

New records of association between caridean shrimps (Decapoda) and sponges (Porifera) in Abrolhos Archipelago, northeastern Brazil

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ABSTRACT

The association of the caridean shrimps *Anchistioides antiguensis* (Schmitt, 1924) and *Typton gnathophylloides* Holthuis, 1951 with the sponges *Dysidea janiae* (Duchassaing & Michelotti, 1864) and *Amphimedon viridis* Duchassaing & Michelotti, 1864, respectively, is reported for the first time. The material was collected in coral reefs surrounding Santa Barbara Island, Abrolhos Archipelago, Bahia, Brazil. The shrimps occupied different locations inside the sponges. Previous records of associations between these carideans and other hosts were revised and the possible type of association between the shrimps and their hosts is discussed. The occurrence of the sponge *A. viridis* in the Abrolhos Archipelago is also reported for the first time.

KEY WORDS

Caridea, Anchistioididae, Palaemonidae, Demospongiae, symbiosis.

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the true kind of symbiosis between shrimps and their hosts remains unknown in most cases and, for this reason, the term “association” has been used to describe such interactions (Bauer, 2004).

Caridean shrimps generally use cavities, cracks or even the inside of sessile organisms as shelters, breeding sites or as refuge from predators. Sponges are one of the main hosts of caridean shrimps (*e.g.*, Bruce, 1976; Anker *et al.*, 2008; Pachelle *et al.*, 2015). The type of the associations varies from facultative to obligatory symbiosis (Bruce, 1976). Some snapping shrimps of the genus *Synalpheus* Spence Bate, 1888, for example, are obligatory sponge symbionts (Duffy, 1992; Macdonald *et al.*, 2006; Ríos and Duffy, 2007).

During a survey of caridean shrimps carried out in the Abrolhos Archipelago, Bahia, Brazil, Soledade *et al.* (2015) registered 11 new shrimp records from this region, with some species collected in association with sponges; however, the identity of the host sponges was not elucidated at that time. Recently, the sponges were identified and we verified that some of them were never previously registered in association with two caridean shrimps that occur in the area. Thus, the objective of this study is to report these new associations and to provide a new record of one of the sponge hosts in the Abrolhos Archipelago. To infer about the kind of association between shrimps and sponges we reviewed previous records of associations of species of shrimp with different hosts, and also took into consideration

the location of the shrimps inside the sponges.

The material analyzed was obtained in coral reefs surrounding Santa Barbara Island (17°57'49"S 38°41'53"W). The sponges were collected between 22th July and 4th August 2013. Once collected, the specimens were placed in plastic bags (*in situ*) to prevent escape of associated organisms.

In the laboratory, the sponges were carefully inspected, and the associated fauna was removed, anesthetized on ice, and fixed in ethanol 70%. The associated shrimp were identified and deposited in the Crustacean Collection of the Museu de Oceanografia of Universidade Federal de Pernambuco, Recife, Brazil (MOUFPE). The sponges were deposited in the Coleção de Porifera of Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil [*Amphimedon viridis* Duchassaing & Michelotti, 1864, UFPEPOR 1890, Fig. 1A; *Dysidea janiae* (Duchassaing & Michelotti, 1864), UFPEPOR 1892, Fig. 1B].

Family Anchistioididae Borradaile, 1915

Anchistioides antiguensis (Schmitt, 1924)

Material examined. 4 males, 11 females (1 ovigerous); MOUFPE 18102; Santa Barbara Island (17°57'28"S 38°42'19"W); 3 Nov. 2013; 9 m; in the sponge *Dysidea janiae*; coll. R.M.C. Barbosa and L.M. Fernandes.

