3}

¹Federal University of Paraíba. Center of Agrarian Sciences. Post-Graduate Program in Biodiversity. Areia-PB, Brazil (CEP 58397-000).

²Federal University of Campina Grande. Teacher Training Center. Academic Unit of Exact and Natural Sciences. Rua Sérgio Moreira de Figueiredo, S/Nº. Casas Populares. Cajazeiras-PB, Brazil (CEP 58900-000).

³Regional University of Cariri. Center for Biological and Health Sciences. Post-Graduate Program in Biological Diversity and Natural Resources. Rua Coronel Antônio Luiz Pimenta, S/Nº. Crato-CE, Brazil (CEP 63105-000).

Abstract. Nassaridae Iredale, 1916 (1835) is one of the main groups of scavenger neogastropods that usually live in a gregarious manner on soft and rocky substrates mainly of estuarine ecosystems in the seas and oceans of the World. The aim of this paper was to describe *Phrontis polygonata* (Lamarck, 1822) feeding on the carrion of the lamellibranch bivalve *Anomalocardia flexuosa* (Linnaeus, 1767) in an estuarine region of Northeast Brazil. A total of 27 adult individuals of *P. polygonata* were observed actively crawling on and around the venerid attempting to feed on its tissue. During the observation period, the proboscis of the nassarids could only reach the mantle margin of *A. flexuosa* due to the narrow spacing of the valves. This study reaffirms the ecological relevance of *P. polygonata* associated with the consumption of bivalve carrion in shallow estuarine waters of the Western Atlantic.

Keywords: Scavenger invertebrates; Scavenger mollusks; Gastropoda; Bivalvia; Carrion.

Resumo. *Gastrópode necrófago devorando um bivalve lamelibrânquio em um estuário no nordeste do Brasil.*

Nassaridae Iredale, 1916 (1835) é um dos principais grupos de neogastropodes necrófagos que comumente vivem de forma gregária associado a diferentes tipos de substratos, principalmente de regiões estuarinas nos mares e oceanos do Mundo. O objetivo deste estudo foi descrever *Phrontis polygonata* (Lamarck, 1822) alimentando-se do bivalve *Anomalocardia flexuosa* (Linnaeus, 1767) em estado de putrefação numa região estuarina do nordeste do Brasil. Um total de 27 indivíduos de *P. polygonata* foi observado rastejando ativamente ao redor e

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ORCID

0000-0002-8877-2616

Evandro Cosmo
Tomaz Abreu

0000-0001-7892-5773

Silvio Felipe Barbosa
Lima

sobre o venerídeo na tentativa de alimentar-se do lamelibrânquio. Durante o período observado, a probóscide dos nassarídeos obteve alcance até a borda do manto de *A. flexuosa* devido ao estreito espaçamento das valvas. Este estudo reafirma a relevância ecológica de *P. polygonata* associado ao consumo de bivalves em putrefação em águas rasas estuarinas do Atlântico Oeste.

Palavras-chave: Invertebrados necrófagos; Moluscos necrófagos; Gastropoda; Bivalvia; Carniça.

Introduction

Marine scavenger metazoans include a considerable diversity of taxonomic groups that play an important role in ecological interactions, providing the rapid removal, cycling and dispersing of carrion in seas and oceans throughout the world (De Broyer et al., 2004; Ates, 2017; Depestele et al., 2019; Dunlop et al., 2020; Carreira-Flores et al., 2023).

Benthic scavenger communities are composed of a large diversity of highly efficient scavenger invertebrates, such as actiniarian cnidarians, decapod, peracarid and amphipod crustaceans, asteroid, ophiuroid and echinoid echinoderms, and gastropod mollusks, living in different tropical to polar seafloor habitats from shallow water to the deep ocean (Moore and Howarth, 1996; Ramsay et al., 1998; De Broyer et al., 2004; Schlacher et al., 2013; Ates, 2017; Depestele et al., 2019; Dunlop et al., 2020; Hyndes et al., 2022).

Mollusks have a wide variety of feeding habits (Scott and Kenny, 1998), including some groups of bivalves, cephalopods and gastropods with an obligate or facultative carrion diet (Scott and Kenny, 1998; Fontoura-da-Silva et al., 2013; Brusca et al., 2018; Giribet and Edgecombe, 2020). Most gastropods of the order Neogastropoda Wenz, 1938 feed on a number of preys (generalized predators), specific preys (selective predators) or carrion (scavengers) in a range of benthic habits (Ponder, 1996; Cheung et al., 2006; Brusca et al., 2018; Giribet and Edgecombe, 2020).

Nassaridae Iredale, 1916 (1835) is one of the major groups of scavenger neogastropods that usually live in a gregarious manner on soft and rocky substrates of estuarine ecosystems to deep waters throughout tropical and temperate seas and oceans (Britton and Morton, 1994; Harasewych, 1998; Morton and Chan, 1999; Morton, 2003; Cheung et al., 2006; Iannotta et al., 2009; Tunnell Jr. et al., 2010; Galindo et al., 2016).

