UNIVERSIDADE FEDERAL DE ALAGOAS
INSTITUTO DE CIÊNCIAS BIOLÓGICAS E DA SAÚDE
Programa de Pós-Graduação em Diversidade Biológica e Conservação nos Trópicos

ANDRÉ FELIPE BISPO DA SILVA

TAXONOMIA DO GÊNERO *Haliclona* Grant, 1835 (DEMOSPONGIAE: HAPLOSCLERIDA: CHALINIDAE) DO BRASIL

MACEIÓ - ALAGOAS
Fevereiro/2015

ANDRÉ FELIPE BISPO DA SILVA

TAXONOMIA DO GÊNERO *Haliclona* Grant, 1835 (DEMOSPONGIAE: HAPLOSCLERIDA: CHALINIDAE) DO BRASIL

Dissertação apresentada ao Programa de Pós-Graduação em Diversidade Biológica e Conservação nos Trópicos, Instituto de Ciências Biológicas e da Saúde. Universidade Federal de Alagoas, como requisito para obtenção do título de Mestre em CIÊNCIAS BIOLÓGICAS, área de concentração em Conservação da Biodiversidade Tropical.

Orientador: Prof. Dr. Eduardo Carlos Meduna Hajdu
Co-orientadora: Prof.ª Dr.ª Monica Dorigo Correia

MACEIÓ - ALAGOAS
Fevereiro/2015

Catalogação na fonte
Universidade Federal de Alagoas
Biblioteca Central
Divisão de Tratamento Técnico
Bibliotecária Responsável: Maria Helena Mendes Lessa

S586t Silva, André Felipe Bispo da.
Taxonomia do gênero *Haliclona* Grant, 1835 (Demospongiae: Haplocleridа: Chalinidade) do Brasil / André Felipe Bispo da Silva. – Maceió, 2015.
160 f. : il.

Orientador: Eduardo Carlos Meduna Hajdu.
Coorientadora: Monica Dorigo Correia.
Dissertação (Mestrado em Diversidade Biológica e Conservação nos Trópicos) – Universidade Federal de Alagoas. Instituto de Ciências Biológicas e da Saúde. Maceió, 2015.

Inclui bibliografias.

1. Porifera - Classificação. 2. Biodiversidade - Brasil. 3. Atlântico Ocidental. I. Título.

CDU: 57.063:593.4(81)

Folha de aprovação

André Felipe Bispo da Silva

TAXONOMIA DO GÊNERO *Haliclona* Grant, 1835 (DEMOSPONGIAE: HAPLOSCLERIDA: CHALINIDAE) DO BRASIL

Dissertação apresentada ao Programa de Pós-Graduação em Diversidade Biológica e Conservação nos Trópicos, Instituto de Ciências Biológicas e da Saúde. Universidade Federal de Alagoas, como requisito para obtenção do título de Mestre em CIÊNCIAS BIOLÓGICAS, área de concentração em Conservação da Biodiversidade Tropical.

Dissertação aprovada em 23 de fevereiro de 2015.

Prof. Dr. Eduardo Carlos Meduna Hajdu/UFRJ
Orientador

Prof. Dr. Ulisses dos Santos Pinheiro/UFPE
(membro titular)

Prof. Dr. Márcio Amorim Efe/UFAL
(membro titular)

Tamí mott

Profa. Dra. Tamí Mott/UFAL
(membro titular)

MACEIÓ - AL
Fevereiro / 2015

Dedico este trabalho a todos aqueles que eu amo, em especial à minha família.

AGRADECIMENTOS

A gratidão é, ou deveria ser, parte fundamental do nosso cotidiano. Até Newton reconheceu que “se conseguir ver mais longe que os outros, foi porque subi sobre ombros de gigantes”. Dessa forma, escrever essa parte da minha dissertação é extremamente prazeroso, pois me remete a diversos momentos do caminho percorrido até aqui.

Devo agradecer primeiramente à Deus, que na sua infinita bondade e amor me dá os meios de me tornar a cada dia um homem melhor.

Meus pais, Ana Cícera da Conceição e Cícero Bispo da Silva, avó, Amara Maria da Conceição, meus tios e primos também merecem um agradecimento especial. Pois sem o trabalho, dedicação e amor que a mim dispensaram, eu hoje não seria quem sou. Serei para sempre grato. Também agradeço à eles pelo apoio financeiro que deram para a minha formação acadêmica, foi fundamental.

Devo agradecer também a uma pessoa que entrou na minha vida um pouco antes dessa dissertação: Ivana Vieira. Ela é quem alegra meus dias, me faz sorrir e que é o exemplo daquela canção... “fundamental é mesmo o amor, é impossível ser feliz sozinho...”. Além disso, a agradeço pela ajuda com as coletas em Alagoas. Agradeço também à família da Ivana, por me receber tão bem no seu convívio.

Sou extremamente grato também ao meu orientador, Prof. Dr. Eduardo Hajdu por sempre ter me incentivado, apoiado e dado a liberdade para que eu andasse com minhas próprias pernas no mundo da taxonomia das esponjas. Agradeço ao Eduardo pelas grandes oportunidades oferecidas no decorrer do mestrado, como as de participar das Expedições para o Ceará-Rio Grande do Norte e Arquipélago de Abrolhos, são lembranças que levarei para sempre. Também sou grato por ter sempre me recebido bem nas estadas no Museu Nacional, e eventualmente, como visita em sua casa. Pela hospitalidade e carinho com que me receberam, também agradeço à Profa. Dra. Gisele Lôbo-Hajdu e aos filhos do casal, Erik e Karina.

Agradeço muito também à minha co-orientadora, Profa. Dra. Monica Dorigo Correia, que foi a primeira a incentivar meu trabalho com esponjas, dando a primeira oportunidade de aprimorar a minha visão espongiológica com as esponjas dos recifes da Praia do Francês, tema de meu trabalho de conclusão de curso em Biologia. Devo também à Profa. Monica por ter me apresentado ao Prof. Eduardo e me incentivado a prestar as seleções de mestrado.

Sou grato à Profa. Dra. Hilda Helena Sovierzoski, por ter aceitado meu pedido para estagiar no Setor de Comunidades Bentônicas e pelo seu incentivo desde então. Confesso que naquela época nem pensava em trabalhar com esponjas...

Aos meus professores sou também grato, desde àqueles dos tempos da escola – que ajudaram a moldar minha personalidade –, passando pelos professores da graduação que me formaram Biólogo e pelos professores do PPGDiBiCT, que me ajudaram a aprofundar meus conhecimentos.

Esse trabalho não chegaria até aqui sem o apoio dos amigos do Museu Nacional, em especial: Dr. João Luís de Fraga Carraro, à MSc Sula Salani Mota, MSc Camille Leal, Dra. Mariana de Souza Carvalho, MSc Cristiana Castello Branco, MSc Cássio Fonseca e MSc Júlio Fernandez. Com eles compartilhei momentos divertidíssimos. Mas todos também me ajudaram, e muito, com coleta de material, com os tombos no banco de dados e com a paciência de aguentar o aperto de mais um visitante lá no Museu!

Agradeço também ao MSc George Santos, o Bal, pela acolhida em sua casa quando tive em Recife para visitar a coleção da UFPE. Também agradeço à MSc Joana Sandes e o Prof. Dr. Ulisses Pinheiro pelo convite para colaborar com seu trabalho, que culminou na descrição de duas novas espécies, e pela recepção no LABPOR/UFPE sou grato a eles e a todos os demais alunos.

Agradeço aos membros da minha banca de avaliação continuada e de mestrado, em especial aos Profs. Drs. Tamí Mott e Ulisses Pinheiro, pelas excelentes sugestões e por sempre tratarem o meu trabalho de uma forma muito positiva e propositiva. Agradeço a eles e também ao Prof. Dr. Marcio Amorim Efe, por terem aceitado participar da banca de defesa dessa dissertação e pelas suas contribuições.

Sou grato à Dra. Maria da Conceição Tavares-Frigo, curadora da coleção de Porifera do Museu de Ciências Naturais (FZB/RS) pelos fragmentos dos holótipos de *Haliclona catarinensis*, *H. lernerae*, *H. lilaceus* e *H. mammillaris*. Ao Dr. Eric-Lazo-Wasem, curador da coleção do Yale Peabody Museum (EUA), pela sua solicitude em disponibilizar imagens dos holótipos de *H. albifragilis*, *H. caerulea* e *H. implexiformis*. Agradeço ao Prof. Dr. Guilherme Muricy por disponibilizar preliminarmente seus dados sobre *Haliclona* (*Halichoclona*) *vansoesti* do Rio de Janeiro. À Profa. Dra. Helena Matthews-Cascon, sua aluna Lorraine Cavalcante e a amiga MSc. Sula S. Mota sou grato por terem disponibilizado um espécime de *Haliclona* (*Reniera*) *chlorilla* do Piauí.

Também devo agradecimentos à todos os pesquisadores com quem tive a oportunidade de trocar e-mails e idéias a respeito das Haplosclerida marinhas, especialmente: Dr Rob Van Soest, Dr Sven Zea, Dr Pedro Alcolado, e Dr Bernard Picton.

Agradeço também ao amigo MSc Victor Cedro, que na graduação me incentivou bastante com o estudo das esponjas e que sempre está disponível para discutir taxonomia. Também sou grato ao próprio Victor Cedro, e ao MSc Anderson Miranda, ao MSc Rodolfo Nascimento, a mestranda Edinir Aprígio e ao biólogo Álvaro Borba Jr. pela ajuda nas coletas em Alagoas e pelas conversas e discussões ao longo do curso.

Aos amigos do Setor de Comunidades Bentônicas agradeço por tornar as tardes no laboratório mais prazerosas. Agradeço também aos amigos da graduação, pelos anos de convívio e amizade, lembranças especiais àqueles que agora prosseguem no mestrado/doutrado: Rodolfo Nascimento, Marvin Lins, Gesika Matias, Gilmar Oliveira Jr., J. Audenor Silva Jr. (Mickey), Yngrid Mickaelly, Yara Feitosa e Nathállia Salvador Aos amigos do mestrado, agradeço pela convivência, ajuda e troca de idéias. Obrigado Anyelet Valencia, Gustavo Ruano, Flávia Machulis, Gabriela Mota Gama, Gesika Matias, Jessika Neves, Jhonatan Santos (o Gaio), Rafael Carnaúba, Rodolfo Nascimento e Washington Azevedo (o Uoxito).

Muito obrigado também à Flávia Scigliano Dabbur, da ECOSCUBA Centro de Mergulho (Praia do Francês, Alagoas) pelo apoio para a amostragem de esponjas através de mergulho autônomo.

Agradeço ao próprio PPGDiBiCT, especialmente aos coordenadores e à Julliene Gonçalves da secretaria, por sempre serem atenciosos comigo e com minhas solicitações. E, por fim, à CAPES pela bolsa de mestrado concedida ao longo dos dois anos de mestrado, e também por juntamente com o CNPq ter financiado diversos projetos em nome dos meus orientadores.

“Objects without names cannot well be talked about or written about; without descriptions they cannot be identified and such knowledge as may have accumulated regarding them is sealed”. – GAHAN, 1923

RESUMO

As espécies de esponjas do gênero *Haliclona* que ocorrem na costa brasileira foram aqui revisadas. Foram encontradas e descritas 16 espécies, nove das quais consideradas espécies novas para a ciência. Quatro das nove espécies novas já estão publicadas, viz. *Haliclona* (*Halichoclona*) *dura* Sandes, Bispo & Pinheiro, 2014; *Haliclona* (*Reniera*) *chlorilla* Bispo, Correia & Hajdu, 2014; *Haliclona* (*Soestella*) *brassica* Sandes, Bispo & Pinheiro, 2014; *Haliclona* (*Soestella*) *peixinhoae* Bispo, Correia & Hajdu, 2014. Enquanto outras cinco espécies ainda serão formalmente descritas: *Haliclona* (*Gellius*) sp. nov., *Haliclona* (*Haliclona*) sp. nov., *Haliclona* (*Reniera*) sp. nov. 1, *Haliclona* (*Reniera*) sp. nov. 2, e *Haliclona* (*Soestella*) sp. nov. Também foram apresentadas a redescrição dos holótipos das espécies *Haliclona* (*Gellius*) *catarinensis* Mothes & Lerner, 1994, *Haliclona* (*Rhizoniera*) *lilacea* Mothes & Lerner, 1994, *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994 e *Haliclona* (*S*oestella) *melana* Muricy & Ribeiro, 1999. Além disso, novos registros são apresentados para as espécies *Haliclona* (*Halichoclona*) *vansoesti* De Weerdt, De Kluijver & Gomez, 1999, *Haliclona* (*Reniera*) *chlorilla* Bispo, Correia & Hajdu, 2014, *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965), *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965) e *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999. Foi ainda elaborada uma chave para identificação de todas as espécies de *Haliclona* de águas-rasas que ocorrem no Brasil. A biodiversidade e afinidades biogeográficas das espécies de *Haliclona* do Brasil foram discutidas. Os registros de *Haliclona* (*Reniera*) *manglaris* Alcolado, 1984 e *Haliclona* (*Rhizoniera*) *curacaoensis* (Van Soest, 1980) para a costa brasileira foram aqui considerados inválidos, pois ambos corresponderam à mesma espécie: *Cladocroce caelum* Santos, Da Silva, Alliz & Pinheiro, 2014.

Palavras-chave: Porifera, Biodiversidade, Atlântico Ocidental.

ABSTRACT

The species of sponges of the genus *Haliclona* occurring in the Brazilian coast were revised. Sixteen species were described, nine of which are new to science. Four of these species are already formally described, viz. *Haliclona* (*Halichoclona*) *dura* Sandes, Bispo & Pinheiro, 2014; *Haliclona* (*Reniera*) *chlorilla* Bispo, Correia & Hajdu, 2014; *Haliclona* (*Soestella*) *brassica* Sandes, Bispo & Pinheiro, 2014; *Haliclona* (*Soestella*) *peixinhoae* Bispo, Correia & Hajdu, 2014. While the five remaining are still to be formally described: *Haliclona* (*Gellius*) sp. nov., *Haliclona* (*Haliclona*) sp. nov, *Haliclona* (*Reniera*) sp. nov. 1, *Haliclona* (*Reniera*) sp. nov. 2, and *Haliclona* (*Soestella*) sp. nov.. We also redescribed the holotypes of *Haliclona* (*Gellius*) *catarinensis* Mothes & Lerner, 1994, *Haliclona* (*Rhizoniera*) *lilacea* Mothes & Lerner, 1994, *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994, and *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999. In addition, we present new records of *Haliclona* (*Halichoclona*) *vansoesti* De Weerdt, De Kluijver & Gomez, 1999, *Haliclona* (*Reniera*) *chlorilla* Bispo, Correia & Hajdu, 2014, *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965), *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965), and *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999. We present a key to all the shallow-water species of *Haliclona* occurring in the Brazilian coast. The biodiversity and biogeographic affinities of the Brazilian *Haliclona* were discussed. The records of *Haliclona* (*Reniera*) *manglaris* Alcolado, 1984 and *Haliclona* (*Rhizoniera*) *curacaoensis* (Van Soest, 1980) for the Brazilian coast were thus considered invalid, both corresponding to the same species: *Cladocroce caelum* Santos, Da Silva, Alliz & Pinheiro, 2014.

Keywords: Porifera, Biodiversity, Western Atlantic

LISTA DE FIGURAS

2 REVISÃO DA LITERATURA

3 ARTIGO 1: Two new shallow-water species of *Haliclona* from north-eastern Brazil (Demospongiae: Haplosclerida: Chalinidae)

4 ARTIGO 2: Two new species of *Haliclona* Grant, 1836 (Haplosclerida: Chalinidae) from Sergipe State, Brazil

5 ARTIGO 3: Biodiversity of shallow-water *Haliclona* (Demospongiae: Haplosclerida: Chalinidae) in the Brazilian coast: taxonomy, new records, and the description of five new species

6 ARTIGO 4: *Cladocroce caelum* in the Brazilian coast: new records and morphological data, with the invalidation of previous records of *Haliclona manglaris* and *Haliclona curacaoensis*

LISTA DE TABELAS

2 REVISÃO DE LITERATURA

3 ARTIGO 1: Two new shallow-water species of *Haliclona* from north-eastern Brazil (Demospongiae: Haplosclerida: Chalinidae)

4 ARTIGO 3: Biodiversity of shallow-water *Haliclona* (Demospongiae: Haplosclerida: Chalinidae) in the Brazilian coast: taxonomy, new records, and the description of five new species

5 ARTIGO 4: *Cladocroce caelum* in the Brazilian coast: new records and morphological data, with the invalidation of previous records of *Haliclona manglaris* and *Haliclona curacaoensis*

SUMÁRIO

1 APRESENTAÇÃO

A presente dissertação é o resultado da revisão taxonômica das espécies de esponjas marinhas do gênero *Haliclona* que ocorrem no Brasil. Este trabalho surgiu como parte da necessidade de descrever novas espécies que há vários anos esperavam por um nome, e de melhor delimitar as espécies já conhecidas, compreendendo melhor o grau de variabilidade morfológica exibido por cada uma delas. Além disso, uma futura revisão da classificação atual da família e da ordem em que está inserido *Haliclona* está por vir em razão das hipóteses filogenéticas baseadas em marcadores moleculares. Por isso é fundamental uma melhor delimitação morfológica das espécies desse grupo. Desta forma, o objetivo deste trabalho é de (re)descrever o mais detalhadamente possível as espécies de *Haliclona* que ocorrem nas águas rasas da costa brasileira e elaborar uma chave dicotômica de identificação dessas espécies.

Esta dissertação está redigida no formato de capítulos que correspondem a artigos científicos, dois dos quais já publicados e outros dois a serem submetidos.

O Artigo 1 trata da descrição de duas espécies de *Haliclona* que ocorrem no nordeste do Brasil. É um exemplo clássico do impedimento taxonômico, pois ambas as espécies já eram conhecidas desde o final da década de 80, porém somente cerca de 20 anos depois foram nomeadas adequadamente. Este capítulo já está publicado como *first view* no periódico Journal of the Marine Biological Association of the United Kingdom, e deve entrar como parte do volume especial com os trabalhos apresentados no *9th International Sponge Conference*.

O Artigo 2 trata da descrição de outras duas espécies de *Haliclona* do estado de Sergipe, preenchendo uma parte da lacuna existente no conhecimento da espongiofauna dessa área do Brasil, que até hoje é pouco conhecida. Este trabalho já está publicado no periódico Zootaxa.

O Artigo 3 apresenta uma sinopse das espécies de *Haliclona* de águas rasas do Brasil. Nele são descritas 16 espécies, sendo cinco delas novas para a ciência. Além disso, as redescrições de espécies pouco conhecidas são apresentadas. Uma chave para a identificação de todas as espécies estudadas é apresentada, o que facilitará o reconhecimento das mesmas.

Por fim, o Artigo 4 apresenta a invalidação dos registros de *Haliclona* (*Rhizoniera*) *curacaoensis* e *Haliclona* (*Reniera*) *manglaris* para o Brasil, onde consideramos que esses registros correspondem, na verdade, à *Cladocroce caelum*, uma espécie recentemente descrita para os recifes costeiros do nordeste do Brasil.

2 REVISÃO DA LITERATURA[1]

2.1 História taxonômica da ordem Haplosclerida

A história taxonômica da ordem Haplosclerida, excluída a subordem Spongillina, é brevemente revisada a seguir. Haplosclerida Topsent, 1928 atualmente se caracteriza por possuir um esqueleto composto de uma reticulação isodictial anisotrópica ou isotrópica e tendo exclusivamente óxeas ou estrôngilos como megascleras (VAN SOEST & HOOPER, 2002).

A simplicidade e grande variabilidade dos caracteres de Haplosclerida permitiu que diferentes autores elaborassem classificações distintas para as relações internas do grupo de acordo com seus respectivos pontos de vista.

GRIESSINGER (1971) e LÉVI (1973) consideraram existir duas tendências evolutivas em Haplosclerida, em uma há tendência do esqueleto de ser cada vez mais reforçado por espongina, representada pela família Haliclonidae. Enquanto em outra há uma tendência para um esqueleto cada vez mais reforçado por espículas, representada pela família Renieridae. Entretanto, a classificação de Griessinger-Leví sucumbiu às críticas de outros autores (WIEDENMAYER, 1977; BERGQUIST & WARNE, 1980; VAN SOEST, 1980) principalmente em razão da variabilidade e intergradação dos caracteres utilizados para distinguir as duas famílias: a quantidade de espongina, regularidade do esqueleto e dimensão das espículas.

WIEDENMAYER (1977) considerou que alguns gêneros recentes de Haplosclerida, como *Petrosia, Xestospongia, Calyx*, dentre outros, eram suficientemente distintos para justificar a criação de uma nova família, que ele chamou de Nepheliospongiidae Clarke, 1900, por considerar que o gênero fóssil *Nepheliospongia* era proximamente relacionado.

BERGQUIST (1980), então, elevou Nepheliospongiidae ao nível ordinal usando além da justificativa paleontológica, o uso de dados químicos, reprodutivos e morfológicos. Entretanto, VAN SOEST (1980) não aceitou a classificação de BERGQUIST (op. cit.) por levar em conta que a oviparidade é uma condição primitiva dentro de Demospongiae e por isso não deveria ser usada para definir um grupo. Ao contrário, VAN SOEST (op. cit) reconheceu cinco famílias dentro de uma única ordem Haplosclerida: famílias Haliclonidae (que é sinônimo-júnior de Chalinidae), Callyspongiidae, Niphatidae, Petrosiidae e Oceanapiidae. Por considerar difícil de

---

[1] A estrutura e critérios de citação deste capítulo seguem as normas do periódico **Zoologia**.

provar a relação entre o gênero fóssil *Nepheliospongia* e as Petrosiidae recentes, VAN SOEST (op. cit) abandonou o nome Nepheliospongidae, usando Petrosiidae em seu lugar.

A partir de então, surge uma dicotomia entre os diferentes autores trabalhando com Haplosclerida. Alguns seguem a classificação de BERGQUIST (1980) e BERGQUIST & WARNE (1980), como por exemplo DESQUEYROUX-FAUNDEZ (1984, 1987); KELLY-BORGES & BERGQUIST (1988) e FROMONT (1991, 1993). Enquanto outros seguem a classificação de VAN SOEST (1980), incluindo DE WEERDT (1985, 1986) e DE WEERDT & VAN SOEST (1986).

Posteriormente, FROMONT (1994) testou se a distribuição de esteróis em espécies de Haplosclerida e Petrosida sensu BERGQUIST (1980) confirmaria ou não esse esquema de classificação. Como resultado, não foi encontrado nas espécies estudadas os esteróis com anéis de ciclopropeno descritos por BERGQUIST (op. cit.) e que seriam uma sinapomorfia de Petrosida. Além disso, os dados químicos não conseguiram separar as espécies em duas ordens, visto que a composição de esteróis era similar entre Haplosclerida e Petrosida.

Atualmente, o *Systema Porifera* (VAN SOEST & HOOPER, 2002) aceita uma única ordem Haplosclerida, com duas subordens Haplosclerina e Petrosina, numa classificação mista das de BERGQUIST (1980) e VAN SOEST (1980).

Dentro da subordem Haplosclerina estão incluídas as famílias Chalinidae, Callyspongiidae e Niphatidae. Enquanto na subordem Petrosina, estão incluídas as famílias Calcifibrospongiidae, Phloeodictyidae e Petrosidae (VAN SOEST & HOOPER, OP CIT.)

2.2 História taxonômica da família Chalinidae

A família Chalinidae Gray, 1867 possui distribuição mundial, é a mais rica – com 474 espécies válidas descritas(VAN SOEST *et al.*, 2014) – e a mais complicada taxonomicamente dentre as famílias da ordem Haplosclerida Topsent, 1928. O que também se deve à escassez, simplicidade e, comumente, alta variabilidade dos caracteres morfológicos em todos os níveis taxonômicos (WIEDENMAYER, 1977; BERGQUIST & WARNE, 1980; DE WEERDT, 1985, 1989, 2000).

A história taxonômica desse grupo de esponjas é extremamente confusa. Cerca de 27 gêneros já foram propostos para essa família, dos quais apenas quatro são atualmente considerados válidos (ver DE WEERDT, 2002), nomeadamente:

Chalinula Schmidt, 1868, *Cladocroce* Topsent, 1892, *Dendroxea* Griessinger, 1971 e *Haliclona* Grant, 1835. Esse último inclui muitas espécies assinaladas a gêneros que foram subsequentemente considerados sinônimos (ver DE WEERDT, 1986, 1989 e 2000). Além desses, o gênero *Dendrectilla* Pulitzler-Finali, 1982 proposto para a espécie *Dendrectilla tremitensis* Pulitzler-Finali, 1982, foi classificado por seu autor como *incertae sedis* em Haplosclerida. Todavia, parece se encaixar em Chalinidae com base na definição dessa família (ver PULITZLER-FINALI, 1982).

De acordo com o *Systema Porifera* (DE WEERDT, 2002), Chalinidae foi originalmente proposta por GRAY (1867) e incluía diversos gêneros não relacionados de esponjas, como *Clathria* Schmidt, 1862 (atualmente na ordem Poecilosclerida), *Isodictya* Bowerbank, 1864 (também Poecilosclerida) e *Chalina* Grant, 1861 (= *Haliclona*). Esse último, o único que se enquadra em Chalinidae sensu De Weerdt, 2002.

Diferentes autores propuseram posteriormente a criação de mais três famílias (Renieridae Schmidt, 1870, Gelliadae Gray, 1872 e Adociidae de Laubenfels, 1936), todas compreendendo uma grande variedade de gêneros não-relacionados, mas cujos gêneros tipos eram proximamente relacionados a *Haliclona*.

A importância dada para os diferentes caracteres morfológicos variava de autor para autor. Enquanto GRIESSINGER (1971) e LÉVI (1973) consideravam que os gêneros *Haliclona* e *Reniera* estavam em famílias diferentes, viz. Haliclonidae e Renieridae, VAN SOEST (1980) considerava que havia muito mais semelhança entre esses dois gêneros que entre eles e os outros gêneros de suas respectivas famílias.

Seguindo esse raciocínio, VAN SOEST (op. cit.) propôs que essas três famílias fossem sinonimizadas com Haliclonidae de Laubenfels, 1932 (=Chalinidae), dando ênfase à arquitetura esquelética coanossomal.

Complementando o que foi proposto por VAN SOEST (op. cit.), DE WEERDT (1986) revisou as espécies de Chalinidae do Atlântico Nordeste e abandonou grande parte dos gêneros nominais da família, que passaram a ser considerados como sinônimos de *Haliclona*. Ao mesmo tempo, ela reconheceu seis grupos de espécies dentro do gênero *Haliclona*, além de manter válido o gênero *Acervochalina* (=sinônimo de *Chalinula*).

DE WEERDT (1989), então trabalhando com espécies de todo o Atlântico Norte, reconstruiu uma hipótese filogenética para Chalinidae na qual reconhece

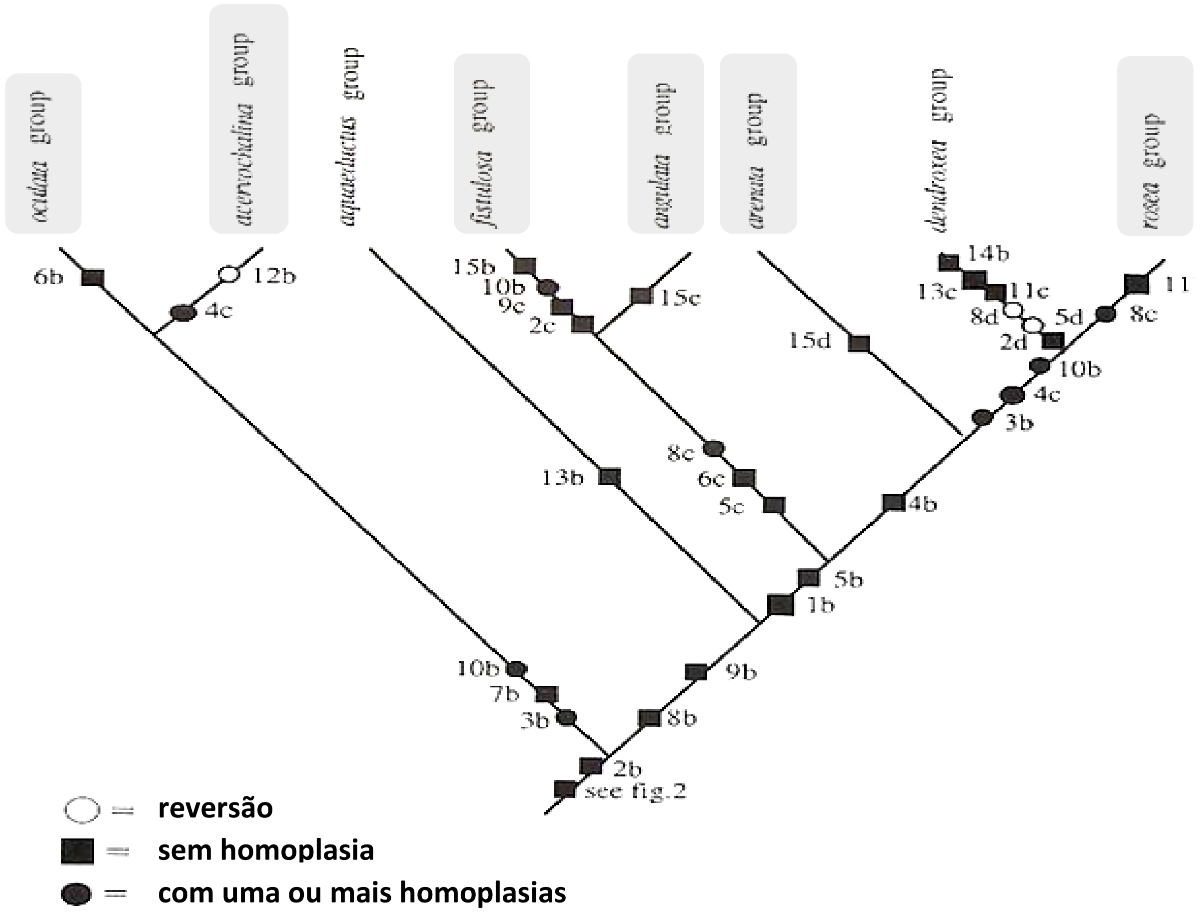


Figura 1. Cladograma representando as hipóteses de relações filogenéticas dos grupos de espécies de Chalinidae (modificado de DE WEERDT, 1986). Os grupos de espécies correspondentes aos atuais subgêneros de *Haliclona* estão destacados em cinza.

apenas oito grupos de espécies monofiléticos (Fig 1), incluindo os seis grupos de espécies de *Haliclona* já reconhecidos por DE WEERDT (1986), além dos grupos "*Acervochalina*" e "*Dendroxea*". A análise foi baseada em dados morfológicos, como a arquitetura do esqueleto, a forma de crescimento, tamanho do ósculo, tamanho e forma das espículas, quantidade de espongina, consistência da esponja e presença/ausência de microscleras. Entretanto, DE WEERDT (1986) não explicita se para reconstruir essa hipótese filogenética ela usou as espécies como táxons terminais ou os próprios grupos de espécies já estabelecidos em DE WEERDT (1989) com as espécies já incluídas *a priori*.

Entretanto, somente na mais recente revisão do grupo, uma monografia de Chalinidae do Caribe, que DE WEERDT (2000), após exame de todas as espécies-tipo disponíveis dos gêneros-nominais da família, nomeou devidamente esses grupos de espécies monofiléticos, substituindo os nomes provisórios utilizados em publicações anteriores (DE WEERDT, 1986, 1989; DE WEERDT *et al*., 1991). Os grupos '*oculata*', '*aquaeductus*', '*arenata*', '*fistulosa*', '*rosea*' e '*angulata*' passaram a ser os respectivos subgêneros de *Haliclona*: *Haliclona* Grant, 1835 (subgênero nominotípico); *Reniera* Schmidt, 1862; *Soestella*, De Weerdt, 2000; *Halichoclona* De Laubenfels, 1932; *Rhizonieira* Griessinger, 1971; *Gellius* Gray, 1867. Enquanto o grupo '*Acervochalina*' corresponde ao gênero *Chalinula* Schmidt, 1868 e o grupo '*Dendroxea*' ao gênero *Dendroxea* Griessinger, 1971. Isso resultou em gêneros com uma definição muito mais ampla, e no caso de *Haliclona*, com mais de 400 espécies e um grande número de subgêneros.

2.3 O gênero *Haliclona*

Haliclona, é o gênero mais rico em espécies dentro de Chalinidae. Assim, como a família, é amplamente distribuído, ocorrendo em todos os oceanos, ocupando as mais distintas faixas batimétricas, desde as águas muito rasas às profundas (DE WEERDT, 2002).

A classificação atual divide *Haliclona* em seis subgêneros com base em características da arquitetura esquelética, com subgêneros que variam desde a mais delicada reticulação unispicular a uma reticulação mais densa, confusa, ou com tratos primários paucispiculares (DE WEERDT, 2000, 2002).

Segundo o *World Porifera Database*, 428 espécies estão assinaladas ao gênero (VAN SOEST *et al.*, 2014), embora 218 delas não tenham sequer sido assinaladas a algum dos subgêneros. Dessas, apenas nove estão registradas para as águas rasas da costa brasileira: *Haliclona catarinensis* Mothes & Lerner, 1994, *Haliclona caerulea* (Hechtel, 1965), *Haliclona curacaoensis* (Van Soest, 1980), *Haliclona implexiformis* (Hechtel, 1965), *Haliclona lilaceus* Mothes & Lerner, 1994, *Haliclona mammillaris* Mothes & Lerner, 1994, *Haliclona manglaris* Alcolado, 1984, *Haliclona melana* Muricy & Ribeiro, 1999 e *Haliclona tubifera* (George & Wilson, 1919). Dentre as quais, apenas três são consideradas endêmicas: *Haliclona catarinensis*, *H. lilaceus* e *H. mammillaris*. Enquanto as demais se distribuem ao longo do Atlântico Tropical Ocidental (MURICY *et al.*, 2011, HAJDU *et al.*, 2011).

O número de espécies desse gênero no litoral brasileiro pode ser considerado pequeno se compararmos às 22 espécies já registradas para o Caribe (DE WEERDT, 2000; JACKSON *et al.*, 2006; DIAZ *et al.*, 2007).

O conhecimento da fauna de *Haliclona* no Brasil está baseado em descrições publicadas em trabalhos isolados (MOTHES & LERNER, 1994; MURICY & RIBEIRO, 1999; HAJDU *et al*., 2011) e em listas de espécies (CEDRO *et al.*, 2007). Santa Catarina e Bahia são, então, os estados com maior número de espécies de *Haliclona* registradas, seguidos por Alagoas, os dois primeiros com quatro e o último com três (MURICY *et al.*, 2011).

Alguns desses registros são incertos, como o de *Haliclona curacaoensis* que não apresenta descrição da espécie (CEDRO *et al*. 2007; MURICY *et al*. 2011), além de *H. tubifera* que foi registrada para Santa Catarina por LERNER (1996), mas DE WEERDT (2000) não considera o material brasileiro como coespecífico de *H. tubifera* do Caribe. Além disso, é provável que existam no litoral brasileiro espécies novas para a ciência que aguardam descrições formais.

2.4 A filogenia molecular de Haplosclerida

Diversas filogenias moleculares demonstraram que a ordem Haplosclerida é polifilética (BORCHIELLINI *et al.*, 2004; NICHOLS, 2005). Isso porque a subordem Spongillina, que corresponde às Haplosclerida de água doce, aparece como grupo-irmão de um clado que inclui membros de outras ordens de Demospongiae. Excluída Spongillina, as Haplosclerida marinhas (Haploscleromorpha) formam um grupo monofilético com elevado suporte (REDMOND *et al*., 2007, 2011, 2013).

O primeiro trabalho de filogenia molecular de Haplosclerida foi o de MCCORMACK *et al.* (2002), usando o marcador 28S rRNA. Embora tenha usado poucos táxons terminais (veja Tabela 1), já neste trabalho já era possível perceber que algumas famílias e gêneros de Haplosclerida são polifiléticos. Entretanto, os autores pontuam que o marcador 28S rRNA poderia estar mascarando as relações internas de Haplosclerida por apresentar uma alta taxa de substituição (Fig 2).

Os principais trabalhos usando marcadores moleculares para propor hipóteses filogenéticas são os de REDMOND *et al*. (2007, 2011, 2013). No primeiro já é possível identificar dois clados principais recuperados pelo marcador 18S rRNA, um dominado por membros das famílias Chalinidae e Callyspongiidae e outro por Petrosiidae (Fig 3). O segundo, usa 3 diferentes marcadores: o 28S rRNA, *cox1* e *nad1* e corrobora os resultados do primeiro, agora com mais táxons terminais é possível visualizar mais Clados: um Clado A dominado por *Haliclona* e *Callyspongia*, um Clado B com poucas espécies incluindo algumas do gênero *Haliclona*, além de *Amphimedon queenslandica* (Niphatidae), além de um Clado C com espécies de *Haliclona* e de membros da família Niphatidae e Petrosiidae (Fig 4).

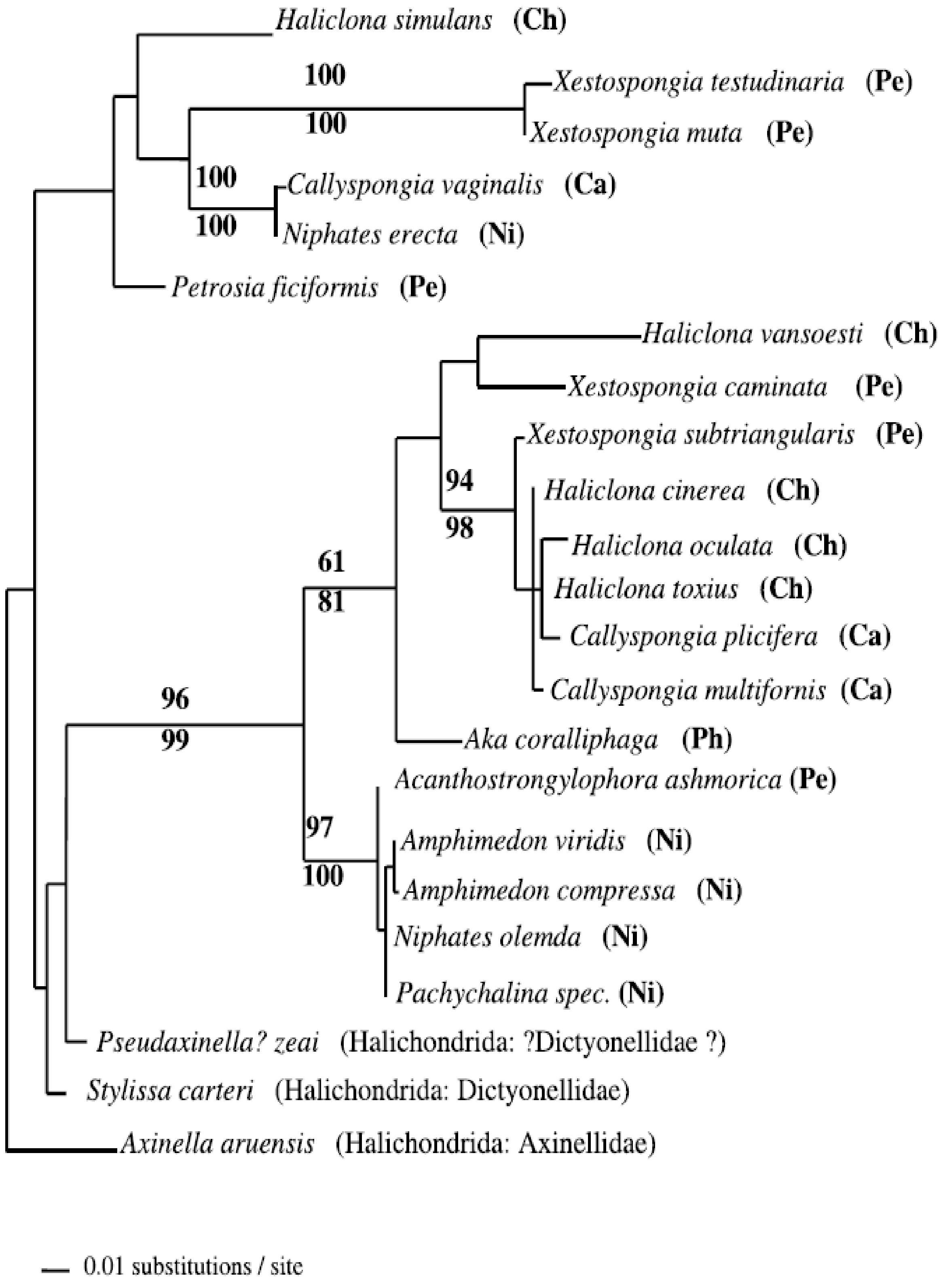


Figura 2. Hipótese filogenética de Haplosclerida proposta com base no marcador 28S rRNA (retirada de MCCORMACK *et al.*, 2002). Os números representam os valores de bootstrap (máxima parcimônia acima dos ramos, e máxima verossimilhança abaixo dos ramos). Ca = Callyspongiidae, Ch = Chalinidae, Ni = Niphatidae, Pe = Petrosiidae, Ph = Phloeodictyidae.

