



Is the octocoral *Erythropodium caribaeorum* (Cnidaria: Anthozoa) a folkloric species from Brazil?

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Abstract The encrusting octocoral *Erythropodium caribaeorum* started being reported in several harbors of the northeastern Brazilian coast as an invasive species. In 2011 a new species was described for the Brazilian coast, *Stragulum bicolor*, and some of its paratypes were previously labeled as *E. caribaeorum*, but that study did not discuss the taxonomic validity of *E. caribaeorum* or its occurrence in Brazil. The objective of the present study was to analyze the taxonomic status of the Brazilian specimens identified and cited as *E. caribaeorum*. All studied specimens belong to the species *S. bicolor*. Hence, we conclude that *E. caribaeorum* has not really been recorded in Brazil so far, being restricted to the northwestern Atlantic. The present study extends considerably the distribution of *S. bicolor* in Brazil, but also brings about interesting ecological data. This species colonizes any type of substratum, both natural and artificial, and lives in all coastal environments. 27 taxa were reported as basibiont organisms of this octocoral. The misidentification of species and the adoption of these folk species can lead to equivocal management and conservation measures, as in the present study in which a potentially invasive species (*E. caribaeorum*), was indeed a probable endemic Brazilian species (*S. bicolor*).

Key words: *Stragulum bicolor*, octocoral, distribution

Resumen El octocoral *Erythropodium caribaeorum* (Cnidaria: Anthozoa) es una especie folclórica en Brasil? El octocoral incrustante *Erythropodium caribaeorum* fue reportado en varios puertos del nordeste brasilero como una especie invasora. En 2011, una nueva especie fue descrita para la costa de Brasil, *Stragulum bicolor*, y algunos de los parátipos estaban previamente etiquetados como *E. caribaeorum*, pero dicho estudio no discutió la validez taxonómica de *E. caribaeorum* o su distribución en Brasil. El objetivo del presente trabajo fue analizar el estatus taxonómico de los especímenes brasileiros identificados como *E. caribaeorum* y definir si esa especie realmente ocurre en Brasil. Todos los individuos analizados pertenecían a la especie *S. bicolor*, razón por la cual podemos concluir que la especie *E. caribaeorum* no posee registros en Brasil hasta el momento, quedando restringida su distribución para el Atlántico Noroccidental. El presente estudio extiende considerablemente la distribución de *S. bicolor* en Brasil, además de otorgar interesantes datos taxonómicos y ecológicos. Esta especie coloniza varios tipos de sustratos, tanto naturales como artificiales y habita todos los ambientes costeros. 27 taxa fueron registrados como organismos basibiontes del octocoral. El error en identificación de especies y la adopción de estas especies folclóricas puede llevar a la

elaboración de medidas de manejo y conservación equivocadas, como en el presente estudio en el cual una especie apuntada como invasora (*E. caribaeorum*) se tornó una posible especie endémica de Brasil (*S. bicolor*).

Palabras clave: *Stragulum bicolor*, octocoral, distribución

Introduction

We define as a folkloric species one that is reported for a given area where it actually does not occur. Such a species has been wrongly identified, which generates a domino effect of citations in scientific publications that support its wrong distribution and may be caused other effects (e.g. invasive species list, etc.). Although this seems absurd, there are several examples. The sea anemone *Phymactis papillosa* (Lesson, 1830) (= *P. clematis*) has been cited for many years, since 1977, as the most abundant species in the coast of Buenos Aires, Argentina, in biological, ecological, and physiological studies (Zamponi 1977, Patronelli *et al.* 1987, 2008, Excoffon & Zamponi 1991, Acuña & Zamponi 1995, 1996, Zamponi & Pérez 1996, Zamponi *et al.* 1998a, 1998b, Oliveira *et al.* 2009). In 2012, a morpho-molecular analysis carried out by Gomes, Schama & Solé-Cava revealed that *P. papillosa* from Argentina was, actually, a new species: *Bunodosoma zamponii*. A folkloric species is based on use and on the lack of questioning of its “confirmed” identity. This seems to be the case of the encrusting octocoral *Erythropodium caribaeorum* (Duchassaing & Michelotti, 1860) in Brazil. This octocoral is very common and abundant in the Caribbean (Deichman 1936, Bayer 1961, Sebens & Miles 1988, Fonseca & Arrivillaga 2003) and started being reported for Brazil in conference abstracts and PhD dissertations (Silva *et al.* 2007, Silva 2008, Farrapeira 2009, 2011), and even in environmental impact reports made by IBAMA-Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA, 2009) as a potentially invasive species, based on its capacity to dominate substrata (Collins *et al.* 2005, García-Sais *et al.* 2005) and on the fact that it is found in harbors. In addition to citations in the grey literature, several specimens deposited in collections in Brazil were labeled as *E. caribaeorum* (Ofwegen & Haddad 2011). In 2011, Ofwegen & Haddad described a new genus and species for the Brazilian coast: *Stragulum bicolor*. Among the paratypes studied by the authors there were four samples previously labeled as *E. caribaeorum*, but their study did not discuss or taxonomically compare these species. The objective of the present study was to analyze the taxonomic status of the Brazilian