Phrontis polygonata (Lamarck, 1822) is a scavenger nassarid that typically inhabits intertidal zones to shallow waters with muddy sandy substrates mainly in bays and estuarine regions of the Western Atlantic. This species has been studied mainly in malacofaunistic surveys (Lee, 2009; Tunnell Jr. et al., 2010). However, no studies have reported on the carrion diet of *P. polygonata*.

The aim of the present study was to describe the feeding of *P. polygonata* on the lamellibranch bivalve *Anomalocardia flexuosa* (Linnaeus, 1767) in state of putrefaction in an estuarine region of Northeast Brazil.

Materials and methods

Study site

The Mamanguape River Estuary is an Environmental Preservation Area of about 5,400 hectares, located in the Municipalities of Rio Tinto and Marcação (06° 43'-06° 51' S, 35° 67'-34° 54' W) and comprising the largest mangrove ecosystem in the State of Paraíba,

Northeast Brazil (Figure 1). The mouth of the Mamanguape River forms a bay six kilometers in width nearly closed by a line of coastal reefs of quaternary formation.

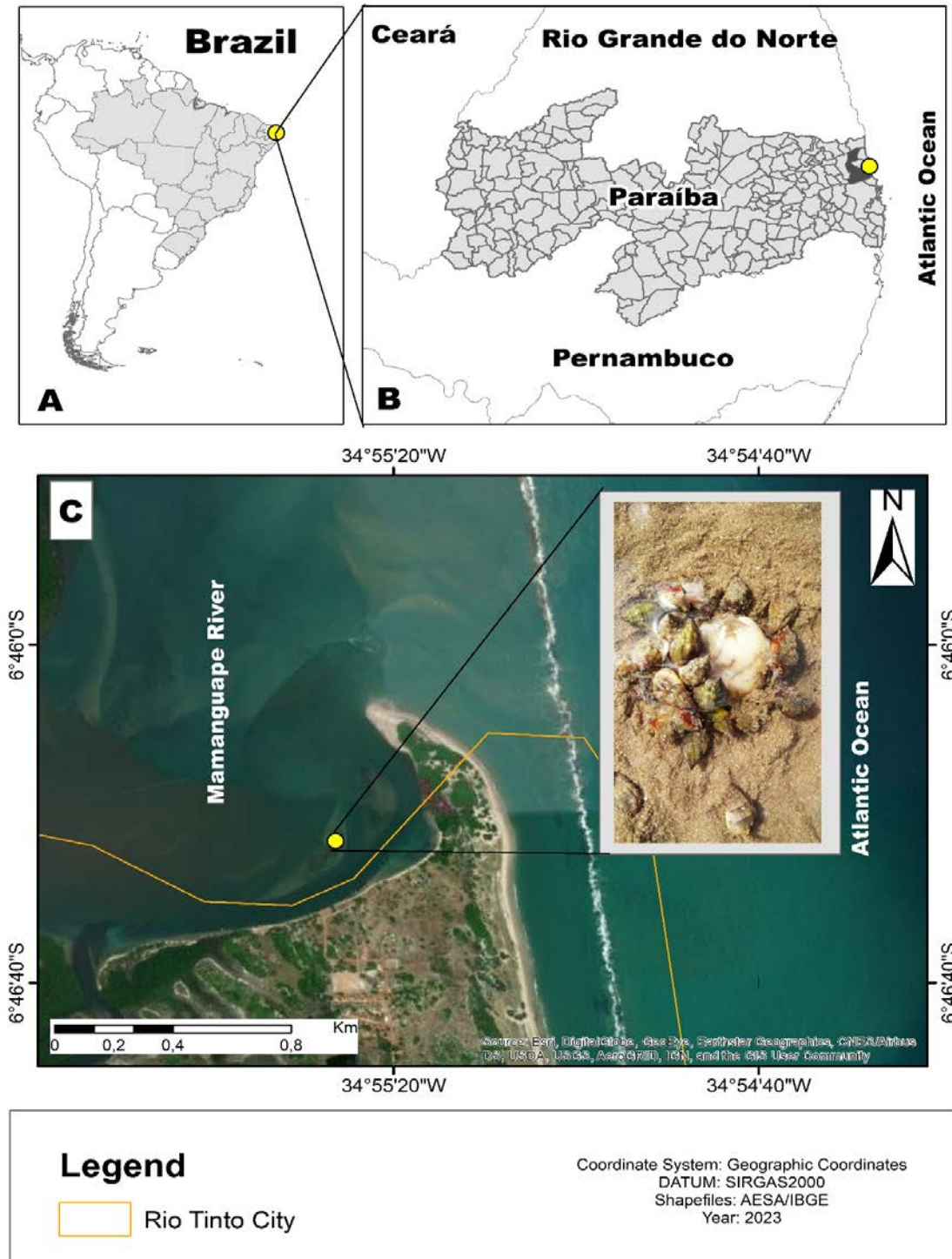


Figure 1. (A). Map of Brazil highlighting State of Paraíba; (B). State of Paraíba highlighting Municipality of Rio Tinto; (C). Study area and collection point (yellow circle) on a sandy bank in the Mamanguape River Estuary.