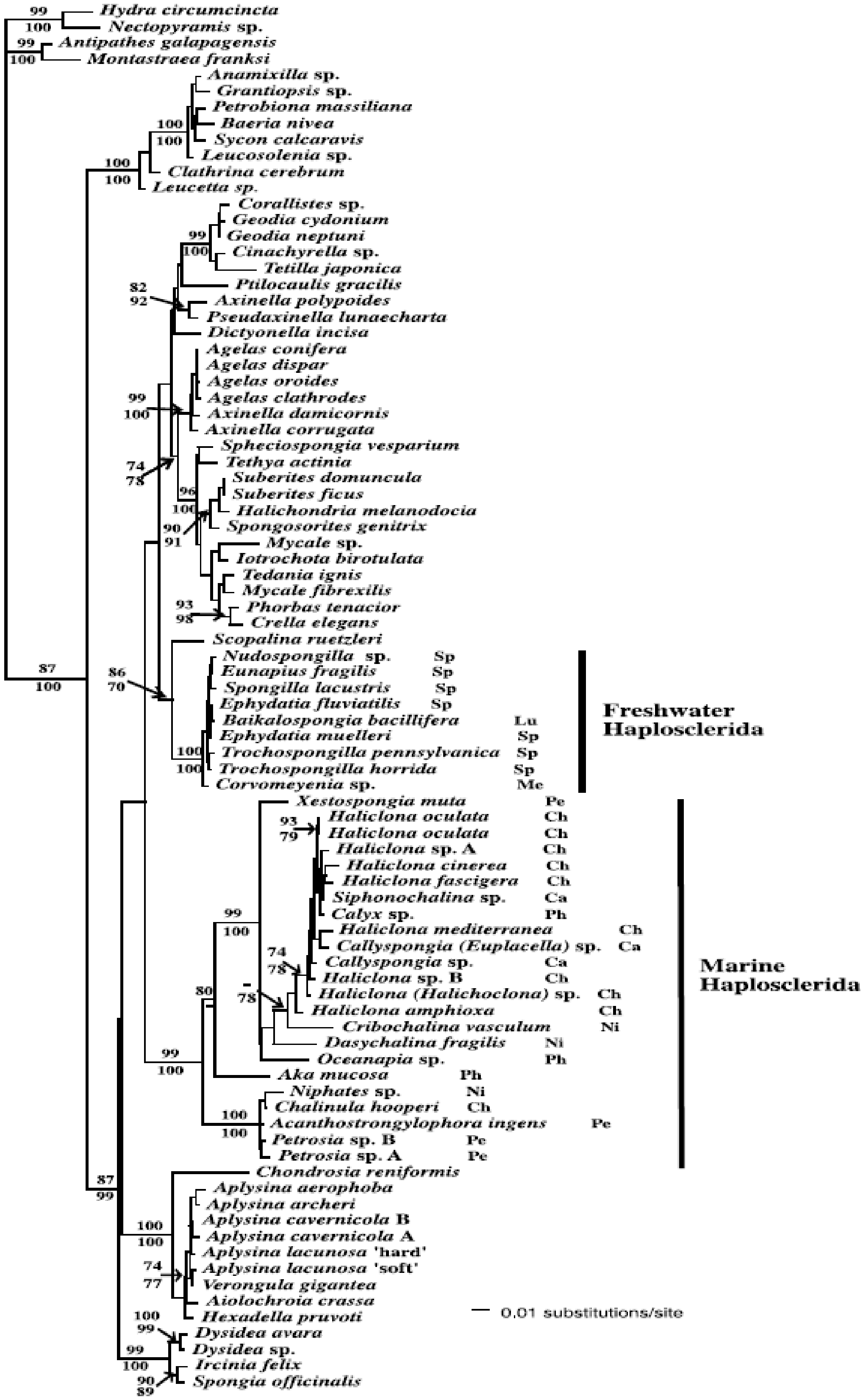


Figura 3. Hipótese filogenética de Haplosclerida proposta com base no marcador 18S rRNA (retirada de REDMOND *et al.*, 2007). Os números representam os valores de bootstrap (máxima parcimônia acima dos ramos, e máxima verossimilhança abaixo dos ramos). Ca = Callyspongiidae, Ch = Chalinidae, Ni = Niphatidae, Pe = Petrosiidae, Ph = Phloeodictyidae.

Tabela 1. Dados metodológicos dos trabalhos publicados sobre filogenia molecular de Haplosclerida.

Autor	**Marcador**	**Pares de base**	**Táxons terminais**	**Método**
MCCORMACK *et al.* (2002)	28S rRNA	352	20	Máxima Parcimônia e Máxima Verossimilhança
REDMOND *et al.* (2007)	18S rRNA	1595	23	Máxima Parcimônia e Máxima Verossimilhança
REDMOND *et al*. (2011)	28S rRNA D1-D5	1044	39	Máxima Verossimilhança e Inferência Bayesiana
	28S rRNA D1	301	74	
	cox1	Não informado	Até 1000	
	nad1	Não informado	Não informado	
REDMOND *et al.* (2013)	18S rRNA	Até 1000	76	Máxima Verossimilhança e Inferência Bayesiana

Já o terceiro trabalho usa dados do marcador 18S rRNA, e recupera os mesmos Clados já revelados em REDMOND *et al.* (2011), além de um novo Clado E (Fig 5) incluindo espécies do gênero *Janulum* (que pensava-se ser membro da Ordem Poecilosclerida), *Oceanapia* e *Siphonodictyon* (ambos Phloeodictyidae)

Apesar de diversos marcadores recuperarem Haploscleromorpha como um agrupamento monofilético, as relações internas nesse grupo ainda são controversas, principalmente quando comparadas à classificação atual, baseada na morfologia (REDMOND *et al.* 2013). Muitos dos gêneros, famílias e até mesmo as subordens Haplosclerina e Petrosina foram recuperados como polifiléticos, com alguns gêneros, a exemplo de *Haliclona*, aparecendo dispersos em vários clados (REDMOND *et al.*, 2007, 2011, 2013).

A concentração de espécies de *Haliclona* (Chalinidae) e *Callyspongia* (Callyspongiidae) no Clado A e de espécies de Petrosiidae e Niphatidae no Clado C das filogenias moleculares de Haploscleromorpha remete à classificação de Griessinger-Lévi que aponta como tendências evolutivas opostas em Haplosclerida de um grupo com o esqueleto reforçado por espongina (Fig 6) e outro com esqueleto reforçado por espículas (REDMOND *et al.*, 2011).

Entretanto, essa semelhança com a classificação de Griessinger-Lévi só é visualizada a nível dos Clados, enquanto gêneros com uma distinção morfológica

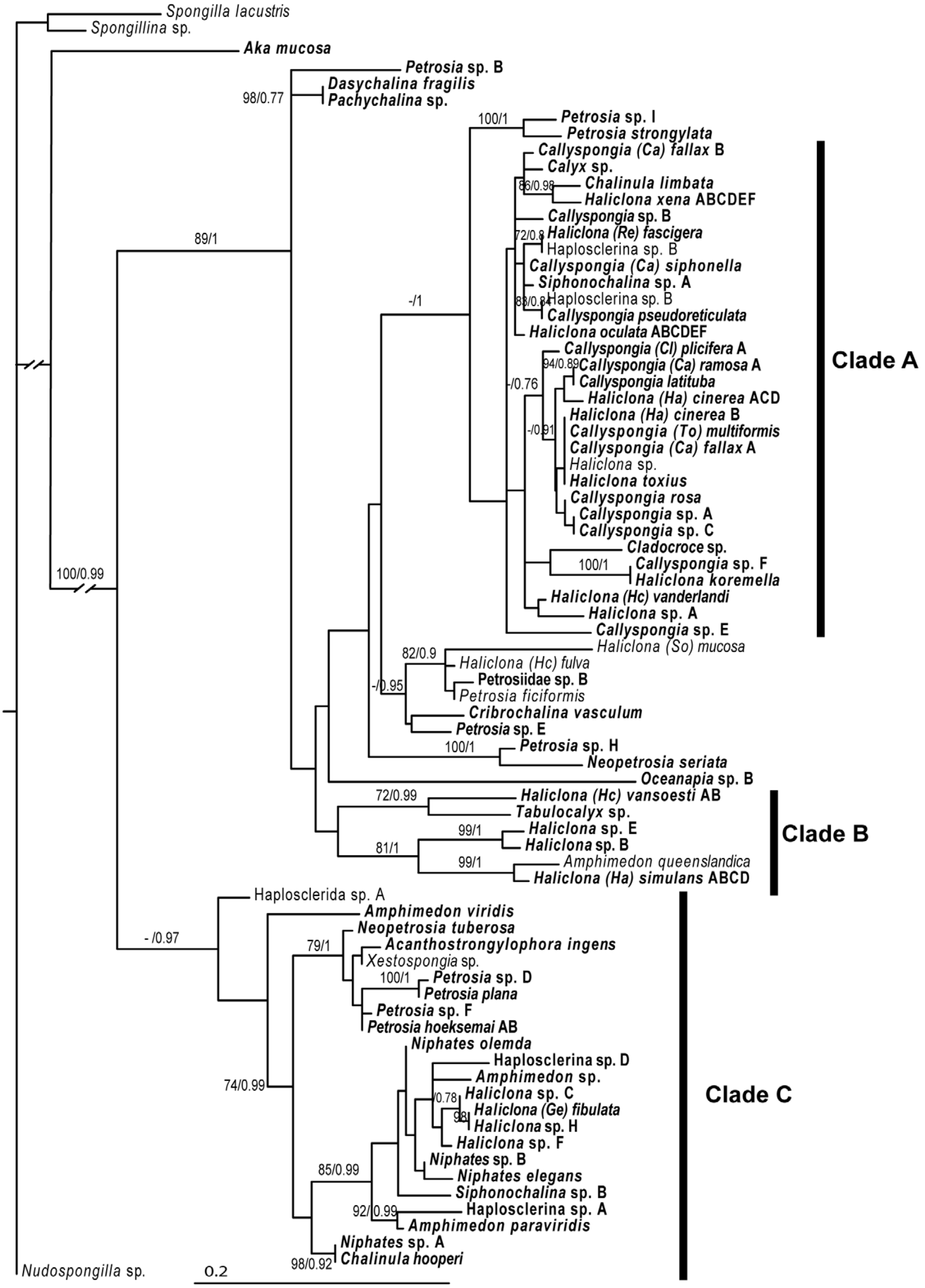


Figura 4. Hipótese filogenética de Haplosclerida proposta com base na região D1 do marcador 28S rRNA (retirada de REDMOND *et al.*, 2011). Números nos ramos representam os valores de bootstrap/probabilidade posterior.

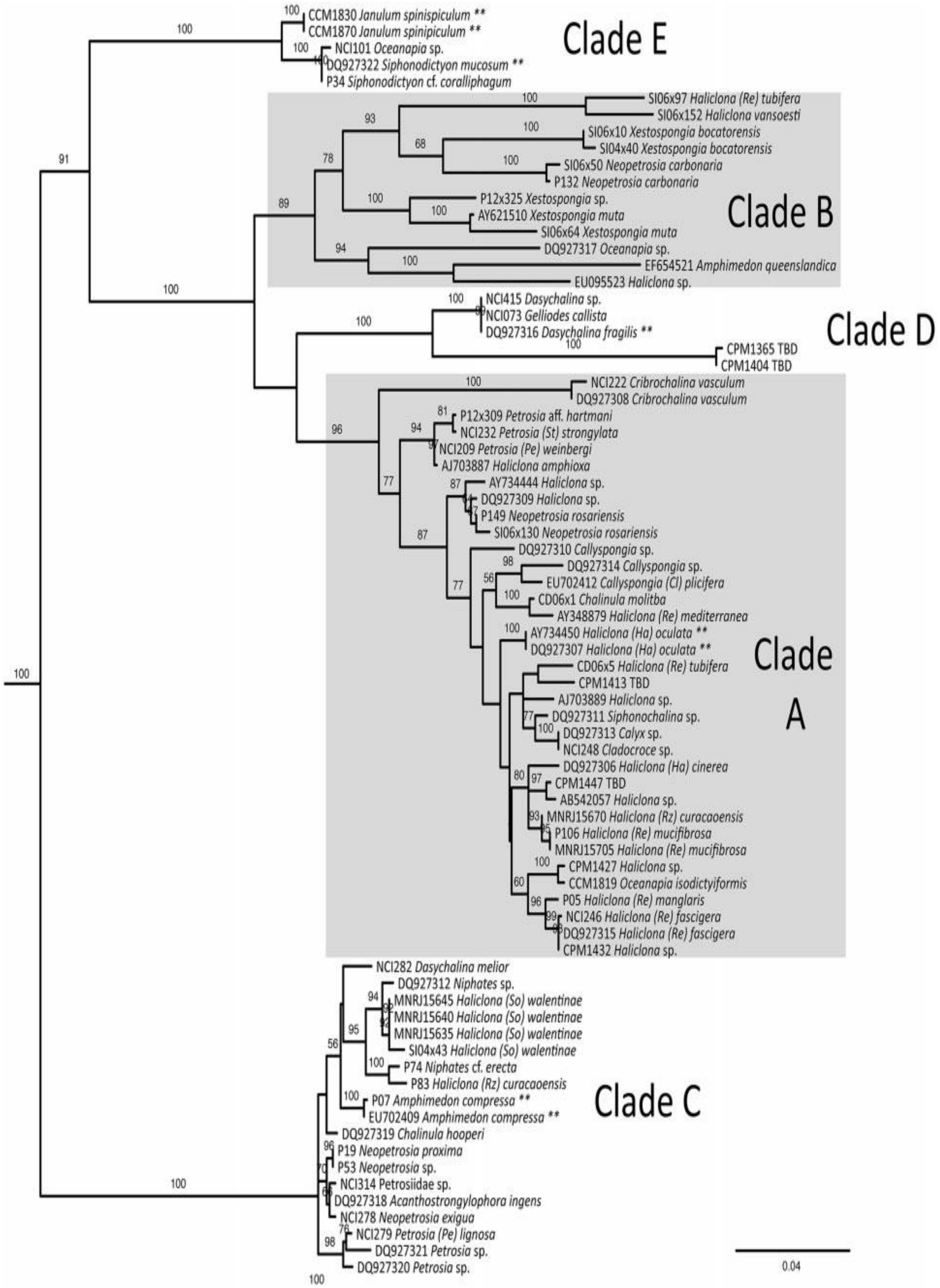


Figura 5. Hipótese filogenética de Haplosclerida proposta com base no marcador 18S rRNA (retirada de REDMOND *et al.*, 2013). Números nos ramos representam os valores de bootstrap.

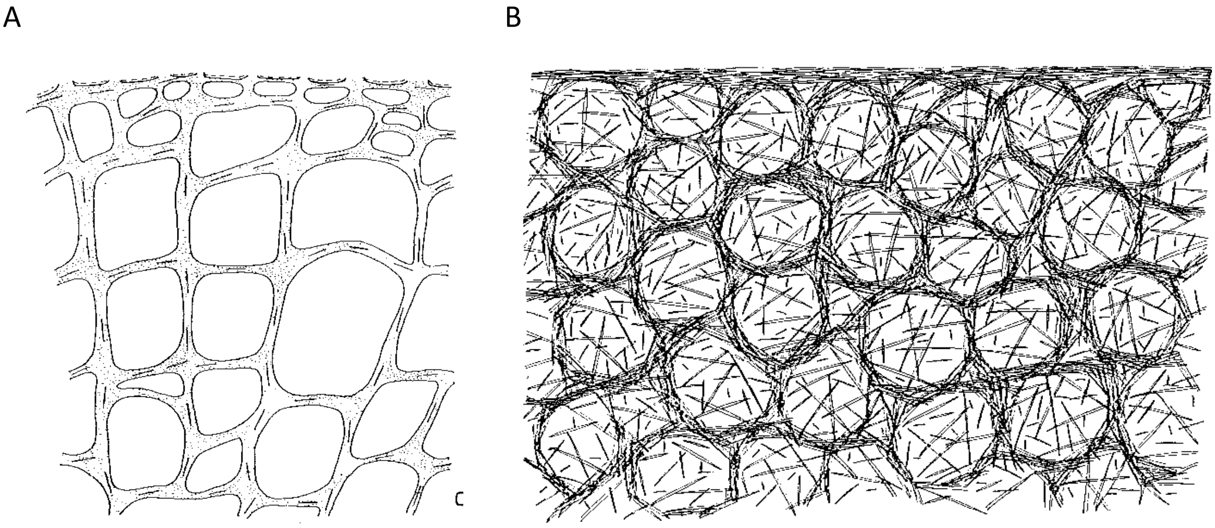


Figura 6. Esqueleto dominado por espongina do gênero *Callyspongia* (A) e esqueleto dominado por espícula do gênero *Petrosia* (B). Figuras retiradas de DE WEERDT (1986).

marcante (até mesmo em relação a dominado por espongina *vs.* dominado por espículas) não são separados pelos marcadores moleculares.

É fato que congruência entre diversos marcadores, como os mitocondriais e ribossomais diminui a chance de que as relações recuperadas pelas filogenias moleculares sejam meros artefatos (CÁRDENAS *et al.*, 2012), todavia o número de táxons terminais utilizados nas diversas filogenias moleculares ainda é pequeno se comparado a grande riqueza de espécies da ordem.

REFERÊNCIAS

ALCOLADO, P.M. 1984. Nuevas especies de esponjas encontradas en Cuba. **Poeyana 271**: 1-22.

BERGQUIST, P.R.. 1980. The ordinal and subclass classification of the Demospongiae (Porifera); appraisal of the present arrangement, and proposal of a new order. **New Zealand Journal of Zoology 7**(1): 1-6.

BERGQUIST, P.R. & WARNE, K.P. 1980. The Marine Fauna of New Zealand: Porifera, Demospongiae, Part 3 (Haplosclerida and Nepheliospongida). **New Zealand Oceanographic Institute Memoir 87**: 1-77.

BORCHIELLINI, C.; CHOMBARD, C.; MANUEL, M.; ALIVON, E.; VACELET, J. & BOURY-ESNAULT, N. 2004. Molecular phylogeny of Demospongiae: implications for classification and scenarios of character evolution. **Molecular Phylogenetics and Evolution 32**: 823-837

CÁRDENAS, P.; PÉREZ, T.& BOURY-ESNAULT, N. 2012. Chapter two – Sponge Systematics Facing New Challenges, p. 79-209. *In*: M.A. BECERRO, M.J. URIZ, M.

MALDONADO & X. TURON (Eds.). Advances in Sponge Science: Phylogeny, Systematics, Ecology. Elsevier: Oxford.

CEDRO, V.R.; HAJDU, E.; SOVIERZOSKY, H.H. & CORREIA, M.D. 2007. Demospongiae (Porifera) of the shallow coral reefs of Maceió, Alagoas State, Brazil, p. 233-237. *In*: M.R. CUSTÓDIO, G. LÔBO-HAJDU, E. HAJDU & G. MURICY (Eds.). Porifera research: biodiversity, innovation and sustainability. Rio de Janeiro: Museu Nacional.

DE WEERDT, W.H. & VAN SOEST, R.W.M.1986. Marine shallow-water Haplosclerida (Porifera) from the south-eastern part of the North Atlantic Ocean. **Zoologische Verhandelingen 225**: 1-49.

DE WEERDT, W.H. 1985. A systematic revision of the north-eastern Atlantic shallow-water Haplosclerida (Porifera, Demospongiae): 1. Introduction, Oceanapiidae and Petrosiidae. **Beaufortia 35** (5): 61-91.

DE WEERDT, W.H. 1986. A systematic revision of the north-eastern Atlantic shallow-water Haplosclerida (Porifera, Demospongiae): 2. Chalinidae. **Beaufortia 36** (6): 81-165.

DE WEERDT, W.H. 1989. Phylogeny and vicariance biogeography of North Atlantic Chalinidae (Haplosclerida, Demospongiae). **Beaufortia 39** (3): 55-90.

DE WEERDT, W.H. 2000. A monograph of the shallow-water Chalinidae (Porifera, Haplosclerida) of the Caribbean. **Beaufortia 50** (1): 1-67.

DE WEERDT, W.H. 2002. Family Chalinidae Gray, 1867, p. 852-873. *In*: J.N.A. HOOPER & R.W.M. VAN SOEST (Eds.*)* Systema Porifera. A guide to the classification of sponges. 1 Kluwer Academic/ Plenum Publishers: New York, Boston, Dordrecht, London, Moscow.

DESQUEYROUX-FAÚNDEZ, R. 1984. Description de la Faune des Haplosclerida (Porifera) de la Nouvelle-Calédonie. I. Niphatidae-Callyspongiidae. **Revue suisse de Zoologie 91** (3): 765-827.

DESQUEYROUX-FAÚNDEZ, R. 1987. Description de la faune des Petrosida (Porifera) de la Nouvelle-Calédonie. I. Petrosiidae-Oceanapiidae. **Revue suisse de Zoologie 94** (1): 177-243.

DÍAZ, M.C.; THACKER, R.W.; RÜTZLER, K. & PIANTONI, C. 2007. Two new haplosclerid sponges from Caribbean Panama with symbiotic filamentous cyanobacteria, and an overview of sponge–cyanobacteria associations. p. 31-39. *In*: M.R. CUSTÓDIO, G. LÔBO-HAJDU, E. HAJDU & G. MURICY (Eds.) Porifera research: biodiversity, innovation and sustainability. Rio de Janeiro: Museu Nacional.

FROMONT, J. 1991. Descriptions of species of the Petrosida (Porifera: Demospongiae) occurring in the tropical waters of the Great Barrier Reef. **The Beagle, Records of the Northern Territory Museum of Arts and Sciences 8** (1): 73-96.

FROMONT, J. 1993. Descriptions of species of the Haplosclerida (Porifera: Demospongiae) occurring in tropical waters of the Great Barrier Reef. **The Beagle, Records of the Northern Territory Museum of Arts and Sciences 10** (1): 7-40.

FROMONT, J.; KERR, S.; KERR, R.; RIDDLE, M. & MURPHY, P. 1994. Chemotaxonomic relationships within, and comparisons between, the orders Haplosclerida and Petrosida (Porifera: Demospongiae) using sterol complements. **Biochemical Systematics and Ecology 22** (7): 735-752.

GEORGE, W.C. & WILSON, H.V. 1919. Sponges of Beaufort (N.C.) Harbor and Vicinity. **Bulletin of the Bureau of Fisheries, Washington 36**: 129-179, pls. LVI-LXVI.

GRAY, J.E. 1867. Notes on the Arrangement of Sponges, with the Descriptions of some New Genera. **Proceedings of the Zoological Society of London 1867**(2): 492-558, pls XXVII-XXVIII.

GRIESSINGER, J.M. 1971. Etude des Réniérides de Méditerranée (Démosponges Haplosclérides). **Bulletin du Muséum national d'Histoire naturelle. 3** (3): 97-182.

HAJDU, E., PEIXINHO, S. & FERNANDEZ, J.C.C. 2011. **Esponjas marinhas da Bahia: guia de campo e laboratório**. Rio de Janeiro: Museu Nacional, 276 pp. [Série Livros, nº 45.]

HECHTEL, G.J. 1965. A systematic study of the Demospongiae of Port Royal, Jamaica. **Bulletin of the Peabody Museum of Natural History 20**: 1-103.

JACKSON, C.P.J.; DE WEERDT, W.H. & WEBBER, M.K. 2006. *Haliclona* (*Reniera*) *portroyalensis* n. sp., a new chalinid sponge (Porifera, Demospongiae, Haplosclerida) from the southeast coast of Jamaica. **Zootaxa 1319**: 59-68.

KELLY-BORGES, M.& BERGQUIST, P.R. 1988. Sponges from Motupore Island, Papua New Guinea. **Indo-Malayan Zoology 5**: 121-159.

LERNER, C.B. 1996. Esponjas da Ilha da Galé, Reserva Marinha Biológica do Arvoredo, Santa Catarina, Brasil (Porifera: Demospongiae). **Biociências 4** (2): 101-129.

LÉVI, C. 1973. Systématique de la classe des Demospongiaria (Démosponges). p. 577-631. *In*: P.P. GRASSÉ (Ed.). Traité de Zoologie. Anatomie, Systématique, Biologie. Spongiaires. 3(1). (Masson et Cie:Paris): 1-716.

MCCOMARCK, G.P.; ERPENBECK, D & VAN SOEST, R.W.M. 2002. Major discrepancy between phylogenetic hypotheses based on molecular and morphological criteria within the Order Haplosclerida (Phylum Porifera: Class Demospongiae). **Journal of Zoological Systematics and Evolutionary Research 40** (4): 237-240.

MOTHES, B. & LERNER, C.B. 1994. Esponjas marinhas do infralitoral de Bombinhas (Santa Catarina, Brasil) com descrição de três espécies novas (Porifera: Calcarea e Demospongiae). **Biociências 2**: 47-62.

MURICY, G. & RIBEIRO, S.M. 1999. Shallow-water Haplosclerida (Porifera, Demospongiae) from Rio de Janeiro State, Brazil (Southwestern Atlantic). **Beaufortia 49** (9): 83-108.

MURICY, G.; LOPES, D.A.; HAJDU, E.; CARVALHO, M.S.; MORAES, F.C.; KLAUTAU, M.; MENEGOLA, C. & PINHEIRO, U. 2011. Catalogue of Brazilian Porifera. Rio de Janeiro: Museu Nacional, 299 pp. [Série Livros n°46]

NICHOLS, S.A. 2005. An evaluation of support for order-level monophyly and interrelationships within the class Demospongiae using partial data from the large subunit rDNA and cytochrome oxidase subunit I. **Molecular Phylogenetics and Evolution 34**: 81-96.

REDMOND, N.E.; VAN SOEST, R.W.M.; KELLY, M.; RALEIGH, J.; TRAVERS, S.A.A. & MCCORMACK, G.P. 2007. Reassessment of the classification of the Order Haplosclerida (Class Demospongiae, Phylum Porifera) using 18S rRNA gene sequence data. **Molecular Phylogenetics and Evolution 43**: 344-352.

REDMOND, N.E.; RALEIGH, J.; VAN SOEST, R.W.M.; KELLY, M. & TRAVERS, S.A.A. 2011. Phylogenetic Relationships of the Marine Haplosclerida (Phylum Porifera) Employing Ribosomal (28S rRNA) and Mitochondrial (cox1, nad1) Gene Sequence Data. **PLoS ONE 6** (9): e24344.

REDMOND, N.E.; MORROW, C.C.; THACKER, R.W.; DIAZ, M.C.; BOURY-ESNAULT, N.; CÁRDENAS, P.; HAJDU, E.; LÔBO-HAJDU, G.; PICTON, B.E.; POMPONI, S.A.; KAYAL, E. & COLLINS, A.G. 2013. Phylogeny and Systematics of Demospongiae in Light of New Small-Subunit Ribosomal DNA (18S) Sequences. **Integrative and Comparative Biology 53** (3): 388-415.

SCHMIDT, O. 1868. Die Spongien der Küste von Algier. Mit Nachträgen zu den Spongien des Adriatischen Meeres (Drittes Supplement). Wilhelm Engelmann: Leipzig: i-iv, 1-44, pls I-V.

VAN SOEST, R.W.M. & HOOPER, J.N.A. 2002. Order Haplosclerida Topsent, 1928. p. 831-832. *In*: J.N.A. HOOPER & R.W.M. VAN SOEST (Eds.). Systema Porifera. Guide to the classification of sponges. 1 Kluwer Academic/ Plenum Publishers: New York, Boston, Dordrecht, London, Moscow.

VAN SOEST, R.W.M. 1980. Marine sponges from Curaçao and other Caribbean localities. Part III. Poecilosclerida. *In*: P.W. Hummelinck & L.J. Van der Steen (Eds.), Uitgaven van de Natuurwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen. No. 112. **Studies on the Fauna of Curaçao and other Caribbean Islands 66** (199): 1-167.

WIEDENMAYER, F. 1977. The Nepheliospongiidae Clarke 1900 (Demospongea, Upper Devonian to Recent), an ultraconservative, chiefly shallow-marine sponge family. **Eclogae geologicae Helvetiae 70** (3): 885-918.

3 ARTIGO 1: Two new shallow-water species of *Haliclona* from north-eastern Brazil (Demospongiae: Haplosclerida: Chalinidae)

ANDRÉ BISPO, MONICA DORIGO CORREIA AND EDUARDO HAJDU

Adapted from manuscript published as first view *in*
Journal of the Marine Biological Association of the United Kingdom (2014)[1]

Abstract

Haliclona is an unusually species-rich genus in Porifera, with more than 400 species described. In spite of many subgenera used in taxonomic housekeeping of these sponges, over half of them remain unassigned to subgenus, thus urging wide range redescriptions and taxonomic revisions of materials from all around the world. In this paper, we describe two new *Haliclona* spp. collected at Pernambuco, Alagoas and Bahia States (north-eastern Brazil, between 08º46' and 13º56'S). *Haliclona* (*Reniera*) *chlorilla* sp. nov. is a dark green or black coloured, delicately-branched species; and *Haliclona* (*Soestella*) *peixinhoae* sp. nov., a beige-coloured, tubular species, where tubes frequently bear large thorns and possess a conspicuous sub-superficial meandering reticulation. These species highlight the importance of including ex-situ collections in compiling baseline data, as both were present in scientific collections already by the 1980s and 1990s.

Keywords: Porifera, Biodiversity, Taxonomy, Tropical Western Atlantic

INTRODUCTION

Chalinidae Gray, 1867 is the largest family within the Haplosclerida Topsent, 1928. It is also the most complicated taxonomically due to the paucity, simplicity and high variability of its taxonomic characters (De Weerdt, 1989, 2000). *Haliclona* is the richest genus in the family and an unusually species-rich genus in the Porifera, with more than 400 species listed in the World Porifera Database (Van Soest *et al*., 2013). Many of these species were described for other genera, later synonymized with *Haliclona*. In spite of the six subgenera currently used for taxonomic housekeeping in *Haliclona*,

---

[1] A estrutura e os critérios de citação deste capítulo seguem as normas do periódico **Journal of the Marine Biological Association of the United Kingdom.**.

over 200 species remain unassigned to subgenus, which reflects the exceedingly poor knowledge on the morphology of these sponges, and calls for urgent redescription of historical materials from all around the world. Ideally, these reassessments shall be conducted side by side with taxonomic revisions of regional faunas, undertaken on the basis of large series of freshly collected materials. This is the rationale underpinning our efforts for an improved knowledge of Brazilian *Haliclona* spp. In this paper, we describe two new species of *Haliclona*, collected at Pernambuco, Alagoas and Bahia States, between 08º46' and 13º56'S.

MATERIAL AND METHODS

Specimens were collected by snorkeling or SCUBA diving in several localities indicated in Figure 1. The preparation of spicules for light and electron microscopy (SEM), and thick sections was made following Hajdu *et al*. (2011). The SEM microscope used was a JEOL 6390 LV of the Departamento de Invertebrados of Museu Nacional/UFRJ. Spicule dimensions are based on measurements of 30 fully grown spicules for each specimen, and presented as minimum–*mean*–maximum length / mi.–*me.*–ma. width. To avoid confusion of Brazilian geopolitical regions (north-eastern) and marine ecoregions (Eastern and Northeastern), whenever referring to the latter, the word ecoregion is employed.

Holotype and paratypes of *Haliclona* (*Reniera*) *chlorilla* sp. nov. are deposited in the MNRJ Porifera collection (Museu Nacional, Universidade Federal do Rio de Janeiro). Holotype and two paratypes of *Haliclona* (*Soestella*) *peixinhoae* sp. nov. are deposited in the MNRJ Porifera collection. The three remaining paratypes of this species are deposited in the Porifera collection of Universidade Federal da Bahia (UFBA-POR). Fragments of types originating from Alagoas State are deposited in the Porifera collection of Universidade Federal de Alagoas (UFALPOR).

Classification follows the Chalinidae chapter in the *Systema Porifera* (De Weerdt, 2002)

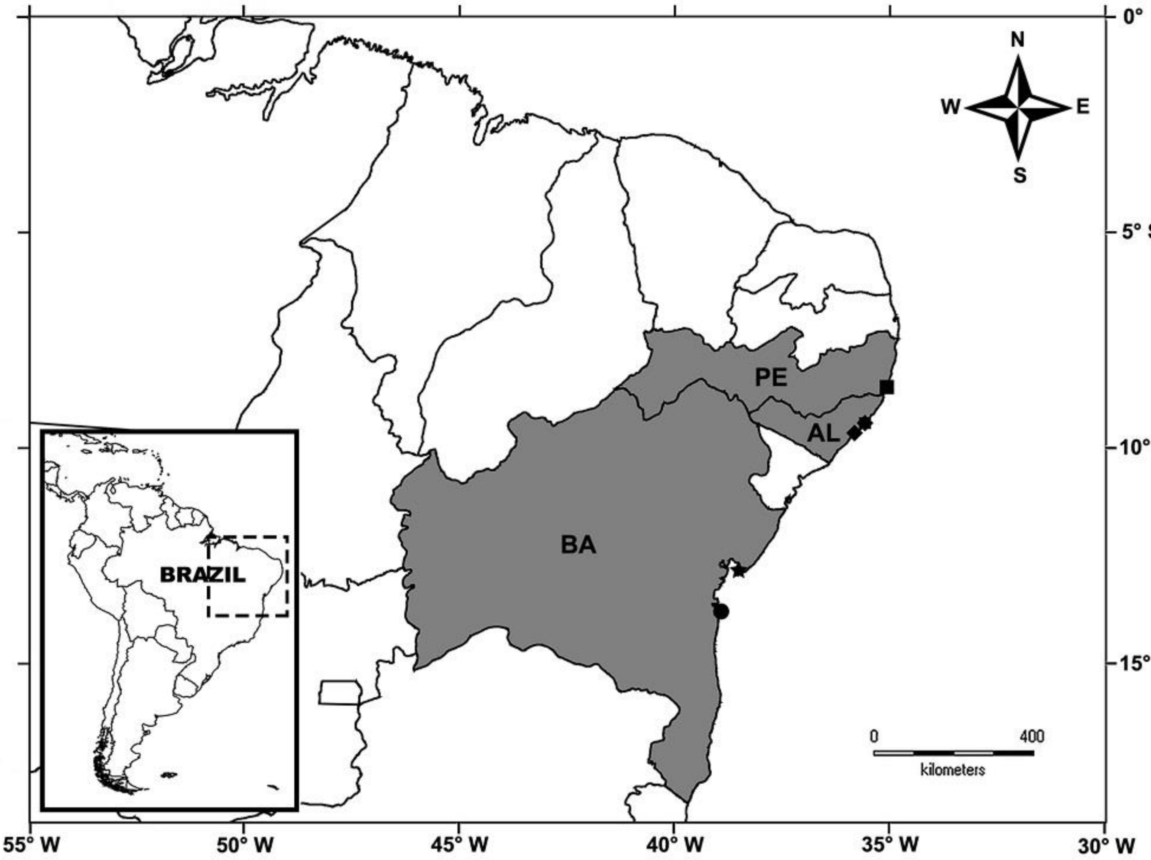


Fig. 1. Collection sites of the two new species. ■ = Ponta dos Carneiros, Tamandaré, PE; ✸ = Ponta do Prego, Maceió, AL; ◆ = Praia do Francês, Marechal Deodoro, AL; ★ = Ponta de Montserrat, Salvador, BA; ● = Taipús de Fora, Maraú, BA. Abbreviations of the states are as follow: AL=Alagoas, BA=Bahia, PE=Pernambuco.

SYSTEMATICS

Class DEMOSPONGIAE Sollas, 1885
Order HAPLOSCLERIDA Topsent, 1928
Family CHALINIDAE Gray, 1867
Genus *Haliclona* Grant, 1836
Subgenus *Reniera* Schmidt, 1862

Haliclona (*Reniera*) *chlorilla* sp. nov.
(Figures 2–3; Tables 1–2)

TYPE MATERIAL

Holotype: MNRJ 17026 - Praia do Francês (sandstone reefs, ca. 09°45'58.35''S, 35°50'10.62''W), Marechal Deodoro (AL, Brazil), ca. 1 m depth, coll. M.D. Correia, 16 June 2011. Fragment deposited under UFALPOR 0718.

Paratypes: MNRJ 1528 - Praia de Ponta dos Carneiros (seagrass, ca. 08°41'46.14''S, 35°04'42.59''W), Tamandaré (PE, Brazil), ca. 1 m depth, coll. E. Hajdu & G. Muricy, 1998; MNRJ 17027 - Ponta do Prego (tide pool on coral reef, ca. 09°31'48''S, 35°35'30''W), Maceió (AL, Brazil), 1 m depth, coll. A. Bispo, 11 January 2012. Fragment deposited under UFALPOR 0773; MNRJ 17610 - Ponta Verde (tide pool on coral reef, ca. 09°39'58''S 35°41'38''W), Maceió (AL, Brazil), ca. 0.5 m depth, coll. M.D. Correia, 06 February 2008. Fragment deposited under UFALPOR 0454.

DIAGNOSIS

Haliclona (*R.*) *chlorilla* sp. nov. is set apart from other Tropical Western Atlantic *Haliclona* spp. by the combination of delicate, anastomosing branches, dark green or black live colour, and absence of any microscleres.

DESCRIPTION

The holotype was growing on calcareous macroalgae (*Jania adhaerens*) and has a more compact morphology than observed in other specimens (Figure 2A). The species is most frequently repent (Figure 2A–D), consisting of slender and delicate, cylindrical, anastomosing branches, 2–5 mm in diameter, with a smooth surface. These branches could grow erect in specimens found in more sheltered habitats, such as crevices in sandstone reefs (Figure 2C). Oscula are numerous, circular, flush with the surface or just slightly elevated, usually aligned in rows along the branches, 0.4–1 mm in diameter. Consistency is very delicate, soft and fragile. Colour alive is dark green or black, becoming beige in ethanol.

Skeleton

The ectosomal skeleton is a tangential, isotropic and unispicular reticulation forming three-, four-sided or polygonal meshes (Figure 3A). The choanosomal skeleton is an isotropic and unispicular reticulation, forming three-, four-sided or polygonal meshes, around an off-central lumen running longitudinally inside the branches (Figure 3B–C). Spongin is scarce, present at the nodes of the reticulation, as usual in the subgenus.

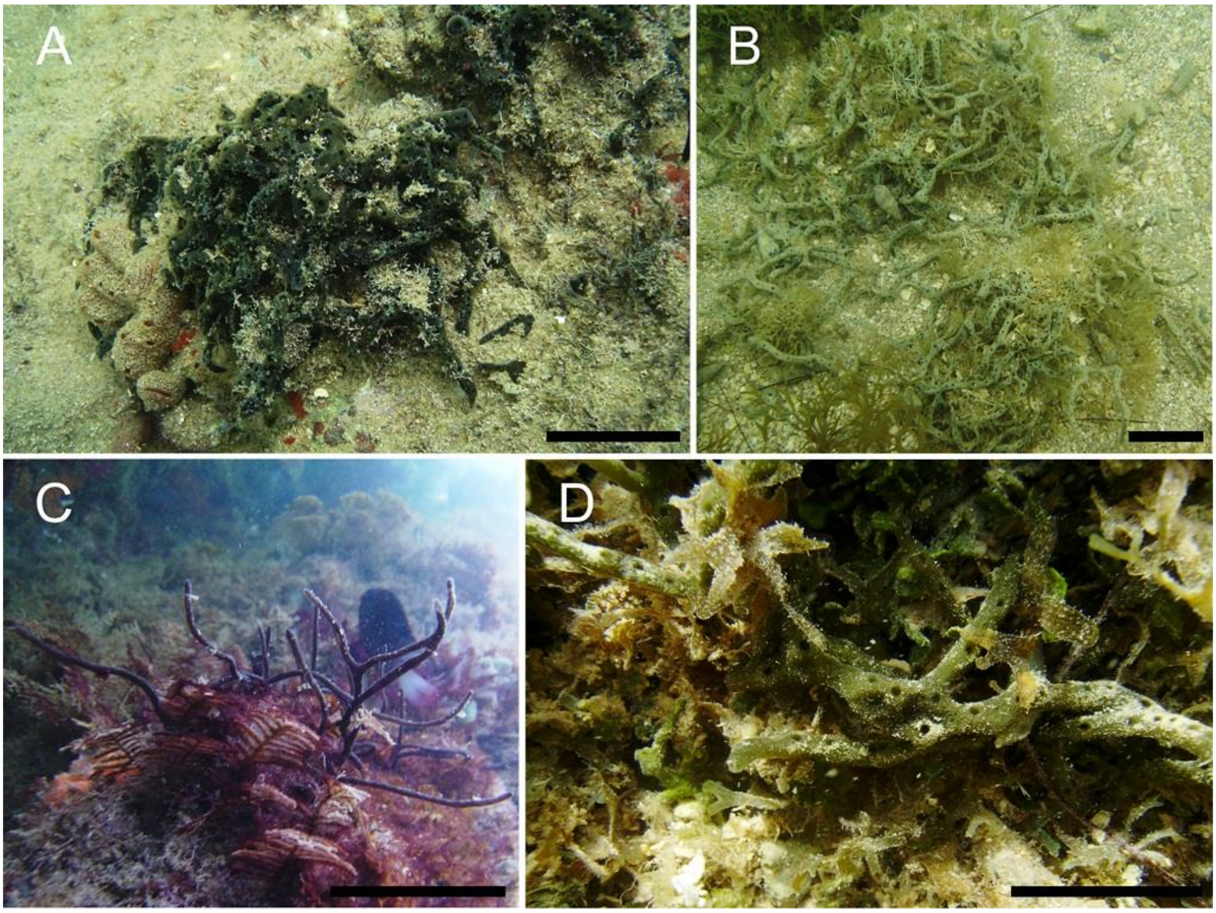


Fig. 2. Morphological variability of *Haliclona* (*Reniera*) *chlorilla* sp. nov in situ. A, black specimen growing on calcareous algae (MNRJ 17026, holotype); B, dark green specimen growing together with magroalgae and covered by fine sediment; C, black specimen with tendency to form erect branches in a reef crevice; D, dark green specimen growing together with macroalgae in close up (MNRJ 17027, paratype). Scales bars: A–C, 5 cm; D, 2 cm.

Spicules

Megascleres are robust, straight or slightly curved oxeas with sharp points. Mature oxeas are 110–135 µm long and 3.8–7.5 µm wide (Figure 3D, Table 1). No microscleres were found.

ECOLOGY

Found in very shallow waters (approximately 0.1–2 m) and in tide pools, growing together with macroalgae or seagrass, mostly in well lit microhabitats.

DISTRIBUTION

The type locality is Praia do Francês (Marechal Deodoro, AL, Brazil), at the southern limit of the species' known geographic distribution, which extends northwards to the

Table 1. Spicule dimensions of *Haliclona* (*Reniera*) *chlorilla* sp. nov. Values are as follow: minimum–*mean*–maximum lenght x mi.–*me.*–ma. width. n= 30.