specimens identified as *E. caribaeorum* and to define whether this species does indeed occur in Brazil or is a folkloric species.

Materials and Methods

In the present study we studied specimens previously identified as *E. caribaeorum* from harbors in the states of Rio Grande do Norte (Natal Harbor) and Paraíba (Cabedelo Harbor), and collected new specimens in the states of Ceará, Rio Grande do Norte, and Pernambuco. Table 1 summarizes the data collected along the Brazilian coast. For comparison we studied specimens identified as *Stragulum bicolor* by Ofwegen & Haddad (2011) from Paranaguá Bay, state of Paraná (Table I), the type locality of the taxon. We collected specimens from natural and artificial substrata in intertidal regions, fixed them in formalin 4%, and preserved them in alcohol 70%. The colonies were identified through an analysis of diagnostic characters such as the shape of the colony, the distribution of polyps, the type of calyx, as well as the type and size of the sclerites. The sclerites were prepared on temporary glass slides and some of them were imaged using a scanning electron microscope (Hitachi S 405-A). Sclerites were measured under an optic microscope using an eyepiece-micrometer. The terminology used is according to Bayer *et al.* 1983. We deposited the studied series in the cnidarian collection of the GPA-Anthozoan Research Group, Centro Acadêmico de Vitória, Universidade Federal de Pernambuco, Brazil.

Results

All studied specimens (Table I) belong to the species *Stragulum bicolor* Ofwegen & Haddad, 2011.

Class Anthozoa Ehrenberg, 1831

Subclass Octocorallia Haeckel, 1866

Order Alcyonacea Lamouroux, 1812

Family Clavulariidae Hickson, 1894

Genus *Stragulum* Ofwegen & Haddad, 2011

Stragulum bicolor Ofwegen & Haddad, 2011

Diagnosis: See Ofwegen & Haddad, 2011: 39-40.

Description of specimens: encrusting colonies with a verrucous aspect, coenenchyme slender, rarely surpassing 0.5 mm in thickness (Fig. 1). Polyps with white anthocodia with a diameter that varies from 0.4 mm to 2.7 mm, short tentacles and fully retrac-

tile tentacles in conical calyces of up to 5 mm in height (Fig. 2). The coenenchyme of the base of the colony has fused sclerites (Fig.3a) and the upper layer has radiates and crosses with 0.10 - 0.18 mm long (Fig. 3b-e). The sclerites of the anthocodium

are small scales of 0.08 – 0.12 mm and tentacles with diminutive spindles. The inner layer of the coenenchyme is colorless and the upper layer is red or reddish.

Table I. - Summary sampling data of the colonies studied from Brazil. GPA: Cnidaria Collection of Grupo de Pesquisa de Antozoários of Universidade Federal de Pernambuco, Brazil. Natural substrate: shells, barnacles, corals and barks of mangrove.