This bay provides calm waters that support manatee reproduction and maintenance (MMA, 1993; Paludo and Klonowski, 1999). Tides with a large amplitude enable the accumulation of sediments in the cove, forming large sandbanks in the bay. Tides with no large amplitude enable the accumulation of sediments in the cusp, causing a sediment deficit from the cove to the downstream area (Sales, 2002). The sandbanks are often visited by self-employed women to capture shellfish in an artisanal way for their own livelihood or commercialization of part of the production.

Field observation

The field observation of the interaction between scavenger and bivalve carrion occurred on September 9, 2018, in the intertidal zone at low tide on the large sandbank in the bay (Figure 1), which is within Environmental Preservation Area. The interaction between a group of individuals of *P. polygonata* attempting to feed on a single *A. flexuosa* in a state of putrefaction was observed for about 22 min. Both mollusks were undisturbed and photographed *in situ*. No individuals were collected due to the usual occurrence of these species in estuarine ecosystems.

Results

A total of 27 adult individuals of *P. polygonata* were observed on and around an individual of *A. flexuosa* in a state of putrefaction (Figure 2). During the observation, this nassarid was the only species attracted and found attempting to feed on the lamellibranch bivalve. Individuals of *P. polygonata* were observed actively crawling around and on the semi-open bivalve in an attempt to feed on the carrion of the venerid. The individuals of *P. polygonata* actively attempted to access the soft parts of the bivalve through the ventral region of the shell, which was narrowly open. The proboscis of the nassarids could only reach the mantle margin of *A. flexuosa* due to the narrow spacing of the valves. Figure 2 shows nine individuals of *P. polygonata* on the shell of *A. flexuosa*, five half-buried individuals, five individuals on the sandy substrate very close to the venerid, and eight other individuals (four of which are shown in Figure 2) a little farther away from the bivalve.



Figure 2. (A). Field observation of a group of *P. polygonata* individuals attempting to feed on the carrion of the clam *A. flexuosa* on a sandbank in the bay of the Environmental Preservation Area of the Mamanguape River Estuary; (B). Ventral view of *Phrontis polygonata* - shell [scale bars: 5 mm - Lima et al. (2017: Fig. 11D)].

Discussion

Nassarids are known for a diversified carrion diet based mainly on fishes, crustaceans or other mollusks (McKillup and McKillup, 1997; Morton and Yeun, 2000; Davenport and Moore, 2002; Morton, 2003; Cheung et al., 2006; Vargas-Zamora and Sibaja-Cordero, 2011; Lucena et al. 2012; Carreira-Flores et al., 2023). However, Tunnell Jr. et al. (2010) pointed out that some nassarids may become facultative herbivores. With regards to the nassarid of the present article, no field or laboratory studies have investigated whether *P. polygonata* is a selective/non-selective-obligate/facultative scavenger or possible facultative herbivores.

The present study corroborates the findings of Cheung et al. (2006), who also determined through field observations that an intertidal scavenger nassarid species [*Nassarius festivus* (Powys, 1835)] has a carrion diet based on a venerid clam. The authors observed *in situ* that *N. festivus* exhibited feeding selectivity on the soft parts of the venerid clam *Marcia hiantina* (Lamarck, 1818). It was not possible to determine whether the nassarids observed in the present study would exhibit evidence of selective feeding on the soft parts of *A. flexuosa*, as the individuals did not have complete access to the tissues due to the narrow opening of the valves.

Individuals of *P. polygonata* were observed attempting to feed on the carrion of the clam for about 22 min. However, feeding time could be shorter if the soft parts of the venerid were fully exposed. Experimental observations showed that groups of individuals of *Phrontis vibex* (Say, 1822) spent an average of 6.38 min (range 1 to 18 min) of consuming fish bait (Lucena et al., 2012).

There are a number of lamellibranch bivalves of the Family Veneridae in the study area as well as in other estuarine ecosystems in the Western Atlantic. More field and laboratory studies are needed to ascertain whether such clams are among the favorite food carrion of nassarids.

Conclusions

This study reaffirms the considerable ecological relevance of the benthic scavenger gastropod *P. polygonata* associated with the consumption of bivalve carrion in shallow coastal ecosystems, mainly in estuarine regions, thus, aiding in nutrient cycling and energy flow in the marine food web.

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Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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