Ecological notes and occurrence of *Astrangia solitaria* (Le Sueur, 1817) (Cnidaria: Astrangiidae) for the Northern Brazilian Coast

Notas ecológicas e ocorrência de *Astrangia solitaria* (Le Sueur, 1817) (Cnidaria: Astrangiidae) para a costa norte brasileira

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Abstract: Ecological associations are widely reported in literature, covering several levels in the trophic chain or with different species interaction. However, the epibiosis between coral and gastropod species is still rarely observed in Brazil. Therefore, herein we report the epibiosis between the coral species *Astrangia solitaria* (Le Sueur, 1817) and the gastropod *Turbinella laevigata* Anton, 1838, additionally, extending the distribution of *A. solitaria* from the northern Brazilian coast (State of Amapá). The species were collected as bycatch fauna during commercial fishing operations along the continental shelf of Amapá, under the supervision of Center for Research and Management of Fisheries Resources of the North Coast (CEPNOR). This paper increases the northernmost record of *A. solitaria* and expands its epibiosis interaction with *T. laevigata*.

Keywords: Epibiosis. Coral. Mesophotic reefs. Gastropod mollusk. State of Amapá.

Resumo: Associações ecológicas são amplamente reportadas na literatura, cobrindo vários níveis na cadeia trófica ou com diferentes interações entre espécies. Contudo, a epibiose entre espécies de corais e gastrópodes é raramente observada no Brasil. Baseados nisso, aqui nós reportamos a epibiose entre a espécie de coral *Astrangia solitaria* (Le Sueur, 1817) e o gastrópode *Turbinella laevigata* Anton, 1838, adicionalmente estendendo a distribuição de *A. solitaria* para a costa norte do Brasil (estado do Amapá). As espécies foram coletadas como fauna acompanhante durante as operações de pesca comercial ao longo da plataforma continental do Amapá, sob a supervisão do Centro de Pesquisa e Gestão dos Recursos Pesqueiros da Costa Norte (CEPNOR). Este trabalho aumenta o registro mais ao norte de *A. solitaria* e expande sua interação de epibiose com *T. laevigata*.

Palavras-chave: Epibiose. Coral. Recifes mesofóticos. Molusco gastrópode. Estado do Amapá.

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INTRODUCTION

For marine invertebrates, the fixation in the hard substrate is very important to perform its biological activities as feeding, growth and reproduction. The epibiosis is widely reported, especially using as hard substrata for the fixation, as observed in crustacean carapace, mollusk shells, sponges, polychaete tubes, dorsal structures of the turtles, dolphins, and whales or associated with marine litter such as tyres, pet bottles, glass and wood (Lewis, 1978; Ross & Newman, 1995; Wahl, 2008; Alves-Júnior et al., 2021, 2022).

One of the best represented groups adhered on consolidated substrate are the corals, which commonly occur in shallow waters, due to the luminosity and presence of nutrients, however, many groups can be observed in rocks or artificial substrata in deep regions with absence of light, as the example of corals azooxanthellate (Kitahara, 2007; Kitahara et al., 2008; Pires, 2007; Cordeiro et al., 2012, 2015; Zibrowius et al., 2017). The coral family Astrangiidae Milne Edwards & Haime, 1857 is represented by the only genus *Astrangia* Milne Edwards & Haime, 1848 with 35 valid species, widely reported in many habitats from the coastal zones to depths of 573 m (Zlatarski & Martínez-Estalella, 1982; Cairns et al., 1999; Cairns, 2000; Cordeiro et al., 2012; Hoeksema & Cairns, 2023). In Brazilian waters, only two species are reported: *Astrangia rathbuni* Vaughan, 1906 and *Astrangia solitaria* (Le Sueur, 1817), being this last, occurring along the southeast United States, Gulf of Mexico, Caribbean Sea, and in some regions of northeast and southeast of Brazil (Cordeiro et al., 2012; Leão et al., 2016).

The occurrence of biological interactions as epibiosis between corals and mollusks are widely reported in the literature (see Alves-Júnior et al., 2021 and references therein), however, the associations between *A. solitaria* and the gastropod shell *Turbinella laevigata* Anton, 1838, never been reported before. Based on that, here we report the coral species *A. solitaria* from the Northern region of Brazil, with ecological notes on its distribution and adhesion on *T. laevigata*.