State	Locality	Geographic coordinates	Substrate	Sampling dates	Previously identified as	Voucher Number
Ceará	Port of Pecém	03°32'30"S 38°48'29"W	Moorings of boats	v.2011	not identified	GPA 257
	Caponga Beach	04°02'21"S 38°11'35"W	Beach rocks	vi.2011	not identified	GPA 258
Rio Grande do Norte	Areia Branca Beach	04°56'07"S 37°08'27"W	Loose stones	iv.2011	not identified	GPA 259
	Port of Natal	05°46'21"S 35°12'20"W	Natural on Hull vessels ("Cape Horn" Ship)	xi.2006 viii.2007	<i>Erythropodium caribaeorum</i>	GPA 260 GPA 261
Paraíba	Port of Cabedelo	06°58'29"S 34°50'18"W	Natural on piers	on	<i>Erythropodium caribaeorum</i>	GPA 262
Pernambuco	Pedra Furada Beach, Itamaracá	07°44'09"S 34°49'25"W	Loose stones	x.2011	not identified	GPA 263
	Catuama Inlet Beach, Itapessoca River	07°40'35"S 34°50'28"W	Natural on corrals fishing and root of <i>Rizhophora mangle</i>	on ix.2011	not identified	GPA 264
Paraná	Paranaguá Bay, Sucuruí Channel	25°31'50"S 48°26'03"W	Sandy on natural substrate	bottom iv.2002	<i>Stragulum bicolor</i>	GPA 265

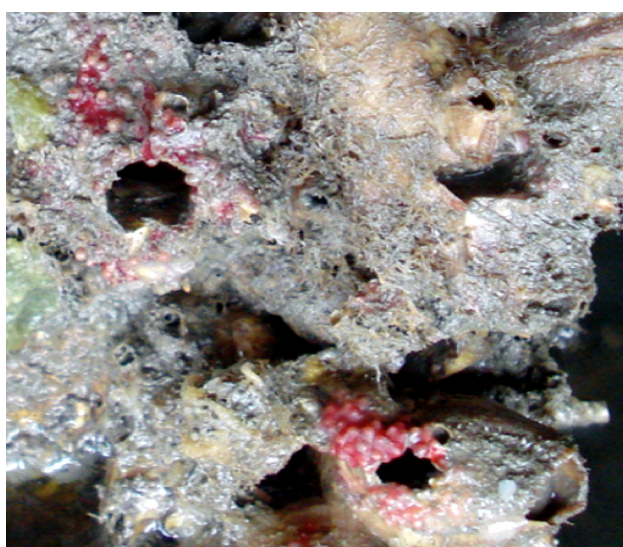


Figure 1. Live verrucous colony of *Stragulum bicolor* Ofwegen & Haddad, 2011 (GPA 262) from Cabedelo Harbor, state of Paraíba, Brazil, growing on barnacles. Scale bar: 1 mm.

Habitat: The species apparently attaches itself to any hard surface, including natural and artificial substrata (Table I). In Natal Harbor, Cabedelo Harbor, Catuama Inlet, and Paranaguá Bay the species was found growing on several encrusting and sedentary organisms. The colonies were on boat hulls, harbor seawalls, and fishing traps (fish weir); they were mainly found on shells of bivalves, polychaete tubes, and cirriped testas (Fig. 1, Table II). Twenty-seven taxa were recorded as secondary basibionts for this octocoral such as sponges, hydroids, bryozoan colonies and solitary and colonial ascidians (Table II), as well as roots of the mangrove plant *Rizhophora mangle*. However, this species is not an exclusive epibiont as it has been found on loose pebbles, beach rocks, and also on artificial substrates, such as boat moorings.