Specimen	**Oxeas (µm)**
MNRJ 17026, holotype	110–*120.5*–128 x 5–*6.9*–7.5
MNRJ 1528, paratype	105–*115.4*–125 x 4–*5.2*–6.5
MNRJ 17027, paratype	113–*123.0*–133 x 3.8–*5.6*–6.3
MNRJ 17610, paratype	118–*126.3*–135 x 5–*5.4*–6

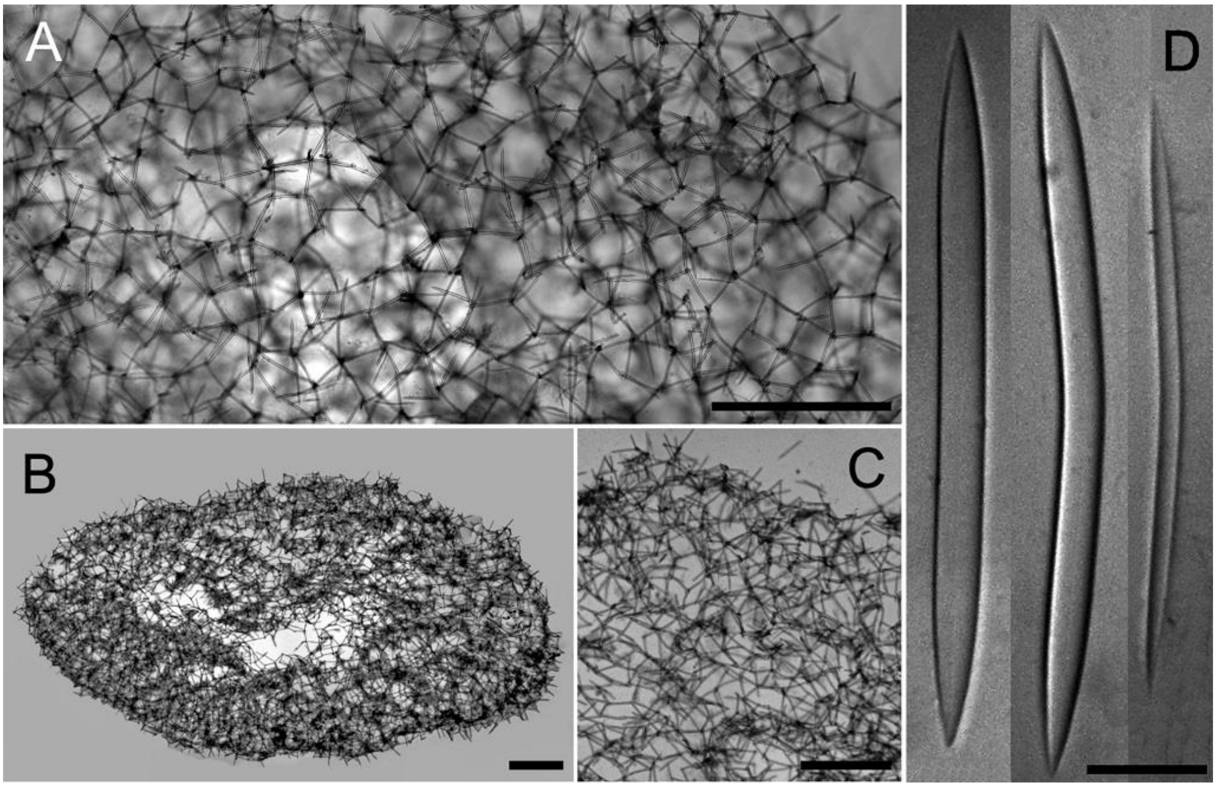


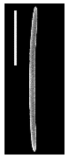
Figure 3. *Haliclona* (*Reniera*) *chlorilla* sp. nov. A. Ectosomal skeleton. B. Choanosomal skeleton. C. Detail of the choanosomal skeleton. C. Oxeas. Scale bars: A, C, 400 µm; B, 500 µm; D, 20 µm.

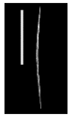
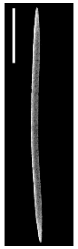
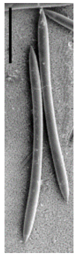
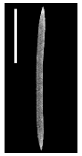
southern coast of Pernambuco State. This far the species is not yet known outside the Northeastern Brazil Ecoregion.

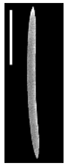
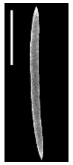
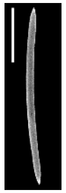
ETYMOLOGY

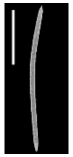
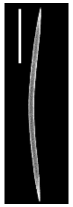
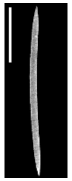
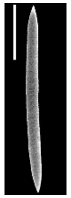
The specific epithet is used as a noun in apposition. It is derived from the juxtaposition of two Greek words, *chloros* (green) and *illas* (rope), and conveys the dark-green, slender ramose habit of the new species.

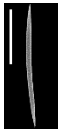
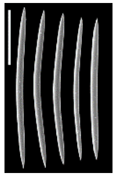
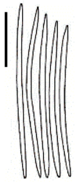
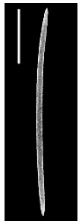
Table 2. Comparative morphological and distributional data for the shallow-water species of *Haliclona* known from the Tropical Western Atlantic. *Halicl., Haliclona; Re., Reniera; S., Soestella; Halich., Halichoclona; Rh., Rhizoniera.* Scale bars = 50 µm.

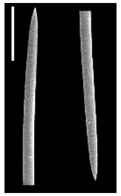
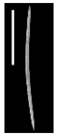
Species	External morphology	Anatomy	Oxeas morphology	Colour – Locality, Depth
H. (Halicl.) catarinensis Mothes & Lerner, 1994 (orig. descr.)	Encrust., oscs. circ., scattered, 2 mm diam., surf. irreg., compressible after preservation.	**Ectos.** – unspecialized. **Choan.** – multispis. ascend. parallel tracts, connect. by single spics. or more in confusion, subisodict. network. **Oxeas**, straight or slightly curved, sharp ends, 111–161 x 3–9 µm.		Live colour grey and orange – S. Brazil
H. (Halicl.) epiphytica Zea & De Weerdt, 1999 (orig. descr.)	Encrust. on seaweeds, 10–40 mm long, 2–11 / 1.5–11 mm diam./thickn.; surf. smooth, even; many oscs., 0.3–1.4 mm diam.; consist. compressible, elastic, fragile.	**Ectos.** – tangent. unispic. retic. w. nodal spongin, meshes triang. to polyg., 30–80 µm diam. **Choan. –** reg., ladder–like, ascend. lines unispic. to 3 spics. across, interconnect. by single spics., meshes polyg. 25–60 µm diam., choan. canals 95–500 µm wide. **Oxeas**, robust, short, acerate points, slightly curved, few styles and styloids, axial canal visible, 63–76 x 2.9–6.9 µm.		Cream alive, light cream in spirit or dry – Colombian Caribbean, ca. 1 m.
H. (Halicl.) lilaceus Mothes & Lerner, 1994 (orig. descr.)	Encrust., osc. not observed, surf. conul., fragile consis. when preserved, compressible.	**Ectos.** – unspecialized. **Choan.** – multispic. ascend. parallel tracts, connect. by single spics. or more in subisodict. network, many spics. strewn among tracts. **Oxeas**, straight or slightly curved, sharp or constricted ends, 88–113 x 3–7 µm		Live colour light lilac – S. Brazil
H. (Re.) implexiformis (Hechtel, 1965) (*sensu* De Weerdt, 2000)	Cushions 2–4 cm thick; circ. osc. 6–10 mm diam., regularly distrib., flush or slightly elev.; surf. even, smooth, occas. with slightly tubercul. areas, strongly punctate; consist. soft, compressible.	**Ectos.** – tangent. unispic., isotrop. retic. **Choan.** – unispic., isotrop. Nodal spongin. **Oxeas**, slightly curved, blunt or strongylote ends, 96–167 x 3.7–9.3 µm.		Live colour pinkish–violet, with creamish shades, light tan in spirit – Wider Caribbean, Brazil.

H. (Re.) manglaris Alcolado, 1984 (*sensu* De Weerdt, 2000)	Encrust., 1–2 mm thick, low chimney– and volcano–shaped elev., about 8/4–12 mm height/diam.; circ. osc. 1–2.5 mm diam., flush, scattered; several rope–like projections; surf. smooth, even, slightly punctate; consis. soft, not very fragile.	**Ectos.** – tangent. unispic., isotrop. retic. with 3–5 sided meshes. **Choan.** – delicate, unispic., isotrop. retic. with 3–5 sided meshes, numerous choan. spaces. Nodal spongin. **Oxeas**, fusiform, with long, very sharp points, slightly to strongly curved, 77–109 x 2–4 µm.		Live colour bright turquoise green or green, sometimes brownish – Wider Caribbean, Brazil, 0.5–1 m.
H. (Re.) mucifibrosa De Weerdt, Rützler & Smith, 1991 (*sensu* De Weerdt, 2000)	Irreg. lumpy, massive base (ca. 10 cm diam.), with 2–3 cm high, thick–walled osc. chimneys, lateral fistules 10–15 cm long; osc. diam. up to 1 cm., surf. smooth. consis. elastic compressible, easily torn, release mucus when torned apart.	**Ectos.** – reg., tangent., (sub)isotrop. retic. **Choan.** – reg., uni– to paucispic., (sub)isotrop;, reinforced in places by short spic. tracts 4–6 spic. wide, numerous choan. spaces, Nodal spongin. **Oxeas**, stout, straight or slightly curved, acerate points, 186–249 x 7.4–13.5 µm.		Live colour greyish purple to bluish gray, light tan in ethanol – Wider Caribbean, 0–20 m.
H. (Re.) portroyalensis Jackson, De Weerdt & Webber, 2006 (orig. descr.)	Digitate, few slightly swollen areas,up to 6 / 1 cm high/thick; osc. flush, scattered, 2–3 mm diam.; surf. smooth, even, microhispid; consist. soft, easily torn, somewhat resilient.	**Ectos.** – Nodal spongin and some spicules fully enclosed, surf. pierced by irreg. distrib. pores, 56–89 µm diam. **Choan.** – unispic., less unif. than ectos., few multispic. tracts. Gemmule–like bodies present. **Oxeas**, straight to slightly curved, with short, conical points, 153–210 x 6–8.7 µm. **Toxas**, abund., variable morphol., 3.6–112.5 x 0.3–1.5 µm.		Live colour purple, beige in ethanol. – Jamaica, 1.25 m.
H. (Re.) ruetzleri De Weerdt, 2000 (orig. descr.)	Delicate, slender, anastom. branches, 30–60 / 1–3 mm long/thick; surf. smooth; numerous circ. to slightly ellipt. oscs. scattered along branches, flush or very slightly elevated, 0.5–1.5 mm diam.; consist. very soft, easily torn.	**Ectos.** – tangent. unispic., isotrop. retic. **Choan.** – unispic., isotrop. Nodal spongin. **Oxeas**, slender, straight or slightly curved, long and sharp points, 104–168 x 3.3–6 µm. **Toxas**, common, varied morphol., 21–96 x 0.5–1.9 µm. **Sigmas**, uncommon, 9.5–19 x 0.5–1.3 µm.		Live colour light brown – Belize, 0.5–2 m.
H. (Re.) strongylophora Lehnert & Van Soest, 1996 (orig. descr.)	Encrust., up to 15 x 30 cm, ca. 1 cm thick, osc. not seen, surf. smooth, consist. soft.	**Ectos.** – irreg., unispic. retic. **Choan.** – isotrop., unispic., few paucispic. ascend. tracts, connect. by single spics. **Strongyles**, 150–200 x 4–10 µm.		Live colour dark brown, in dry state it is light grey – Jamaica, 76–78 m.

H. (Re.) tubifera (George & Wilson, 1919) (*sensu* De Weerdt, 2000)	Cushion–shaped base with up to 5 cm high osc. elevations, oscs. 1–10 mm diam., with numerous thin, long proliferations branching off from main body; or delic. clusters of anastom. thin branches, 2–5 mm thick, with small oscs., 0.5–1 mm diam. on top of slight elevat. or flush with surf.; consist. soft, compressible, fragile, release mucus when squeezed or torn apart; surf. smooth, even, slightly punctate.	**Ectos.** – tangent. unispic., isotrop. retic. **Choan.** – unispic., isotrop. retic. reinforced by short, loosely organ. spic. tracts, 3–6 spics. wide. Nodal spongin. **Oxeas**, sharp points, hastate, commonly thinner in the middle, 104–172 x 4.1–9.5 µm.		Live colour different shades of purle and pink – North Carolina, Wider Caribbean, 0.1–15 m.
H. (S.) caerulea **(**Hechtel, 1965) (*sensu* De Weerdt, 2000)	Irreg. cushion–shaped, with oscular mounds or chimneys, digitate (0.3–1 mm diam.); numerous thin, long proliferations branching off from the distal parts (up to 8 cm long); oscs. not abundant, scattered along branches, 1–4 mm diam., flush or slightly raised; consist. soft to moderat. firm, compressible, fragile; surf. smooth, even, punctate.	**Ectos.** – tangent., paucispic., rounded to polyg. meshes, 170–400 µm diam., many spics. in confusion. **Choan.** – paucispic., ill–defined primary and secondary tracts, choan. spaces present. Nodal spongin. **Oxeas**, slender, slightly curved, hastate, sharp or blunt ends, rarely strongylote, 128–204 x 3–9.5 µm. **Sigmas**, slightly centrangulated or weakly bent, 13–28 x 0.5–1.9 µm		Live colour yellowish green to sky blue, rarely light purplish brown, tan in ethanol – Wider Caribbean, Pacific side Panama, Brazil, 0–27 m.
H. (S.) lehnerti De Weerdt, 2000 (orig. descr.)	Thick cushions, low partially hollow digitations, apical oscs. 1–4 mm in diam.; surf. uneven, slightly hispid, with meandering and anastom. grooves; consist. moderately firm, incompressible when dry.	**Ectos.** – tangent., uni– to paucispic., ill–defined rounded to elliptical meshes, 190–570 µm diam., framed by tracts 2–4 spics. wide. **Choan.** – ill–defined paucispic. primary and secondary tracts, rounded to subelliptical meshes, 200–300 µm diam. Nodal spongin. **Oxeas**, straight to slightly curved, hastate, sharp points, 127–156 x 3.3–6.3 µm.		Live colour dark red, dark yellowish-cream when dry – Jamaica, 8–12 m.
H. (S.) luciensis De Weerd, 2000 (orig. descr.)	Thick crust to lobate/cushion–shaped, up to 2.5 / 1.5 cm high/thick; wide oscs., circular, up to 8 mm diam., surf. smooth, even; consist. very soft, fragile.	**Ectos.** – tangent. retic. of vaguely strewn oxeas around and in-between irreg. meshes, 250–665 µm diam. **Choan.** – subanisotrop., ill–defined paucispic. primary tracts, irreg. connect. by unispic. primaries (?), many spics. in confusion, many rounded/elliptical meshes, choan. spaces present. Nodal spongin. **Oxeas**, straight or slightly curved, with short, conical points, 144–174 x 4.4–7 µm. **Raphides**, found mainly in the ectos., 51–93 x 0.3 µm		Live colour dark brown, also in ethanol – St. Lucia.

H. (S.) melana Muricy & Ribeiro, 1999 (*sensu* De Weerdt, 2000)	Repent/lobate base, several osc. chimneys and anastom. branches, up to 7 / 1 cm high/thick; osc. at the end of the chimneys, to 4 mm diam., irregularly scattered on the surf.; consis. soft, compressible, fragile; surf. smooth, even.	**Ectos.** – tangent., discontinuous, with irreg. distrib. meshes, 228–513 µm diam., framed by single spic. **Choan.** – ill–defined, paucispic. prim. lines, irreg. connect. by unispic. primaries (?), many rounded meshes and choan. spaces, many spics. in confusion. Nodal spongin. **Oxeas**, slightly curved, hastate, with long and sharp points, 105–159 x 2.8–6 µm. **Toxas**, weakly curved, straight legs or slightly recurved apicies, 30–72 x 0.6–1.3 µm		Live colour black, dark brown in spirit – St. Lucia, Brazil, up to 6 m.
H. (S.) piscaderensis (Van Soest, 1980) (*sensu* De Weerdt, 2000)	Flat cushions, up to ca. 55 / 1–4 mm diam./thick, with few, circ. osc. flush or slightly raised elevations, 1–2 mm diam.; consis. soft, fragile; surf. even, strongly reticulate.	**Ectos.** – consisting of vaguely strewn, tangentially oriented spic. **Choan. –** confused retic., ill–defined paucispic. prim. lines, many spic. in confusion. Nodal spongin. **Oxeas**, slightly curved or sinuous, hastate, very long and sharp points, 140–227 x 2.3–7.4 µm; **Sigmas**, C–shaped, numerous, 7–12 x 0.3–1.2 µm.		Live colour varying from greyish yellow to light purplish brown – Wider Caribbean, 1–20 m.
H. (S.) smithae De Weerdt, 2000 (orig. descr.)	Tubes partly fused, 1–2 / 0.7–1 cm height/diam., or cushion–shaped base with osc. mounds, the tubes end in an osc., 1–3 mm diam.; surf. smooth, punctate; consis. firm but fragile, incompressible.	**Ectos. –** stout, tangent., paucispic., with well–defined rounded to elliptical meshes, 247–513 µm diam., many spic. in confusion. **Choan.** – stout retic. with ill–defined paucispic. primary lines, irreg. connect. by uni– paucispic. secondary lines, many spic. in confusion and many choan. spaces. Spongin not visible. **Oxeas**, straight to slightly curved, with hastate, sharp points, 138–172 x 3.9–8.8 µm. **Rhaphides**, abundant in the ectos., absent in the choan., ca. 70 x 0.3 µm.		Live colour yellow–green, drab in spirit – Belize, 1 m.
H. (S.) twincayensis De Weerdt, Rützler & Smith, 1991 (*sensu* De Weerdt, 2000)	Slender to very thin, erect, partly fused branches, 5–10 / 0.2–1.2 cm long/thick, projecting directly from the subst.; osc. rare, ca. 1 mm, irregularly distrib. along the branches; consist. firm, slightly compressible, fragile; surf. smooth, stongly punctate.	**Ectos.** – discontinuous, tangent., retic. of oxeas, tendency to form short paucispic. lines of 2–5 spic. thick around wide meshes of 190–475 diam. **Choan.** – irreg., somewhat confused, paucispic. primary lines, irreg. connect. by unispic. secondary lines, many spics. in confusion. Nodal spongin. **Oxeas**, slightly curved, hastate, 161–186 x 6–9 µm.		Live colour whitish gray to pinkish, light tan in spirit – Wider Caribbean, up to 3 m.

H. (S.) vermeuleni De Weerdt, 2000 (orig. descr.)	Encrust. or cushion–shaped base, with small outgrowths as osc. chimneys, hollow fistules, blind–ending digitations and lobes, 15 / 1–4 mm high/diam..; osc. small, circular, 1–2 mm diam., at the end of the chimneys and alongside outgrowths; surf. smooth, even, slightly punctate; consis. soft, fragile.	**Ectos.** – dense, tangent. retic., slight tendency to form rounded meshes, 130–215 µm diam., many spics. in confusion. **Choan.** – somewhat irreg., dense retic., with ill–defined, paucispic. prim. lines, irregularly connect. by uni– paucispic. second. lines, many spics. in confusion. Nodal spongin. **Oxeas**, very slender, with long, sharp points, straight or slightly, evenly curved, 75–167 x 2.1–5.7 µm		Live colour blue to sky blue, light cream in spirit – North Carolina, Wider Caribbean
H. (S.) walentinae Diaz, Thacker, Rützler & Piantoni, 2007 (orig. descr.)	Encrust., 1–2 mm thick; osc. 1–2 mm diam., with transparent membran., reg. distrib., radial canals converg. toward osc.; surf. smooth to irreg. rugose, porous and microhispid under microscope; consis. soft, compressible, resilient.	**Ectos.** – poorly develop., paucispic. spic. tracts and loosely strewn spics., not peelable. **Choan.** – paucispic., loosely organized primary tracts (20–40 µm diam.), connect. by unispic. tracts or single spics., tracts enveloped by filamentous cyanobacteria. Scarce spongin. **Oxeas**, hastate to fusiform, straight or slightly curved, 100–180 x 3–9 µm.		Live colour deep dark–brown to purple outside, tan inside; cream to white in alcohol – Panama
H. (Halich.) albifragilis (Hechtel, 1965) (*sensu* De Weerdt, 2000)	Encrust., ca. 1 / 1 cm diam./thick; osc. not apparent; consis. friable, slightly brittle; surf. even, smooth.	**Ectos.** – dense, tangent., subisotrop.; easily detachable, but without large subectos. spaces. **Choan.** – subisotrop., dense, few choan. spaces. Nodal spongin. **Oxeas**, slender, weakly to strongly curved, with long, sharp points, 63–168 x 2.1–8.4 µm.		Live colour opaque white or light cream – Wider Caribbean, up to 74 m.
H. (Halich.) lernerae Campos, Mothes, Eckert & Van Soest, 2005 (orig. descr.)	Massive, osc. 0.3–0.6 cm diam., osc. projections tube–like, 2.6 x 1.1 cm; surf. smooth, slightly rough; consis. little compressible, firm.	**Ectos.** –dense, tangente., subisotrop. **Choan.** – subisotrop., few choan. spaces. **Oxeas**, thin, slightly curved, some straight, acerate ends, but hastate and blunt also occur, 138–161 x 1.2–4.6 µm		Colour in spirit creamy white – NE. Brazil, 94 m.
H. (Halich.) magnifica De Weerdt, Rützler & Smith, 1991 (*sensu* De Weerdt, 2000)	Irreg. massive base, thickwalled tubes, up to 15 / 5 cm high/thick, each tube tapers towards an osc. of 1–2 cm diam. with a membran. rim; smaller fistules arise at all parts of the sponge; consis. slightly crisp, fragile, slightly compressible; surf. smooth.	**Ectos.** – dense, subisotrop., loosely lying on the choan. skel., easily detachable. **Choan.** – dense, subisotrop., with few choan. spaces. Nodal spongin. **Oxeas**, long, slender, slightly flexuous, fusiform, 147–221 x 3.6–6.7 µm.		Live colour pink to dull pink and drab, oscular fistules whitish transparent – Wider Caribbean, 0–1 m.

H. (Halich.) perforata **(**Pulitzer–Finali, 1986) (orig. descr.)	Massive; consis. firm, compressible, not resilient, easy to tear; pierced by canals up to 6 mm wide.	**Ectos.** – tangent., unispic., meshes ca. 100 µm wide. **Choan.** – similar to ectos., only tridimensional, no main tracts are observable. Nodal spongin. **Oxeas**, straight to slightly curved, ends not quite sharp, 100–115 x 3.5–4.5 µm.		Colour dull violaceous drab externally, tan–cream internally, drab in formalin – Puerto Rico, 0.5–1 m.
H. (Halich.) vansoesti De Weerdt, Kluijver & Gomez, 1999 (orig. descr.)	Thick cushions, loose and cavernous structure, up to 15 / 2–3 cm diam./thick, with large, circ. to elliptic. osc., 0.8–1 cm diam., on slightly raised elevations, with transparent rims; surf. smooth; consis. crispy, fragile, slightly compressible.	**Ectos.** – delicate, tangent., subisotrop., extremely loosely lying on the choan. skel. **Choan.** – subisotrop., denser than ectos., many subectos. and choan. spaces. **Oxeas**, slightly curved, hastate, 120–222 x 3.6–10.7 µm.		Live colour in the choanosome is light purple, and white (semi-transparent) in the ectosome – Wider Caribbean, 2–52 m.
H. (Halich.) stoneae De Weerdt, 2000 (orig. descr.)	Thick cushions, ca. 12 / 2 cm diam./thick, with large, circ. osc., 0.4–0.9 cm diam., flush with the surf. or on low volcano–shaped elevations; surf. smooth, even, punctate; consis. brittle, fragile, slightly compressible.	**Ectos.** – tangent., subisotrop., paucispic. **Choan.** – paucispic., subisotrop. **Oxeas**, large, straight or slightly, evenly curved, with short, acerate points, 286–359 x 7.7–12.8 µm. **Sigmas**, weakly to strongly curved, abund. in both ectos. and choan., 12–21 x 0.6–1.5 µm		Live colour whitish–pink, light greenish in spirit – Belize, 21 m.
H. (Rh.) curacaoensis (Van Soest, 1980) (*sensu* De Weerdt, 2000)	Encrust. base with close–packed osc. mounds, 2–4 / 2–3 cm high/diam.; osc. 2–3 cm diam.; consis. soft, easily torn, stickly to the touch, mucous when rubbed; surf. smooth, strongly punctuate.	**Ectos.** – absent, or consist. vaguely strewn, tangentially oriented. spic. **Choan.** – irregular, paucispic, somewhat sinuous, primary lines, irreg. connect. by unispic. secondary lines, many choan. meshes. Nodal spongin. **Oxeas**, slender, with acerate to conical points, slightly to strongly curved, 78–146 x 2.8–5.7 µm.		Live colour bluish purple – South Carolina, Wider Caribbean, 0.3–58 m.
H. (Rh.) mammillaris Mothes & Lerner, 1994 (orig. descr.)	Encrust., osc. circ., ca. 0.2 cm diam., at the top of mammiliform projections. Preserved material has consis. fragile, compressible	**Ectos.** – not specialized. **Choan.** – multispic. ascend. tracts, 2–6 spics., parallels, connect. by single spics., or many spics. disorganized, creating a subisodict. network. **Oxeas**, straight or slightly curved, sharp ends, 99–131 x 3–5 µm.		Colour in spirit white – S. Brazil

REMARKS

Table 2 compiles literature data on *Haliclona* spp. used in comparison with the new species. *Haliclona* (*Reniera*) *chlorilla* sp. nov. is distinguished within the subgenus by the combination of its repent delicate cylindrical branches of dark green or black colour, and absence of microscleres of any sort. In the Tropical Western Atlantic (TWA), such slender cylindrical branches are mostly seen as off-shoots from the main sponge body, as reported by De Weerdt (2000) for *H.* (*Re.*) *manglaris* and *H.* (*Re.*) *tubifera*. The exception is *H*. (*Re*.) *ruetzleri* De Weerdt, 2000, reported to be entirely composed of slender, delicate, anastomosing branches, 1–3 mm in diameter. This species, albeit its rather similar habit, has light brown live colour, larger oxeas, as well as sigmas and toxas as microscleres, which renders it clearly distinct from the new species.

The only additional TWA *Haliclona* (*Reniera*) with a dark live colour (dark brown to black) is *H*. (*Re*.) *strongylophora* Lehnert & Van Soest, 1996. This Jamaican species is cushion-shaped and has strongyles as megascleres, two markedly distinct features given what is seen in the new species. Furthermore, its single record was obtained at 77 m depth, while the new species is this far known only from 0.1–2 m. Other rather dark TWA *Haliclona* spp. fall within *H.* (*Soestella*), being notably distinct from the new species in terms of skeletal architecture. These are *H*. (*S.*) *luciencis* De Weerdt, 2000; *H*. (*S*.) *melana* Muricy & Ribeiro, 1999 and *H*. (*S*.) *walentinae* Díaz *et al*., 2007.

Subgenus *Soestella* De Weerdt, 2000

Haliclona (*Soestella*) *peixinhoae* sp. nov.

(Figures 4–5; Tables 2–3)

Haliclona sp.: Hajdu *et al*., 2011: 188–190.

MATERIAL EXAMINED

Holotype. MNRJ 13299 - Taipús de Fora (algal/coral reef, ca. 13°56'03.64"S, 38°55'32.55"W), Maraú (BA, Brazil), 1 m depth, coll. E. Hajdu & G. Lôbo-Hajdu, 26 July 2009.

Paratypes. MNRJ 2472, 2563 - Ponta de Montserrat (rocky coast, ca. 12°55'37"S, 38°31'11"W), Salvador (BA, Brazil), 3–5 m depth, coll. E. Hajdu *et al*., 31 July 1999 and 05 August 1999, respectively; UFBA 1596–POR, UFBA 1602–POR, UFBA 1616–

POR - Ponta de Montserrat (ca. 12°55'37''S – 38°31'11''W), Salvador (BA, Brazil), 4.5 m depth, coll. E. Hajdu, 14 January 1997.

DIAGNOSIS

Haliclona (*Soestella*) *peixinhoae* sp. nov. is set apart from other Tropical Western Atlantic *Haliclona* spp. by a combination of its habit comprising a dense aggregation of erect tubes, mostly bearing large thorns, albeit very soft, and a conspicuous subsuperficial reticulation visible to the naked eye on live specimens.

DESCRIPTION

Sponge forming dense aggregations of tubes up to 5 cm high (Figure 4), sometimes recalling a pan flute (partially fused tubes, Figure 4A–B). Specimens usually reach up to 15–25 cm in diameter. Tubes stand mostly erect, and appear to originate from a reptant tube (holotype). Tubes usually bear slender thorn-like projections up to 1 cm long (Figure 4A, C–D). Oscula are abundant, large (1–15 mm in diameter), usually circular and located apically on tubes. Surface smooth, but sometimes irregularly outlined due to development of early stage tubes or thorn-like projections. A conspicuous, irregular subsuperficial meandering reticulation is visible to the naked eye (Figure 4D), but disappears in ethanol. Consistency is very soft and fragile, easily torn. Colour alive is light brown, beige or yellowish beige, fading in alcohol.

Skeleton

The ectosome is a tangential, uni- to paucispicular reticulation with a tendency to form ill- or well-defined rounded meshes (Figure 5A). The choanosome consists of ill-defined, uni- to paucispicular primary lines, irregularly connected by uni- to paucispicular secondary ones, with a slight tendency to form rounded meshes (Figure 5B). A few of the secondary lines, if not artefactual, are two or three spicules long, forming an open and discontinuous reticulation with wide and irregular meshes.

Spicules

The megascleres are straight or slightly curved oxeas, with blunt ends, 73–115 x 3–5.5 μm (Figure 5C, Table 3). Immature oxeas are variably common and thinner than mature ones (1–2.5 μm).

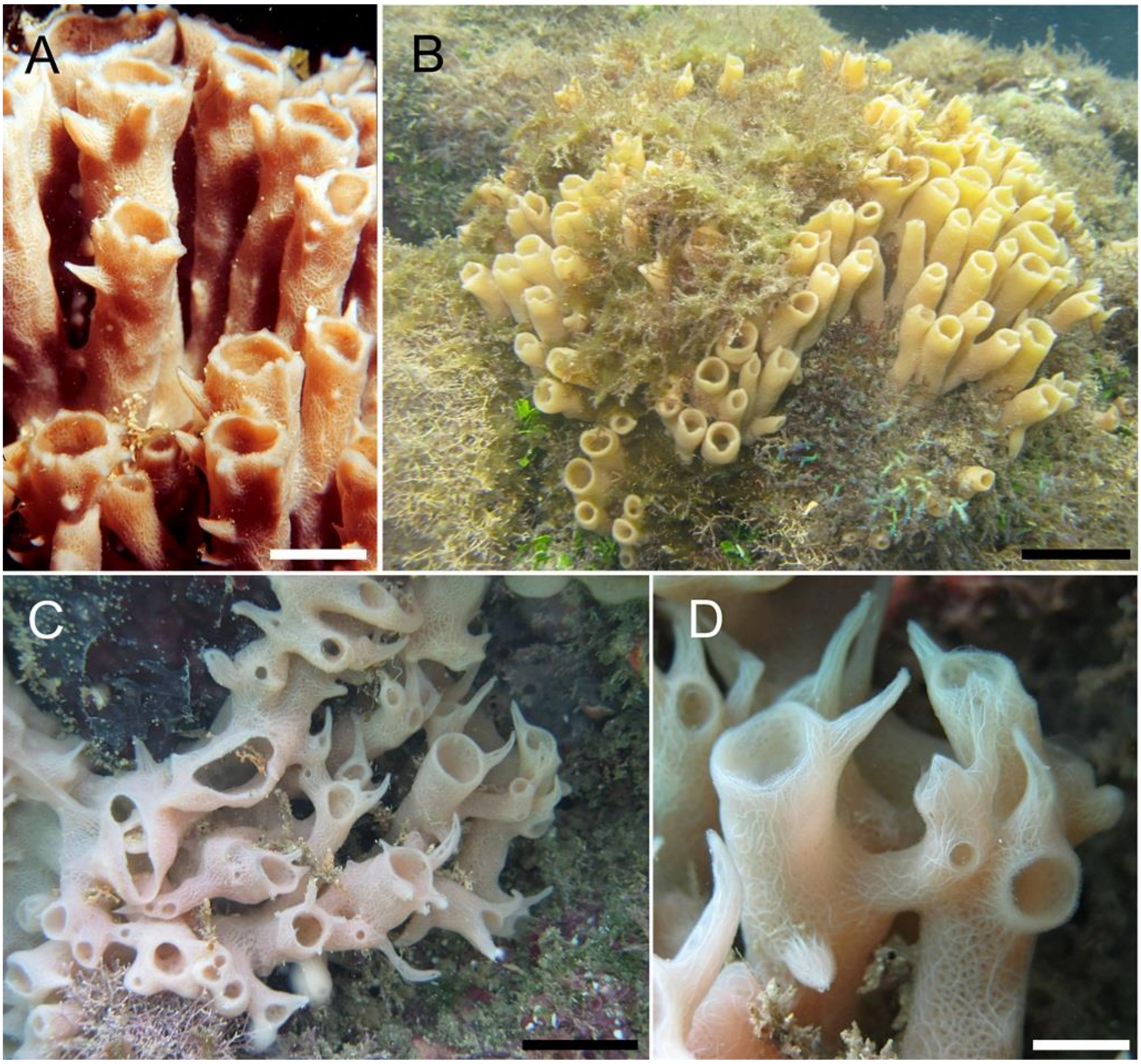


Fig. 4. Morphological variability of *Haliclona* (*Soestella*) *peixinhoae* sp. nov in situ. A, Yellowish beige specimen with full-growth tubes and thorn-like projections (uncollected specimen from Ponta de Montserrat, Salvador, BA); B, Yellowish specimen with juxtaposed tubes growing with macroalgae (Taipús de Fora, Maraú, BA); C–D, Beige specimen with a repent-tubular shape (MNRJ 13299, holotype). Scale bars: A, 2 cm; B, 5 cm; C, 2 cm; D, 1 cm.

ECOLOGY

A rare species, found in 1–5 m depth, in well-lit areas with low hydrodynamics. It frequently grows intermingled to bushy algae.

DISTRIBUTION

The type locality is Taipús de Fora (Maraú, BA, Brazil). This far the species is endemic from the upper half of the State of Bahia (Eastern Brazil Ecoregion, Northeastern Brazil geopolitical region), known from Salvador and Maraú only.

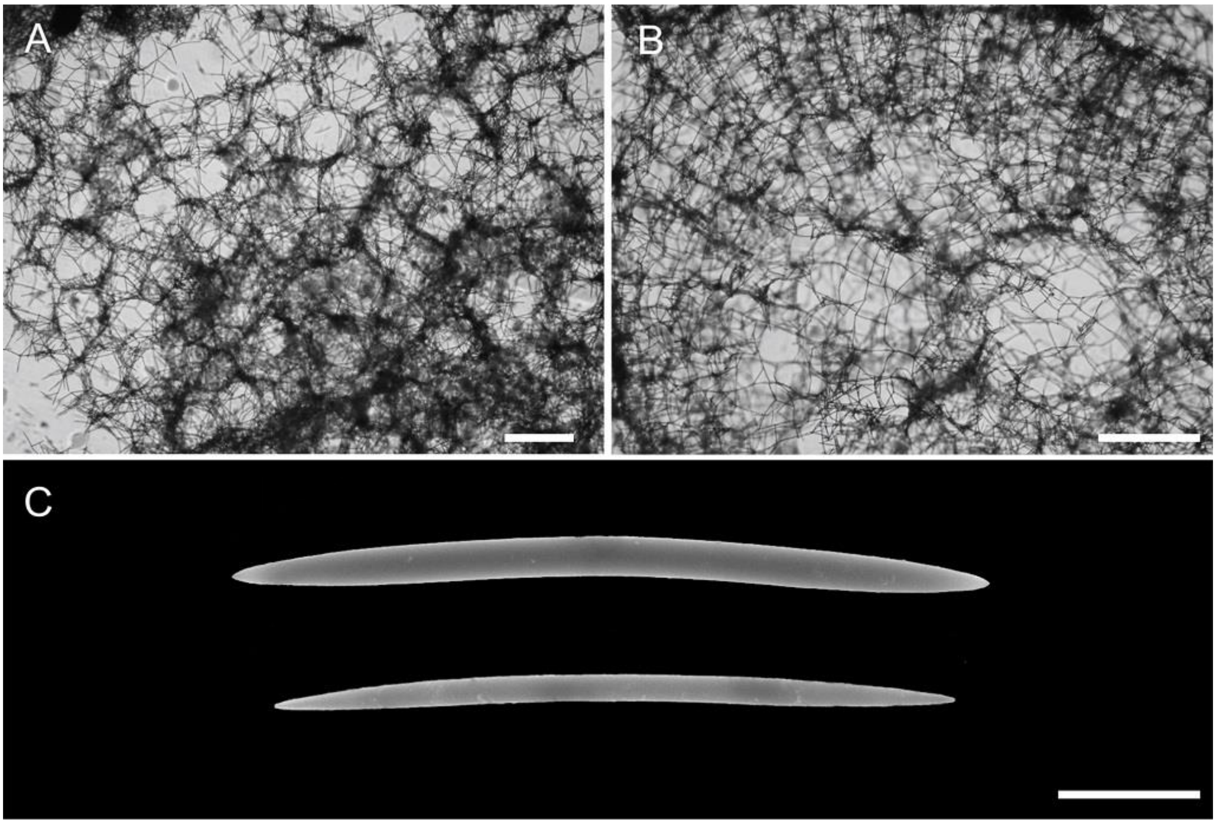


Fig. 5. *Haliclona* (*Soestella*) *peixinhoae* sp. nov. A. Ectosomal skeleton. B. Choanosomal skeleton. C. Oxeas. Scale bars: A–B, 500 um; C, 20 um.

ETYMOLOGY

The new species is named after the late Prof. Dr. Solange Peixinho, a dear friend, and an important advocate of the importance of taxonomy, and more specifically, taxonomy of Bahian sponges.

REMARKS

Hajdu *et al*. (2011) refered to the presence of rare toxas in *Haliclona* (*Soestella*) *peixinhoae* sp. nov. (as *Haliclona* sp.), but we carefully reexamined all the material available of this species and no toxa was found. The illustration given by those authors surely represents a contamination.

Haliclona (*Soestella*) *peixinhoae* sp. nov. is well distinguished among other *Haliclona* spp. in the Tropical Western Atlantic by its habit, comprising a dense aggregation of erect tubes with large apical oscula, mostly bearing large thorns, albeit very soft, and by a conspicuous subsuperficial reticulation visible to the naked eye on live specimens.

Tropical Western Atlantic *Haliclona* (*Soestella*) spp. includes only *H.* (*S.*) *melana* and *Haliclona* (*S.*) *smithae* De Weerdt, 2000 as tubular sponges (Table 2). Both are

Table 3. Spicule dimensions of *Haliclona* (*Soestella*) *peixinhoae* sp. nov.. Values are as follow: minimum – *mean* – maximum length x mi. – *me.* – ma. width. n=30.

Specimen	**Oxeas (µm)**
MNRJ 13299 (holotype)	83–*94.3*–115 x 3–*4.9*–5.5
MNRJ 2472 (paratype)	73–*91.4*–110 x 3–4.7–5.5
MNRJ 2563 (paratype)	75–*88.7*–100 x 3–*4.4*–5.5

rather distinct from the new species in that they do not form dense aggregates of erect tubes, do not possess the conspicuous sub-superficial reticulation, have black or yellow-green (respectively) live-colour, and possess microscleres (respectively, toxas and raphides). Other subgenera comprise a few additional tubular species in this area, even if optional. These are *H.* (*Halichoclona*) *magnifica* De Weerdt *et al*., 1991; *H.* (*Re.*) *mucifibrosa* De Weerdt *et al.*, 1991; *Haliclona* (*Re.*) *tubifera* De Weerdt, 2000; and *H.* (*Rhizoniera*) *curacaoensis* (Van Soest, 1980). Besides their skeletal architectures, these species differ from the new species in several traits. The first of these has a crispy consistency and much larger oxeas, reaching up to 220 µm, in contrast to the rather soft consistency and oxeas only up 115 µm. *H.* (*Re.*) *mucifibrosa* produces copious amounts of mucus when torn apart, a feature not observed in the new species, and also has much larger oxeas, up to 250 µm. *Haliclona* (*Re.*) *tubifera*, albeit its name, has only optional tubes. Specimens are frequently thin, ramose. Live colour is generally pink or pink/violet, and oxeas can reach over 170 µm. Finally, *H.* (*Rh.*) *curacaoensis* has oxeas only a bit larger (up to 146 µm) than those of the new species, but its bluish purple live colour adds to the skeletal architecture in setting it quite far apart from the new species.

DISCUSSION

Recent taxonomic effort dedicated to sponges of reef ecosystems in the NE Brazilian geopolitical region has been rewarding in terms of new records and species found (Cedro *et al*., 2007, 2011, 2013; Peixinho *et al.*, 2007; Hajdu *et al*., 2011; Barros *et al*., 2013; Sandes & Pinheiro, 2013). The two new *Haliclona* spp. reported upon here highlight the fact that discoveries need not always rely on new field work, as both were present in scientific collections already by the 1980s and 1990s.

Notwithstanding the 400+ extant species of *Haliclona*, only eleven have been registered for the Brazilian coast this far (Hajdu *et al.* 2011, Muricy *et al*. 2011, this study). Six are provisional endemics from various sectors of this coastline. *Haliclona*

(*Halicl.*) *catarinensis* Mothes & Lerner, 1994; *H.* (*Halicl.*) *lilaceus* Mothes & Lerner, 1994; and *H.* (*Rh.*) *mammillaris* Mothes & Lerner, 1994 are known only from their type localities in the Southeastern Brazil Ecoregion (Bombinhas, ca. 27ºS). *Haliclona* (*Halich.*) *lernerae* Campos *et al.*, 2005 is known from a single record for the Amazonia Ecoregion (off São Luís, ca. 0ºS), and both new species described herein stem each from a distinct ecoregion, namely Northeastern Brazil with *H.* (*Re.*) *chlorilla* sp.nov., and Eastern Brazil with *H.* (*S.*) *peixinhoae* sp.nov. (cf. above).