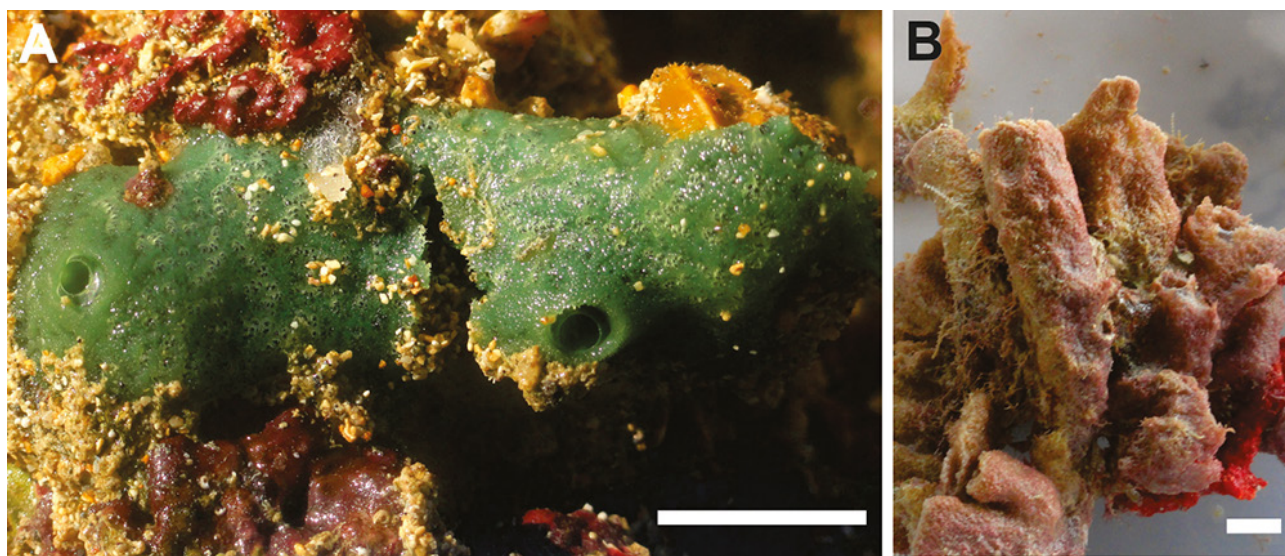


Figure 1. External appearance and color pattern of the two species of sponges associated with caridean shrimps from Abrolhos Archipelago, Bahia, northeastern Brazil. (A) *Amphimedon viridis* Duchassaing & Michelotti, 1864; (B) *Dysidea janiae* (Duchassaing & Michelotti, 1864). Scale bars = 1 cm.

Remarks. Specimens of *A. antiguensis* were found inhabiting the host's osculae. Only one specimen was found inside each sponge tube and none was observed on the surface. This species occurs from Bermuda to Espírito Santo, Brazil (De Grave and Anker, 2017) from the intertidal to 118 m (Williams, 1984). Previous reports of this species on the coast of Brazil did not provide information about its ecological relationships (Chace, 1972; Coelho and Ramos, 1972; Cardoso, 2006; Coelho *et al.*, 2006; Soledade *et al.*, 2015). Specimens of *A. antiguensis* have been observed living inside the sponges *Mycale (Arenochalina) laxissima* (Duchassaing & Michelotti, 1864) and *Niphates erecta* (Duchassaing & Michelotti, 1864) in Bocas del Toro, Panama, and it has been considered a facultative sponge associated species (De Grave and Anker, 2017). However, considering that the specimens of *A. antiguensis* were found within the host's osculae and the fact that each tube contained one organism, *A. antiguensis* and *D. janiae* may have a true relationship. *Anchistioides antiguensis* may use the interior of *D. janiae* as refuge or even site for reproduction, given the presence of individuals of both sexes, as well as one ovigerous female in the examined single host.

Family Palaemonidae Rafinesque, 1815

Typton gnathophylloides Holthuis, 1951

Material examined. 1 male, 1 ovigerous female; (MOUFPE 18104); Santa Barbara Island (17°57'49"S 38°41'53"W); 3 Nov. 2013; shallow tide pool, in the sponge *Amphimedon viridis*; coll. G.O. Soledade.

Remarks. Specimens of *T. gnathophylloides* inhabited the channels of the aquiferous system of *A. viridis*. Sponges of the genus *Amphimedon* Duchassaing & Michelotti, 1864 have a considerable level of toxicity, which can limit the presence of associated organisms within (Albrizio *et al.*, 1995; Berlink *et al.*, 1996). Evidences of toxicity have been verified in *A. viridis* (Campos *et al.*, 2012), which may indicate a natural sponge defense against symbionts. The location of the two specimens of *T. gnathophylloides* inside *A. viridis* suggests that shrimp can tolerate the chemical defense of the sponge. Species of *Typton* Costa, 1844 are commonly recognized as sponge associated

(Holthuis, 1951) and evidence of parasitism in these shrimps based on tissue consumption of host sponges by symbiotic shrimp have already been reported in *Typton carneus* Holthuis, 1951, *Typton distinctus* Chace, 1972 and *Typton spongicola* Costa, 1844 (Duris *et al.*, 2011); however, little information is known regarding *T. gnathophylloides*. The species has been reported from the southeastern coast of Brazil (Nalesso *et al.*, 1995; Duarte and Nalesso, 1996). However, this material was recently reanalyzed (in part) and attributed to a new species (*Typton fapespae* Almeida, Anker and Mantelatto, 2014). *Typton gnathophylloides* has been previously reported for the Canary Islands (Pérez Sánchez and Moreno Batet, 1991; González Pérez *et al.*, 1995) but, according to d'Udekem d'Acoz (1999) these records need confirmation. Besides the type material, two specimens from Dry Tortugas, Florida (Holthuis, 1951), the two specimens reported here (previously cited in Soledade *et al.*, 2015) are the only known specimens of *T. gnathophylloides*. It is important to highlight that *A. viridis* is the first host of *T. gnathophylloides* identified to species level. *Amphimedon viridis* has been commonly reported along the Brazilian coast, but this is the first record of the species in the Abrolhos archipelago (Hajdu *et al.*, 2011).