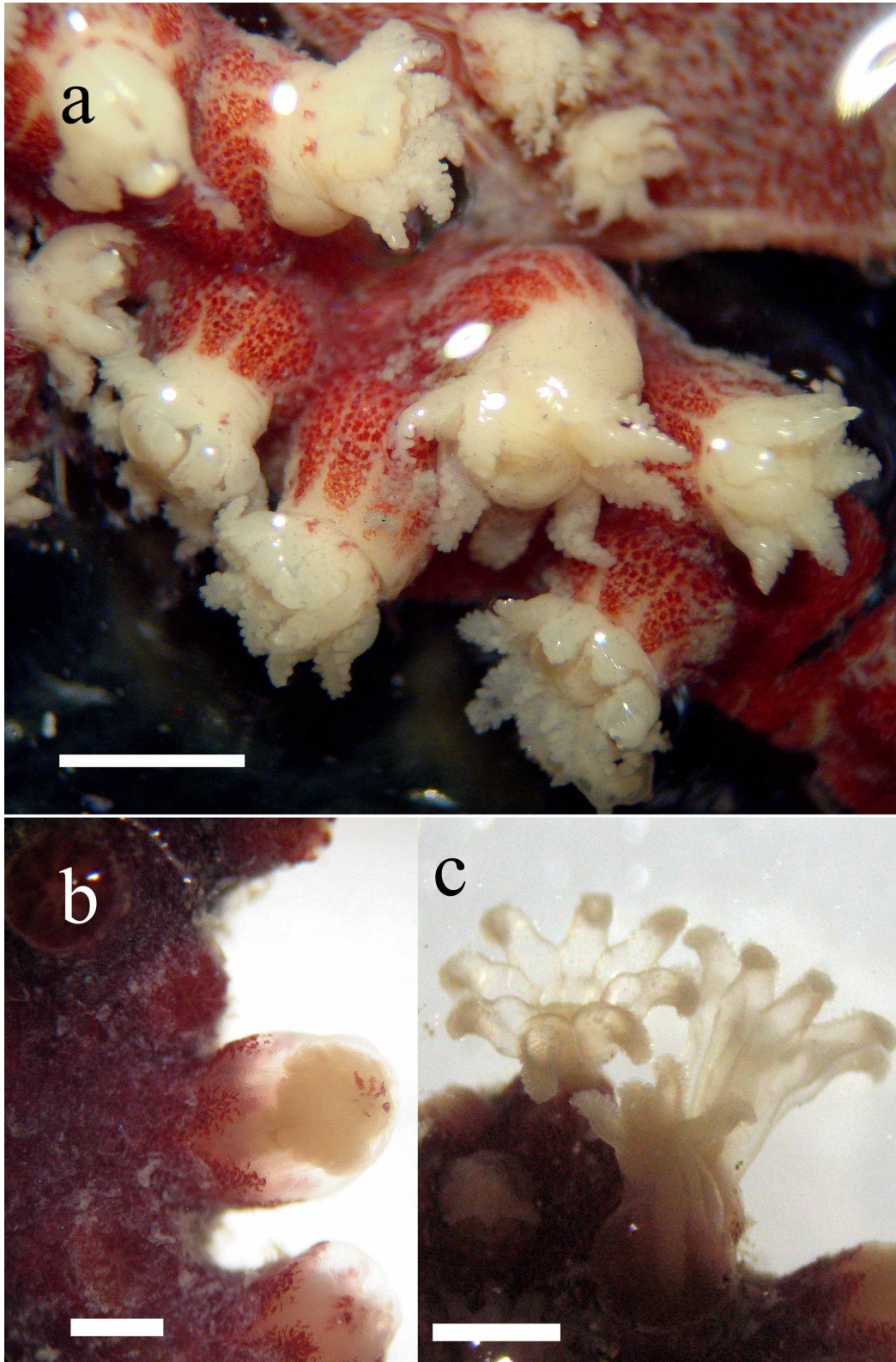


Figure 2. Live colony of *Stragulum bicolor* Ofwegen & Haddad, 2011 (GPA 264) from Catuama Inlet, Itapessoca River, state of Pernambuco, Brazil. a. colony growing on hydroids; b. retracted polyps in prominent calices; c. polyps with expanded short tentacles. Scale bar: a: 2.33 mm; b and c: 1.0 mm.