We have adopted De Weerdt's (2000) subgeneric assignment for *H.* (*Rh.*) *mammillaris*, as she had access to the holotype. Muricy *et al.*'s (2011) assignment of this species to *Haliclona* (*Halicl.*) is thus considered mistaken. On the other hand, these latter authors also assigned *H.* (*Halicl.*) *catarinensis* and *H.* (*Halicl.*) *lilaceus* to the nominotypical subgenus, which is followed here despite types not being re-examined this far. From Mothes & Lerner's (1994) descriptions, all three *Haliclona* spp. would appear to have nearly the same architecture.

The remaining five *Haliclona* spp. known from Brazil also occur in the Tropical Northwestern Atlantic (Caribbean Region): *H.* (*Soestella*) *caerulea* (Hechtel, 1965); *H.* (*Reniera*) *implexiformis* (Hechtel, 1965); *H.* (*Re.*) *manglaris* Alcolado, 1984; *H.* (*S.*) *melana* Muricy & Ribeiro, 1999; and *H.* (*Re.*) *tubifera* (George & Wilson, 1919) [sensu Lerner (1996), = *H.* (*Halich.*) sp. sensu De Weerdt (2000)]. The record of *H.* (*Rh.*) *curacaoensis* by Cedro *et* al. (2007; MNRJ 10280, UFALPOR 0241) has been briefly revised here and found to be best assigned to *H.* (*Re.*) *manglaris*. Its oxeas were found to reach only up to 85 µm in length, and its architecture, to be more on the *Reniera* side of the spectrum.

ACKNOWLEDGEMENTS

AB is thankful to Victor Cedro for help in field work and discussions on the taxonomy of sponges, to the colleagues of the Laboratório de Taxonomia de Poríferos (*TAXPO*) of Museu Nacional/UFRJ for the assistance during my visits to the lab, to Prof. Dr. Hilda H. Sovierzoski and all other colleagues from Setor de Comunidades Bentônicas of the Universidade Federal de Alagoas (UFAL) for help in field trips. Prof. Dr. Cláudio Sampaio (UFAL at Penedo) is thanked for kindly letting us use Figure 4B. M.Sc. Júlio Cesar Cruz Fernandez is thanked for kindly providing Figure 5A–B. Two anonymous reviewers are thanked for providing valuable comments that improved the manuscript. AB, MDC and EH are thankful to Conselho Nacional de Desenvolvimento Científico e

Tecnológico (CNPq), Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ), and Programa de Pós-graduação em Diversidade Biológica e Conservação nos Trópicos (PPGDiBiCT) for grants and/or scholarships.

REFERENCES

Alcolado P.M. (1984) Nuevas especies de esponjas encontradas en Cuba. *Poeyana* 271, 1–22

Barros L.V., Santos G.G. and Pinheiro U. (2013) *Clathria* (*Clathria*) Schmidt, 1862 from Brazil with description of a new species and a review of records (Poecilosclerida: Demospongiae: Porifera). *Zootaxa* 3640(2), 284–295.

Campos M., Mothes B., Eckert M. and Van Soest R.W.M. (2005) Haplosclerida (Porifera: Demospongiae) from the coast of Maranhão State, Brazil, Southwestern Atlantic. *Zootaxa* 963, 1–22.

Cedro V.R., Hajdu E., Sovierzosky H.H. and Correia M.D. (2007) Demospongiae (Porifera) of the shallow coral reefs of Maceió, Alagoas State, Brazil. In Custódio M.R.; Lôbo-Hajdu G.; Hajdu E. and Muricy G. (eds). *Porifera Research: Biodiversity, Innovation and Sustainability*. Rio de Janeiro: Museu Nacional, pp. 233–237.

Cedro V.R., Hajdu E. and Correia M.D. (2011) *Mycale alagoana* sp.nov. and two new formal records of Porifera (Demospongiae, Poecilosclerida) from the shallow-water reefs of Alagoas (Brazil). *Biota Neotropica* 11(1), 161–171.

Cedro V.R., Hajdu E. and Correia M.D. (2013) Three new intertidal sponges (Porifera: Demospongiae) from Brazil's fringing urban reefs (Maceio, Alagoas, Brazil), and support for *Rhabderemia*'s exclusion from Poecilosclerida. *Journal of Natural History* 47(33-34), 2151–2174.

De Weerdt W.H. (1989) Phylogeny and vicariance biogeography of North Atlantic Chalinidae (Haplosclerida, Demospongiae). *Beaufortia* 39(3), 55–90.

De Weerdt W.H. (2000) A monograph of the shallow-water Chalinidae (Porifera, Haplosclerida) of the Caribbean. *Beaufortia* 50(1), 1–67.

De Weerdt W.H. (2002) Family Chalinidae. In Hooper J.N.A. and Van Soest R.W.M. (eds.). *Systema Porifera. A guide to the supraspecific classification of the phylum Porifera*. New York: Kluwer Academic/Plenum Publishers, pp. 852–873.

De Weerdt W.H., Kluijver M.J. and Gomez R. (1999) *Haliclona* (*Halichoclona*) *vansoesti* n. sp., a new chalinid sponge species (Porifera, Demospongiae, Haplosclerida) from the Caribbean. *Beaufortia* 49(6), 47–54.

De Weerdt W.H., Rützler K. and Smith K.P. (1991) The Chalinidae (Porifera) of Twin Cays, Belize, and adjacent waters. *Proceedings of the Biological Society of Washington* 104(1), 189–205.

Díaz M.C., Thacker R.W., Rützler K. and Piantoni C. (2007) Two new haplosclerid sponges from Caribbean Panama with symbiotic filamentous cyanobacteria, and an overview of sponge-cyanobacteria associations. In Custódio M. R.; Lôbo-Hajdu G.; Hajdu E. and Muricy G. (eds). *Porifera Research: Biodiversity, Innovation and Sustainability*. Rio de Janeiro: Museu Nacional, pp. 31–39.

George W.C. and Wilson H.V. (1919) Sponges of Beaufort (N.C.) Harbor and Vicinity. *Bulletin of the Bureau of Fisheries* 36, 129–179, pls LVI–LXVI.

Grant R.E. (1836) Animal Kingdom. *In*: Todd, R.B. (Ed.). *The Cyclopaedia of Anatomy and Physiology. Volume 1*. London: Sherwood, Gilbert, and Piper, pp. 107–118.

Gray J.E. (1867) Notes on the Arrangement of Sponges, with the Descriptions of some New Genera. *Proceedings of the Zoological Society of London* 1867(2), 492–558, pls XXVII–XXVIII.

Hajdu E., Peixinho S. and Fernandez J.C.C. (2011) *Esponjas marinhas da Bahia: guia de campo e laboratório*. Rio de Janeiro: Museu Nacional, 276 pp. [Série Livros 45.]

Hechtel G.J. (1965) A systematic study of the Demospongiae of Port Royal, Jamaica. *Bulletin of the Peabody Museum of Natural History* 20, 1–103.

Jackson C.P.J., De Weerdt W.H. and Webber M.K. (2006) *Haliclona* (*Reniera*) *portroyalensis* n. sp., a new chalinid sponge (Porifera, Demospongiae, Haplosclerida) from the southeast coast of Jamaica. *Zootaxa* 1319, 59–68.

Lehnert H. and Van Soest R.W.M. (1996) North Jamaican deep fore-reef sponges. *Beaufortia* 46(4), 53–81.

Lerner C.B. (1996) Esponjas da Ilha da Galé, Reserva Marinha Biológica do Arvoredo, Santa Catarina, Brasil (Porifera: Demospongiae). *Biociências* 4(2), 101–129

Mothes B. and Lerner C.B. (1994) Esponjas marinhas do infralitoral de Bombinhas (Santa Catarina, Brasil) com descrição de três espécies novas (Porifera: Calcarea e Demospongiae). *Biociências* 2(1), 47–62.

Muricy G. and Ribeiro S.M. (1999) Shallow-water Haplosclerida (Porifera, Demospongiae) from Rio de Janeiro State, Brazil (Southwestern Atlantic). *Beaufortia* 49(9), 83–108.

Muricy G., Lopes D.A., Hajdu E., Carvalho M.S., Moraes F.C., Klautau M., Menegola C. and Pinheiro U. (2011) *Catalogue of Brazilian Porifera*. Museu Nacional, Rio de Janeiro, 299 pp. [Série Livros 46.]

Peixinho S., Fernandez J.C.C., Oliveira M., Caires S. and Hajdu E. (2007) Description of two new species of *Acanthotetilla* Burton, 1959 from NE Brazil. In Custódio, M. R.; Lôbo-Hajdu, G.; Hajdu, E. and Muricy, G. (eds). *Porifera Research: Biodiversity, Innovation and Sustainability*. Rio de Janeiro: Museu Nacional, pp. 509–515.

Pulitzer-Finali G. (1986) A collection of West Indian Demospongiae (Porifera). In appendix, a list of the Demospongiae hitherto recorded from the West Indies. *Annali del Museo civico di storia naturale Giacomo Doria* 86, 65–216.

Sandes J. and Pinheiro U. (2013) New species of *Myrmekioderma* (Demospongiae: Halichondrida: Heteroxidae) from Brazil. *Zootaxa* 3702(4), 370-378.

Schmidt O. (1862) *Die Spongien des adriatischen Meeres*. Leipizig: Wilhelm Engelmann, I–VIII, 1–88, pls 1–7.

Sollas W.J. (1885) A Classification of the Sponges. *Annals and Magazine of Natural History* 16(95), p. 395.

Topsent E. (1928) Spongiaires de l'Atlantique et de la Méditerranée provenant des croisières du Prince Albert ler de Monaco. Résultats des campagnes scientifiques accomplies par le Prince Albert I. *Monaco* 74, 1–376, pls. I–XI.

Van Soest R.W.M. (1980) Marine sponges from Curaçao and other Caribbean localities. Part II. Haplosclerida. *Studies on the Fauna of Curaçao and other Caribbean Islands* 62(191), 1–173.

Van Soest R.W.M, Boury-Esnault N., Hooper J.N.A., Rützler K., de Voogd N.J., Alvarez de Glasby B., Hajdu E., Pisera A.B., Manconi R., Schoenberg C., Janussen D., Tabachnick K.R., Klautau M., Picton B., Kelly M., Vacelet J., Dohrmann M. and Díaz M.C. (2013) *World Porifera database*. Available at http://www.marinespecies.org/porifera (accessed 18 November 2013).

Zea S. and De Weerdt W.H. (1999) *Haliclona* (*Haliclona*) *epiphytica* n. sp. (Porifera, Demospongiae, Haplosclerida), a seaweed-dwelling sponge from the Colombian Caribbean. *Beaufortia* 49(13), 171–176.

4 ARTIGO 2: Two new species of *Haliclona* Grant, 1836 (Haplosclerida: Chalinidae) from Sergipe State, Brazil

JOANA SANDES, ANDRÉ BISPO & ULISSES PINHEIRO

Adapted from manuscript published at

Zootaxa 3793 (2): 273–280[1]

Abstract

Haliclona is one of the most species-rich genera among Demospongiae, but with only 11 species recorded for the Brazilian coast. Here we describe two new species of *Haliclona* collected by trawling at Sergipe State (Northeastern Brazil). *Haliclona* (*Halichoclona*) *dura* sp. nov. is distinguished by the combination of confused choanosome with dense reticulation, oxeas with stepped and mucronate points, color dark brown externally and light beige internally, consistency firm and incompressible. *Haliclona* (*Soestella*) *brassica* sp. nov. is set apart by the combination of a choanosomal skeleton with rounded meshes, strongyles, raphides, color beige and consistency soft.

Keywords: Porifera, Demospongiae, Biodiversity, Western Atlantic.

Introduction

Haliclona is the richest and most abundant taxon within the family Chalinidae (de Weerdt, 2002), with more than 400 species (van Soest *et al.*, 2013). The genus is distributed worldwide, occurring from polar to tropical areas and from shallow to deep-water environments (de Weerdt, 2002).

Despite this high species richness, only 11 species of *Haliclona* are registered from the Brazilian coast. Six of them are provisional endemic, while the five other co-occur in the Caribbean (Hajdu *et al.*, 2011; Muricy *et al.*, 2011; Bispo *et al.*, 2014).

The high number of species in *Haliclona* may reflect the difficulty in working with the systematics of this group, since many authors indicated the high variability and paucity of characters as the main taxonomic problems in Chalinidae (de Weerdt, 1989, 2000; McCormack *et al.*, 2002; Redmond *et al.*, 2007).

Phylogenetic trends revealed by study of ribosomal RNA 18S and 28S (McCormack *et al.*, 2002; Redmond *et al.*, 2007), and the mitochondrial genes *cox1* and *nad1* (Redmond *et al.*, 2011) demonstrated that many of the families and genera

---

[1] A estrutura e os critérios de citação deste capítulo seguem as normas do periódico **Zootaxa.**.

within Haplosclerida, including *Haliclona*, are polyphyletic. This means that the current classification needs a comprehensive revision.

Independent of these supra-specific problems in the systematics of the Haplosclerida, there are still many new species that deserve a formal description and a name. In this paper, we describe two new species of *Haliclona* collected along the coast of the Sergipe State (Northeastern Brazil Ecoregion), a region where the sponges' biodiversity remains almost unknown (see Muricy *et al.*, 2011).

Material and Methods

Samples were collected in 2003, on the continental shelf of Sergipe State, by trawling. The specimens were collected in one site at 20 m depth (Fig. 1). In the laboratory, the specimens were fixed in 10% formaldehyde and thereafter preserved in 70% ethanol. Dissociated spicule mounts and skeletal sections were made using classical procedures for Demospongiae, observed by optical microscope and Scanning Electron Microscopy (SEM) (Hajdu *et al.*, 2011). Spicule measurement for each specimen was presented as minimum–<u>mean</u>–maximum and length/width, with n = 30. The holotypes of *Haliclona* (*Halichoclona*) *dura* sp. nov. and *Haliclona* (*Soestella*) *brassica* sp. nov. were deposited in the Porifera collection of Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ) and the paratypes were deposited in the Porifera collections of Universidade Federal de Pernambuco (UFPEPOR) and Universidade Federal de Sergipe (UFSPOR).

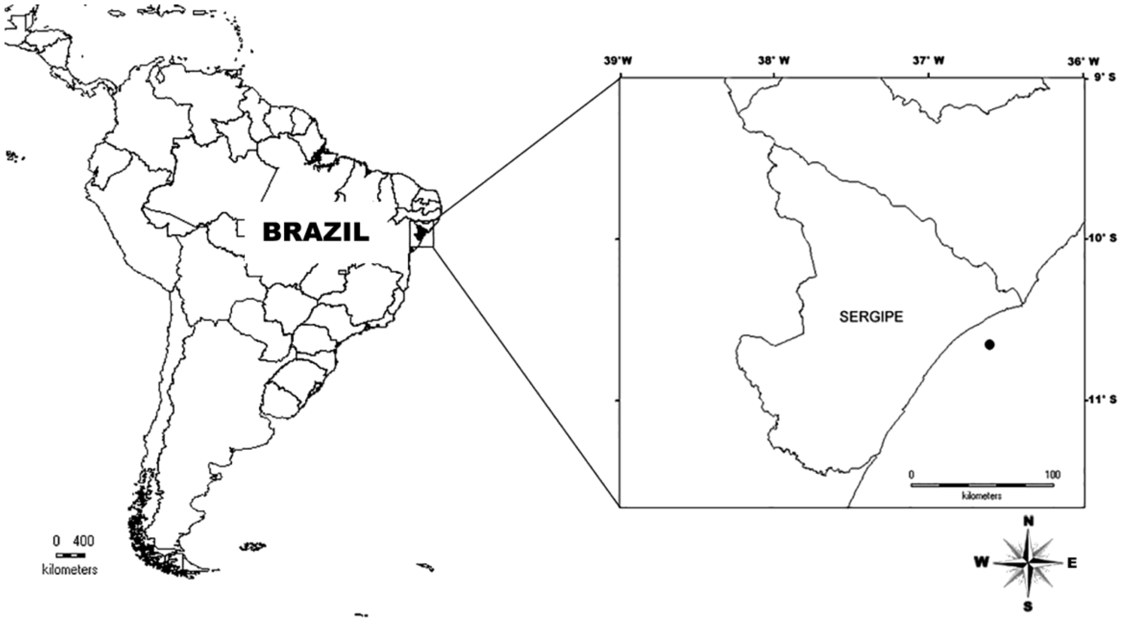


FIGURE 1: Collection site (black circle) of *Haliclona* (*Halichoclona*) *dura* sp. nov. and *Haliclona* (*Soestella*) *brassica* sp. nov. off Pirambu city, Sergipe State, Brazil (10º45'36"S, 36º36'08"W).

Systematics

Class Demospongiae Sollas, 1885

Order Haplosclerida Topsent, 1928

Family Chalinidae Gray, 1867

Genus *Haliclona* Grant, 1836

Definition: Chalinidae with unispicular secondary lines (from de Weerdt, 2002).

Subgenus *Halichoclona* de Laubenfels, 1932

Definition: Chalinidae with a choanosomal skeleton consisting of a subisotropic, somewhat confused reticulation, commonly intercepted by many choanosomal spaces. Ectosomal skeleton of the same structure as the choanosome, usually very loosely overlaying the choanosome, from which it may be separated by extensive subectosomal spaces. Spongin absent or very scarce, at the nodes of the spicules. Megascleres usually acerate or hastate oxeas. Microscleres, if present, microxeas or sigmas. Sponges commonly relatively crisp and brittle, only slightly compressible (from de Weerdt, 2002).

***Haliclona* (*Halichoclona*) *dura* sp. nov.**
(Fig. 2, 3; Tab. 1)

Type specimens: Holotype – MNRJ17606, off Pirambu (10º45’36”S, 36º36’08”W), Sergipe State, Brazil, 20 m depth, coll. Cosme Assis & Damião Assis (VI/2003). Paratypes: UFPEPOR1518, UFSPOR49, UFSPOR123, UFSPOR124, UFSPOR141, UFSPOR142, UFSPOR163, UFSPOR271 (same data as the holotype); UFSPOR 272, off Pirambu (10º45’36”S, 36º36’08”W), Sergipe State, Brazil, 20 m depth, coll. Cosme Assis & Damião Assis (VI/2002).

Diagnosis. *Haliclona* (*Halichoclona*) *dura* sp. nov. is set apart from its congeners in the Tropical Western Atlantic by the combination of a dense ectosome, oxeas with stepped and mucronate points, color dark brown externally and light beige internally, consistency firm and incompressible.

External morphology (Fig. 2A–B)**.** Thick encrustations. The holotype is the biggest specimen, reaching 3 x 2 cm (length x width). Oscula at the top of small tubular

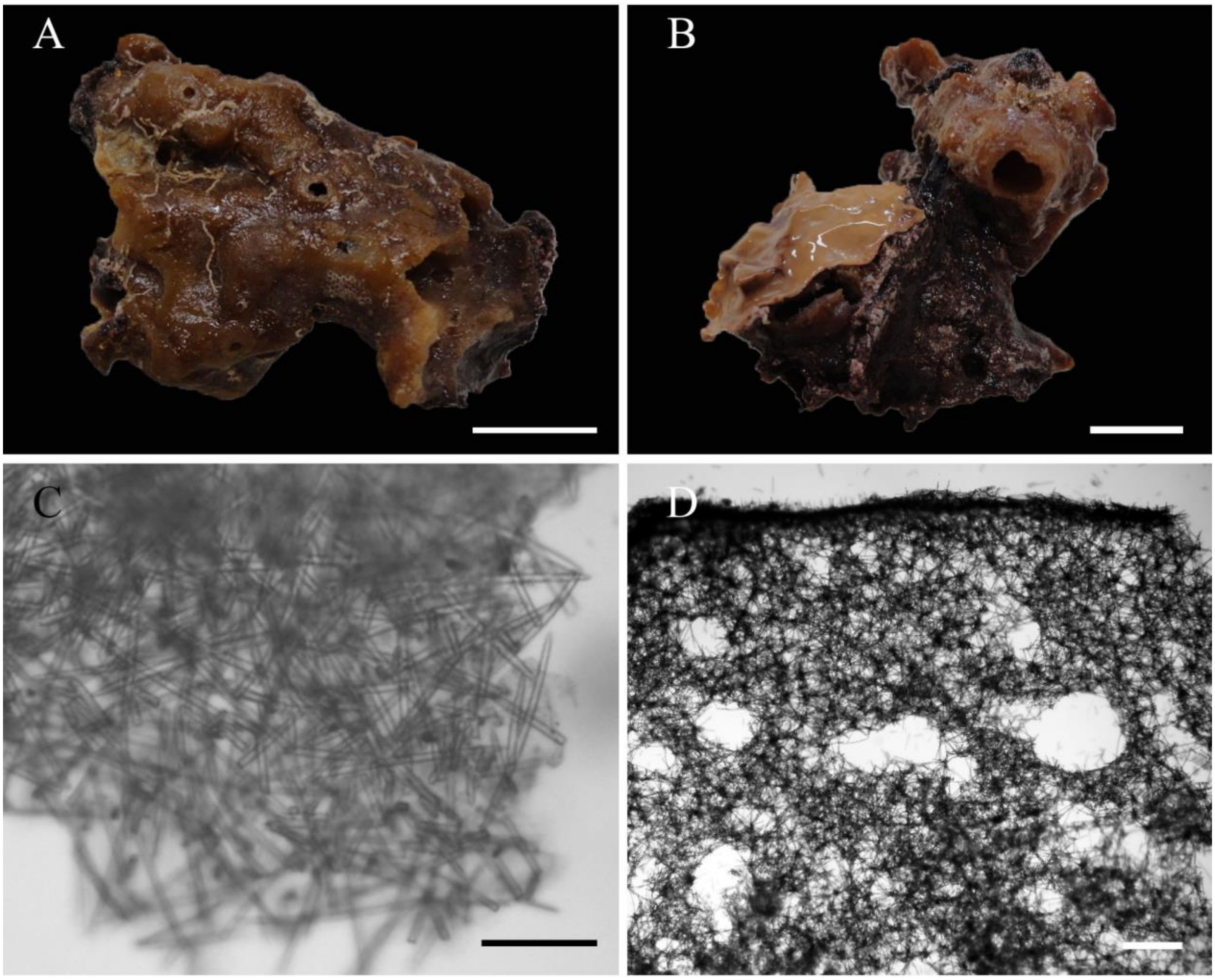


FIGURE 2: *Haliclona* (*Halichoclona*) *dura* sp. nov. (A–B) holotype (MNRJ17606); (C) tangential view of ectosomal skeleton; (D) ectosome and choanosome through transverse section. Scale bars: A–B, 1 cm; C, 82 µm; D, 150 µm.

projections, up to 1 cm in height and 5 mm in diameter, or flush with the surface, 0.5 to 2 mm in diameter. Consistency is hard, incompressible. Surface even, slightly rough to the touch. Color externally is dark brown and light beige internally, in ethanol.

Skeleton (Fig. 2C–D)**.** Ectosome is a *Calyx*-like tangential reticulation of spicules, confused and dense, without subectosomal spaces (Fig. 2C). Choanosome is an isotropic, confused, and dense reticulation (but not as dense as the ectosome), with some choanosomal spaces. Spongin scarce, present only at the nodes of the spicule (Fig. 2D).

Spicules (Fig. 3A–N)**.** Oxeas with stepped (varying from subtly to clearly marked) or mucronate points, rarely with acerate tips, some with strongylote modifications, 105–157.2–193/2.5–5.6–9 µm. Occasionally, the same oxea has opposite points of different shapes (see Fig. 3A, F, G).

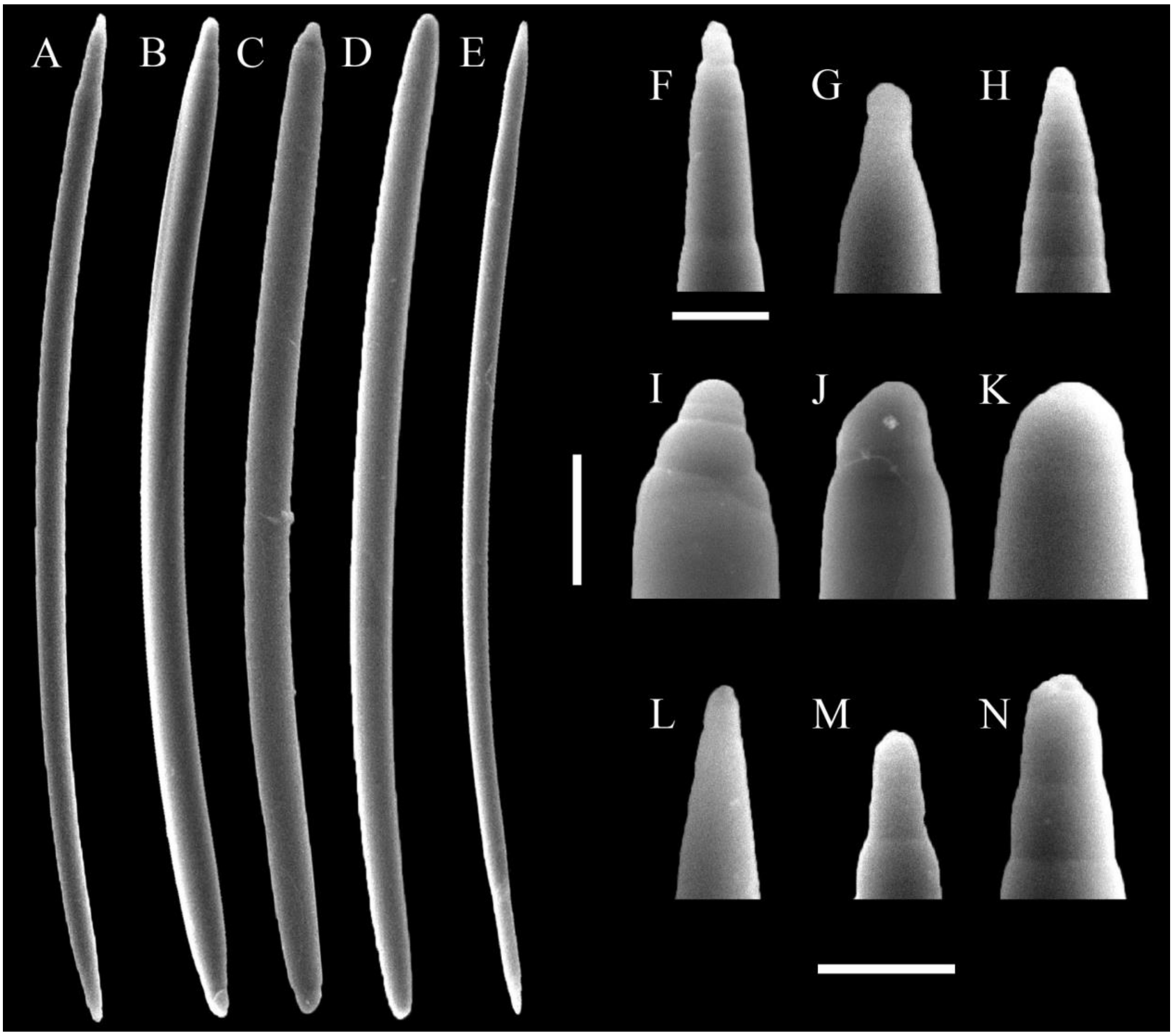


FIGURE 3: *Haliclona* (*Halichoclona*) *dura* sp. nov. (A–C) stepped oxeas; (D) strongyloxea; (E) acerate oxea; (F–G) points of oxea A; (H) point of oxea B; (I–J) points of oxea C; (K) point of strongyloxea D; (L) point of oxea E; (M) mucronate point; (N) subtly stepped point. Scale bars: A–E, 20 µm; F, 5 µm; G–N, 5 µm.

Ecology. The specimens were found at 20 m depth, encrusting on rhodoliths with other sponges, as *Iotrochota birotulata* (Higgin, 1877) and *Hymedesmia* (*Stylopus*) sp.

Distribution. Sergipe State (Northeastern Brazil Ecoregion).

Etymology. The specific epithet derives from the hard consistency of the sponge.

Remarks. *Haliclona* (*Halichoclona*) *dura* sp. nov. is distinguished from the other species in this subgenus in the Tropical Western Atlantic by the combination of oxeas with stepped or mucronate points and large range in width (2.5–$\underline{5.6}$–9 µm), colour dark brown externally and light beige internally, consistency firm and incompressible.

Haliclona (*Halichoclona*) *lernerae* Campos *et al.*, 2005 is the most similar to the new species due to its skeletal features, such as dense ectosome and choanosome. However, it differs from *Haliclona* (*Halichoclona*) *dura* sp. nov. by the massive shape, colour beige in ethanol, and by possessing slender oxeas (1.2–3.3–4.6) without stepped or mucronate points (Tab. 1).

Hechtel (1965) in his description of *H.* (*Halichoclona*) *albifragilis* reported the presence of some oxeas with mucronate points. De Weerdt (2000) reexamined the type material of this species, but only observed oxeas with long sharp points. Even if we accept the presence of mucronated oxeas in *H.* (*Halichoclona*) *albifragilis*, it still differs from the new species by the presence of a subisotropic ectosome, with triangular meshes, few choanosomal spaces, consistency brittle and compressible, pale color in ethanol and also by the absence of oxeas with stepped points (Tab. 1).

Haliclona (*Halichoclona*) *stoneae* de Weerdt, 2000 and *H.* (*Halichoclona*) *vansoesti* de Weerdt *et al.*, 1999 resemble *Haliclona* (*Halichoclona*) *dura* sp. nov. by the shape and oscula position. However, they differ from the new species by their brittle and fragile consistency, colour and absence of oxeas with stepped or mucronate points. Moreover, *H.* (*Halichoclona*) *stoneae* also differs by the possession of sigmas (Tab. 1).

Although clearly distinguished from its congeners, *Haliclona* (*Halichoclona*) *dura* sp. nov. shares striking resemblances with *Calyx podatypa* (de Laubenfels, 1934) such as: external color brownish [varying from drab to different shades of brown in *C. podatypa*, or just brown in *H.* (*Halich*) *dura* sp. nov], and internal color lighter [varying from pale white or yellow to cream in *C. podatypa*, or beige in *H.* (*Halich*) *dura* sp. nov.]; presence of a remarkable dense ectosomal skeleton, forming a kind of crust with spicules in confusion densely grouped; choanosomal skeleton is an isotropic reticulation riddled by canals. Nevertheless, *C. podatypa* presents the typical Phloeodictyidae multispicular reinforcing tracts (parallel to the surface) in the choanosome that are not present in *H.* (*Halich.*) *dura* sp. nov.. Moreover, *C. podatypa* is referred as soft, spongy, and fragile, with oscula of remarkable shape (Y- or heart-shaped, human footprint-like, or rounded), whereas *H.* (*Halich.*) *dura* sp. nov is an incompressible sponge, with rounded oscula, and oxeas with mucronate or stepped points. These features clearly distinguish both species. For detailed descriptions of *C. podatypa* see: de Laubenfels (1934) as *Haliclona podatypa*, van Soest (1980) as *Pachypellina podatypa*, van Soest & Stentoft (1988) as *Calyx* cf. *podatypa*, Wiedenmayer (1977) as *Haliclona* (*?Reniera*) *podatypa*, and Zea (1987) as *Pachypellina podatypa*.

Surely, such a dense ectosomal skeleton as that of *Haliclona* (*Halichoclona*) *dura* sp. nov. deviates from the pattern among the subgenus *Haliclona* (*Halichoclona*). On the other hand, we preferred to assign this species to *Haliclona* instead of *Calyx* given the abscence of multispicular tracts. But, in our opinion, the similarity among *H.* (*Halich.*) *dura* sp. nov and *Calyx podatypa* could simply be reflecting the polyphyletic nature of the Haplosclerida.

Subgenus *Soestella* de Weerdt, 2000

Definition: Chalinidae with a subanisotropic choanosomal skeleton consisting of ill-defined paucispicular primary lines, irregularly connected by paucispicular secondary lines. There is a slight but consistent tendency of the spicules to form rounded meshes. Ectosomal skeleton a discontinuous, tangential, rather open reticulation, due to many rounded meshes framed by spicules in lines of 2–5 spicules thick. Spongin always present at the nodes of spicules, but never abundant. Oxeas usually slender. Microscleres, if present, sigmas, toxas or raphides (from de Weerdt, 2002).

Haliclona (*Soestella*) *brassica* sp. nov.

(Fig. 4; Tab. 2)

Type specimens. Holotype – MNRJ17607, off Pirambu (10º45'36"S, 36º36'08"W), Sergipe State, Brazil, 20 m depth, coll. Cosme Assis & Damião Assis (VI/2003). Paratypes – UFPEPOR1527, UFSPOR256 (same data as the holotype).

Diagnosis. *Haliclona* (*Soestella*) *brassica* sp. nov. is the only *Haliclona* in the Tropical Western Atlantic with the combination of a choanosomal skeleton with rounded meshes and a spiculation of strongyles and raphides.

External morphology (Fig. 4A)**.** The holotype consists of lamellate encrustations like a cabbage. Oscula were not apparent. Consistency soft, very fragile, easily torn. Surface even, velvety. Color in ethanol is beige.

Skeleton (Fig. 4B–C)**.** Ectosome is a tangential, subisotropic reticulation, composed by meshes of tri- to polygonal meshes formed by 1-4 spicules in width (Fig. 3B). Choanosome is a confuse reticulation of ill-defined paucispicular lines forming rounded meshes with spicules disorganized. Spongin in small amounts (Fig. 3C).

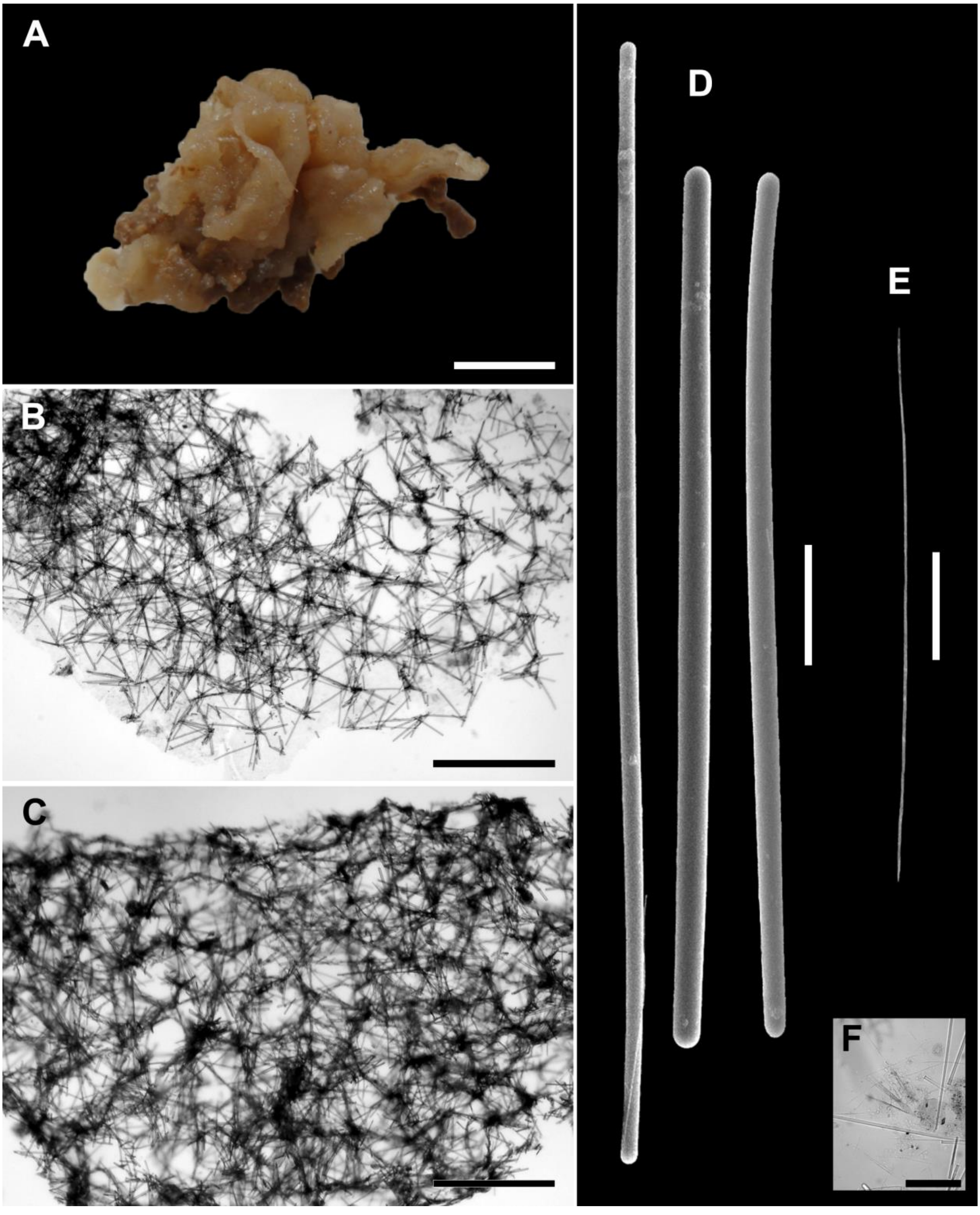


FIGURE 4: *Haliclona* (*Soestella*) *brassica* sp. nov. (A) holotype (MNRJ17607); (B) tangential view of ectosomal skeleton; (C) ectosome and choanosome through transverse section; (D) strongyles; (E) raphide; (F) tichodragmata. Scale bars: A, 1 cm; B–C 400 µm; D–E, 20 µm; F, 40 µm.

Spicules (Fig. 4D–F)**.** Strongyles, straight or slightly curved, 111–<u>148.4</u>–195/3–<u>3.8</u>–4.5 µm (Fig. 3D). Raphides, 32–<u>46.5</u>–125 µm (Fig. 3E), rare trichodragmata (Fig. 3F).

Ecology. Found at 20 m depth, associated to hydroids.

Distribution. Sergipe State (Northeastern Brazil Ecoregion).

Etymology. The specific epithet derives from the shape of lamellate encrustations like a cabbage, which corresponds to brassica in Latin.

Remarks. *Haliclona* (*Soestella*) *brassica* sp. nov. is the only *Haliclona* in the Tropical Western Atlantic with the combination of strongyles and raphids. Only one other species in this region has strongyles: *H*. (*Reniera*) *strongylophora* Lehnert & van Soest, 1996. However, it is distinguished from the new species by the unispicular ectosome, isotropic and uni- to paucipiscular choanosome and absence of raphides. Furthermore, the strongyles are more robust (4–10 µm) and the color is dark brown in spirit.

Haliclona (*Reniera*) *implexiformis* (Hechtel, 1965), *H.* (*Re.*) *tubifera* (George & Wilson, 1919), *H.* (*Soestella*) *caerulea* (Hechtel, 1965) and *H.* (*Halichoclona*) *albifragilis* (Hechtel, 1965) possess oxeas with strongyloid modifications, but they never have strongyles exclusively and they lack raphides entirely.

Two other species of *Haliclona* (*Soestella*) in the Tropical Western Atlantic also possess raphids as microscleres: *H.* (*S.*) *luciensis* de Weerdt, 2000 and *H.* (*S.*) *smithae* de Weerdt, 2000. However, they differ from *H.* (*S.*) *brassica* sp. nov. by the absence of strongyles (Tab. 2).

Bispo *et al.* (2014) recently described a new species of *Haliclona* (*Soestella*) from the Eastern Brazil Ecoregion. But it is a tubular sponge with a remarkable subsuperficial reticulation that is visible to the naked eye, possessing oxeas as megascleres.

Discussion

The biodiversity of sponges from the Sergipe State (Northeastern Brazil Ecoregion) remained almost unexplored until very recently: up to 2011, only seven species were reported to this sector of the Brazilian coast (see Muricy *et al*., 2011). Nevertheless, recent (Sandes & Pinheiro, 2013; this study) and ongoing studies are helping to fill the gap on the knowledge of the spongofauna of this region.

Furthermore, the two new species here described are also an addition to the known biodiversity of Chalinidae on the Brazilian coast. Now, there are thirteen species of *Haliclona* registered for the Brazilian coast (Bispo *et al*., in press; this study). For a detailed overview of the previous records of *Haliclona* from Brazil, see Bispo *et al*. (in press).

Acknowledgments

The authors are grateful to the Laboratório de Bentos Costeiro of the Universidade Federal de Sergipe (UFS), especially to Dr. Carmen Regina Parisotto Guimarães for the loan of material. Guilherme Muricy and Eduardo Hajdu are thanked for discussing the generic assignment of *Haliclona* (*Halichoclona*) *dura* sp. nov. Two anonymous reviewers are thanked for valuable suggestions that helped us to improve this manuscript. The authors are also thankful to Beatriz Cordeiro for SEM operation and to Eduardo Hajdu for kindly providing access to SEM equipment through the Center for Scanning Electron Microscopy of Museu Nacional/UFRJ. The establishment of this Center was made possible by a grant from CENPES-PETROBRAS, and is part of the company's thematic network for marine environmental monitoring. AB is grateful to all the colleagues from the Laboratório de Taxonomia de Poríferos (TAXPO) of Museu Nacional for the assistance provided during his visit to the museum. Financial support and scholarship were provided by Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco (FACEPE), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), and Coordenação de Aperfeiçoamento de Pessoal do Nível Superior (CAPES).

References

Bispo, A., Correia, M.D. & Hajdu, E. (2014) Two new shallow-water species of *Haliclona* from the Northeastern Brazil (Demospongiae: Haplosclerida: Chalinidae). *Journal of the Marine Biological Association of the United Kingdom*.

Campos, M., Mothes, B., Eckert, M. & van Soest, R.W.M. (2005) Haplosclerida (Porifera: Demospongiae) from the coast of Maranhão State, Brazil, Southwestern Atlantic. *Zootaxa* 963, 1–22.