MATERIAL AND METHODS

The species were collected as bycatch fauna during commercial fishing operations of the southern brown shrimp along the Amazon continental shelf (coordinates 02° 04' 00" N, 48° 33' 15" W), in Amapá State (Figure 1). Samples were performed using an otter trawl net (1 cm of mesh), in 2010, under the supervision of Center for Research and Management of Fisheries Resources of the North Coast (CEPNOR) (SISBIO Number: 44915–3).

After sampling, the individuals were frozen and stored in Styrofoam, and transferred to the Carcinology Laboratory (LabCrus); in the laboratory, the species were sorted out, photographed and measured in shell length (SL) and shell width (SW), using a digital caliper (0.01 mm). After the procedures, the individuals were preserved in 70% ethyl alcohol and stored in the carcinological collection at *Universidade Federal Rural da Amazônia*. The coral species were identified following (Le Sueur, 1817; Milne Edwards & Haime, 1848; Kitahara, 2007) and the gastropod species according to Rios (1994, 2009).

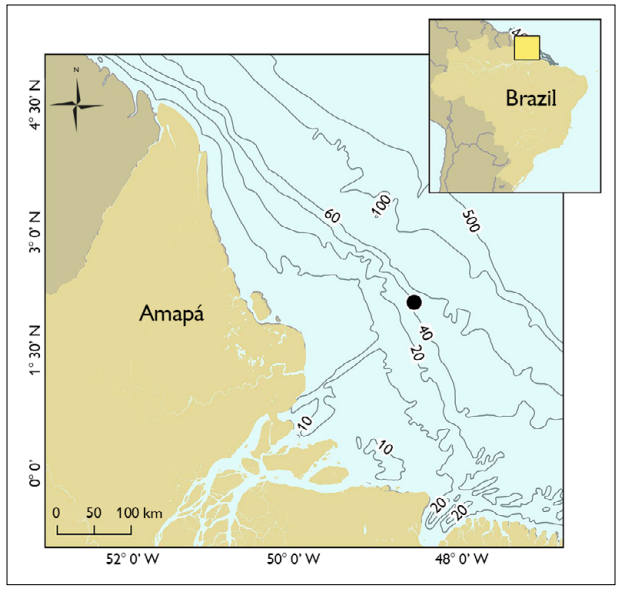

Figure 1. Localization of the study area of fishery activities called *Lixeira* in continental shelf of Amapá. Black circle = sampled point. Map created by Déborah E. G. Martins (2023).

RESULTS AND DISCUSSION

It was observed only one specimen of *T. laevigata* found with soft parts (SL: 10,52 cm; SW: 4,41 cm) (*Voucher* ID: LABCRUS.MTTL001) which was collected at 45 m of depth, infested by corals of the species *A. solitaria*, with the area showing epibiosis equivalent to 40% of the dorsal surface of shell (Figure 2). We observed 115 colonies of *A. solitaria*, and additionally, the presence of other invertebrates' epibionts as polychaete tubes of the family Serpulidae Rafinesque, 1815 and the colonies of bryozoan of the genus *Schizoporella* Hincks, 1877.

The coral species *A. solitaria* is reported along the Western Atlantic, with records in Florida, Bermudas, Mexico, Nicaragua, Jamaica, Bahamas, Haiti, Belize, Porto Rico, Colombia, Venezuela, Guyana and in Brazil, recorded from few States such as: Amapá (present study), Pará, Maranhão, Saint Peter and Saint Paul Archipelago, Pernambuco, Alagoas, Bahia, São Paulo; and Ascension Island, found in coastal hard bottom or in deep coral reefs, with individuals found from 50 to 573 m (Zlatarski & Martínez-Estalella, 1982; Cairns, 2000; Kitahara et al., 2008; Cordeiro et al., 2012, 2015; Leão et al., 2016; Zibrowius et al., 2017). Thus, in this paper, we report the first record of the *A. solitaria* from the northern region of Brazil (State of Amapá), collected as bycatch fauna of fishery activities in the region.