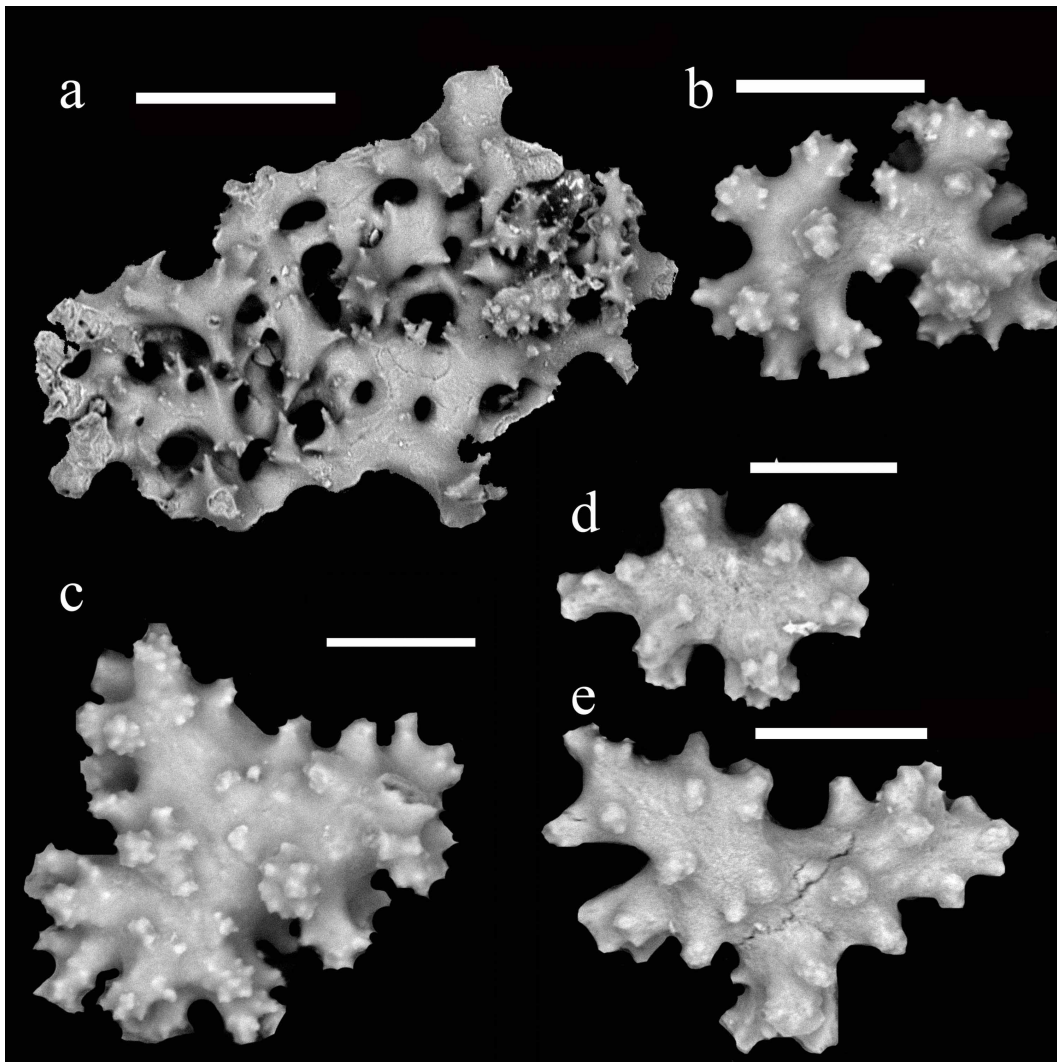


Figure 3. Sclerites of *Stragulum bicolor* Ofwegen & Haddad, 2011 (GPA 264). a. fused sclerites on the base of the colony; b-e. radiates and crosses from the upper layer of coenenchyme. Scale bar: a: 0.16 mm; b and e: 0.04 mm; c and d: 0.03 mm.

Distribution: Brazil: states of Ceará, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina (Ofwegen & Haddad, 2011). With the new records made in the present study its distribution was extended in north-eastern Brazil to the states of Rio Grande do Norte, Paraíba, and Pernambuco (Fig. 4).

Remarks

All records made so far, as well as the series collected and identified as *Erythropodium caribaeorum*, belong to the species *Stragulum bicolor*. Hence, we can state that there are no true records of *E. caribaeorum* in Brazil. Its distribution is restricted to the northwestern Atlantic, mainly in the Caribbean (Bayer 1961, Sebens & Miles 1988, Fonseca & Arrivillaga 2003). The diagnostic characters of *E. caribaeorum* differ a lot from the characters observed in the studied specimens. *E. caribaeorum* is characterized by forming encrusting colonies with a

plumose aspect, cream-colored or light brown, with small polyps with fine and long tentacles, without defined calyces and fully retractable (Bayer 1961), whereas *S. bicolor* forms verrucous colonies, usually reddish, with large polyps with robust, short and retractable tentacles on prominent calyces. In addition, *E. caribaeorum* is characterized by having a second type of tentacles, the sweeper tentacles, which help defend the colony (Sebens & Miles 1988). Both species are similar in their encrusting habit and in the sclerite types of both the coenenchyme and the basal layer of the fused sclerites, but this seems to be an adaptation of encrusting octocoral species. How species that are so different could be confounded? The main reason lies in the fact that identification was not carried out by specialists in octocoral taxonomy and the mistake was accepted and repeated by the scientific community, which created a folkloric species in the Brazilian fauna.