Díaz, M.C., Thacker, R.W., Rützler, K. & Piantoni, C. (2007) Two new haplosclerid sponges from Caribbean Panama with symbiotic filamentous cyanobacteria, and an overview of sponge-cyanobacteria associations. *In:* Custódio, M. R., Lôbo-Hajdu, G., Hajdu, E. & Muricy, G. (Eds). *Porifera Research: Biodiversity, Innovation and Sustainability*. Museu Nacional, Rio de Janeiro, Brazil, 694 p.

George, W.C. & Wilson, H.V. (1919) Sponges of Beaufort (N.C.) Harbor and Vicinity. *Bulletin of the Bureau of Fisheries* 36, 129–179, pls. LVI–LXVI.

Grant, R.E. (1836) Animal Kingdom. *In*: Todd, R.B. (Ed.). *The Cyclopaedia of Anatomy and Physiology. Volume 1.* (Sherwood,Gilbert, and Piper: London), 1–813.

Gray, J.E. (1867) Notes on the Arrangement of Sponges, with the Descriptions of some New Genera. *Proceedings of the Zoological Society of London 1867* (2), 492–558, pls. XXVII–XXVIII.

Hajdu E., Peixinho, S. & Fernandez, J.C.C. (2011) *Esponjas marinhas da Bahia: guia de campo e laboratório*. Rio de Janeiro: Museu Nacional. [Série Livros, nº 45.]

Hechtel, G.J. (1965) A systematic study of the Demospongiae of Port Royal, Jamaica. *Bulletin of the Peabody Museum of Natural History* 20, 1–103.

Laubenfels, M.W. de (1932) The marine and fresh-water sponges of California. *Proceedings of the United States National Museum* 81(2927), 1–140.

Laubenfels, M.W. de (1934) New sponges from the Puerto Rican deep. *Smithsonian Miscellaneous Collections* 91(17), 1–28.

Lehnert, H. & van Soest, R.W.M. (1996) North Jamaican deep fore-reef sponges. *Beaufortia* 46(4), 53–81.

McCormack G.P., Erpenbeck D. & van Soest R.W.M. (2002) Major discrepancy between phylogenetic hypotheses based on molecular and morphological criteria within the Order Haplosclerida (Phylum Porifera: Class Demospongiae). *Journal of Zoogical Systematics and Evolutionary Research* 40(4), 237–240.

Muricy, G. & Ribeiro, S.M. (1999) Shallow-water Haplosclerida (Porifera, Demospongiae) from Rio de Janeiro State, Brazil (Southwestern Atlantic). *Beaufortia* 49(9), 83–108.

Muricy, G., Lopes, D.A., Hajdu, E., Carvalho, M.S., Moraes, F.C., Klautau, M., Menegola, C. & Pinheiro, U. (2011) *Catalogue of Brazilian Porifera*. Rio de Janeiro: Museu Nacional, pp. 88–91. [Série Livros, nº 46.]

Redmond N.E., van Soest R.W.M., Kelly M., Raleigh J., Travers S.A.A. & McCormack G.P. (2007) Reassessment of the classification of the Order Haplosclerida (Class Demospongiae, Phylum Porifera) using 18S rRNA gene sequence data. Molecular Phylogenetics and Evolution 43, 344–352.

Redmond N.E., Raleigh J., van Soest R.W.M., Kelly M. & Travers S.A.A. (2011) Phylogenetic Relationships of the Marine Haplosclerida (Phylum Porifera) Employing Ribosomal (28S rRNA) and Mitochondrial (*cox1*, *nad1*) Gene Sequence Data. *PLoS ONE* 6 (9), e24344.

Sandes, J. & Pinheiro, U. (2013) New species of *Myrmekioderma* (Demospongiae: Halichondrida: Heteroxidae) from Brazil. *Zootaxa* 3702(4), 370–378.

Sollas, W. J. (1885) Classification of the Sponges. *Scientific Proceedings of the Royal Dublin Society* 5(2), 112.

Topsent, E. (1928) Spongiaires de l'Atlantique et de la Méditerranée provenant des croisières du Prince Albert ler de Monaco. Résultats des campagnes scientifiques accomplies par le Prince Albert I. *Monaco* 74, 1–376, pls. I–XI.

Soest, R.W.M. van (1980) Marine sponges from Curaçao and other Caribbean localities. Part II. Haplosclerida. pp. 1–173. *In*: Hummelinck, P.W. & Van der Steen, L.J. (Eds), *Uitgaven van de Natuurwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen*. No. 104. Studies on the Fauna of Curaçao and other Caribbean Islands, 62(191).

Soest, R.W.M. van & Stentoft (1988) Barbados Deep-Water Sponges. pp. 1–175. *In*: Hummelinck, P.W. & Van der Steen, L.J. (Eds), *Uitgaven van de Natuurwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen*. No. 122. Studies on the Fauna of Curaçao andother Caribbean Islands, 70(215).

Soest, R.W.M. van, Boury-Esnault, N., Hooper, J., Rützler, K., De Voogd, N.J., Alvarez, B., Hajdu, E., Pisera, A., Vacelet, J., Manconi, R., Schoenberg, C., Janussen, D., Tabachnick, K.R. & Klautau, M. (2013) *World Porifera Database*. Available from: http://www.marinespecies.org/porifera/ (01 November 2013).

Weerdt, W.H. de (1989) Phylogeny and vicariance biogeography of North Atlantic Chalinidae (Haplosclerida, Demospongiae). *Beaufortia* 39(3), 55–90.

Weerdt, W.H. de, Rützler, K. & Smith, K.P. (1991) The Chalinidae (Porifera) of Twin Cays, Belize, and adjacent waters. *Proceedings of the Biological Society of Washington* 104(1), 189–205.

Weerdt, W.H. de, De Kluijver, M.J. & Gomez, R. (1999) *Haliclona* (*Halichoclona*) *vansoesti* n.sp., a new chalinid sponge species (Porifera, Demospongiae, Haplosclerida) from the Caribbean. *Beaufortia* 49(6), 47–64.

Weerdt W.H. de (2000) A monograph of the shallow-water Chalinidae (Porifera, Haplosclerida) of the Caribbean. *Beaufortia* 50(1), 1–67.

Weerdt W.H. de (2002) Family Chalinidae. *In*: Hooper, J.N.A. & Van Soest, R.W.M. (Eds). *Systema Porifera. A guide to the supraspecific classificationof the phylum Porifera*. Kluwer Academic/Plenum Publishers, New York, pp. 724–747.

Wiedenmayer, F. (1977) Shallow-water sponges of the western Bahamas. *Experientia Supplementum* 28, 1–287, pls 1–43.

Zea, S. (1987) *Esponjas del Caribe Colombiano*. Bogotá: Catálogo Cientifico, pp. 1–286.

5 ARTIGO 3: Biodiversity of shallow-water *Haliclona* (Demospongiae: Haplosclerida: Chalinidae) in the Brazilian coast: taxonomy, new records, and the description of five new species

ANDRÉ BISPO, JOÃO L. CARRARO, MONICA D. CORREIA AND EDUARDO HAJDU

To be submitted to
Zootaxa[1]

Abstract

The species of the genus *Haliclona* occurring in the Brazilian coast are revised. Sixteen species are described, five of which are new to science: *Haliclona* (*Gellius*) sp. nov., *Haliclona* (*Haliclona*) sp. nov, *Haliclona* (*Reniera*) sp. nov. 1, *Haliclona* (*Reniera*) sp. nov. 2, and *Haliclona* (*Soestella*) sp. nov.. We also redescribed the holotypes of *H.* (*Gellius*) *catarinensis*, *H.* (*Rhizoniera*) *lilacea*, *H.* (*Rhizoniera*) *mammillaris*, and *H.* (*Soestella*) *melana*. In addition, we present new records of *Haliclona* (*Halichoclona*) *vansoesti, H.* (*Reniera*) *chlorilla*, *H.* (*Reniera*) *implexiformis*, *H.* (*Soestella*) *caerulea*, and *H.* (*Soestella*) *melana.* We present a key to all the shallow-water species of *Haliclona* occurring in the Brazilian coast. The biodiversity and biogeographic affinities of the Brazilian *Haliclona* are discussed.

Keywords: Porifera, Western Atlantic, marine sponges, Brazil

Introduction

The genus *Haliclona* Grant, 1835 is recognized by having a reticulated skeleton of oxeas or strongyles organized in primary lines connected by unispicular secondary lines, but with some degree of variation accepted for each of its subgenus (De Weerdt, 2002). Due to their simple spiculation, skeletal architecture and the plasticity of its characters, *Haliclona* and the family Chalinidae are of difficult taxonomy and represents a challenge to the classification of the order Haplosclerida (De Weerdt, 1986, 2000; Redmond *et al.*, 2007, 2011, 2013).

Haliclona is worldwide distributed, occurring from very shallow to deep waters, and in a wide range of habitats (De Weerdt, 2000). However, most of the taxonomic studies dealing with chalinid or haliclonid species were geographically restricted (Griessinger, 1971; Bergquist & Warne, 1980; Van Soest, 1980; De Weerdt, 1986, 2000; and Fromont, 1993) or consisted of simple taxonomic description (De Weerdt *et*

---

[1] A estrutura e os critérios de citação deste capítulo seguem as normas do periódico **Zootaxa**.

al., 1999; Zea & De Weerdt, 1999; De Weerdt & Van Soest, 2001; Cruz-Barraza & Carballo, 2006; Abdo & Fromont, 2014). The latter is also the case of the Brazilian haliclonids, which were only treated in isolated taxonomic descriptions (Mothes & Lerner, 1994; Muricy & Ribeiro, 1999; Campos *et al.*, 2005; Bispo *et al*., 2014; Sandes *et al.*, 2014; Muricy *et al*., in press).

The genus is also the most species-rich member of the family Chalinidae, with more than 400 valid species (Van Soest *et al.*, 2015). This high number of species was achieved after a large synonymization made by De Weerdt (1986, 2000, 2002), in which 17 genera were collapsed within *Haliclona* after examination of their type species.

A phylogenetic analysis based mainly on the skeletal features of North Atlantic Chalinidae recovered 8 monophyletic species group, two of which kept in the rank of genera: *Chalinula*, *Dendroxea*, and the six remaining considered as subgenera of *Haliclona*: *Gellius*, *Haliclona*, *Halichoclona*, *Reniera*, *Rhizoniera*, and *Soestella* (De Weerdt, 1989, 2000). As well, all the classification of the order Haplosclerida, in which *Haliclona* is included, rely mainly on the characteristics of the skeleton. This turned in a problem since molecular phylogenies (Redmond *et al.*, 2007, 2011, 2013) showed that skeleton solely is not a good character for classifying most of the genera and families of Haplosclerida. Although molecular markers recover a monophyletic Haplosclerida, most of the genera and families within this order are polyphyletic, viz. *Haliclona* spp. (Chalinidae) falling dispersed in different clades together with species of different genera, such as *Callyspongia* spp (Callyspongiidae).

Even knowing that it is probably not monophyletic, we consider that the current classification of *Haliclona* is still useful, since it helps to sort out a high number of species in groups that shares some similarities. For this reason, we used the classification scheme proposed by De Weerdt (2002) in the *Systema Porifera*.

In this synopsis, we aimed to perform a comprehensively revision of the taxonomy of the *Haliclona*'s species occurring in shallow-water along the Brazilian coast. In addition, we provide a taxonomic key to the recognition of these species.

Material and Methods

Field efforts along the Brazilian coast during the years of 2012-2014 were made. Fresh material of *Haliclona* were collected in the States of Ceará, Rio Grande do Norte, Alagoas (Northeastern Brazil Ecoregion), and Santa Catarina (Southeastern Brazil

Ecoregion). All the specimens were collected by snorkelling or SCUBA diving, fixed in 96% ethanol, and preserved in 70-80% ethanol in MNRJ and UFALPOR Porifera collections. The specimens were also photographed underwater, in order to produce faithful descriptions and posterior easy recognition in the field.

Old collected undescribed specimens from different sectors of the coast was studied in MNRJ Porifera collection, but only those with underwater images were considered to this paper.

We obtained fragments of types from MCNPOR and UFRJPOR. In addition, microphotographs from the type material of *Haliclona* (*Halichoclona*) *albifragilis*, *H.* (*Reniera*) *implexiformis* and *H.* (*Soestella*) *caerulea* were obtained from the YPM.

The species descriptions were based on the external morphology (shape, size, colour, consistency, surface), as well as the internal morphology (skeletal architecture, shape and size of the spicules). We follow Hajdu *et al*. (2011) to prepare spicules for light and electron microscopy (SEM), as well as for thick sections of the skeleton. SEM images were obtained using a Shimadzu SSX-550 Superscan (from Grupo de Óptica e Materiais – OPTMA/UFAL) or a JEOL 6390 LV (from Departamento de Invertebrados of Museu Nacional/UFRJ or Laboratório Central de Microscopia Eletrônica/UFSC). Spicules dimensions are based on measurements of 30 fully grown spicule for each studied specimen, and presented as minimum–*mean*–maximum length/width.

Maps of species geographic distribution were elaborated using the open software QGIS v. 2.6.1. In the maps, the species were identified by symbols such as circles, squares, triangles, pentagons and a red margin involving these symbols means the type locality. We identify (Fig. 1) the distinct ecoregions where the species occur using the Marine Ecoregions of the World (MEOW, *sensu* Spalding *et al.* 2007 and Sealey & Bustamante, 1999). The Brazilian States were identified in the maps by their abbreviations: AL – Alagoas, BA – Bahia, CE – Ceará, ES – Espírito Santo, PB – Paraíba, PE – Pernambuco, PI – Piauí, RJ – Rio de Janeiro, RN – Rio Grande do Norte, SC – Santa Catarina, and SP – São Paulo.

Abbreviations of the institutions cited in the text:

MCNPOR – Porifera collection of Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul, Brazil

MNRJ – Porifera collection of Museu Nacional da Universidade Federal do Rio de Janeiro, Brazil

UFAL – Universidade Federal de Alagoas, Brazil

UFALPOR – Porifera collection of Universidade Federal de Alagoas, Brazil
UFRJ – Universidade Federal do Rio de Janeiro, Brazil
UFRJPOR – Porifera collection of the Universidade Federal do Rio de Janeiro, Brazil
UFSC – Universidade Federal de Santa Catarina, Brazil
YPM – Yale Peabody Museum, USA

Systematics

Class Demospongiae Sollas, 1885

Order Haplosclerida Topsent, 1928

Family Chalinidae Gray, 1867

Genus *Haliclona* Grant, 1835

Subgenus *Haliclona* (*Gellius*) Gray, 1867

Haliclona (*Gellius*) *catarinensis* Mothes & Lerner, 1994

(Fig. 1a–d)

Haliclona catarinensis Mothes & Lerner: 55, figs. 30, 31, 37.
Haliclona (*Haliclona*) *catarinensis* Muricy *et al.*: 101.

Material examined. Holotype: MCNPOR 1053 – Praia de Bombinhas (rocky coast, ca. 27°08’48”S 48°29’00”W), Bombinhas (Santa Catarina State, Brazil), intertidal, coll. B. Mothes, 15 October 1982.

Diagnosis. The only *Haliclona* in the Western Atlantic with the combination of a grey with orange colour, encrusting shape, rugose surface and confused, subisotropic choanosome.

Description (Fig. 1a). Encrusting, ca. 2 mm in thickness. Oscules are circular, distributed along the surface, and very small (ca. 2 mm sensu Mothes & Lerner, 1994). Surface is irregular, rugose. Consistency is very fragile, compressible, and easily torn. Colour is grey with orange alive (sensu Mothes & Lerner, 1994), and greyish beige in alcohol.

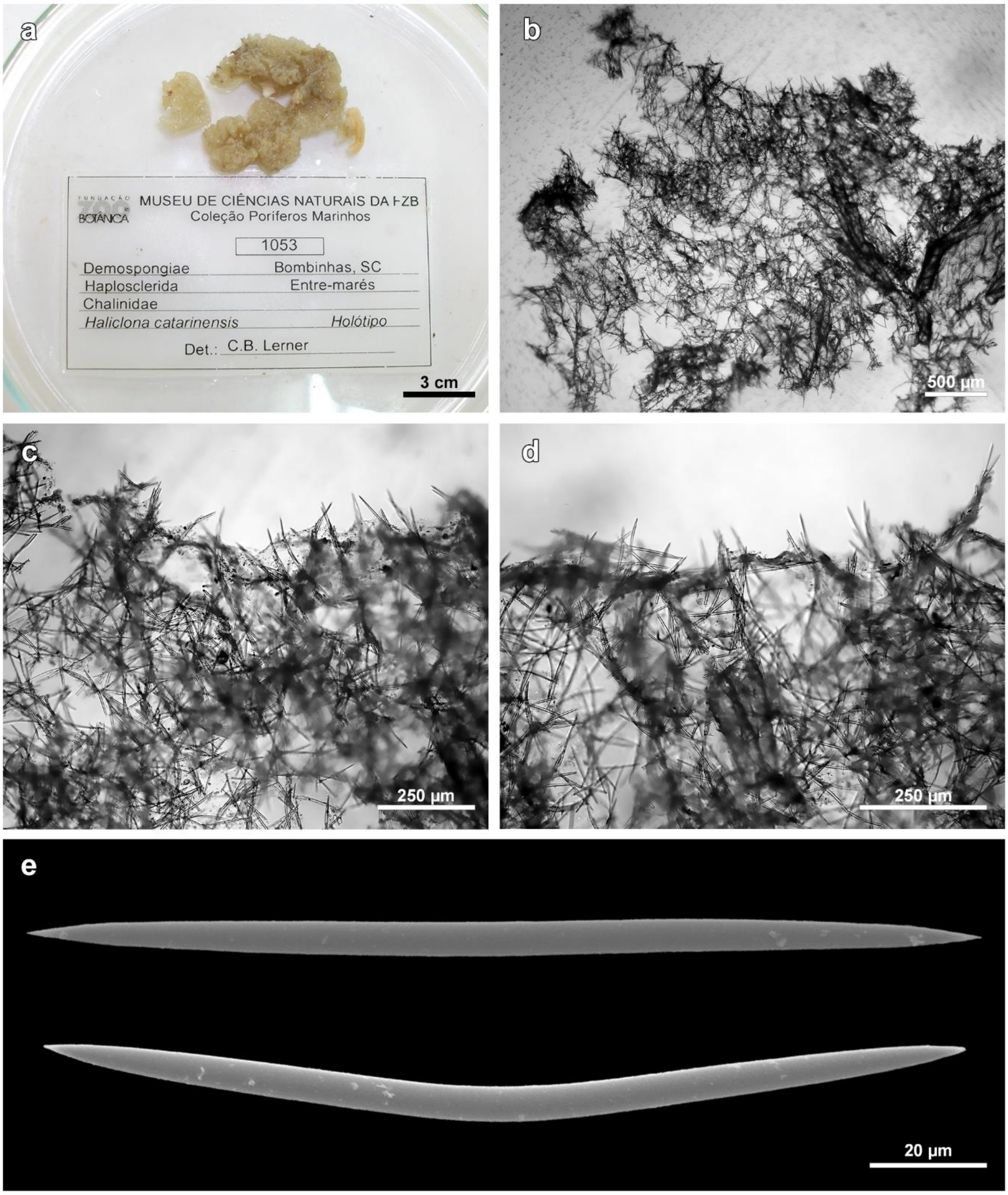


FIGURE 1. *Haliclona* (*Gellius*) *catarinensis* Mothes & Lerner, 1994. a. MCNPOR 1053, holotype. b. panoramic view of the choanosomal structure. c-d. choanosome in detail, showing some paucispicular primary lines protruding the surface. e. oxeas.

Skeleton (Fig. 1b–d). Ectosome: absent, not specialized. Choanosome: A subisotropic reticulation, with some ill-defined paucispicular (2-5 spicules) primary lines irregularly connected by unispicular secondary lines with many spicules in confusion. Near the surface, the primary lines become more evident (Fig. 1c-d). Spongin is scarce, barely visible in the reticulation. The specimen is infested with a bryozoan, which makes difficult the visualization of the skeleton.

Spicules (Fig. 1e). Oxeas, acerate, with long points, mostly curved, but with some straight, 105–*124.4*–138 x 4–*4.7*–5.5 µm.

Ecology. Found in shallow waters on rocky substrate, in association with the Bryozoa *Crisulipora* sp.

Distribution (Fig. 4). Only known for its type locality, Bombinhas (27°S, Santa Catarina State). MEOW distribution: Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

Remarks. The species is included within the subgenus *Haliclona* (*Gellius*) mainly to its highly confused skeleton, summed with the absence of an ectosomal skeleton. The absence of microscleres is thought to be of minor importance, despite its widespread presence in members of this subgenus.

In the Tropical Western Atlantic (TWA), the subgenus *Haliclona* (*Gellius*) is represented solely by four species, *H.* (*G.*) *calcinea* Burton, 1954 and *H.* (*G.*) *megasclera* Lehnert & Van Soest, 1996 from deeper waters, and *H.* (*G.*) *tenerrima* Burton, 1954 and *Haliclona* (*Gellius*) sp. nov. from shallow waters.

Haliclona (*G.*) *catarinensis* approaches *H.* (*G.*) *megasclera* by lacking microscleres and grey colour, but both differs in oxeas length (282–372 x 9–12 µm in *H*. *megasclera* vs. 105–138 x 4–5.5 µm in *H. catarinensis*), and by the presence of a tangential unispicular ectosomal skeleton in *H.* (*G.*) *megasclera*. In addition, the deep-water habit of *H*. *megasclera* is also distinctive.

The remaining *H.* (*Gellius*) in the TWA differs by the presence of sigmas and toxas microscleres and the longer oxeas (ca. 500 x 16 µm in *H*. *calcinea*, and ca. 194–258 x 5–9 µm in *H*. *tenerrima* vs. 105–138 x 4–5.5 µm in *H. catarinensis*). *H*. *calcinea*, in addition, is a deep-water species occurring from 720–800 m depth.

***Haliclona* (*Gellius*) sp. nov.**

(Figs. 2a–d; 3a–d, table 1)

Material examined. Holotype: MNRJ 19201 – Praia do Francês (sandstone reef, ca. 9°45’54”S 35°50’04”W), Marechal Deodoro (Alagoas State, Brazil), ca. 0.5 m depth, coll. A. Bispo, 30 June 2014, fragment deposited under UFALPOR 1021. Paratype:

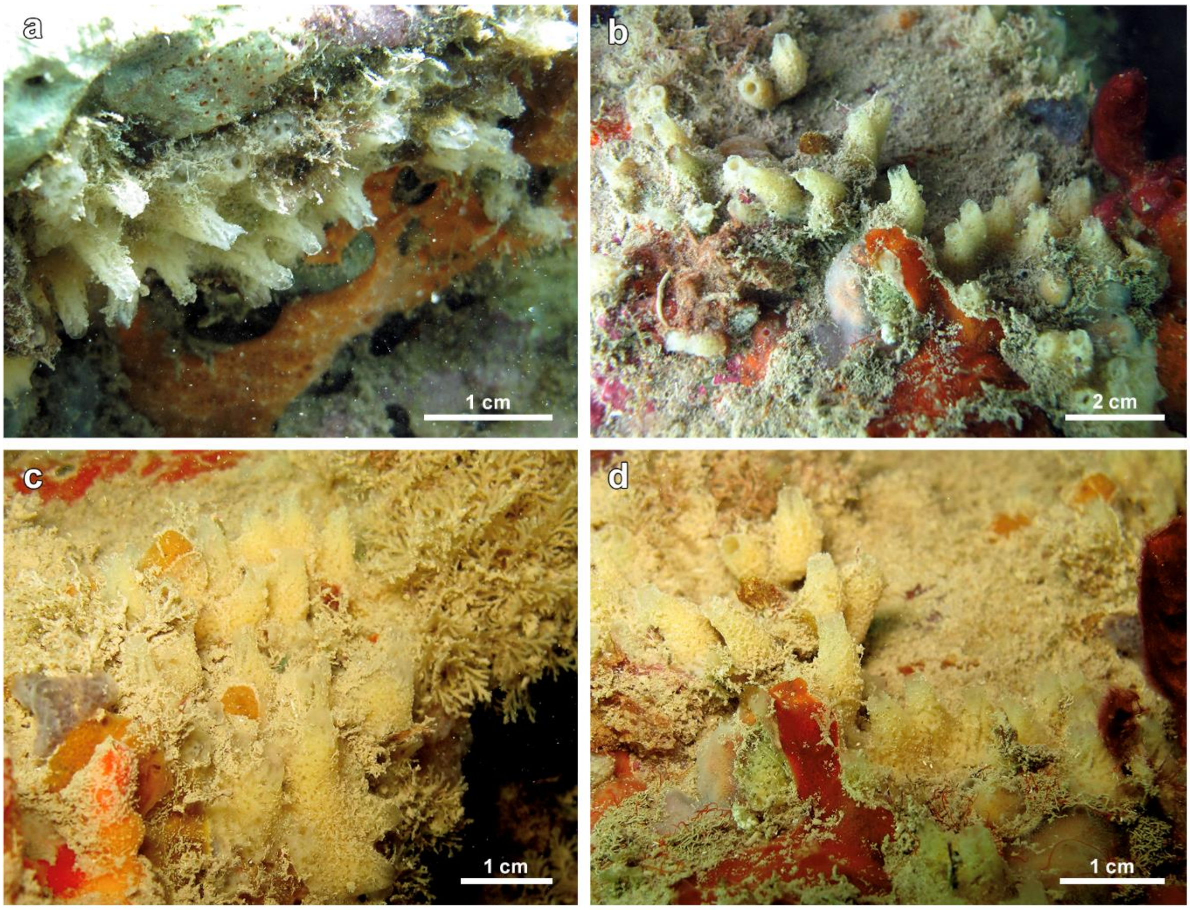


FIGURE 2. *Haliclona* (*Gellius*) sp. nov. a. Paratype MNRJ 14985, on vertical surface exposed to light. b–d. MNRJ 19201, holotype, on horizontal surface on a shaded crevice Fig. 2a–b took without flash, fig. 2c–d took with flash.

MNRJ 14985 – Praia do Francês (sandstone reef, ca. 9°45’54”S 35°50’04”W), Marechal Deodoro (Alagoas State, Brazil), ca. 0.5 m depth, coll. E. Hajdu, 15 June 2011, fragment deposited under UFALPOR 0700.

Diagnosis. The only *Haliclona* spp. in the Western Atlantic with the combination of closed-packed tubular mounds with an apical oscule, white to beige colour, subisotropic and cavernous choanosome.

Description (Fig. 2). Small volcaniform and closed-packed tubular mounds, up to 1.2 cm in height, that arise from a common thickly encrusting base. Oscules are abundant, at the top of the tubular mounds, 1.4–2.9 µm in diameter. Surface is smooth, even, punctate, with some loose small subdermal meandering channels (Fig. 2d), in the distal parts of the mounds the surface becomes more transparent. Consistency is soft, easily torn. Colour alive vary from white to beige.

Skeleton (Fig. 3a–c). Ectosome: absent. Choanosome: a subisotropic reticulation, very dense (Fig. 3a) and almost completely isotropic in the inner parts (Fig. 3b), becoming more regular near the surface, forming paucispicular (2–4 spic.) primary lines irregularly connected by unispicular secondary lines (Fig. 3c). Many large choanosomal spaces (Fig. 3a), up to 875 µm in diameter, forming a cavernous choanosome. Spongin is scarce, found mainly at the nodes of the reticulation.

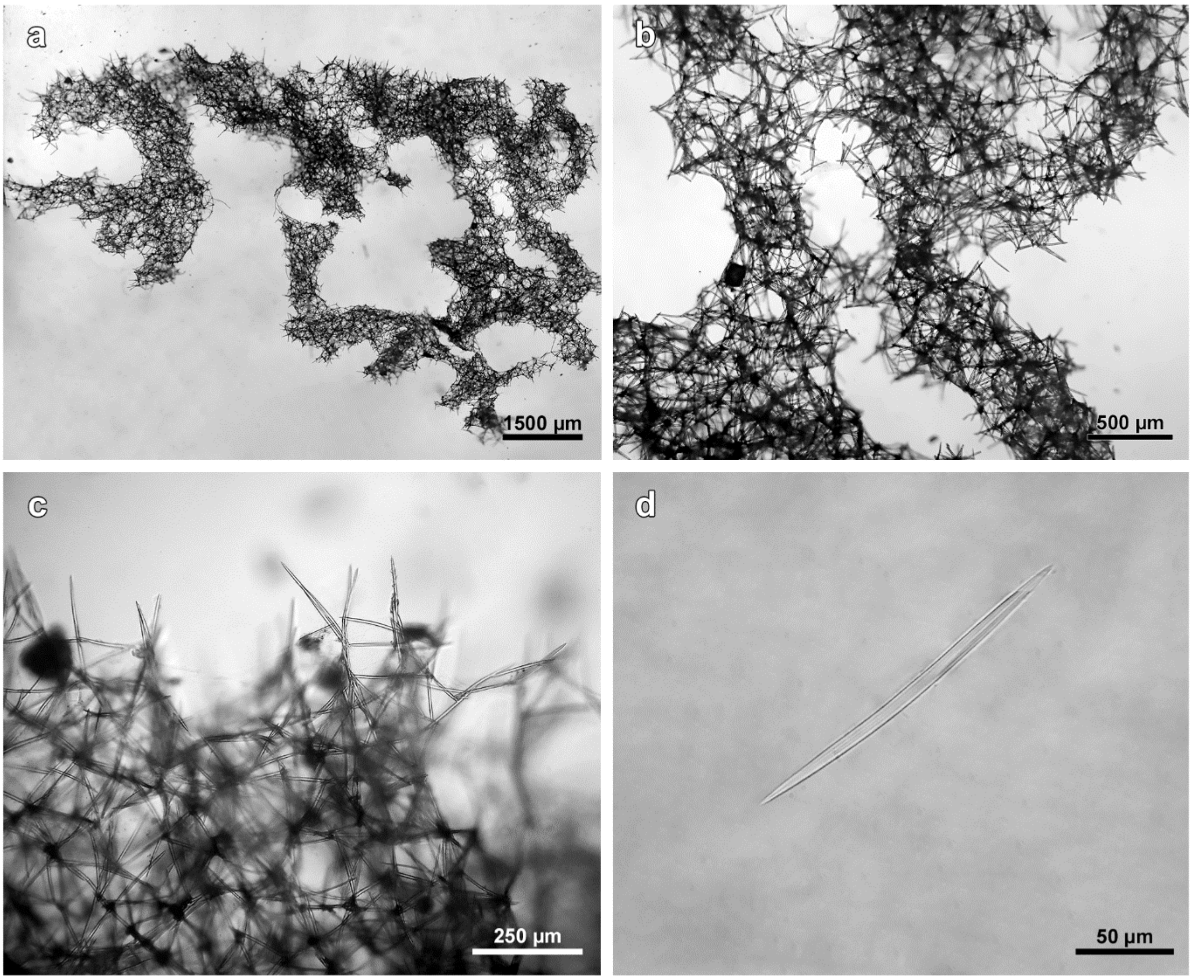


FIGURE 3. *Haliclona* (*Gellius*) sp. nov., holotype MNRJ 19201. a. panoramic view of the choanosome. B. inner section of the choanosome. c. the choanosome near the surface. d. oxea.

TABLE 1. Oxea measurements of *Haliclona* (*Gellius*) sp. nov.

Specimen	Brazilian State	Oxeas (µm)
MNRJ 19201, holotype	Alagoas	120–*147.2*–165 x 3–*5.7*–7
MNRJ 14895, paratype	Alagoas	128–*153.9*–183 x 3–*5.9*–8

Spicules (Fig. 3d). Oxeas, slightly curved, some straight, long hastate points; in MNRJ 14985 there were some oxeas modified to style, strongyle, or strongyloxea, 120–183 x 3–8 µm (Table 1).

Ecology. Found in shallow-water sandstone reefs, growing vertically or horizontally in shaded or lit areas (Fig. 2).

Distribution (Fig. 4). Only known for its type locality, Praia do Francês (9°S, Alagoas State). MEOW distribution: Tropical Southwestern Atlantic (Northeastern Brazil Ecoregion).

Remarks. *Haliclona* (*Gellius*) sp. nov. is included in the subgenus *Haliclona* (*Gellius*) due to its mainly irregular and confused skeleton. As well as *H.* (*G.*) *megasclera* and *H.* (*G.*) *catarinensis*, the new species lacks microscleres.

Haliclona (*G.*) *megasclera* is easily distinguished from the new species by its much longer oxeas (282–372 x 9–12 µm in *H. megasclera* vs. 120-183 x 3-8 um in *H.* (*Gellius*) sp. nov.), by the grey colour of *H. megasclera* in contrast with the white to beige colour of *H.* (*Gellius*) sp. nov. In addition, the overall shape and external morphology of both species is very different, being *H. megasclera* a massive species, with a leather-like surface, and without oscules apparent.

H. (G.) *catarinensis* is similar to *H.* (*Gellius*) sp. nov. by lacking microscleres and the confused skeleton with some ill-defined paucispicular primary lines. But both differs by colour, by the cavernous choanosome and the longer oxeas of the first. In addition, the external morphology of both species is very different, since *H.* (*G.*) *catarinensis* does not have the remarkable oscular mounds of *Haliclona* (*Gellius*) sp. nov.

In contrast, the most similar species to *H.* (*Gellius*) sp. nov. in respect to the external shape and morphology is *Haliclona* (*Rhizoniera*) *curacaoensis* Van Soest, 1980, both exhibiting a common encrusting base from which arise several oscular mounds. Nevertheless, both species are very dissimilar in terms of skeletal structure, as indicated by each subgenus assignment, having *H.* (*Rh.*) *curacaoensis* a reticulation with more conspicuous paucispicular primary lines in contrast with the confused skeleton of *Haliclona (Gellius*) sp. nov.. Furthermore, the species differs by colour, bluish purple in *H. curacaoensis*, and in oxeas length, 78–146 x 2.8–5.7 µm *H. curacaoensis*.

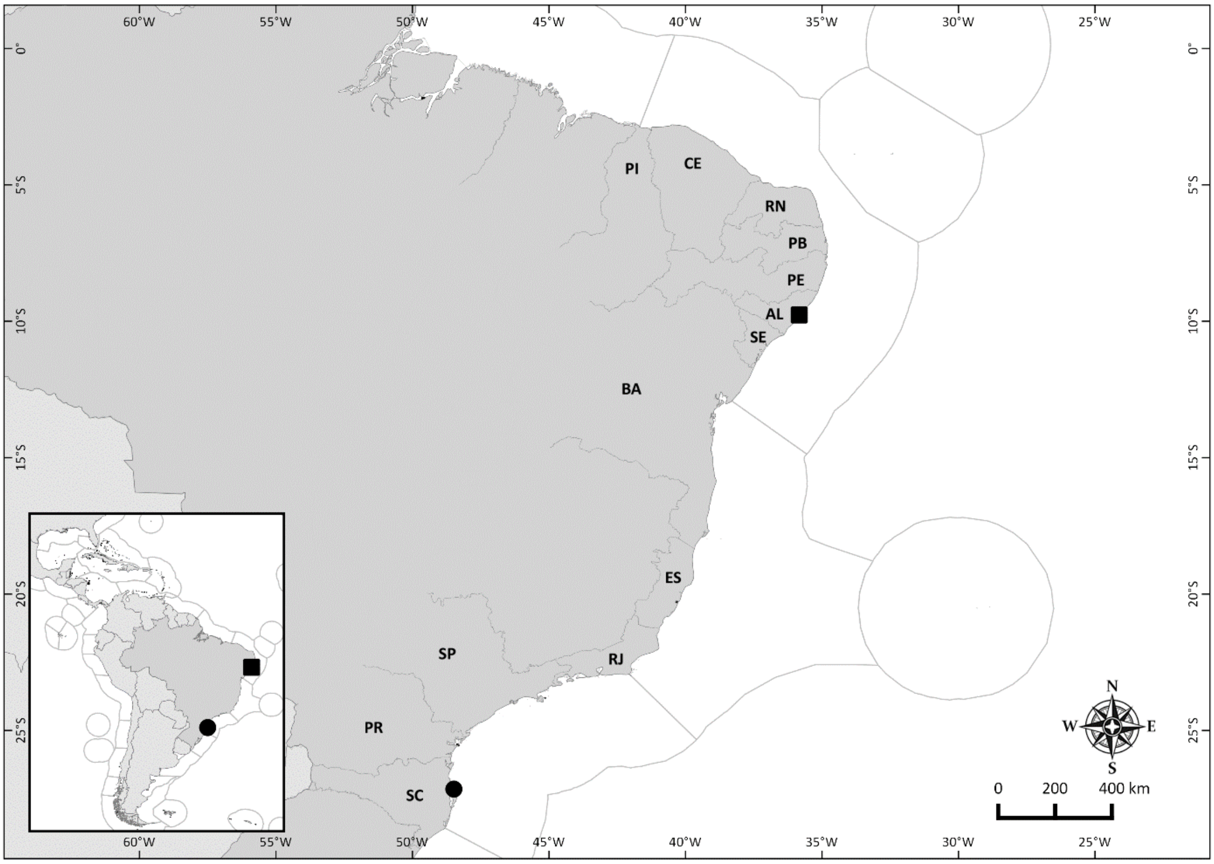


FIGURE 4. Map of the geographical distribution of *Haliclona* (*Gellius*) *catarinensis* Mothes & Lerner, 1994 (circle) and *Haliclona* (*Gellius*) sp. nov. (square).

Subgenus *Haliclona* (*Halichoclona*) De Laubenfels, 1932

Haliclona (*Halichoclona*) *dura* Sandes, Bispo & Pinheiro, 2014

Haliclona (*Halichoclona*) *dura* Sandes *et al.*: 275, figs. 2, 3.

Material examined. See Sandes *et al.* (2014)

Diagnosis. *Haliclona* (*Halichoclona*) *dura* Sandes, Bispo & Pinheiro, 2014 is set apart from its congeners by the combination of a dense ectosome (*Calyx*-like), oxeas (105–193 x 2.5–9 µm) with stepped and mucronate points, colour dark brown externally and light beige internally, consistency firm and incompressible. (partially from Sandes *et al.*, 2014)

Distribution (Fig. 7). Only known from its type locality, Off Pirambu (10°S, Sergipe State). MEOW distribution: Tropical Southwestern Atlantic (Northeastern Brazil Ecoregion).

Remarks. *Haliclona* (*Halichoclona*) *dura* is a peculiar *Haliclona* due the presence of an ectosomal crust, an uncommon feature for the genus. The presence of an ectosomal crust approaches this species with those of the genus *Calyx* and *Pachypellina* (Haplosclerida: Pholoedictyiidae). Nevertheless, *H.* (*Halich.*) dura lacks the multispicular tracts also present in these genus and their type species, that was the main reason why Sandes *et al.* (2014) assigned this species to *Haliclona* (*Halichoclona*).

The internal relationships of the order Haplosclerida are controversial, since there is no congruence between morphological and molecular data. For example, a *Calyx* sp. nested in the same clade as many *Haliclona* spp. in a molecular phylogeny hypothesis recovered by Redmond *et al*. (2007, 2011, 2013), this may be an indicative that these characters are uninformative for a natural classification. In such scenario, we follow Sandes *et al.* (2014) and keep this species within the subgenus *Haliclona* (*Halichoclona*).

***Haliclona* (*Halichoclona*) *vansoesti* De Weerdt, De Kluijver & Gomez, 1999**

(Figs. 5a–h; 6a–d, tables 2, 3)

Haliclona (*Halichoclona*) *vansoesti* De Weerdt, De Kluijver & Gomez, 1999: 49, figs. 1–3; De Weerdt, 2000: 49, figs. 2D, 3C, 34A-D.

Haliclona tubifera Lerner, 1996: 114, figs. 21, 36 [Non *Haliclona* (*Reniera*) *tubifera* (George & Wilson, 1919)

Haliclona (*Reniera*) *tubifera* Muricy *et al.*, 2011 [Non *Haliclona* (*Reniera*) *tubifera* (George & Wilson, 1919)

Material examined. MNRJ 19202–19206 – Ponta Sul, Ilha do Xavier (coastal island, 27°36’42”S 48°23’17”W), Florianópolis (Santa Catarina State, Brazil), 10–12 m depth, coll. J.L. Carraro, 14 June 2013.