The association between mollusks and other invertebrate groups are widely reported in literature (Boyko & Mikkelsen, 2002; Hoffmeister & Martin, 2003; Villegas et al., 2005; Góngora-Gómez et al., 2015; Lima et al., 2017; Alves-Júnior et al., 2021, 2022), especially the mollusk shells acting as hard substrata (basibiont) for the fixation of many others invertebrates such as sponges, corals, other mollusks, barnacles, bryozoans, polychaetes and plants as micro and macroalgae (Stauber, 1945; Garcia et al., 2003; Doldan et al., 2012; Hanke et al., 2015). The presence of the coral *A. solitaria* as epibiont of *T. laevigata* can be a opportunistic relation, which may facilitate the distribution of coral in different estuarine and marine habitats, especially in adjacent areas along the coral reefs, with this regional distribution, composing a wide range of different foods and the protection against coral predators as fishes, sea stars and sea urchins (Arnaud, 1978; Luzzatto & Pastorino, 2006).

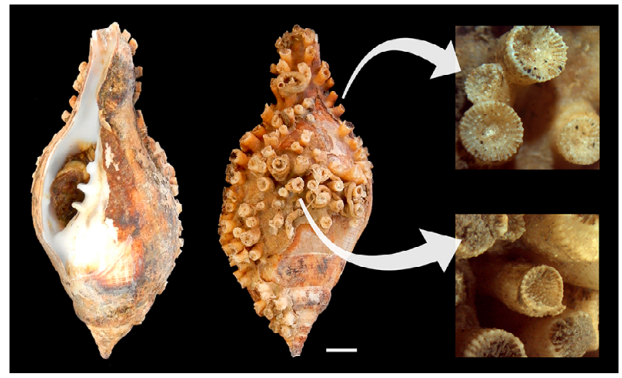

Figure 2. *Astrangia solitaria* (Le Sueur, 1817) as epibiont of *Turbinella laevigata* Anton, 1838, collected from the State of Amapá, Brazil. (A) Ventral view of shell, (B) dorsal view of shell with presence of *A. solitaria*, (C-D) corallites isolated of *A. solitaria*. Image credit: Déborah E. G. Martins (2023). Scale bar = 1 cm.

The presence of epibiosis can benefit the basibiont with extra protection against predators, as observed from many crustaceans as in the genus *Dromia* Weber, 1795 and *Moreiradromia* Guinot & Tavares, 2003, which covers its carapace with sponges and ascidians for protection; from reports of mollusks as basibiont, studies provided by Garcia et al. (2003), observed the presence of the hermit crab *Paguristes erythrops* Holthuis, 1959 occupying the shell of *Favartia cellulosa* (Conrad, 1846), which was analyzed with commensal association with the *Astrangia rathbuni*; Luzzatto and Pastorino (2006), in observations from Argentine waters, reported the occurrence of the sea anemone *Antholoba achates* (Drayton in Dana, 1846) as epibiont of gastropod *Pachycymbiola brasiliana* (Lamarck, 1811) [= *Adelomelon brasilianum* (Lamarck, 1811)], additionally, Schejter & Bremec (2007) highlighted in experiments the importance of the bivalve shell *Zygochlamys patagonica* (King, 1832) as basibiont for the fixation of many invertebrate species (hard substrata).

Many other studies indicated the species *A. solitaria* occurring in natural and artificial substrates such as floating woods, tyres and as biofouling in ships; additionally, this species is observed in small colonies, adhered between sponges, algae, rhodoliths bed, individuals of the same species and other corals, showing a low competition for space, when compared to other corals and invertebrates (Grohmann et al., 2003; Cordeiro et al., 2015; Asp et al., 2022). On the other hand, the presence of *A. solitaria* in mollusks shells can hinder the mobility of basibiont, increasing friction with waves and steam, and makes it difficult for basibionts to burrow in the sediment (Marin & Belluga, 2005). The coral biodiversity of the northern region of Brazil remains underestimated, it is necessary more collecting efforts to understand the real biodiversity in the region, additionally, further studies are necessary to assess the real ecological damage of fishing activities, and the risk of oil exploration in the region.

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AUTHORS' CONTRIBUTION

F. A. Alves-Júnior contributed to writing (original draft, proofreading and editing), investigation, and conceptualization; D. E. G. Martins with writing (original draft, proofreading and editing), investigation, and validation; K. C. A. Silva with writing (original draft and editing), methodology, and validation; A. G. C. M. Klautau with resources, and methodology; and I. H. A. Cintra with writing (original draft and editing), methodology, resources, supervision, and data curation.