Table II. Basibionts list of the octocoral *Stragulum bicolor* Ofwegen & Haddad, 2011 from Brazil

Phylum	Class	Taxon
Mollusca	Bivalvia	<i>Crassostrea gazar</i>
		<i>Crassostrea rhizophorae</i>
		<i>Ostrea equestris</i>
		<i>Pinctada imbricata</i>
Annelida	Polychaeta	<i>Serpulidae</i>
		<i>Sabellidae</i>
Crustacea	Maxillopoda	<i>Amphibalanus improvisus</i>
		<i>Amphibalanus reticulatus</i>
		<i>Balanus trigonus</i>
		<i>Megabalanus tintinnabulum</i>
		<i>Striatobalanus amaryllis</i>
Porifera	Demospongiae	<i>Chondrylla nucula</i>
		<i>Halichondria sp.</i>
Cnidaria	Hydrozoa	<i>Dynamena crisioides</i>
	Anthozoa	<i>Leptogorgia setacea</i>
Bryozoa	Gymnolaemata	<i>Amathia vidovici</i>
		<i>Nolella stipata</i>
		<i>Savignyella lafontii</i>
		<i>Synnotum aegyptiacum</i>
Chordata	Asciacea	<i>Microcosmus exasperatus</i>
		<i>Pyura vitatta</i>
		<i>Styela canopus</i>
		<i>Styela plicata</i>
		<i>Botryllus planus</i>
		<i>Didemnum perlucidum</i>
		<i>Diplosoma listerianum</i>
		<i>Symplegma rubra</i>

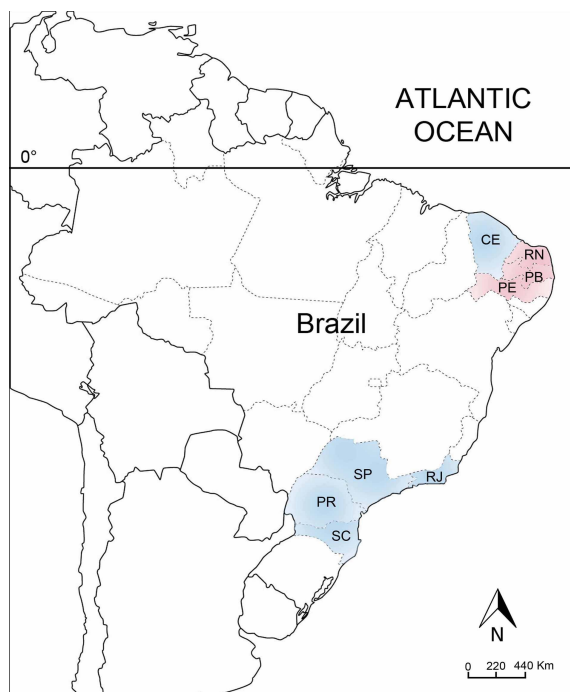


Figure 4. Distribution of *Stragulum bicolor* Ofwegen & Haddad, 2011. Blue: previous records; Pink: new records. Brazilian States: CE: Ceará; RN: Rio Grande do Norte; PB: Paraíba; PE: Pernambuco; RJ: Rio de Janeiro; SP: São Paulo; PR: Paraná; SC: Santa Catarina.