Diagnosis. *Haliclona* (*Halichoclona*) *vansoesti* is easily distinguished from other *Haliclona* spp. in the Western Atlantic by the combination of an isotropic skeleton, with semi-transparent and detachable ectosome, and choanosome coloured (purple, lilac, pink, white or beige)

Description (Fig. 5). Thick and highly cavernous encrustations, 10–60 mm in thickness, and occupying areas that can reach up to 500 cm^2. Oscules are abundant,

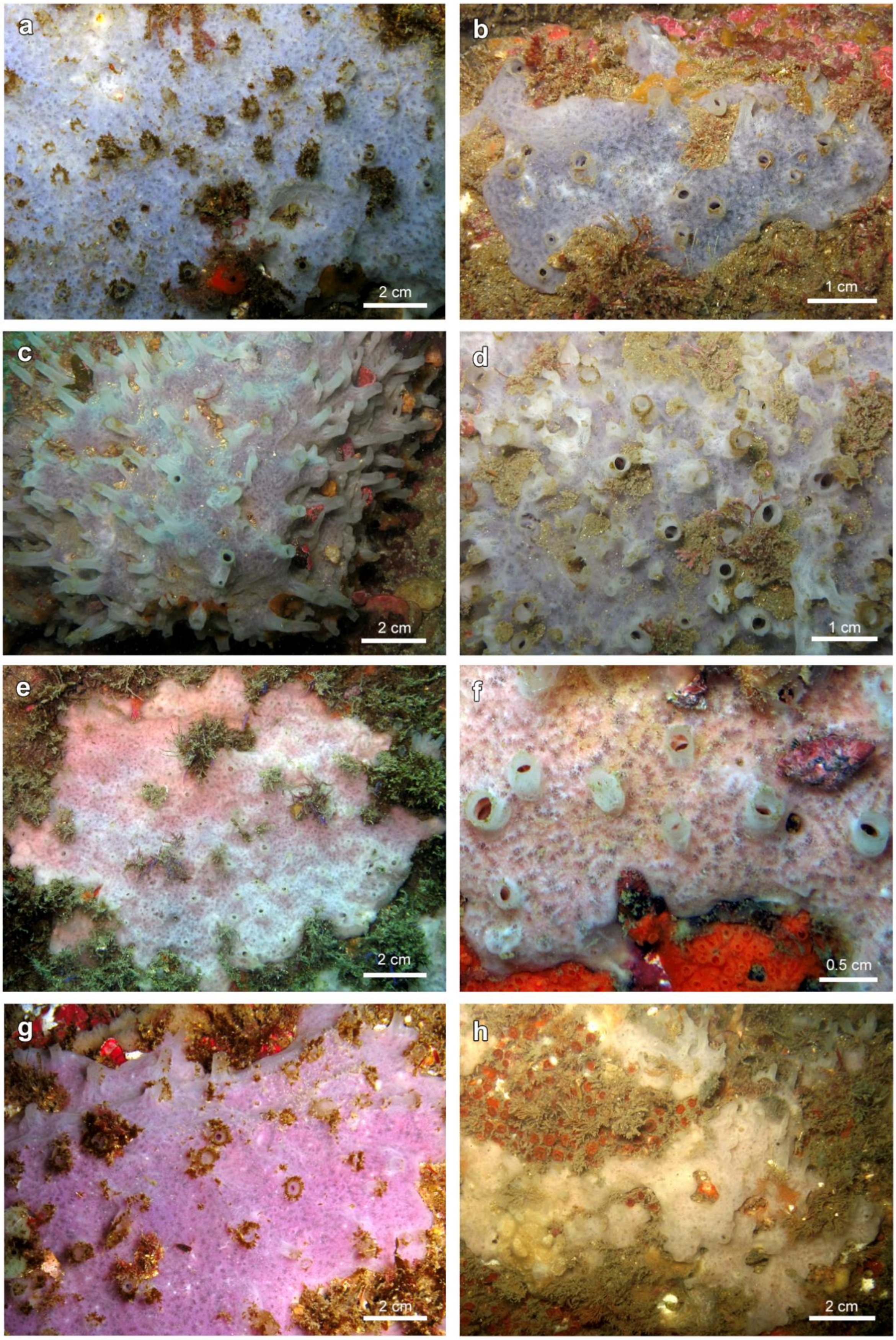


FIGURE 5. *Haliclona* (*Halichoclona*) *vansoesti* De Weerdt *et al*., 1999. a-d. lilac specimens, a=MNRJ 19205; e-g. pink specimens, g=MNRJ 19206; h. white specimen.

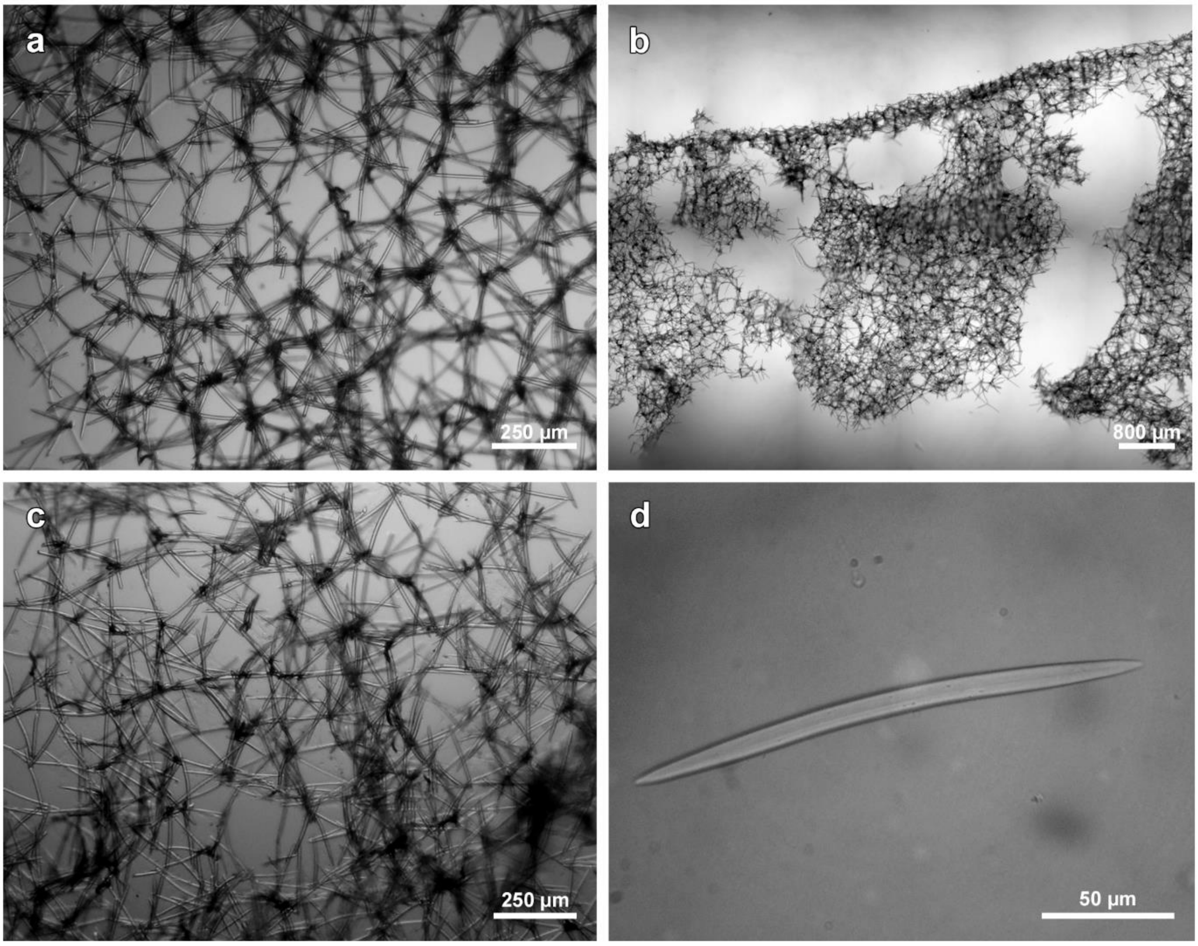


FIGURE 6. *Haliclona* (*Halichoclona*) *vansoesti* De Weerdt *et al.*, 1999. MNRJ 19206. a.ectosomal skeleton; b. panoramic view of the choanosome; c. detail of the choanosome; d. oxea.

circular, 1–5 mm in diameter, and situated on the top of semi-transparent tubular elevations, 5-20 mm. Surface is semi-transparent, reticulated at the naked eye, smooth, punctate, but also easily detached from the choanosome. Consistency is firm, brittle, and slightly compressible. Colour is a combination of a semi-transparent ectosome, with a choanosome that could have different shades of lilac, pink, white, or beige.

Skeleton. Ectosome (Fig. 6a): a tangential, dense isotropic reticulation, loosely lying on the choanosome due to subectosomal spaces; some rounded meshes are also observable, probably following the pores of the surface. Choanosome: an isotropic reticulation, denser than that of the ectosome, with many subectosomal and choanosomal spaces (Fig. 6b-c). Spongin is very scarce, with small amounts in some of the spicular nodes.

TABLE 2. Oxeas measurements of *Haliclona* (*Halichoclona*) *vansoesti* De Weerdt *et al*., 1999.

Specimen	Brazilian State	Oxeas (µm)
MNRJ 19202	Santa Catarina	163–*176.8*–190 x 7–*8.8*–10
MNRJ 19203	Santa Catarina	175–*186.4*–200 x 7.5–*9.3*–11
MNRJ 19204	Santa Catarina	160–*177.1*–190 x 7–*8.9*–10
MNRJ 19205	Santa Catarina	178–*189.8*–203 x 7.5–*10.6*–12
MNRJ 19206	Santa Catarina	165–*178.7*–193 x 7.5–*8.1*–9.5

Spicules. Oxeas, slightly curved, tips are hastate and sharp pointed, 160–203 x 7–12 µm (Table 2).

Ecology. A very common species in the coastal islands off south-eastern Brazil (from Rio de Janeiro to Santa Catarina State), occurring from 6–12 m depth. Bryozoans are often found in association with this species.

Distribution (Fig. 7). The species has a probably disjunct distribution, known to occur in the Wider Caribbean (Tropical Northwestern Atlantic) and in subtropical Brazil (Warm-Temperate Southwestern Atlantic). Detailed distribution in the Caribbean: Jamaica, Martinique, St. Vicent, Curaçao [type locality] (De Weerdt *et al.*, 1999; De Weerdt, 2000), Belize (Rützler *et al*., 2014), Colombia (Valderrama & Zea, 2013); Detailed distribution in Brazil: Rio de Janeiro State (23°S, G. Muricy, pers. comm.), Santa Catarina State (27°S, Lerner, 1996; present study). MEOW distribution: Tropical Northwestern Atlantic and Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

Remarks. *Haliclona* (*Halichoclona*) *vansoesti* was originally described from the Caribbean (Jamaica, Martinique, St. Vicent, and Curaçao) by De Weerdt *et al*. (1999), who distinguished it from its congeners mainly by the crispy consistency, ectosome semi-transparent and easily detachable, and choanosome purple and cavernous.

Only very recently other specimens from distinct areas of the Caribbean were also described: Colombia (Valderrama & Zea, 2013) and Belize (Rützler *et al*., 2014). Nevertheless, those specimens from Belize apparently have some deviation of the diagnostic characters established by De Weerdt *et al*. (1999) for *H.* (*Halich.*) *vansoesti* such as hard consistency, black colour in alcohol and apparently the lack of a semi-transparent detachable ectosomal skeleton (see Rützler *et al*., 2014).

Indeed, our specimens fit very well with the original description of the species, except for the following characters: 1. The smaller oscules in our specimens (0.1–0.5 mm in the present study, vs. 0.8–10 mm De Weerdt, 1999); 2. The greater colour

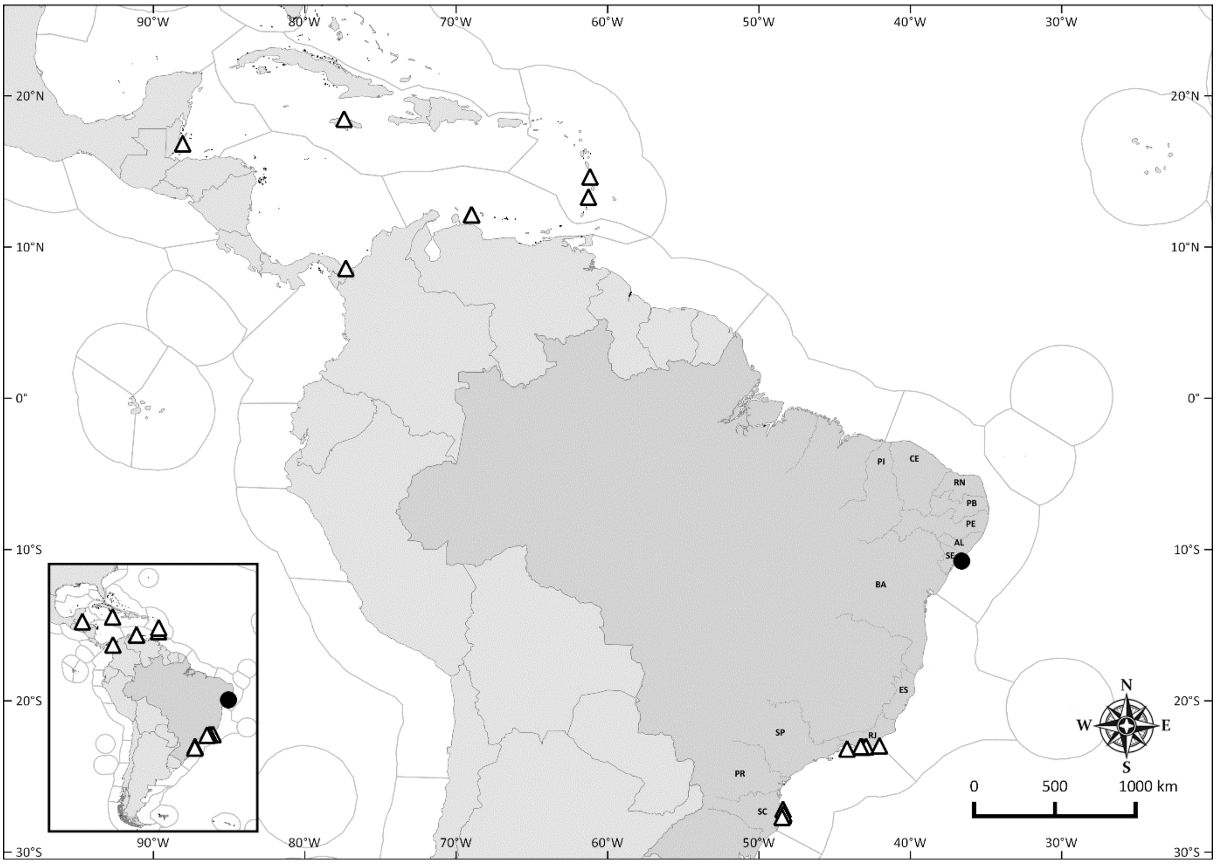


FIGURE 7. Geographic distribution of *Haliclona* (*Halichoclona*) *vansoesti* De Weerdt *et al*., 1999 (triangle) and *Haliclona* (*Halichoclona*) *dura* Sandes *et al.*, 2014 (circle).

variation (lilac, purple, bluish, whitish, beige in the present study, vs. only purple in the Caribbean De Weerdt, 1999); 3. The more delicate ectosomal skeleton of the Caribbean specimens (see Fig. 34C in De Weerdt, 2000) than in the Brazilian ones; 4. The longer and thicker oxeas in our specimens (120–222 x 3.6–10.7 µm from De Weerdt, 2000 vs. 160–203 x 7–12 µm in the present study). At the first glance, we believe that the Brazilian species consisted of a different and new species of *Haliclona* (*Halichoclona*). However, supporting the similar aspects of the morphology we described, Muricy *et al*. (in press) also indicates a high genetic similarity between specimens of *H.* (*Halich*.) *vansoesti* from Rio de Janeiro (Brazil) and the Caribbean. These evidences led us to consider the Brazilian material as conspecific with *H.* (*Halich.*) *vansoesti* from the Caribbean.

This species was first described in the Brazilian coast by Lerner (1996) as *Haliclona tubifera*. In her monograph of the Caribbean chalinids, De Weerdt (2000) considered this record of *H. tubifera* for the Brazilian as not valid, since the species corresponded to the subgenus *Haliclona* (*Halichoclona*). Interestingly, De Weerdt (op. cit.) did not assigned the species to *H.* (*Halich.*) *vansoesti*, probably due to the

Table 3. Comparative morphological data for *Haliclona* (*Halichoclona*) *vansoesti* De Weerdt *et al*., 1999.

Haliclona* (*Halich.*) *vansoesti	**External morphology**	**Skeleton**	**Colour – locality, depth**
Haliclona* (*Halichoclona*) *vansoesti (orig. descrip., from De Weerdt *et al.*, 1999)	Thick cush., cavernous struct., ca. 15 cm in diam., 2-3 cm thick; oscs. circul. to elliptic., 0.8-1 cm in diam. on slight. raised elevat. w. transpar. rims.; surf. smooth; consist. crisp, fragile, slightly compress.	**Ectos.** – delicate, tangent., subisotrop., loosely lying on the choan. **Choan.** – subisotrop., denser than ectos., w. many subectos. and choan. spaces. **Spongin**, not observable. **Oxeas**, slightly curv., hastate, 120–221.6 x 3–10.7 µm.	Light purple choan., white/transparent ectos. – Curaçao, Jamaica, St. Vicent, Martiniqu,. 2–52 m depth.
Haliclona* (*Halichoclona*) *vansoesti (from Valderrama & Zea, 2013)	Lobate, massively encrust.; oscs. slightly raised, ca. 5 mm in diameter.	**Ectos.** – not described. **Choan.** – not described. **Oxeas**, hastate, 166–214 x 4.8–11.9 µm.	Light blue, almost white. – Colombia, 9 m depth.
Haliclona* (*Halichoclona*) *vansoesti (from Rützler *et al*., 2014)	Cavernous cush., to 2.5 cm thick; oscs. large, raised, circul., to 1.2 cm in diam; consist. hard and brittle.	**Ectos.** – unispic. **Choan.** – denser than ectosome, w. numerous cavities. **Oxeas**, curved, sharp points, 160–280 x 3–7 µm	Light blue (neon-tone), turning black in alcohol – Belize, 24 m depth.
as ***Haliclona tubifera*** (from Lerner, 1996)	Thick. encrusting; oscs. on the top of slightly raised or chimney elevat., ca. 1-6 mm in diam.; surf. transpar., punctate.	**Ectos.** – not described. **Choan.** – not described. **Oxeas**, straight to slightly curved, sharp points, 140.3–211.6 x 4.6–12.7 µm.	Light lilac or bluish lilac, turning beige in spirit – Santa Catarina State (S Brazil), 10–13 m depth.
Haliclona* (*Halichoclona*) *vansoesti (present study)	Thick. encrusting, cavernous, 1-6 mm thick; oscs. circular, 1-5 mm in diam., on the top of semi-transpar. tubul. elevat.; surf. semi-transpar., reticulated, smooth, punctate, easily detach.; consist. firm, brittle, slight. compress.	**Ectos.** – dense, isotropic, loosely lying on the choanosome, some rounded meshes. **Choan.** – isotropic, denser than ectosome, w. subectos. and choan. spaces. **Spongin**, scarce, at the nodes. **Oxeas**, 160–203 x 7–12 µm.	Lilac, pink, white or beige choan., semi-transpar. ectos. – Rio de Janeiro (SE Brazil) and Santa Catarina State (S Brazil), 6–12 m depth.

morphological variation we described above and the geographic disjunction, in addition to the subtropical affinity of the coast of Santa Catarina State. See Table 3 for a detailed comparison with previous descriptions of *H.* (*Halich.*) *vansoesti*.

This apparent disjunct distribution of *H.* (*Halich.*) *vansoesti* in the Western Atlantic is a point to concern. There is a large gap between the Colombian coast and the Rio de Janeiro/Santa Catarina coast (Southeastern Brazil), where *H.* (*Halich.*) *vansoesti* has never been recorded. We failed in finding this species in north-eastern Brazil (from Ceará 3°S to Abrolhos 18°S) despite diving in sites at depths of up to 20 m, depths where the species was already been collected in the Caribbean and in the Brazilian State of Santa Catarina. Possible explanations to this are the high abundance of the species in depths varying from 20–45 m in Curaçao (De Weerdt *et al.*, 1999), which indicates a preference for deeper waters (but it occurs at 10 m depth in Rio de Janeiro and Santa Catarina). Since deep reef formations in the Northeastern/Eastern Brazil are very ill-known, it is not impossible that the species also occur in this sector of the Brazilian coast. It is high likely that the connectivity of the specimens of Santa Catarina with those of the Caribbean might be sustained by a faunal corridor of species associated with deep reef formations (40–200 m depth) off the north-eastern and eastern Brazil from 13°S to 22° S (Olavo *et al.*, 2011). Nevertheless, the morphological variation in our specimens are so remarkable, that the connectivity between these populations must be further explored through molecular markers.

Subgenus *Haliclona* Grant, 1835

Haliclona (*Haliclona*) sp. nov.

(Figs. 8a-d)

Material examined. Holotype: MNRJ 485 – Between Praia do Cabelo Gordo and Ponta do Jaroba (rocky coast, ca. 23°49’37.51”S 45°25’16.82”W), São Sebastião (São Paulo State, Brazil), 0.5–1 m depth, coll. E. Hajdu, 16 June 1997.

Diagnosis. *Haliclona* (*Haliclona*) sp. nov. is distinguished from its congeners in the Western Atlantic by the combination of a greyish-white colour, with a punctate surface, subsuperficial canals, no ectosomal skeleton, and pauciscpiular choanosomal skeleton of acerate, and fusiform oxeas.

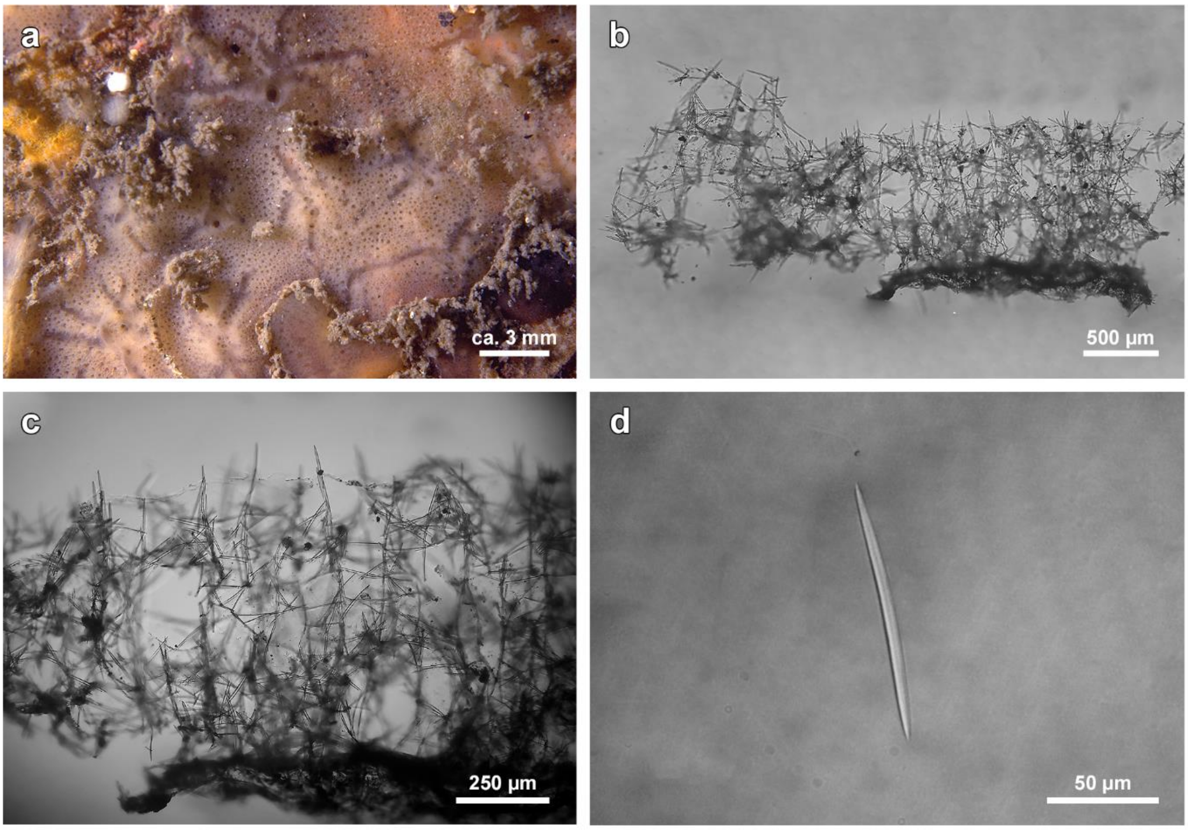


FIGURE 8. *Haliclona* (*Haliclona*) sp. nov., holotype MNRJ 485. a. species alive. b. panoramic view of the choanosome. c. choanosome in detail. d. oxea.

Description (Fig. 8a). Thinly encrusting, ca. 1 mm thick. Oscules are circular or oval, ca. 0.3–0.8 mm, irregularly scattered on the surface, not observable in spirit. Surface is even, smooth, very punctate, with many subsuperficial canals distributed along the surface, or surrounding the oscules, forming a star-shaped pattern. Consistency is soft, and fragile. Colour alive is greyish white, becoming beige in alcohol.

Skeleton (Fig.8b–c). Ectosome: absent. Choanosome: a ladder-like reticulation of paucispicular (2-5 spicules) primary lines regular- to irregularly connected by secondary unispicular lines that could be inserted in the primary lines at oblique or straight angles, many spicules in confusion. Spongin is scarce.

Spicules (Fig. 8d). Oxeas: acerate, fusiform, with long points, 75–*111.8*–123 x 3–*5.1*–7 µm.

Ecology. Found in very shallow waters (0.5–1 m depth) in rocky substrate.

Distribution (Fig. 9). Only known from the type locality, São Sebastião (23°S, São Paulo State). MEOW distribution: Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

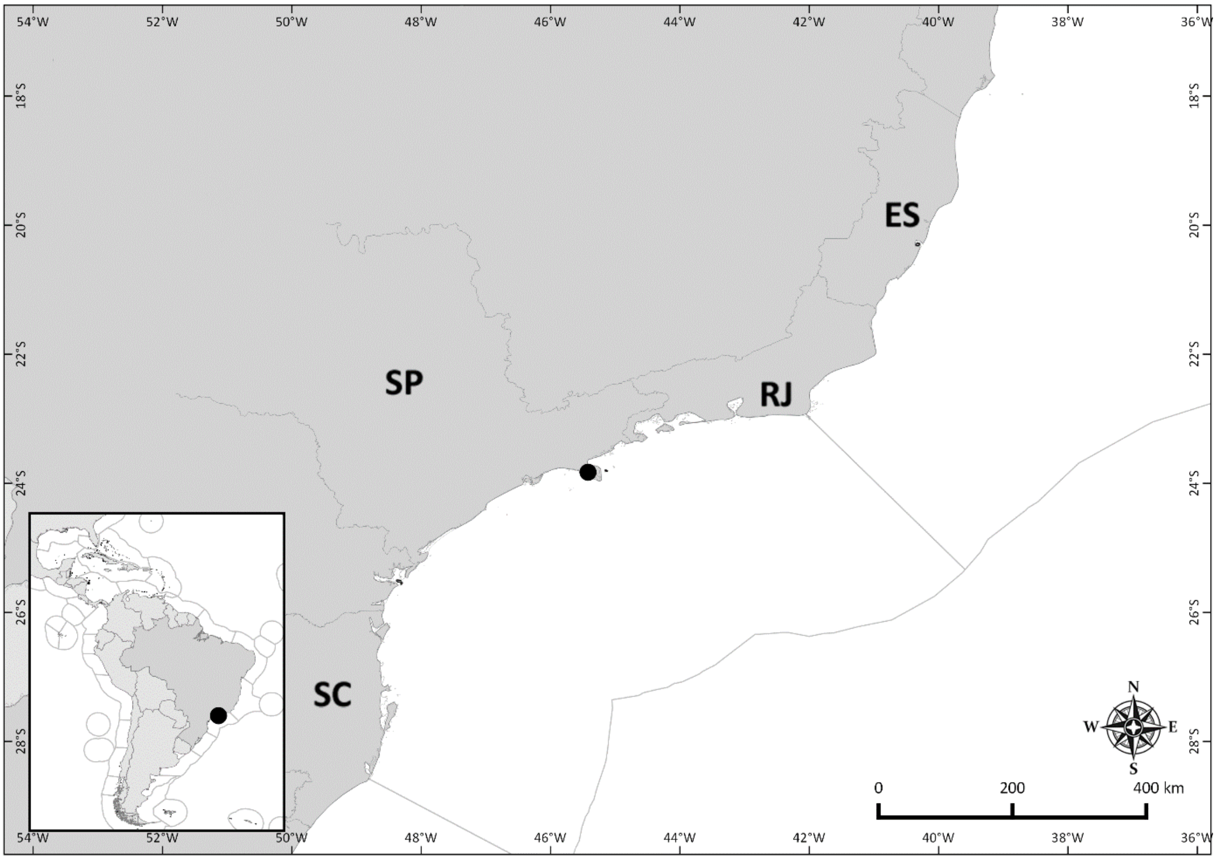


FIGURE 9. Geographic distribution of *Haliclona* (*Haliclona*) sp. nov..

Remarks. We assigned this species to the subgenus *Haliclona* (*Haliclona*) due the presence of a ladder-like reticulation in the choanosome of paucispicular primary lines regular- to irregularly connected by unispicular secondary ones.

There is only another *Haliclona* (*Haliclona*) in the Western Atlantic: *Haliclona* (*Haliclona*) *epiphytica* Zea & De Weerdt, 1999, that is easily distinguished from *Haliclona* (*Haliclona*) sp. nov. by its seaweed-dwelling habit, the cream colour alive, presence of individual outgrowths from the main body, compressible consistency, presence of an isodictyal ectosomal skeleton, and smaller oxeas (63–76 µm in *H. epiphytica* vs. 75–123 µm in *Haliclona* (*Haliclona*) sp. nov).

Other species with greyish colours are: *Haliclona* (*Gellius*) *catarinensis*, *Haliclona* (*Reniera*) *mucifibrosa*, *Haliclona* (*Soestella*) *piscaderensis*, and *Haliclona* (*Soestella*) *twincayensis*.

Haliclona (*Gellius*) catarinensis is distinguished by irregular surface, the presence of many spicules in confusion in the choanosome, the longer oxeas (111–161 µm in *H. catarinensis* vs. 75–123 µm in *Haliclona* (*Haliclona*) sp. nov) and oscules (ca. 2 mm in *H. catarinensis* vs. ca. 0.3–0.8 mm in *Haliclona* (*Haliclona*) sp. nov.).

Haliclona (*Reniera*) *mucifibrosa*, is distinguished by its shape of massive base with oscular chimneys and fistules, oscules of up to 1 cm, compressible consistency, the releasing of mucus when disturbed, the typical skeleton of the sugenus *Haliclona* (*Reniera*), with an isotropic to isodictyal reticulation, and the much longer oxeas of 186–249 x 7.4–13.5 µm.

Haliclona (*Soestella*) *piscaderensis* is distinguished by its shape of flat thick cushions, with oscules of 1–2 mm in diameter, and reticulate surface, oxeas are longer (140–227 µm) and sigmas are present.

Haliclona (*Soestella*) *twincayensis* is distinguished by its shape of erect and partly fused branches, absence of subsuperficial canals, and longer oxeas (161–186 µm).

Subgenus *Reniera* Schmidt, 1862

Haliclona (*Reniera*) *chlorilla* Bispo, Correia & Hajdu, 2014

(fig. 10a-e)

Haliclona (*Reniera*) *chlorilla* Bispo *et al.*, 2014: 2, figs. 2, 3.

Material examined. MNRJ 18550 – Barra Grande (*Halodule wrightii* bank, ca. 02°54’06.6”S 41°24’33.4”W), Cajueiro da Praia (Piauí State, Brazil), intertidal, coll. H. Matthews-Cascon & L. Cavalcante, 13 June 2014. For further material, see Bispo *et al.* (2014).

Diagnosis. *Haliclona* (*Reniera*) *chlorilla* is the only *Haliclona* in the Tropical Western Atlantic with the combination of delicate, anastomosing branches, dark green or black live colour, and absence of any microscleres (from Bispo *et al.*, 2014)

Description (fig. 10a). Delicate, slender and cylindrical branches that usually anastomose, ca. 1–2 mm in thickness. Oscules are numerous, circular or oval, flush with the surface and usually aligned in rows, up to ca. 1.9 mm in diameter. The surface is smooth. Consistency is very fragile, delicate and soft. Colour alive was grayish, probably due to sediment deposition on the surface of the sponge. Colour in ethanol is beige.

Skeleton (fig. 10c–d). Ectosome: an isotropic, isodictyal, unispicular and tangential reticulation (fig. 10b). Choanosome: of the same structure of the ectosome (fig. 10d), with a central channel passing through it (fig. 10c). Spongin is scarce.

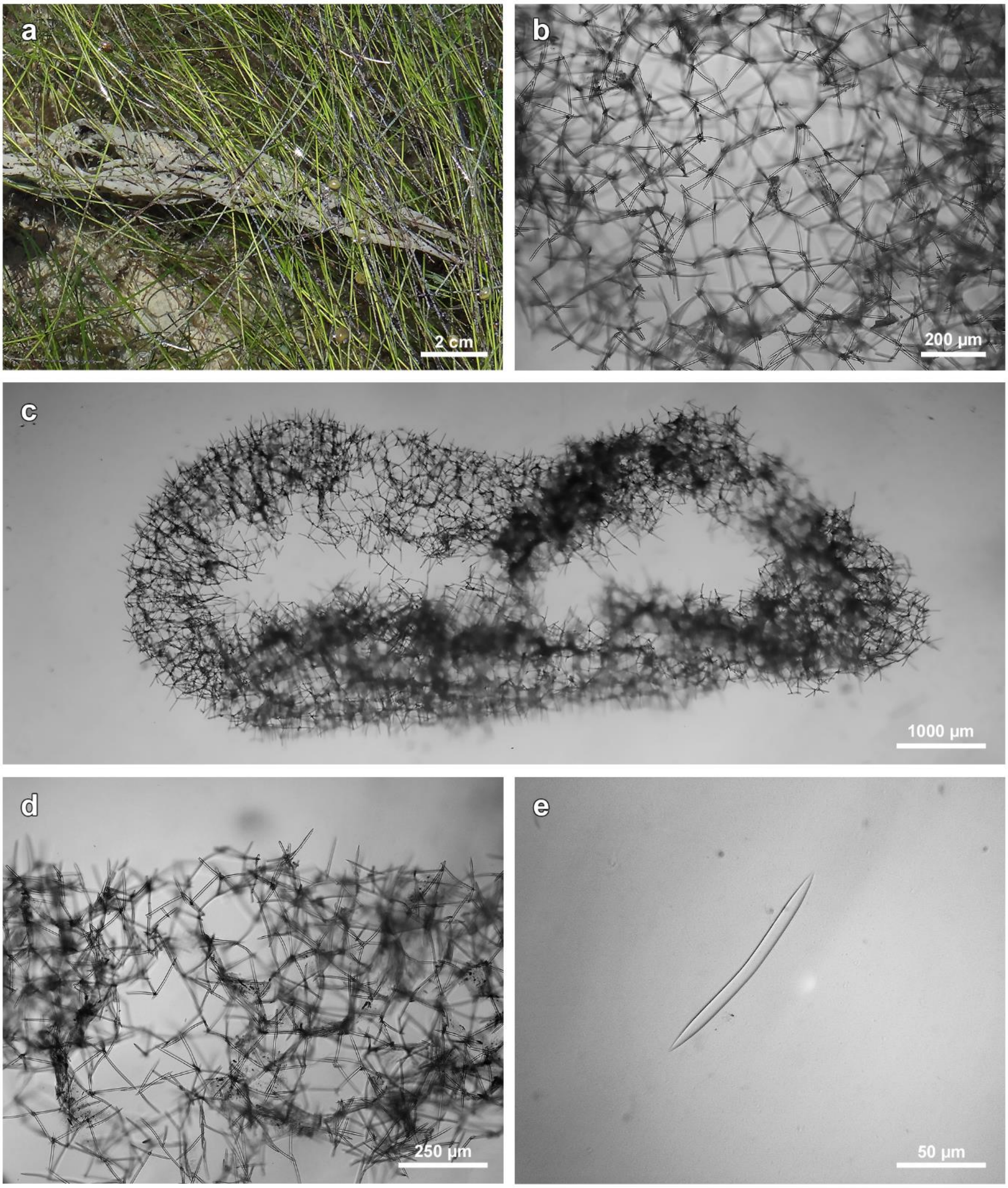


FIGURE 10. *Haliclona* (*Reniera*) *chlorilla* Bispo *et al*., 2014, MNRJ 18550. a. habit in situ. b. ectosomal skeleton. c. panoramic view of the choanosome. d. choanosome in detail. e. oxea, from holotype MNRJ 17226.

Spicules. Oxeas, hastate, straight or slightly curved, with sharp points, 85.1–*106.8*–119.6 x 3.2–*4.5*–5.1 µm.

Ecology. Only found in very shallow waters. In reefs ecosystems grows intermingled in macroalgae or together with calcareous macroalgae (*Jhania* sp./*Amphiroa* sp.). In fanerogams banks, is found growing intermingled in *Halodule wrightii* (fig. 10a).

Distribution. Brazil: Piauí (2°S, present study), Pernambuco, and Alagoas States (8-9°SBispo *et al.*, 2014). MEOW distribution: Tropical Southwestern Brazil (Northeastern Brazil Ecoregion).

Remarks. *Haliclona* (*Reniera*) *chlorilla* is a very characteristic species, being easily distinguished from its congeners in the Tropical Western Atlantic. The only similar species in this biogeographic region is *Haliclona* (*Reniera*) *ruetzleri*, which shares the shape of delicate and cylindrical anastomosing branches, but differs by the brown colour and the presence of sigmas and toxas as microscleres, a feature completely absent in *H.* (*Re.*) *chlorilla*. The habitat of *H*. (*Re.*) *chlorilla* is also characteristic, the species is only found associated with macroalgae or *Halodula wrightii*, growing intermingled between them (Fig. 10a, see Fig. 2 in Bispo *et al*., 2014)

***Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965)**

(figs. 11a–h; 12a–h; 13a–b, tables 4, 5)

Adocia implexiformis Hechtel, 1965: 27, text-fig. 2, plate II fig. 2; Van Soest, 1980: 18, fig. 6, plate II fig. 3; Zea, 1987: 67, fig. 15, plate 7 fig. 6.
Chalinula molitba Cedro *et al.* 2007: [Non *Chalinula molitba* (De Laubenfels, 1949)]
Haliclona implexiformis De Weerdt *et al*., 1991: 202, figs. 3h, 6a, b, d.
Haliclona (*Reniera*) *implexiformis* Hajdu *et al*., 2011: 182.
For further synonyms see De Weerdt, 2000.

Material examined. MNRJ 8380 – Channel between Ilha de Maria Guarda and Ilha Bimbarras, Baía de Todos os Santos (ca. 12°43’43”S 38°38’02.3”W), Madre de Deus (Bahia State, Brazil), ca 1–2 m depth, 04 June 2004. MNRJ 8759 – Taíba (sandstone reefs, ca. 3°30’19”S 38°54’19”W), São Gonçalo do Amarante (Ceará State, Brazil), 0.5 m depth, 16 July 2004. MNRJ 18089 – Guamaré Harbour (ca. 5°06’22.5”S 36°19’03.4”W), Guamaré (Rio Grande do Norte State, Brazil), coll. A. Bispo, 04 April 2014. MNRJ 17287, 17288 – Praia do Saco da Pedra (sandstone reefs, ca. 9°44’33”S 35°49’06”W), Marechal Deodoro (Alagoas State, Brazil), 0.2 m depth, coll. E. Hajdu, 11 October 2014. MNRJ 19209 – Praia do Saco da Pedra (sandstone reefs, ca. 9°44’33”S 35°49’06”W), Marechal Deodoro (Alagoas State, Brazil), 0.5 m depth, coll.

A. Bispo, 15 September 2012; Fragment deposited under UFALPOR 0871. MNRJ 19207 – Alagoas Iate Clube (pilasters next to a coral reef, ca. 9°39’57”S 35°41’43”W), Maceió (Alagoas State, Brazil), 0.3 m depth, coll. A. Bispo, 16 April 2014; Fragment deposited under UFALPOR 1008. MNRJ 19208 – Praia do Francês (sandstone reefs, ca. 9°45’54”S 35°50’04”W), Marechal Deodoro (Alagoas State, Brazil), 0.5 m depth, coll. A. Bispo, 30 June 2014; Fragment deposited under UFALPOR 1022. UFALPOR 0374 – Praia de Ponta Verde (coral reefs, ca. 9°40’01”S 35°41’43’W), Maceió (Alagoas State, Brazil), coll. M.D. Correia, 18 January 2006. UFALPOR 0794 – Praia do Saco da Pedra (sandstone reefs, ca. 9°44’33”S 35°49’06”W), Marechal Deodoro (Alagoas State, Brazil), 0.5 m depth, coll. A. Bispo, 26 January 2012.

Comparative material. *Haliclona* (*Reniera*) *implexiformis*, digital images of the choanosome and oxeas of the holotype YPM IZ 005035, Port Royal (Jamaica). *Haliclona* (*Reniera*) *implexiformis*, UFRJPOR 4124, Twin Cays (Belize).

Diagnosis. *Haliclona* (*Reniera*) *implexiformis* is distinguished from its congeners in the Western Atlantic by the combination of encrusting to cushion-shaped form, large oscules, colour purple to pinkish violet, and blunt to strongylote oxeas (modified from De Weerdt, 2000).

Description (Fig. 11a–h). Massive encrusting to cushion shaped, ca. 1-2 cm in thickness. Oscules are common, circular, at the top of volcano-shaped elevations (Fig. 11a–c, e, g) or just slightly elevated (Fig. 11d, f, h), ca. 0.8 to 7.7 mm in diameter. The surface is smooth and even, slightly hispid at the touch, although some species shows tuberculated areas (MNRJ 17288, Fig. 11b) and one other presents some small fistules close to the oscules (MNRJ 19208, Fig. 11d). The surface could be reticulated in some specimens (Fig. 11a–d, f). Consistency vary from soft and compressible to firm, some easily torned. Colour alive vary from purple (Fig. 11a–b, g), pale purple (Fig. 11c–d) to pinkish violet (Fig. 11e–f, h).

Skeleton (Fig. 12a–h). Ectosome (Fig. 12b, d, f, h): a slightly detachable, regular, unispicular, isodictyal reticulation, with three-, four-sided or polygonal meshes. Choanosome (Fig. 12a, c, e, g): an isotropic to isodictyal reticulation, forming three-, four-sided or polygonal mesehes, with some spicules in confusion, mainly unispicular, but with some loose paucispicular tracts in some specimens. Subectosomal and choanosomal spaces are common. Some rounded meshes. MNRJ 17287 and 17288 have skeleton of the same structure, but denser. Spongin is scarce, found mainly at the nodes of the reticulation.