In summary, new records of association between carideans and sponges are provided. It is important to emphasize the taxonomic accuracy of the present reports regarding the identifications of both associated organisms. This reinforces the importance of joint work of taxonomists from different zoological groups, which promotes a greater refinement of results related to the documentation of association records.

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REFERENCES

- Albrizio, S.; Ciminiello, P.; Fattorusso, E.; Magno, S. and Pawlik, J.R. 1995. Amphitoxin, a new high molecular weight antifeedant pyridinium salt from the Caribbean sponge *Amphimedon compressa*. *Journal of Natural Products*, 58: 647–652.
- Almeida, A.O.; Anker, A. and Mantelatto, F.L. 2014. A new snapping species of the shrimp genus *Typton* Costa, 1844 (Decapoda: Palaemonidae) from the coast of São Paulo, southeastern Brazil. *Zootaxa*, 3835: 110–120.
- Anker, A.; Hurt, C.; Javier, A.J. and Knowlton, N. 2008. Revision of the *Alpheus cylindricus* Kingsley, 1878 species complex (Crustacea: Decapoda: Alpheidae), with revalidation of *A. vanderbilti* Boone, 1930. *Zootaxa*, 1943: 53–68.
- Baeza, J.A.; Bolaños, J.A.; Hernandez, J.E.; Lira, C. and López, R. 2011. Monogamy does not last long in *Pontonia mexicana*, a symbiotic shrimp of the amber pen-shell *Pinna carnea* from the southeastern Caribbean Sea. *Journal of Experimental Marine Biology and Ecology*, 407: 41–47.
- Bauer, R.T. 2004. Remarkable shrimps: adaptations and natural history of the Carideans. Norman, University of Oklahoma Press, 282p.
- Berlink, R.G.S.; Ogawa, C.A.; Almeida, A.M.P.; Sanchez, M.A.A.; Malpezzi, E.L.A.; Costa, L.V.; Hadju, E. and Freitas, J.C. 1996. Chemical and pharmacological characterization of halitoxin from *Amphimedon viridis* (Porifera) from the southeastern Brazilian coast. *Comparative Biochemistry and Physiology*, 115: 155–163.
- Borradaile, L.A. 1915. Notes on Carides. *The Annals and Magazine of Natural History*, 15: 205–213.
- Bruce, A.J. 1976. Coral Reef Caridea and “Commensalism”. *Micronesica*, 12: 83–98.
- Campos, C.J.A.; Migotto, A.E.; Pinheiro, U. and Marques, A.C. 2012. Sponges as substrata and early life history of the tubulariid *Zyzzyzus warreni* (Cnidaria: Hydrozoa) in the São Sebastião Channel, Brazil. *Marine Biology Research*, 8: 573–583.
- Cardoso, I. 2006. Caridea (Crustacea, Decapoda) collected on the Brazilian (13°/22°) continental shelf and slope. *Zootaxa*, 1364: 1–44.
- Castro, P. 1971. The natantian shrimps (Crustacea, Decapoda) associated with invertebrates in Hawaii. *Pacific Science*, 25: 395–403.
- Chace Jr., F.A. 1972. The shrimps of the Smithsonian-Bredin Caribbean expeditions with a summary of the West Indian shallow-water species (Crustacea: Decapoda: Natantia). *Smithsonian Contributions to Zoology*, 98: 1–179.
- Coelho, P.A.; Almeida, A.O.; Souza-Filho, J.F.; Bezerra, L.E.A. and Giralde, B.W. 2006. Diversity and distribution of the marine and estuarine shrimps (Dendobranchiata, Stenopodidea and Caridea) from North and Northeast Brazil. *Zootaxa*, 1221: 41–62.
- Coelho, P.A. and Ramos, M.A. 1972. A constituição e a distribuição da fauna de decápodos do litoral leste da América do Sul entre as latitudes 5° N e 39° S. *Trabalhos Oceanográficos da Universidade Federal de Pernambuco*, 13: 133–236.
- Costa, O.G. 1844. Su due nuovi generi di Crostacei decapodi macrouri. *Annali delle Accademia degli Aspiranti Naturalisti, Napoli*, 2: 285–292.
- De Grave, S. and Anker, A. 2017. An annotated checklist of marine caridean and stenopodidean shrimps (Malacostraca: Decapoda) of the Caribbean coast of Panama. *Nauplius*, 25: e2017015.
- Duarte, L.F.L. and Nalesso, R.C. 1996. The sponge *Zygomycale parishii* (Bowerbank) and its endobiotic fauna. *Estuarine, Coastal and Shelf Science*, 42: 139–151.
- Duchassaing, P. and Michelotti, G. 1864. Spongiaires de la Mer Caraïbe. *Natuurkundige verhandelingen van de Hollandsche maatschappij der wetenschappen te Haarlem*, 21: 1–124.
- Duffy, J.E. 1992. Host use patterns and demography in a guild of tropical sponge-dwelling shrimps. *Marine Ecology Progress Series*, 90: 127–138.
- Duris, Z.; Horká, I.; Juracka, P.J.; Petrusek, A. and Sandford, F. 2011. These squatters are not innocent: the evidence of parasitism in sponge-inhabiting shrimps. *PLoS ONE*, 6: e21987.
- González Pérez, J.A.; Santana, J.I.; Jimenez S. and Pérez-Barroso, F.I. 1995. Primera cita de *Nematocarcinus gracilipes* y *Centroscomus crytacanthus* para Canarias. *Boletim do Instituto Oceanográfico*, 9: 257–259.
- Hajdu, E.; Peixinho, S. and Fernandez, J. 2011. Esponjas marinhas da Bahia: Guia de campo e laboratório. Rio de Janeiro, Museu Nacional, 276p. [Série Livros 45].
- Holthuis, L.B. 1951. A general revision of the Palaemonidae (Crustacea Decapoda Natantia) of the Americas. I. The subfamilies Euryrhynchidae and Pontoniinae. *Occasional Papers of the Allan Hancock Foundation*, 11: 1–332.
- Karplus, I. 1987. The association between gobiid fishes and burrowing alpheid shrimp. *Oceanography and Marine Biology: an annual Review*, 25: 507–562.
- Knowlton, N. and Keller, B.D. 1983. A new, sibling species of snapping shrimp associated with the Caribbean sea anemone *Bartholomea annulata*. *Bulletin of Marine Science*, 33: 353–362.
- Macdonald, K.S.; Ríos, R. and Duffy, J.E. 2006. Biodiversity, host specificity, and dominance by eusocial species among sponge-dwelling alpheid shrimp on the Belize Barrier Reef. *Diversity and Distributions*, 12: 165–178.
- Nalesso, R.C.; Duarte, L.F.L.; Pierozzi, I. Jr. and Enumo, E.F. 1995. Tube epifauna of the polychaete *Phyllochaetopterus socialis* Claparède. *Estuarine, Coastal and Shelf Science*, 41: 91–100.
- Pachelle, P.P.G.; Anker, A. and Tavares, M. 2015. New and additional records of the sponge shrimp genus *Typton* Costa, 1844 (Decapoda: Palaemonidae) from the Brazilian coast. *Papéis Avulsos de Zoologia*, 55: 317–322.
- Pérez Sánchez, J.M. and Moreno Batet, E. 1991. Invertebrados marinos de Canarias. *Ediciones del Abildo Insular de Grand Canaria. Las Palmas de Gran Canaria*, 1–335. ISBN 84–86127–62–9.
- Rafinesque, C.S. 1815. Analyse de la Natures ou Tableau de l’Univers et dès corps organisés. Palerme, pp. 1–224.