The present study not only clarifies the status of *E. caribaeorum* in Brazil, but also brings out interesting data on the ecology of *S. bicolor*. This octocoral was reported by Ofwegen & Haddad (2011) as a potentially invasive species in Brazil, as there are no records before 2000. In addition, no colonies were found on acrylic plates submerged monthly for one year (1987/1988) in Paranaguá Bay (Correia & Silva 1990 *sensu* Ofwegen & Haddad 2011), the same location where M. A. Haddad first found the new species on artificial substrata. This does not prove the invasive status of the species, especially because its reproductive biology and the periodicity of its reproductive cycle are unknown, as well as its distribution, since it was only recorded from Brazil. However, the species presents typical characteristics of an invasive species, such as fast growth (Ofwegen & Haddad 2011) and the multiplicity of habitats that it colonizes, both natural and artificial, as well as the diversity of environments that it inhabits, which include costal reefs, estuary, mangroves, and harbors. Another important result of the present study is the significant extension of the species' distribution in the Brazilian coast, which, except for the states of Bahia and Sergipe, is continuous from Santa

Catarina to Ceará (Fig. 4). One possible reason for this species passing unnoticed in several fauna inventories is the inconspicuous nature of its colonies, which at first sight do not look like a soft coral. In ten years of work on the reefs of Pernambuco we have never noticed this species, which was hidden among mangrove roots, shells, and valves, or under rocks. We cannot say that it has been recently introduced, but instead we highlight that it is an inconspicuous and very abundant species in the Brazilian coast, and for this reason we don't exclude the possibility that *S. bicolor* would be endemic instead of invasive.

It is important to base scientific studies on any subject on a strong taxonomical basis, otherwise wrong conclusions are likely to arise, which may lead to mistakes in environmental management and conservation, as in the present study in which a potentially invasive species (*E. caribaeorum*), was indeed a possible endemic Brazilian species (*S. bicolor*).

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References

- Acuña, F. H. & Zamponi, M. O. 1995. Ecology of intertidal sea anemones. Density, dispersion and autoecology of *Phymactis clematis* Dana, 1849 (Anthozoa: Actiniaria). **Ciencias Marinas**, 21: 1-12.
- Acuña, F. H. & Zamponi M. O. 1996. Ecología trófica de las anémonas intermareales *Phymactis clematis* Dana, 1849, *Aulactinia marplatensis* (Zamponi, 1977) y *A. reynaudi* (Milne-Edwards, 1857) (Actiniaria: Actiniidae): relaciones entre las anémonas y sus presas. **Ciencias Marinas**, 22: 397-413.
- Bayer, F. M. 1961. The Shallow-Water Octocorallia of the West Indian Region. A manual for marine biologist. Haya. **Fauna Curaçao and other Caribbean Islands** 12: 1-373.
- Bayer, J., Grasshoff, M. & Verseveldt J. 1983. **Illustrated trilingual glossary of morphological and anatomical terms applied to Octocorallia**. E.J. Brill/Dr. W. Backhuys, Leiden.
- Collin, R., Diaz M. C, Norenburg, J. L., Rocha, R. M., Sánchez, J. A., Schulz, A., Schwartz, M.L. & Valdés, A. 2005. Photographic identification guide to some common marine invertebrates of Bocas Del Toro, Panama. **Caribbean Journal of Science**, 41 (3): 638-707.
- Deichmann, E. 1936. The Alcyonaria of the Western part of the Atlantic Ocean. **Memoirs of the Museum of Comparative Zoology**, 53: 253-308.
- Excoffon, A.C. & Zamponi, M.O. 1991. La biología reproductiva de *Phymactis clematis* Dana, 1849 (Actiniaria: Actiniidae); gametogénesis, períodos reproductivos, desarrollo embrionario y larval. **Spheniscus**, 9: 25-39.
- Farrapeira, C. M. R. 2009. Cascos de embarcações como vetores passivos de transporte de espécies bentônicas brasileiras. **I Congresso Brasileiro sobre Bioinvasão**, São Luís, Maranhão, Brazil, 1-4.
- Farrapeira, C. M. R. 2011. Análise da biota portuária estuarina do nordeste brasileiro para detecção de espécies introduzidas. **Tese (doutorado)**. Pós-Graduação em Oceanografia, Universidade Federal de Pernambuco, Pernambuco, Brazil, 180 p.
- Fonseca, A.C. & Arrivilagra, A. 2003. Coral reefs of Guatemala, Pp. 159-169. *In*: J. Cortés (Ed.). **Latin American Coral Reefs**, Elsevier Science.
- García-Sais, J. R., Appeldoorn, R., Bruckner, A., Caldwell, C., Christensen, J. D., Lilyestrom, C., Monaco, M. E.; Sabater, J., Williams, E. & Diaz, E. 2005. The state of coral reef ecosystems of the commonwealth of Puerto Rico. *In*: J.E. Waddell (Ed.). **The state of coral reef ecosystems of the United States and Pacific freely associated states**. NOAA Technical Memorandum NOS NCCOS 11. NOAA/NCCOS Center for Coastal Monitoring and Assessment's Biogeography Team. Silver Spring, MD. 522 p.
- Gomes, P. B., Schama, R. & Solé-Cava, A. M. 2012. Molecular and morphological evidence that *Phymactis papillosa* from Argentina is, in fact, a new species of the genus *Bunodosoma* (Cnidaria: Actiniidae). **Journal of the Marine**