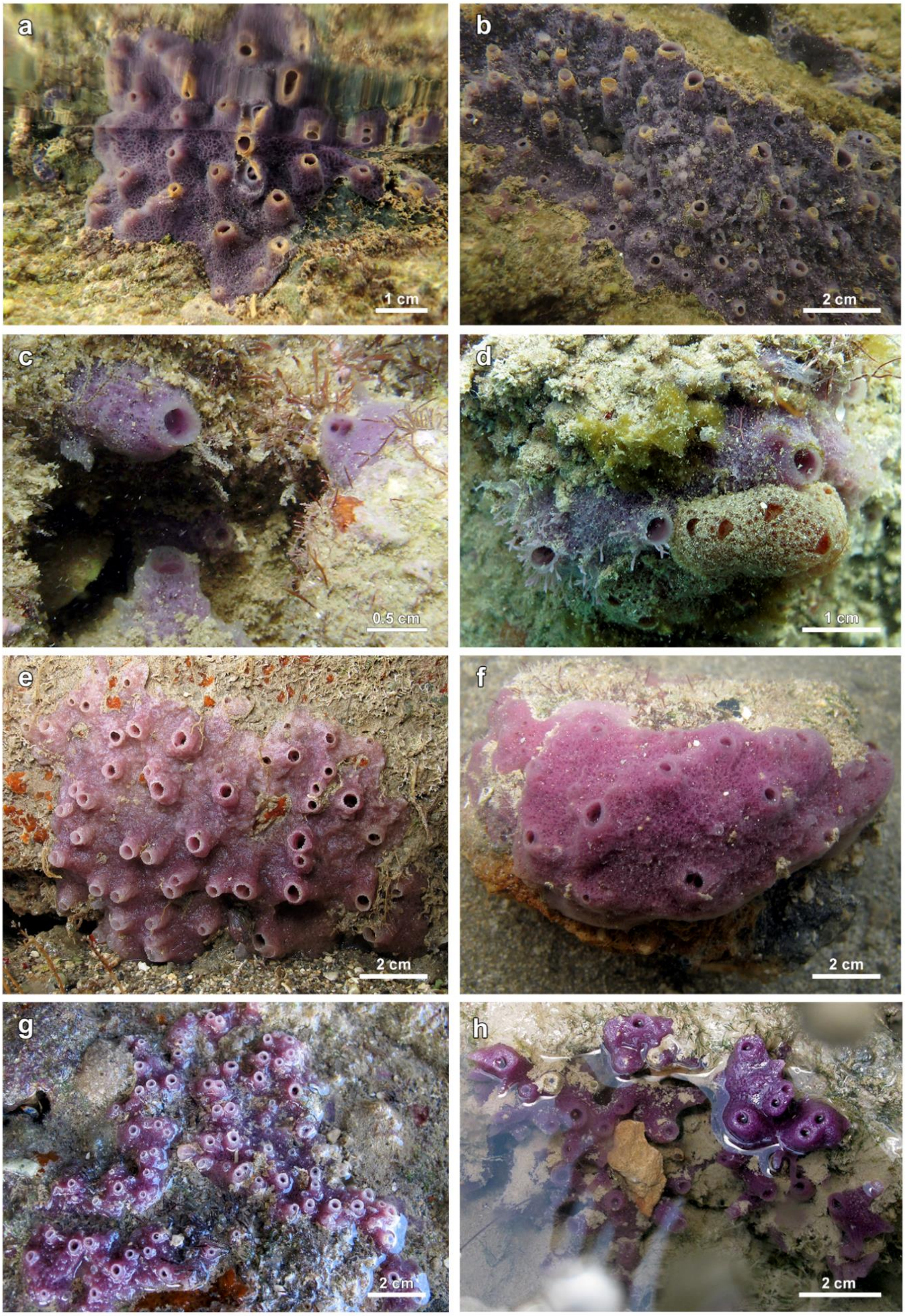


FIGURE 11. *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965), morphological variation. a. MNRJ 17287. b. MNRJ 17288. c. UFALPOR 0794. d. MNRJ 19208. e, g. not collected. f. MNRJ 19207. h. MNRJ 18089.

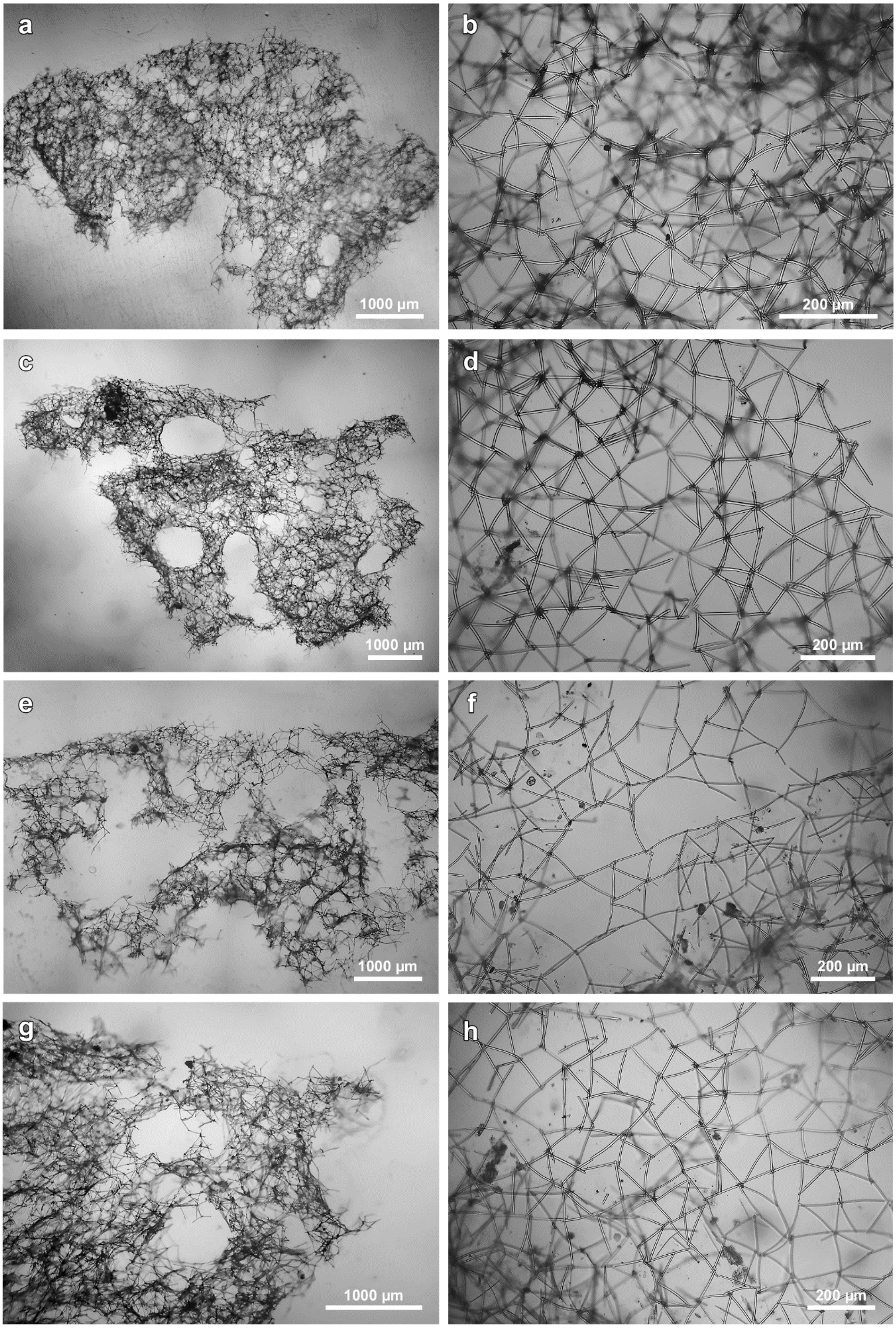


FIGURE 12. *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965), skeletal arrangement. a–b. MNRJ 17287. c–d. MNRJ 19208. e–f. MNRJ 19207. g–h. MNRJ 18089. Sections at the left are from the choanosome, at the right are from the ectosome.

TABLE 4. Oxeas measurements of Brazilian specimens of *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965).

Specimen	Brazilian State	Oxeas (µm)
MNRJ 8380	Bahia	123–*130.1*–140 x 5.5–*7.2*–8
MNRJ 8759	Ceará	120–*136.3*–145 x 6.5–*7.2*–8
MNRJ 18089	Rio Grande do Norte	108–*130.6*–149 x 5–*6.2*–7.5
MNRJ 17287	Alagoas	110–*132.6*–170 x 5–*7.6*–10
MNRJ 17288	Alagoas	107.5–*134.3*–162.5 x 5.5–*8.3*–10.5
MNRJ 19209	Alagoas	125–*139.9*–150 x 7.5–*9.1*–10
MNRJ 19208	Alagoas	114–*132.3*–140 x 5.5–*6.4*–7.5
MNRJ 19207	Alagoas	110–*126.3*–146 x 5.5–*7.4*–10
UFALPOR 0374	Alagoas	107.5–*128.9*–160 x 4.5–*6.4*–10
UFALPOR 0794	Alagoas	136.5–*151.5*–167.5 x 5–*8.2*–10

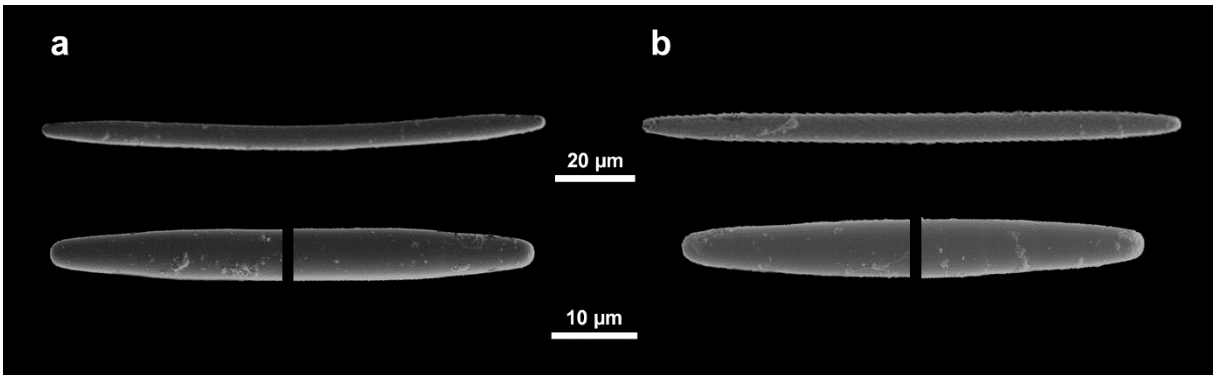


FIGURE 13. *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965), oxeas. a. MNRJ 18089. b. MNRJ 19208.

Spicules (Fig. 13a-b). Oxeas, predominantly with blunt points or modified to strongyles (some mucronate in MNRJ 19208), some styles and acerate oxeas are present in different proportions in each specimen, 108–170 x 4.5–10.5 µm (Table 4).

Ecology. This species is a rather common one in the Brazilian coast. It looks to prefers areas next to the influence of freshwater, in very shallow waters. We found some specimens in the Guamaré Harbour (Fig. 11h) and in internal regions of the Todos os Santos Bay, both estuarine regions. Specimens from Praia do Saco (Alagoas State) were also found near a channel mouth of the Manguaba lagoon. This species is also resistant to dissecation when exposed to air during the low tides, especially in shaded areas (Fig. 11e–g), but also in tide pools in well lit areas (Fig. 11a–b).

Distribution (Fig. 14). Widespread in the Tropical Western Atlantic, known to occur in the Wider Caribbean (Tropical Northwestern Atlantic) and in tropical Brazil (Tropical Southwestern Atlantic). Detailed distribution in the Caribbean: Bermuda, Florida, Bahamas, Belize, Jamaica [type locality], Dominician Republica, Puerto Rico,

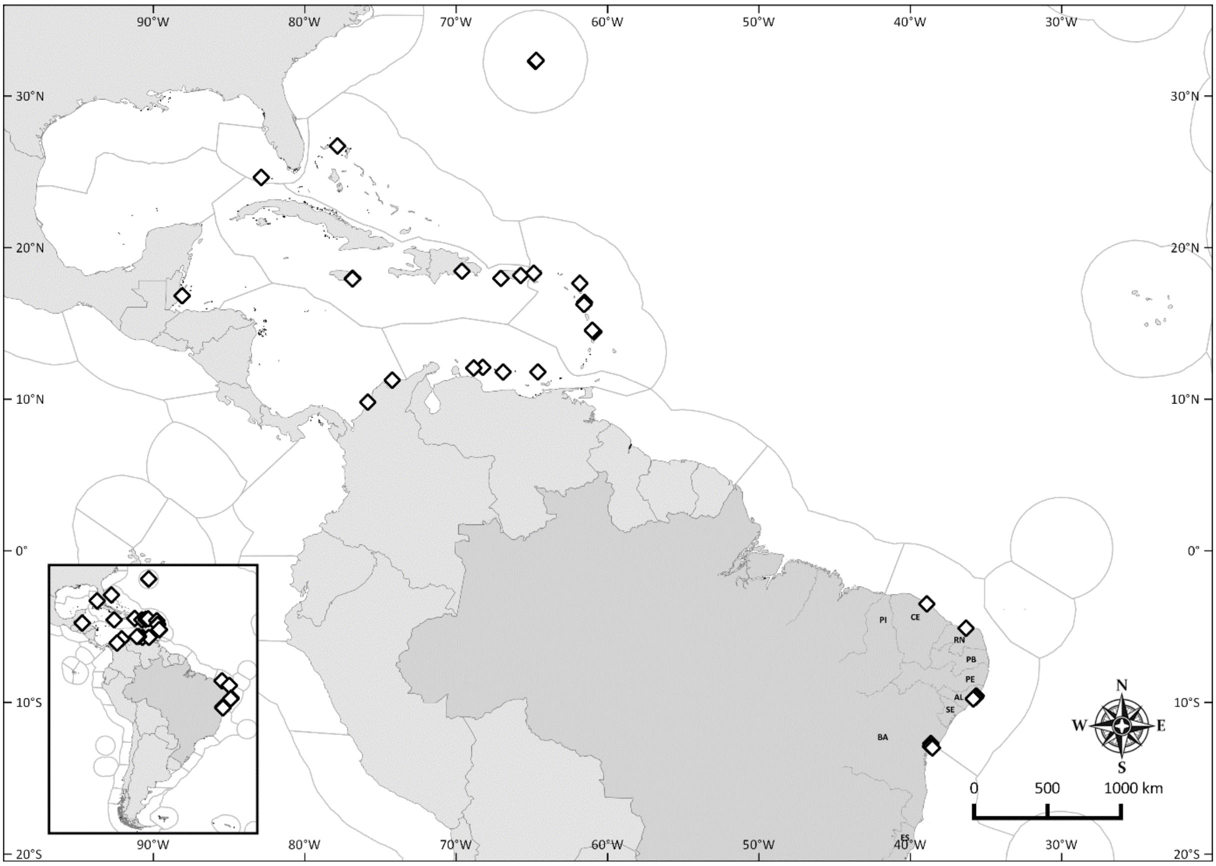


FIGURE 14. Geographic distribution of *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965).

St. Thomas, Martinique, Colombia, Curaçao, Bonaire, Venezuela (De Weerdt *et al.*, 1999; De Weerdt, 2000; Rützler *et al.*, 2014; Zea, 1987). Detailed distribution in Brazil: Ceará State (3°S), Rio Grande do Norte State (5°S), Alagoas State (9°S), and Bahia State (12°S) (present study, with some records from Bahia State made by Hajdu *et al*, 2011). MEOW distribution: Tropical Northwestern Atlantic and Tropical Southwestern Atlantic (Northeastern Brazil Ecoregion).

Remarks. *Haliclona* (*Reniera*) *implexiformis* is a highly plastic species, as we can see from the illustrated specimens here. Nevertheless, all of our specimens fits within the known morphological variation of the species (see Table 5). We assume that the variability we found could be explained by the different environmental conditions where the specimens were collected. For example, it is well known that the estuarine areas where the species prefers to live provide a higher influx of silica, creating longer and thicker spicules (Mercurio *et* al., 2000; McDonald *et al.*, 2002) and, possibly, denser skeletons. Light exposition is also known to affect the colour of the specimens. Specimens from tidal pools, such as MNRJ 17287 and 17288, are known to produce longer and thicker oxeas and to possess a higher silica content than those from calm habitats (Meroz-Fine *et al*., 2005)

Despite its high plasticity, *Haliclona* (*Re.*) *implexiformis* is an easily distinguished species due to its purple to violet colour, the presence of blunt oxeas or strongyles and an isodictyal to isotropic skeleton typical of the subgenus *Haliclona* (*Reniera*). Cedro *et al.* (2007) identified *H.* (*Re.*) *implexiformis* as *Chalinula molitba* (UFALPOR 0374), possible due to their similar colour and aspect, but both species are easily distinguished by the absence of ectosome and choanosome with secondary lines more than one spicule in length in *Chalinula molitba*.

***Haliclona* (*Reniera*) sp. nov. 1**

(fig. 15a–e, table 6)

Material examined. Holotype: MNRJ 18015 – Taíba (sandstone reefs, ca. 3°30'19"S 38°54'19"W), São Gonçalo do Amarante (Ceará State, Brazil), 0.5 m depth, coll. A. Bispo, 01 April 2014.

Comparative material. *Haliclona* (*Halichoclona*) *albifragilis*, digital images of the choanosome and oxeas of YPM IZ 005035 PR – Holotype, Drunkenmans Cays (Parish of St. Andrew, Jamaica), coll. G.J Hechtel, 24 June 1961.

Diagnosis. *Haliclona* (*Reniera*) sp. nov. is clearly distinguished from its congeners in the Tropical Western Atlantic by the combination of a regular unispicular skeleton, oscules at the top of slight elevations, punctate surface, hastate oxeas, and beige colour alive.

Description (Fig. 15a). Thinly encrusting cushions, 3 mm thick, and ca. 5 cm in diameter. Oscules are circular, measuring 2.0–3.5 mm, they are common, irregularly distributed, and situated at the top of slightly elevated mounds. Surface is smooth and punctate. Consistency is soft and fragile. Colour alive and in alcohol is beige.

Skeleton (Fig. 15b–d). Ectosome: a slightly detachable, regular unispicular, isodictyal, and delicate reticulation, forming three- to four-sided meshes. Choanosome: of the same structure of the ectosome, although more irregular in some parts, with few choanosomal spaces. Spongin is scarce, found mainly at the nodes of the reticulation.

Spicules (Fig. 15e). Oxeas: hastate, mostly are slightly curved, but some are also straight, 137–*153*–170 x 5.5–*6.8*–7.5 µm.

Ecology. Found under rocks in very shallow waters of a sandstone reef.

TABLE 5. Comparative morphological data of *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965).

Haliclona* (*Re.*) *implexiformis	**External morphology**	**Skeleton**	**Colour – locality, depth**
as ***Adocia neens*** (from De Laubenfels, 1936)	Encrust., ca. 1 cm thick, 5 cm in diam., oscs. 3–4 mm in diam., raised 10–15 mm from the base; surf. nearly smooth; consist. very fragile, only slightly compress.	**Ectos.** – easily detach., very simmetrical in struct., isodict. reticul. **Choan.** – somewhat isodic., few vague tracts of 3-5 rows of spics. **Oxeas**, verging toward strongylote, ca. 118 x 5 um.	Very pale purple, near white – Florida (Dry Tortugas), intertidal.
as ***Haliclona permollis*** (from De Laubenfels, 1950)	Encrust. (1–5 cm), oscs. volcaniform, 2–10 mm in diam., on conic. elevat., with conspic. elevated rims; surf. microturbeculated; consist softly spongy, easily torn.	**Ectos.** – not specialized? **Choan.** – cavernous, isodict., unispic. Nodal spongin. **Oxeas**, 105–110 x 4–5 µm.	Violet – Bermuda (Hungry Bay), depth unknown.
as ***Adocia implexiformis*** (orig. descr., from Hechtel, 1965)	Thick-walled, cylind. oscul. projections arising from the base, 2–4 cm in height; 1–2 cm in diam.; oscs. 2–10 mm in diam.; slender projections on distal parts, 0.5–1 cm in height, 2–3 mm in diam.; surf. even; consist. compress., easily crumbled.	**Ectos.** – detach., tangent., isodict., unispic. network. **Choan.** – similar to ectos., paucispic. meshes ocasional., w. 2–3 spics., few subectos. spaces. Nodal spongin. **Oxeas**, 129–192 x 5–10 µm, straight to slightly curved, blunt, few styles/strongyles, immature spics. are sharp-pointed and thin.	Dull purple – Jamaica (Port Royal), ca. 1 m depth.
as ***Adocia implexiformis*** (from Van Soest, 1980)	Massive-lobate, 4 cm high, with thick-walled oscs. on lobal apices; thin, blind fistules are often present; consist. soft, fragile, easily torn.	**Ectos.** – detach., tangent., unispic. isotrop. retic. **Choan.** – uni-paucispic. lines connected by single spic. Nodal spongin. **Oxeas**, blunt or sharply pointed, some styles, 108–142 x 3.5–10 µm.	Reddish or bluish purple – Curaçao, up to 10 m depth.
as ***Adocia implexiformis*** (from Zea, 1987)	Massive to globose, 4-6 cm in diam., 0.6–4 cm thick; oscs. scattered, elevated, with a thin collar, some blind fistules (height, 6 mm; diam., 1–3 mm); surf. smooth; consist. fragile.	**Ectos.** – detach., tangent., unispic. isodict. retic. **Choan.** – uni-paucispic. lines connected by single spic., in some parts isodict., subectos. canals present. Nodal spongin. **Oxeas**, hastate or strongyloxeas, some telescopic, 142–214 x 2.4–11.9 µm.	Pink to violet – Colombia, 0–20 m depth
as ***Haliclona implexiformis*** (from De Weerdt *et al.*, 1991)	Thick (2–4 cm) cushions, oscs. conspic., circ., large, 6–10 mm, regular. distribut., flush with the surf. or on slightly elevat. mounds; surf. even, smooth, punctate; consist. soft, compressib.	**Ectos.** – regular, isotrop., unispic. reticulation. **Choan.** – of the same structure of the ectosome. Nodal spongin. **Oxeas**, slightly, evenly curved, blunt points (strongylote), 110–150 x 4.5–7.5 µm.	Pinkish violet – Belize, 0–1 m depth.
Haliclona* (*Reniera*) *implexiformis (from De Weerdt, 2000)	Thick cushions, 2–4 cm thick, regul. outline; rarely fingershaped; oscs. circular, large, 6–10 mm in diam., regular. distribut., flush with the surf., or on slightly elevat. mounds; surf. even, smooth, punctate, some tuberculated areas; consist. soft, compressib.	**Ectos.** – regular, tangent., unispic., isotrop. reticulation. **Choan.** – regular, unispic, isotrop. reticulation. Nodal spongin. **Oxeas**, slightly curved, blunt points or strongylote, sometimes with sharp-pointed oxeas intermixed, 95.5–167.1 x 3.7–9.3 µm.	Pinkish violet – Wider Caribbean, 0–25 m depth.
Haliclona* (*Reniera*) *implexiformis	Massive encrust. to cushions, 1-2 cm thick; oscs. circular, just slightly elevat. or at the top of volcaniform elevat., 0.8-7.7 mm in diam.; surf. smooth, even, w. tuberculated areas and fistules in some species; consist. from soft and compressible to firm.	**Ectos.** – detachable, regular, unispic., isodic. **Choan.** – mainly unispic., isotrop. to isodic., some spic. in confus., some paucispic. tracts, subectos. and choan. spaces are present. Nodal sponging. **Oxeas**, slightly curved or straight, blunt points to strongyles, 108–170 x 4.5–10.5 µm.	Purple to pinkish violet – Brazil, 0-2 m depth.

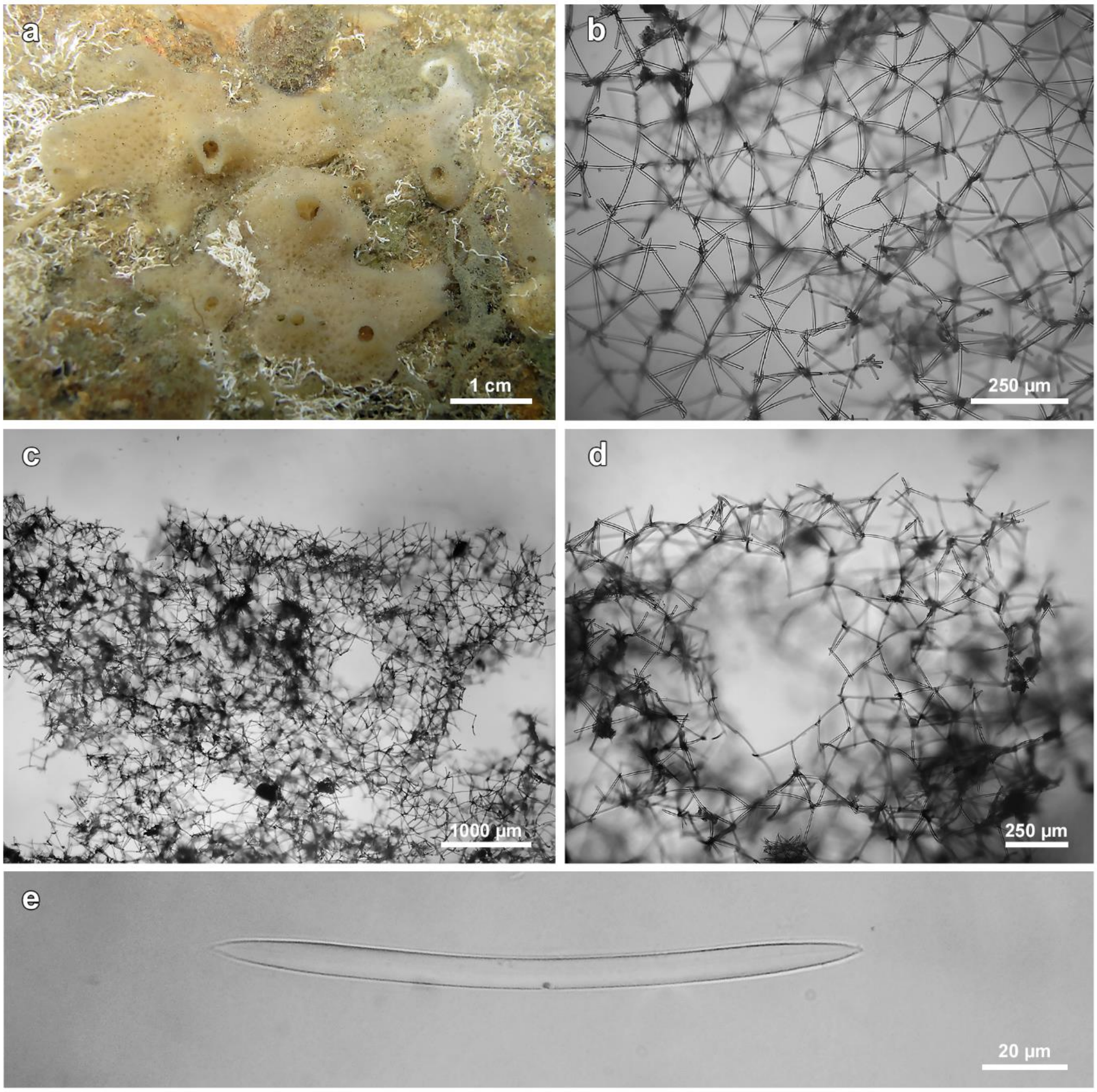


FIGURE 15. *Haliclona* (*Reniera*) sp. nov. 1, holotype MNRJ 18015. a. species in situ. b. ectosomal reticulation. c. panoramic view of the choanosome. d. detail of the choanosome. e. oxea.

Distribution (Fig. 18). Brazil, only know from the type locality: Taíba (3°S, Ceará State). MEOW distribution: Tropical Southwestern Atlantic (Northeastern Brazil Ecoregion).

Remarks. This species is better assigned to the subgenus *Haliclona* (*Reniera*) due to its regular unispicular skeleton, typical of the subgenus.

There are some *Haliclona* spp. in the Tropical Western Atlantic that approaches *Haliclona* (*Reniera*) sp. nov 1. in colour: *Haliclona* (*Halichoclona*) *albifragilis* (Hechtel, 1965), *Haliclona* (*Halichoclona*) *stoneae* (De Weerdt, 2000), and *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994. The latter, despite the white or cream colour alive, is very distinct from *Haliclona* (*Reniera*) sp. nov. 1 due to its skeletal architecture, and mammilliform projections. *Haliclona* (*Halich.*) *stoneae* has whitish-pink colour alive, a subisotropic and paucispicular skeleton, longer and thicker oxeas (286–359 x 7.7–12.8 µm), and sigmas as microscleres (12–21 x 0.6–1.5 µm), being thus very distinct from the new species. The most similar to *Haliclona* (*Reniera*) sp. nov 1 is *Haliclona* (*Halich.*) *albifragilis*, both sharing similar colours (beige in *H.* (*Reniera*) sp. nov. 1 *vs.* white or cream in *H. albifragilis*) and skeletal characteristics.

We compared in detail (Table 6) our specimen with the available data of *Haliclona* (*Halich.*) *albifragilis* from the literature, also the skeletal features of our new species were compared with those of the holotype of *H.* (*Halich.*) *albifragilis*. We observed that *H.* (*Halich.*) *albifragilis* has a much denser subisotropic skeleton typical of its subgenus, while *Haliclona* (*Reniera*) sp. nov. 1 has a much more unispicular, regular and delicate skeleton. Moreover, the oscules in *Haliclona* (*Reniera*) sp. nov. 1 are common, bigger (2.0–3.5 mm in *H.* (*Reniera*) sp. nov. 1 *vs.* ca. 2 mm in *H. albifragilis*) and located at the top of slightly elevated mounds, while it is flush with the surface (Hechtel, 1965) or apparently absent (De Weerdt, 2000) in *Haliclona* (*Halich.*) *albifragilis*. Another important difference between both species is the oxea morphology: *Haliclona* (*Halich.*) *albifragilis* has slender oxeas (63–174 x 2.1–8.4 µm), with sharp or blunt long points, while *Haliclona* (*Reniera*) sp. nov. 1 has thicker oxeas (137–170 x 5.5–7.5 µm), with short hastate points. From this, we can conclude that both species are clearly distinguished, being *Haliclona* (*Reniera*) sp. nov. 1 a new species.

***Haliclona* (*Reniera*) sp. nov. 2**

(figs. 16a–b; 17a–d)

Material examined. Holotype: MNRJ 17224 – Ilha do Sandri, Baía da Ilha Grande (coastal island., ca. 23°03’04”S 44°03’04”W), Angra dos Reis (Rio de Janeiro State, Brazil), 4.5 m depth, coll. E. Hajdu, 18 July 2013.

Diagnosis. *Haliclona* (*Reniera*) sp. nov. 2 is distinguished from its congeners by the combination of an unispicular and isotropic skeleton, a punctate surface and the presence of a conspicuous silver collar surrounding the oscules.

Description. Irregular thinly encrustation, ca. 2 mm thick, occupying an area of about 6 x 1.5 cm^2, in the distal parts of the sponge’s body there are some areas of expansion, showing that the sponge is growing laterally. Oscules are circular, common,

TABLE 6. Comparative morphological data of *Haliclona* (*Halichoclona*) albifragilis (Hechtel, 1965) and *Haliclona* (*Reniera*) sp. nov. 1.

Species	External morphology	Skeleton	Colour – locality, depth
as ***Adocia albifragilis*** (from Hechtel 1965)	Thin crusts, 2–3 mm thick, oscs., ca. 2 mm in diam., flush with the surf.; surf even, microtuberculate; consist. compres., easily torn.	**Ectos.** – tangent. network, single or several loosely arranged spics, a node w. up to 10–12 spics., no large subectos. spaces.; **Choan.** – similar to ectos. Nodal sponging. **Oxeas**, thin, straight to slightly curved, points fusiform, hastate or mucronate, or rounded, few styles or strongyles, 145–174 x 3–5 µm.	White – Jamaica (Port Royal), few feet of water
as ***Adocia neens*** (from Little, 1963)	Encrust., 3–4 mm thick, 3–4 cm in diam.	**Ectos.** – reticulat., detach.. **Choan.** – neatly reticulate skeleton. **Oxeas**, verging toward strongyles, ca. 110-134 x 6 um	White – Florida, 2.5 m depth
as ***Haliclona* (*Halichoclona*) *albifragilis*** (from De Weerdt, 2000)	Small, thinly encrust., up to 1 cm in diam., less than 1 mm thick; oscs. not apparent; surf. even, smooth; consist. friable, slightly brittle	**Ectos.** – dense, tangential, subisotrop. reticulation, easily detach., without large subectosomal spaces. **Choan.** – subisotrop., dense reticulation, few choan. spaces. Nodal spongin. **Oxeas**, slender, weakly to strongly curved, with long, sharp points, 63–168.1 x 2.1–8.4 µm	Opaque white or light cream – Wider Caribbean, from very shallow to 74 m depth
***Haliclona* (*Reniera*) sp. nov. 1**	Thinly encrust. cushion, 3 mm thick, ca. 5 cm in diam.; oscs. circular, 2–3.5 mm in diam., irreg. distributed, at the top of slightly elev. mounds; surf. smooth, punctate; consist. soft, fragile.	**Ectos.** – detach, unispic. isodic., delicate. **Choan.** – same struct. of the choan., w. few ectosomal spaces. Nodal spongin. **Oxeas**, hastate, slightly curved or straight, 137–170 x 5.5–7.5 µm.	Beige – Ceará State (Brazil), intertidal.

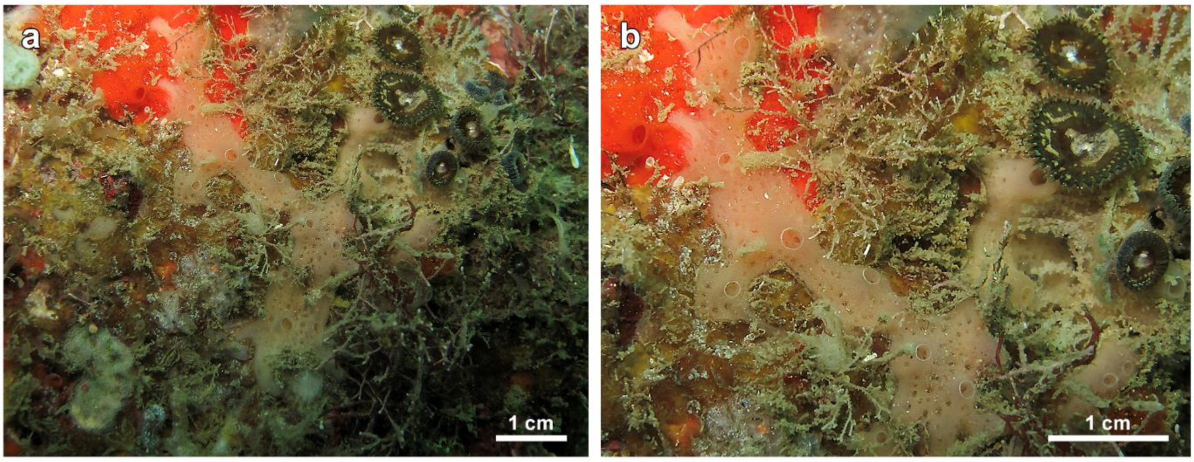


FIGURE 16. *Haliclona* (*Reniera*) sp. nov. 2, holotype MNRJ 17224. a–b. the specimen in situ, overgrowing in rocky substrate together with other sessile animals, it is possible to see lateral expansions of the sponge's body.

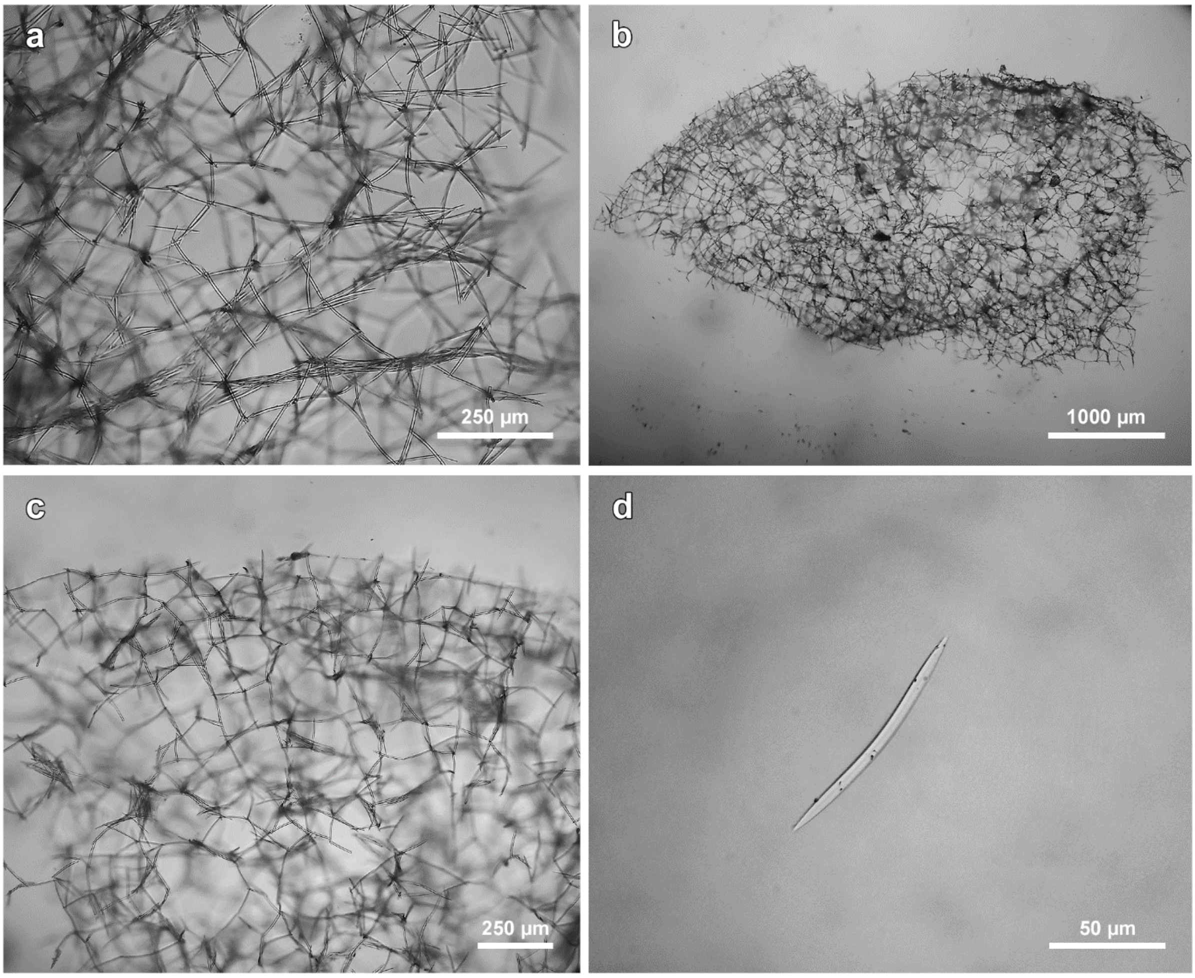


FIGURE 17. *Haliclona* (*Reniera*) sp. nov. 2, holotype MNRJ 17224. a. ectosomal skeleton. b. panoramic view of the choanosome. c. choanosome in detail. d. oxea.

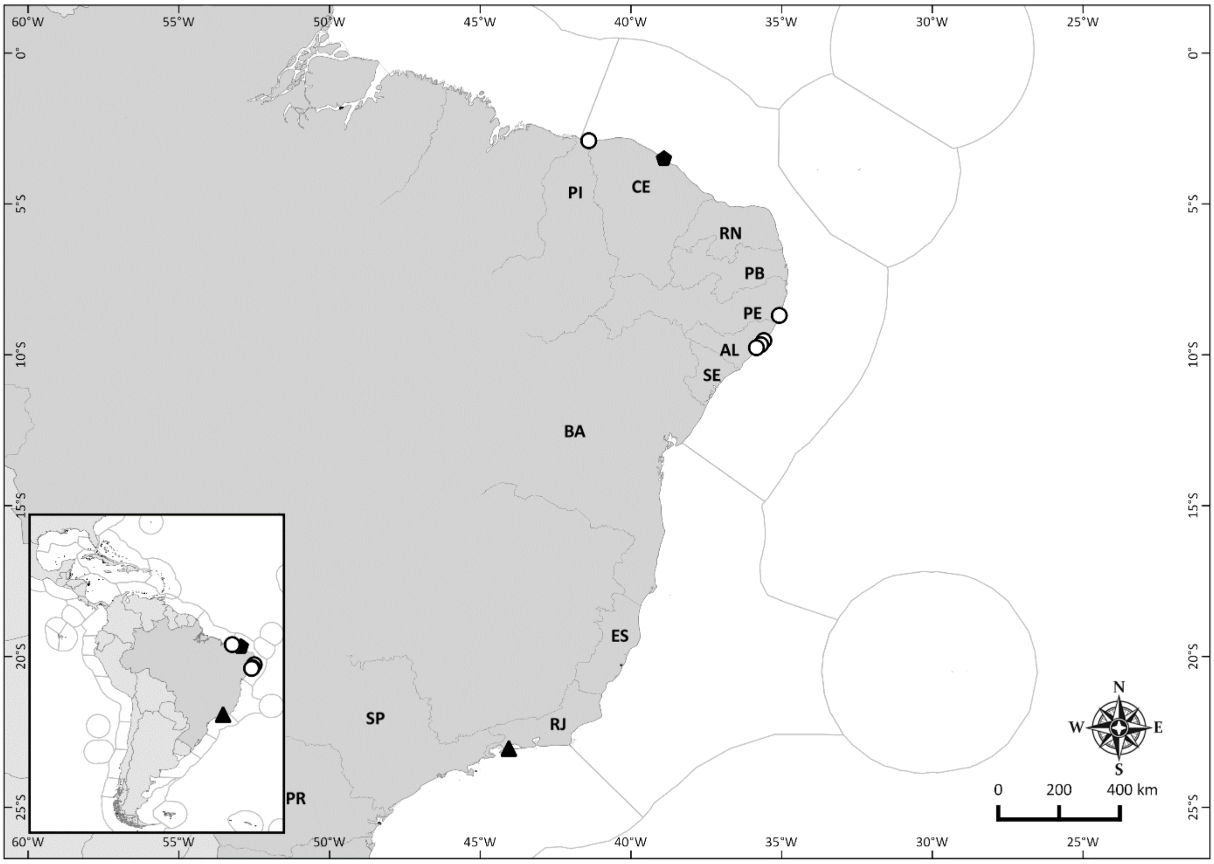


FIGURE 18. Geographic distribution of *Haliclona* (*Reniera*) *chlorilla* Bispo *et al.*, 2014 (circle), *Haliclona* (*Reniera*) sp. nov. 1 (pentagon), and *Haliclona* (*Reniera*) sp. nov. 2 (triangle).

irregularly distributed, just slightly elevated, and showing a remarkable silver collar, varying from 1 to 2.2 mm in diameter. Surface is even, smooth, and punctate. Consistency is very fragile, easily torn. Colour alive is pinkish beige, with oscules surrounded by a silver collar, in alcohol the sponge become yellowish cream, and semi-transparent.