- Ríos, R. and Duffy, J.E. 2007. A review of the sponge-dwelling snapping shrimp from Carrie Bow Cay, Belize, with description of *Zuzalpheus*, new genus, and six new species (Crustacea: Decapoda: Alpheidae). *Zootaxa*, 1602: 3–89.
- Schmitt, W.L. 1924. Report on the Macrura, Anomura and Stomatopoda collected by the Barbados-Antigua Expedition from the University of Iowa in 1918. *University of Iowa Studies in Natural History*, 10: 65–99, pls. 1–5.
- Spence Bate, C. 1888. Report on the Crustacea Macrura collected by the Challenger during the years 1873-76.— Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the years 1873-76 24: i-xc, 1–942, Pl., 1–157.
- Soledade, G.O.; Fonseca, M.S. and Almeida, A.O. 2015. Shallow water stenopodidean and caridean shrimps from Abrolhos Archipelago, Brazil: new records and updated checklist. *Zootaxa*, 3905: 52–68.
- Udekem d'Acoz, C.d'. 1999. Inventaire et distribution des crustacés décépodes de l'Atlantique nord-oriental, de la Méditerranée et des eaux continentales adjacentes au nord de 25°N. *Patrimoines naturels (M.N.H.N./S.P.N.)*, 40, 383p.
- Williams, A.B. 1984. *Shrimps, Lobsters, and Crabs of the Atlantic Coast of the Eastern United States, Maine to Florida*. Washington, Smithsonian Institution Press, 550p.