- Biological Association of the United Kingdom**, 92(5): 895-910.
- IBAMA - Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. 2009. **Estudo de impacto ambiental do estaleiro e base naval para a construção de submarinos convencionais e de propulsão nuclear, em Itaguaí – Rio de Janeiro**. Estudo de Impacto Ambiental, Volume 3. Brasília. 379p. Accessible at <http://licenciamento.ibama.gov.br> (Accessed 02/05/2014)
- Ofwegen, L. P. V. & Haddad M. A. 2011. A probably invasive new genus and new species of soft coral (Octocorallia: Alcyonacea: Clavulariidae) from Brazil. **Zootaxa**, 3107: 38-46.
- Olivera E. G., Patronelli, D. L. & Zamponi, M. O. 2009. Morphological and functional study of the marginal sphincter of the sea anemones *Phymactis clematis* and *Aulactinia marplatensis* from intertidal of Mar del Plata, Argentina. **Iheringia**, 99, 313-316.
- Patronelli, D., Olivera, E.G., Zamponi, M.O. & Crupkin, M. 2008. Caracterización morfológica, funcional y bioquímica del esfínter marginal de la anémona de mar *Phymactis clematis* (Cnidaria). **Investigaciones Marinas**, 29, 73-77.
- Patronelli D., Zamponi M. O., Bustos, A. & Vega, F. 1987. Morphological adaptations in the marginal sphincter of anemone *Phymactis clematis* Dana, 1849 from different environment. **Biochemical Physiology**, 88a: 337-340.
- Sebens, K.P. & Miles, J.S. 1988. Sweeper tentacles in a gorgonian octocoral: morphological modifications for interference competition. **Biological Bulletin**, 175: 378-387.
- Silva, J. S. V., Junqueira, A. O. R. & Fernandes, F. C. 2007. Espécies exóticas e criptogênicas do macrozoobentos do substrato consolidado da Baía de Sepetiba. **VIII Congresso de Ecologia do Brasil**, Caxambu, Minas Gerais, Brazil, 1-2.
- Silva, J. S. V. 2008. Comunidades macrobentônicas de substratos consolidados naturais e artificiais da Baía de Sepetiba /RJ com ênfase na dinâmica de espécies introduzidas. **Tese (Doutorado em Zoologia)**. Museu Nacional/Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, 169 p.
- Zamponi, M. O. 1977. La anemofauna de Mar del Plata y localidades vecinas. I. Las anemonas Boloceroidaria y Endomyaria (Coelenterata: Actiniaria). **Acta Neotrópica**, 23: 137-153.
- Zamponi M. O. & Pérez, C. D. 1996. Comparative morphological study of different species of Actiniaria between the intertidal zone from Mar del Plata and Santa Clara del Mar (Argentina). I. *Phymactis clematis* Dana, 1849 (Anthozoa, Actiniidae). **Biociências**, 4: 91-102.
- Zamponi M. O., Belém, M. J. C., Schlenz, E. & Acuña, F. H. 1998a. Distribution and some ecological aspects of Corallimorpharia and Actiniaria from shallow waters of the South American Atlantic Coast. **Physis**, A 55: 31-45.
- Zamponi M. O., Genzano, G. N., Acuña, F. H. & Excoffon, A.C. 1998b. Studies of benthic cnidarian populations along a transect off Mar del Plata (Argentina). **Russian Journal of Marine Biology**, 24: 7-13.

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