Skeleton. Ectosome: a very delicate, mostly unispicular confused and isotropic reticulation, with some vague paucispicular (3–8 spicules) tracts running along the surface. Choanosome: a very delicate, unispicular and irregular isotropic reticulation, forming meshes mostly four-sided, although three-sided and polygonal meshes are also common. Spongin is very scarce, found mainly at the nodes of the reticulation.

Spicules. Oxeas: hastate, mostly slightly curved, although some straight also occur, 95–*107.4*–118 x 3.5–*4.8*–5.5 µm

Ecology. Found at 4.5 m depth, on a rocky substrate of a costal island (Ilha do Sandri). The species seems to be a good space competitor, since it was found overgrowing other sponges (Fig. 16).

Distribution (Fig. 18). Brazil, only known from the type locality: Ilha do Sandri at Ilha Grande Bay, Angra dos Reis (ca. 23°S, Rio de Janeiro State). MEOW distribution: Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

Remarks *Haliclona* (*Reniera*) sp. nov. 2 is a remarkable distinct species. Its most diagnostic features, i.e. the oscules surrounded by a silver collar, an uncommon feature for chalinids, in addition to its unispicular and deliticate skeleton makes it a unique species (see Table 2, from Bispo *et al*, 2014).

Subgenus *Rhizoniera* Griessinger, 1971p

Haliclona (*Rhizoniera*) *lilacea* Mothes & Lerner, 1994

(fig. 19a–e)

Haliclona lilaceus Mothes & Lerner, 1994: 55, figs. 28, 29, 36.
Haliclona (*Haliclona*) lilaceus Muricy *et al.*, 2011: 101.

Material examined. Holotype: MCNPOR 1479 – Praia de Bombinhas (rocky coast, ca. 27°08’48”S 48°29’00”W), Bombinhas (Santa Catarina State, Brazil), intertidal, coll. M.C.M. Tavares, 07 November 1987.

Diagnosis. *Haliclona* (*Rhizoniera*) *lilacea* is distinguished from its congeners in the Western Atlantic by having a combination of lilac colour, thinly encrusting shape, and the skeleton of stout primary lines.

Description (Fig. 19a). The holotype consists of four small fragments, the biggest one reaching ca. 1.3 x 0.7 cm^2. Thinly encrusting shape, up to 3 mm in thickness. Oscules not apparent. The surface is irregular, slightly hispid. Consistency is fragile, easily torn, slightly compressible. Colour alive is light lilac and cream in spirit.

Skeleton (Fig. 19b–d). Ectosome: absent, not specialized. Choanosome: pauci- to multispicular (3–10 spicules) primary lines irregularly connected by unispicular secondary lines, with spicules in confusion. In some parts of the skeleton, the primary lines are connected by paucispicular tracts, forming some rounded paucispicular meshes. Spongin is scarce.

Spicules (Fig. 19e). Oxeas, acerate, with long points, most slightly curved, some straight. 85–*106.3*–120 x 3–*4.5*–5 µm

Ecology. Found in very shallow waters, on rocky substrate.

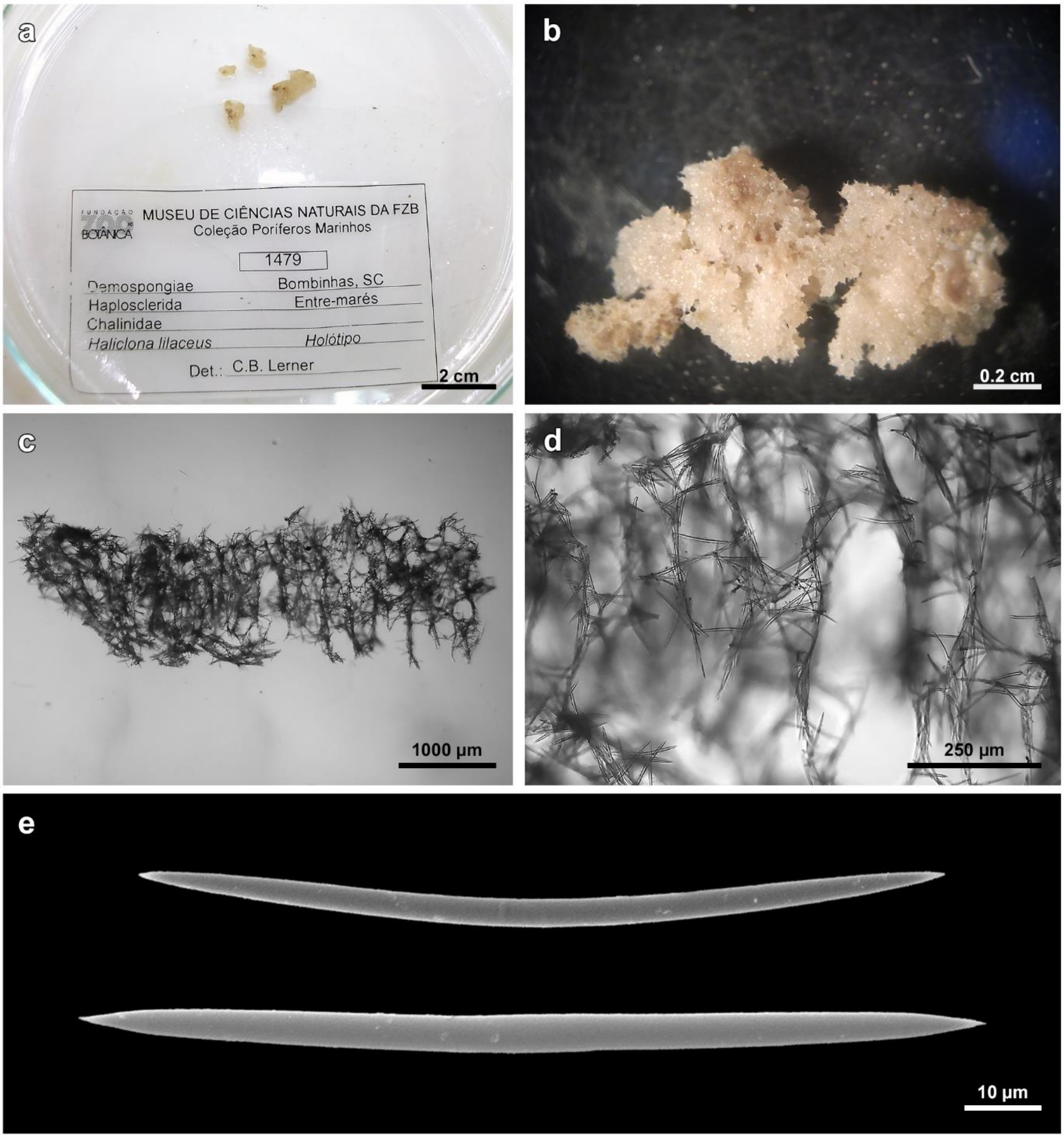


FIGURE 19. *Haliclona* (*Rhizoniera*) *lilacea* Mothes & Lerner, 1994, holotype MCNPOR 1479. a–b. preserved fragments of the holotype. c. panoramic view of the choanosome. d. choanosome in detail. e. oxeas.

Distribution (Fig. 24). Brazil, only known for its type locality, Bombinhas (27°S, Santa Catarina State). MEOW distribution: Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

Remarks. The original spelling of this species is to be corrected following Art. 31.2 and 34.2 from the ICZN (1999), since *lilaceus* is a latin adjective that must agree with the gender of the genus name. "*Haliclona*" is a greek-derived name that means something like "branches (*clonos*) in the sea (*als*)" and is deduced to be a feminine name because of its ending and intonation, in addition to the use by Grant (1835) of the feminine specific epithet “*occulata*” accompanying *“Haliclona*”, a clearly indicative of its feminine gender (E. Voultsiadou, pers. comm.). From this, we corrected the original spelling of this species from *Haliclona lilaceus* to *Haliclona* (*Rhizoniera*) *lilacea*, modifying the ending *–us* to *–a* in order to agree with the gender of the genus name.

Mothes & Lerner (1994) described *Haliclona* (*Rhizoniera*) *lilacea* as being a member of the group *“arenata*” of the genus *Haliclona*, now the subgenus *Haliclona* (*Soestella*). Nevertheless, our analysis of the type material led us to conclude that this species is best assigned to the subgenus *Haliclona* (*Rhizoniera*) due to its skeleton of pauci- to multispicular primary lines connected by unispicular secondary ones.

The lilac colour, thinly encrusting shape, and the skeleton of stout primary lines easily distinguish *H.* (*Rh.*) *lilacea* from other species of *Haliclona* in the Western Atlantic. However, there are some species that approach *H.* (*Rh.*) *lilacea* by similar colours, such as purple and violet: *H.* (*Halich.*) *vansoesti* De Weerdt *et al.* (1999), *H.* (*Re.*) *implexiformis* (Hechtel, 1965), *H.* (*Re.*) *mucifibrosa* De Weerdt *et al.* (1991), *H.* (*Re.*) *portroyalensis* Jackson *et al.* (2006), *H.* (*Re.*) *tubifera* (George & Wilson, 1919), *H.* (*S.*) sp. nov, and *H.* (*Rh.*) *curacaoensis* (Van Soest, 1980).

Haliclona (*Halichoclona*) *vansoesti,* except by the colour, is very distinct from *H.* (*Rh.*) *lilacea*, it has an isotropic skeleton, without primary lines, and has a detachable semi-transparent ectosome. These characters clearly set both species apart.

Haliclona (*Re.*) *implexiformis*, *H.* (*Re.*) *portroyalensis*, and *H.* (*Re.*) *tubifera* are also very distinct from *H.* (*Rh.*) *lilacea*, by the overall external morphology, by having a unispicular isodictyal to isotropic skeleton typical of the subgenus *Haliclona* (*Reniera*), and by having toxas in the case of *H.* (*Re.*) *portroyalensis*.

Haliclona (*Haliclona*) sp. nov. is a purple new species from São Paulo State (Brazil) that also lives in the subtropical Southeastern Brazil Ecoregion, although it differs from *H.* (*Rh.*) *lilacea* by having conspicuous subdermal canals and the typical skeleton of the subgenus.

Another similar species to *Haliclona* (*Rh.*) *lilacea* is *H.* (*Rh.*) *curacaoensis*, a purple to bluish purple coloured species. Both share the skeleton of the subgenus *Haliclona* (*Rhizoniera*), although the primary lines in *H.* (*Rh.*) *lilacea* are stouter. In addition, *H.* (*Rh.*) *curacaoensis* has a distinctive shape, with oscular mounds, while *H.* (*Rh.*) *lilacea* is a thinly encrusting species, without oscular mounds.

***Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994**

(figs. 20a–e, 21a–h, 22a–j, 23a–f, table 7)

Haliclona mammillaris Mothes & Lerner, 1994: 54, figs. 26, 27, 35; Lerner, 1996: 115, figs. 22, 23, 32., Mothes *et al.*, 2003: 55; Mothes *et al.*, 2006: 95.
Haliclona (*Haliclona*) *mammillaris* Muricy, 2011: 101.

Diagnosis. The only *Haliclona* spp. in the Western Atlantic with a combination of anisotropic choanosomal skeleton with pauci- to multispicular primary lines, white to beige colour, punctate surface, oscules at the top of small mounds or mammilliform projections.

Redescription of the Holotype

Material examined. Holotype: MCNPOR 1482 – Praia de Bombinhas (rocky coast, ca. 27°08’48”S 48°29’00”W), Bombinhas (Santa Catarina State, Brazil), intertidal, coll. M.C.M. Tavares, 07 November 1987. Fragment deposited under MNRJ 19212.

Description (Fig. 20a). Encrusting, ca. 3 mm in thickness. Oscules are circular, small, ca. 2 mm, surrounded by a translucent membrane, with some canals close to the oscules. Surface is smooth, slightly irregular, covered with sediment in many areas. Colour alive is white, and beige in spirit.

Skeleton (Fig. 20b–d). Ectosome: absent. Choanosome: skeleton mainly anisotropic, with pauci- to multispicular (3–7 spicules) sinuous primary lines, irregularly connected by unispicular secondary lines. This pattern is clearer near the surface, becoming obscured in the inner parts of the skeleton due the presence of many spicules in confusion. Spongin is scarce.

Spicules (Fig. 20e). Oxeas, hastate, usually slightly curved, but there are also some straight, 110–*123*–133 x 3.5–*5*–5.5 µm.

Ecology. The holotype was collected in the intertidal zone of a rocky shore.

Description of further material from Southeastern Brazil Ecoregion

Material examined. MNRJ 17226 – Angra dos Reis (coastal island, ca. 23°03'30"S 44°19'26"W), Angra dos Reis (Rio de Janeiro State, Brazil), 3 m depth, coll. E. Hajdu,

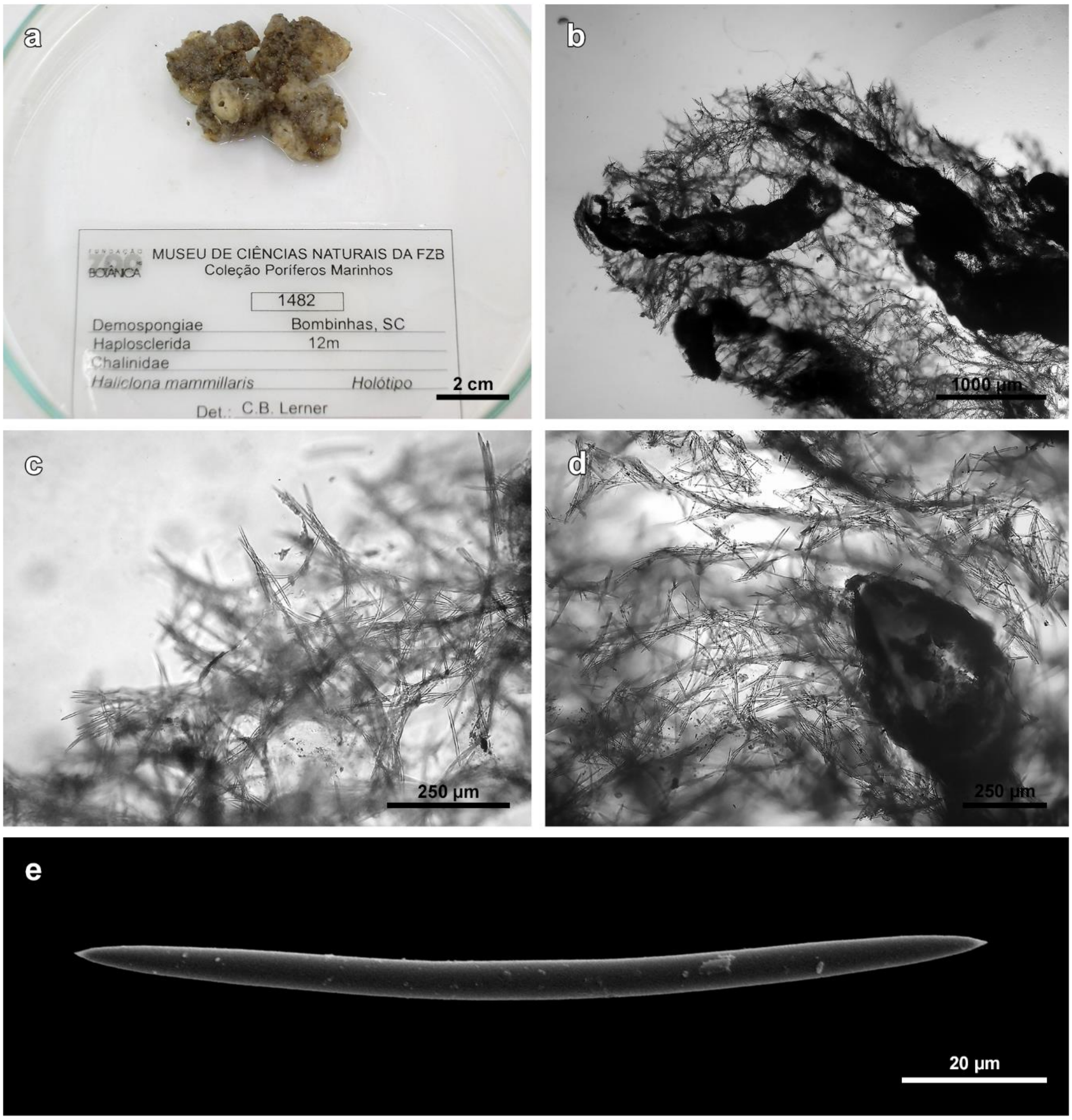


FIGURE. 20. *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994, holotype MCNPOR 1482. a. preserved holotype. b. panoramic view of the choanosome. c. choanosomal skeleton near the surface. d. inner part of the choanosome. e. oxea.

19 July 2013. MNRJ 17227 – Angra dos Reis (coastal island, ca. 23°03'30"S 44°19'26"W), Angra dos Reis (Rio de Janeiro State, Brazil), 3–5 m depth, coll. E. Hajdu, 19 July 2013.

Description (Fig. 21a–b). Encrusting or cushion-shaped sponge, ca. 7 mm in thickness. Oscules are common, circular, small, ca. 0.8–1.6 mm in diameter, surrounded by a translucent membrane, at the top of slightly elevated mammiliform projections or flush with the surface. Surface is smooth, even, punctate, with loose subdermal transparent canals close to oscular aperture. Consistency is fragile, compressible, but slightly firm in MNRJ 17227. Colour alive is beige, with pink shades in some small areas. Colour in spirit is cream.

Skeleton (Fig. 22a–d). Ectosome: absent. Choanosome: anisotropic skeleton, with uni- to paucispicular (1–6 spicules) primary lines, irregularly connected by unispicular secondary lines. If not artefactual, some of the secondary lines could be also paucispicular (2–3 spicules). The anisotropic pattern of the skeleton is obscured by many spicules in confusion, becoming more unispicular and confused in the inner parts. Some choanosomal spaces are also present. Spongin is scarce.

Spicules (Fig. 23d, f). Oxeas, hastate, most are slightly curved, but there are also some straight, 118–160 x 3–7.5 µm.

Description of the material from Northeastern Brazil Ecoregion

Material examined. MNRJ 17773, 17779, 17799 – Praia de Mundaú (sandstone reefs, ca. 3°10’21”S 39°21’22”), Trairi (Ceará State, Brazil), 0.5 m depth, coll. A. Bispo, 29 March 2014, MNRJ 19213 – Praia da Sereia (sandstone reefs, ca. 9°33’57”S 35°38’42”W), intertidal, coll. A. Bispo, 09 January 2012; Fragment deposited under UFALPOR 0766. MNRJ 19214 – Praia da Sereia (sandstone reefs, ca. 9°33’57”S 35°38’42”W), intertidal, coll. A. Bispo, 01 February 2014; Fragment deposited under UFALPOR 0971. UFALPOR 0573 – Ponta do Meirim (coral reef, ca. 9°32’35”S 35°36’49”W), Maceió (Alagoas State, Brazil), intertidal, coll. E. Hajdu, 30 January 2010.

Description (Fig. 21c–h). Encrusting to cushion shaped, ca. 6–7 mm in thickness. Oscules are circular, small, ca. 0.6–2.1 mm in diameter, usually surrounded by a translucent membrane, at the top of slightly elevated mammilliform projections. Surface is regular, punctate, with loose subdermal canals close to the oscular aperture in UFALPOR 0766. Consistency is fragile, but also compressible, and firmer for UFALPOR 0766. Colour alive vary from white to beige, becoming beige in spirt.

Skeleton (Fig. 22e–j). Ectosome: absent. Choanosome: consists of a reticulation of pauci- to multispicular (2–10 spicules) primary lines irregularly connected by unispicular secondary ones, but commonly also with spicules in confusion. Choanosomal spaces are present. This anisotropic pattern is also commonly obscured in much specimens by the tendency of the skeleton becoming more isotropic in its inner areas, which is more clearly observed in UFALPOR 0766. Spongin is scarce.

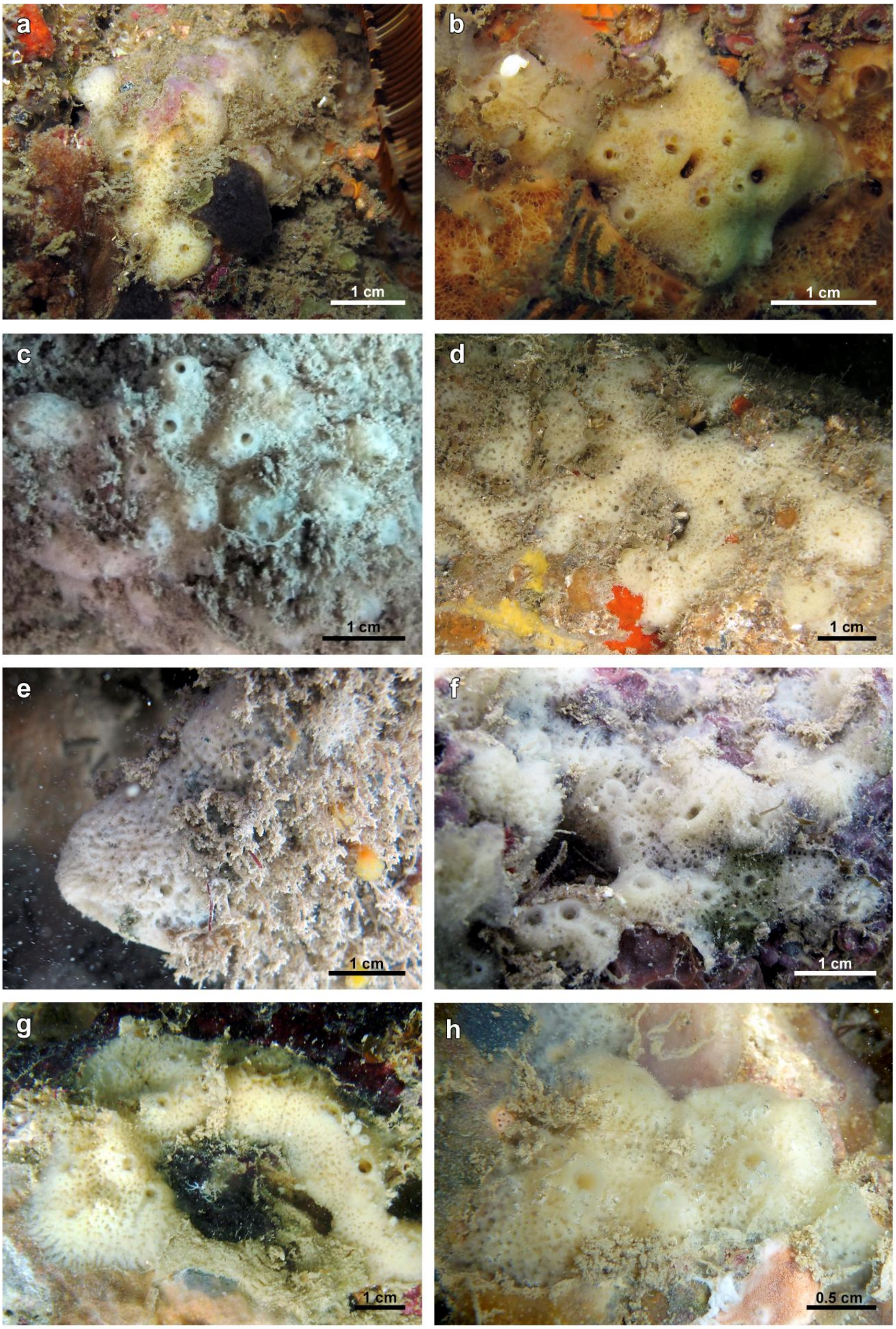


FIGURE. 21. *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994, morphological variation. a–b. specimens from Southeastern Brazil (MNRJ 17226 and 17227, respectively). c–h. specimens from Northeastern Brazil (MNRJ 17779, 17799, 17773, UFALPOR 0573, MNRJ 19213, 19214, respectively).

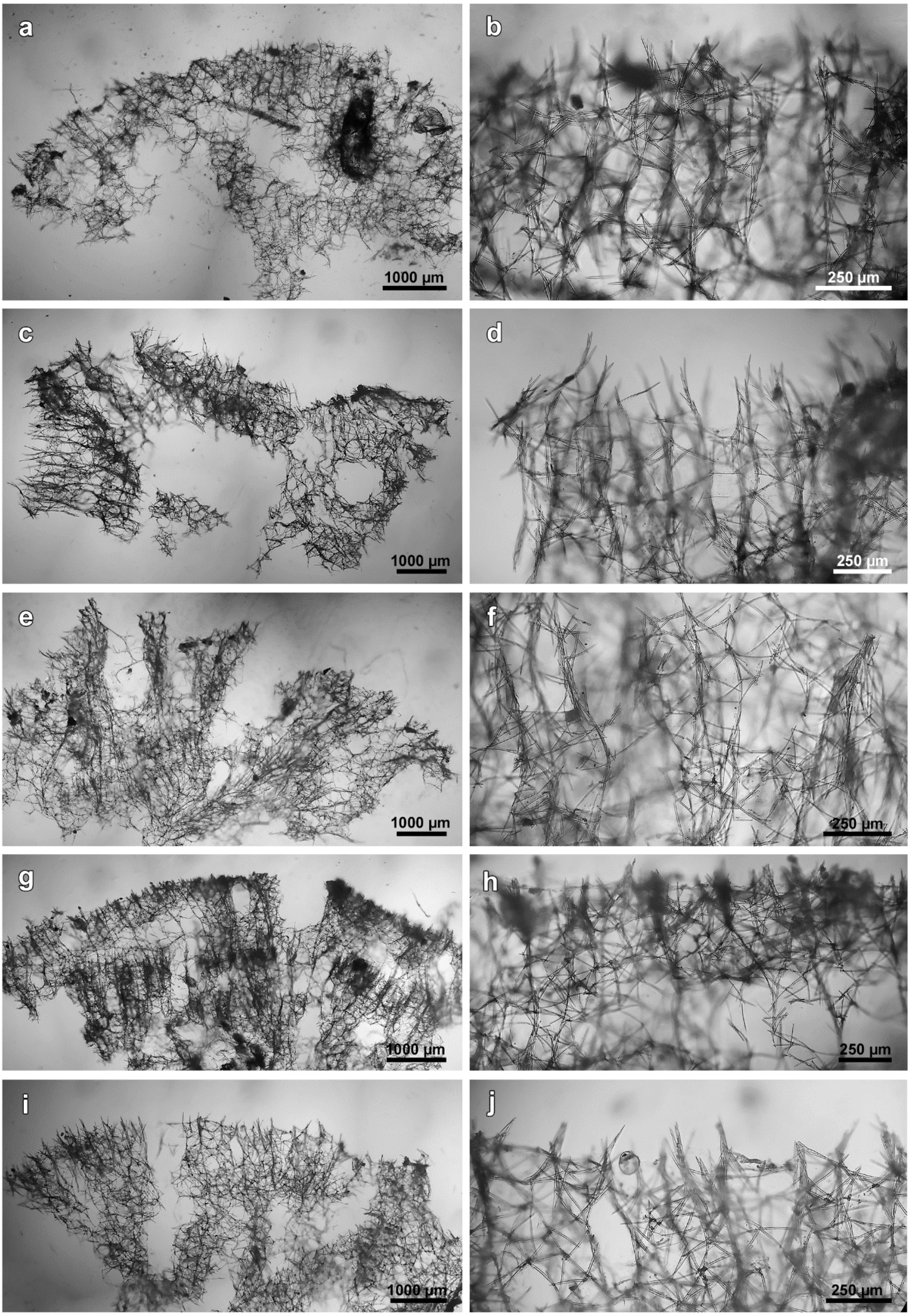


FIGURE 22. *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994, choanosomal arrangement in a panoramic view (left) and in detail (right). a–b. MNRJ 17226. c–d. MNRJ 17227. e–f. MNRJ 17779. g–h. MNRJ 17799. i–j. MNRJ 19214.

TABLE 7. Oxeas measurements of *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994.

Specimen	Brazilian State	Measurements (µm)
MCNPOR 1482	Santa Catarina	110–*121.8*–133 x 3.5–*4.9*–5.5
MNRJ 17226	Rio de Janeiro	118–*141.1*–160 x 3–*5.9*–7.5
MNRJ 17227	Rio de Janeiro	120–*136.3*–155 x 3–*5.2*–7
MNRJ 17773	Ceará	118–*136.8*–150 x 3.5–*5.3*–7
MNRJ 17779	Ceará	125–*135.5*–143 x 3.5–*4.9*–5.5
MNRJ 17799	Ceará	123–*137.9*–153 x 5–*5.2*–6
MNRJ 19213	Alagoas	128–*154.3*–178 x 4.5–*6.7*–8
MNRJ 19214	Alagoas	145–*161.9*–178 x 4–*5.9*–7.5

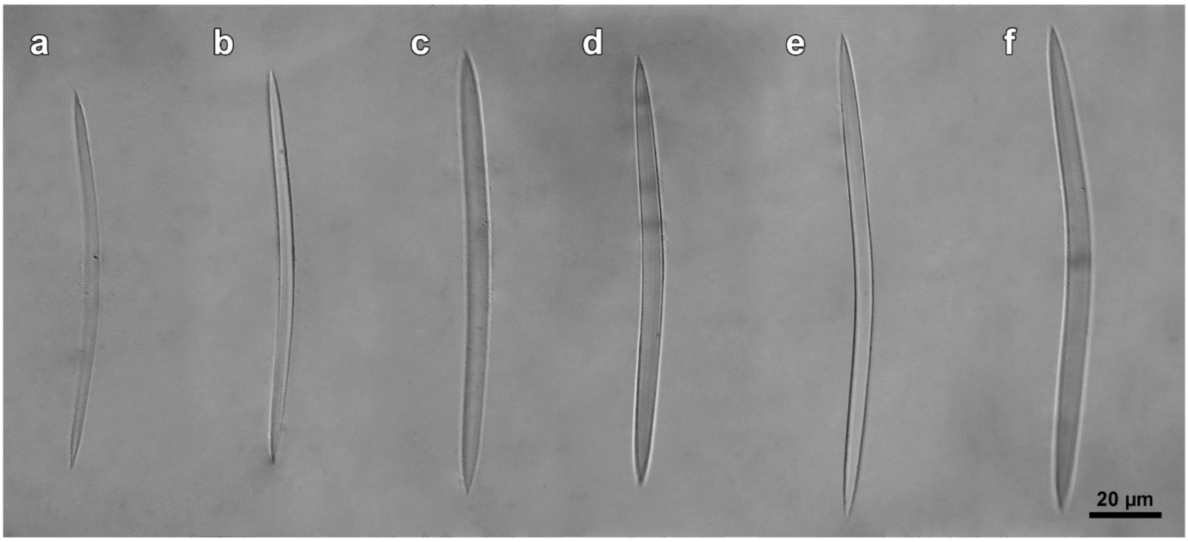


FIGURE 23. *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994, oxeas. a. MNRJ 17779. b. MNRJ 17799. c. MNRJ 19213. d. MNRJ 17226 e. MNRJ 19214. f. MNRJ 17227.

Spicules (Fig. 23a–c, e). Oxeas, hastate, most are slightly curved, but there are also some straight, 118–178 x 3.5–8 µm.

Ecology. Found mainly in coastal intertidal reefs (sandstone or coral reefs), in cryptic habitats, such as under rocks or small crevices.

Distribution (Fig. 24). Brazil, known for the northeastern States of Ceará (3°S) and Alagoas (9°S), and for the.south/southeastern States of Rio de Janeiro (23°S) and Santa Catarina (27°S, type locality). MEOW distribution: Tropical Southwestern Atlantic (Northeastern Brazil Ecoregion), and Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

Remarks. In their description of *H.* (*Rh.*) *mammillaris*, Mothes & Lerner assigned it to the '*arenata'* group of species, now corresponding to the subgenus *Haliclona* (*Soestella*). However, due to its skeletal features, this species is better assigned to *Haliclona* (*Rhizoniera*) instead. This assignment was first proposed by De Weerdt (2000: 47) and is followed here.

In the present paper, we found many specimens from different sectors of the Brazilian coast that approach *H.* (*Rh.*) *mammillaris* in external morphology and skeletal organization. We assigned all of them to this species based on the morphological similarity between them and the holotype.

It is remarkable the variability in which the skeletal organization is exhibited even in the same specimen. For example, we made several slides from the same specimens and in some of them, the structure was more isotropic, while in other slides it was clearly anisotropic.

The specimens from Alagoas showed a tendency to have a more isotropic and dense skeleton, with a bit longer and wider oxeas. Probably, this was due to their presence in an environment subjected to a high hydrodynamics and to the presence of a river mouth very close to where the specimens were collected (Mercurio *et al.*, 2000; Meroz-Fine *et al*., 2005).

In summary, despite these minor variability, all the specimens from Northeastern and Southeastern Brazil are here considered as conspecific mainly to its similar shape, skeleton, and the size and morphology of the oxeas.

Subgenus *Soestella* De Weerdt, 2000

Haliclona (*Soestella*) *brassica* Sandes, Bispo & Pinheiro, 2014

Haliclona (*Soestella*) *brassica* Sandes *et al*., 2014: 277, fig. 4

Material examined. See Sandes *et al*. (2014).

Diagnosis. *Haliclona* (*Soestella*) *brassica* is the only *Haliclona* in the Tropical Western Atlantic with the combination of a choanosomal skeleton with rounded meshes and a spiculation of strongyles and raphides (from Sandes *et al.*, 2014)

Distribution (Fig. 36). Brazil, only known from its type locality, Off Pirambu (10°S, Sergipe State). MEOW distribution: Tropical Southwestern Atlantic (Northeastern Brazil Ecoregion).

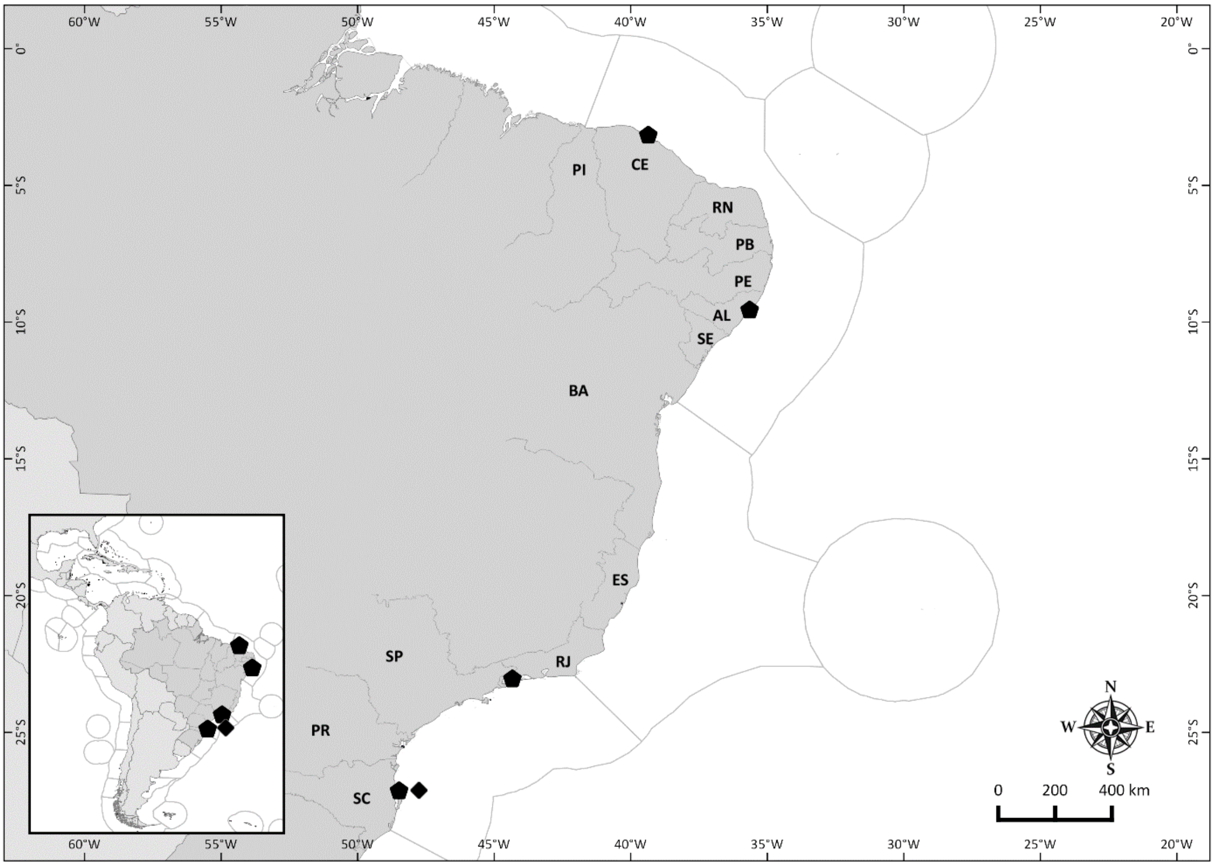


FIGURE 24. Geographic distribution of *Haliclona* (*Rhizoniera*) *lilacea* Mothes & Lerner, 1994 (rhombus) and *Haliclona* (*Rhizoniera*) *mammillaris* Mothes & Lerner, 1994 (pentagon).

Remarks. *Haliclona* (*Soestella*) *brassica* is a peculiar *Haliclona* due to its unique combination of strongyles and raphids. None of its congeners in the Tropical Western Atlantic exhibit such a combination. Those which have strongyles, such as *H.* (*Re.*) *strongylophora* and *H.* (*Re.*) *implexiformis*, does not have raphids. While those which have raphids, such as *H.* (*S.*) *luciensis* and *H.* (*S.*) *smithae*, does not have strongyles. However, it is also peculiar for *Haliclona* (*Soestella*) *brassica* the tendency of the ectosomal skeleton to become more isotropic instead of forming rounded meshes, as common in the subgenus. Nevertheless, we keep it assigned to the subgenus *Haliclona* (*Soestella*) due to its tendency to form rounded meshes in the choanosome.

***Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965)**

(figs. 25a–h, 26a–h, 27a–f, 28a–b, tables 8–9)

Sigmadocia caerulea Hechtel, 1965: 30, fig. 5, plate III fig. 4; Zea, 1987: 69, fig. 16 plate 7 fig. 7.

Sigmadocia coerulea (misspelling) Van Soest, 1980: 21, fig. 7, plate II fig. 4.

Haliclona caerulea Hajdu *et al.*, 2011: 180.

Haliclona (*Soestella*) *caerulea* De Weerdt, 2000: 29, figs. 3F, 16A–E.
For further synonyms see De Weerdt (2000)

Material examined. MNRJ 8333 – Pedra Grande, Off Jiribatuba, Ilha de Itaparica (ca. 13°04’22”S 38°47’52”W), Vera Cruz (Bahia State, Brazil), ca 0.5–2 m depth, 05 June 2004. MNRJ 8381 – Channel between Ilha de Maria Guarda and Ilha Bimbarras, Baía de Todos os Santos (ca. 12°43’43”S 38°38’02.3”W), Madre de Deus (Bahia State, Brazil), ca 1–2 m depth, 04 June 2004. MNRJ 14623 – Praia do Pacheco (ca. 3°41’10”S 38°38’13”W), Caucaia (Ceará State, Brazil), intertidal, 06 November 2010. MNRJ 17004, 17005 – Praia do Saco da Pedra (sandstone reefs, ca. 9°44’33”S 35°49’06”W), Marechal Deodoro (Alagoas State, Brazil), ca. 1 m depth, coll. V.R. Cedro & A. Bispo, 22 June 2013, Fragments deposited under UFALPOR 0962 and 0963 , respectively. MNRJ 17028, 17029 – Praia do Saco da Pedra (sandstone reefs, ca. 9°44’33”S 35°49’06”W), Marechal Deodoro (Alagoas State, Brazil), ca. 1 m depth, coll. A. Bispo, 15 September 2012, Fragments deposited under UFALPOR 0879 and 0876. MNRJ 17771, 17776 – Praia de Mundaú (sandstone reefs, ca. 3°10’21”S 39°21’22”), Trairi (Ceará State, Brazil), 0.5 m depth, coll. A. Bispo, 29 March 2014. MNRJ 17775, 17795 – Praia de Mundaú (sandstone reefs, ca. 3°10’21”S 39°21’22”), Trairi (Ceará State, Brazil), 0.5 m depth, coll. A. Bispo, 31 March 2014. MNRJ 18016 – Taíba (sandstone reefs, ca. 3°30’19”S 38°54’19”W), São Gonçalo do Amarante (Ceará State, Brazil), 0.5 m depth, coll. A. Bispo, 01 April 2014. MNRJ 19215, 19216 – Alagoas Iate Clube (pilasters next to a coral reef, ca. 9°39’57”S 35°41’43”W), Maceió (Alagoas State, Brazil), intertidal, coll. A. Bispo, 16 April 2014; Fragments deposited under UFALPOR 1009, 1010, respectively. MNRJ 19217 - Alagoas Iate Clube (pilasters next to a coral reef, ca. 9°39’57”S 35°41’43”W), Maceió (Alagoas State, Brazil), intertidal, coll. A. Bispo, 06 October 2014; Fragment deposited under UFALPOR 1039..

Comparative material. *Haliclona* (*Soestella*) *caerulea*, digital images of the choanosome and oxeas of the holotype YPM IZ 005037 PRA – Port Royal (Jamaica).

Diagnosis. *Haliclona* (*Soestella*) *caerulea* is distinguished by its bluish to whitish colour, oxeas usually curved, presence of centrangulated sigmas, ectosome isotropic/isodictyal unispicular, but usually with rounded paucispicular meshes, choanosome iso- to subanisotropic with many choanosomal spaces.

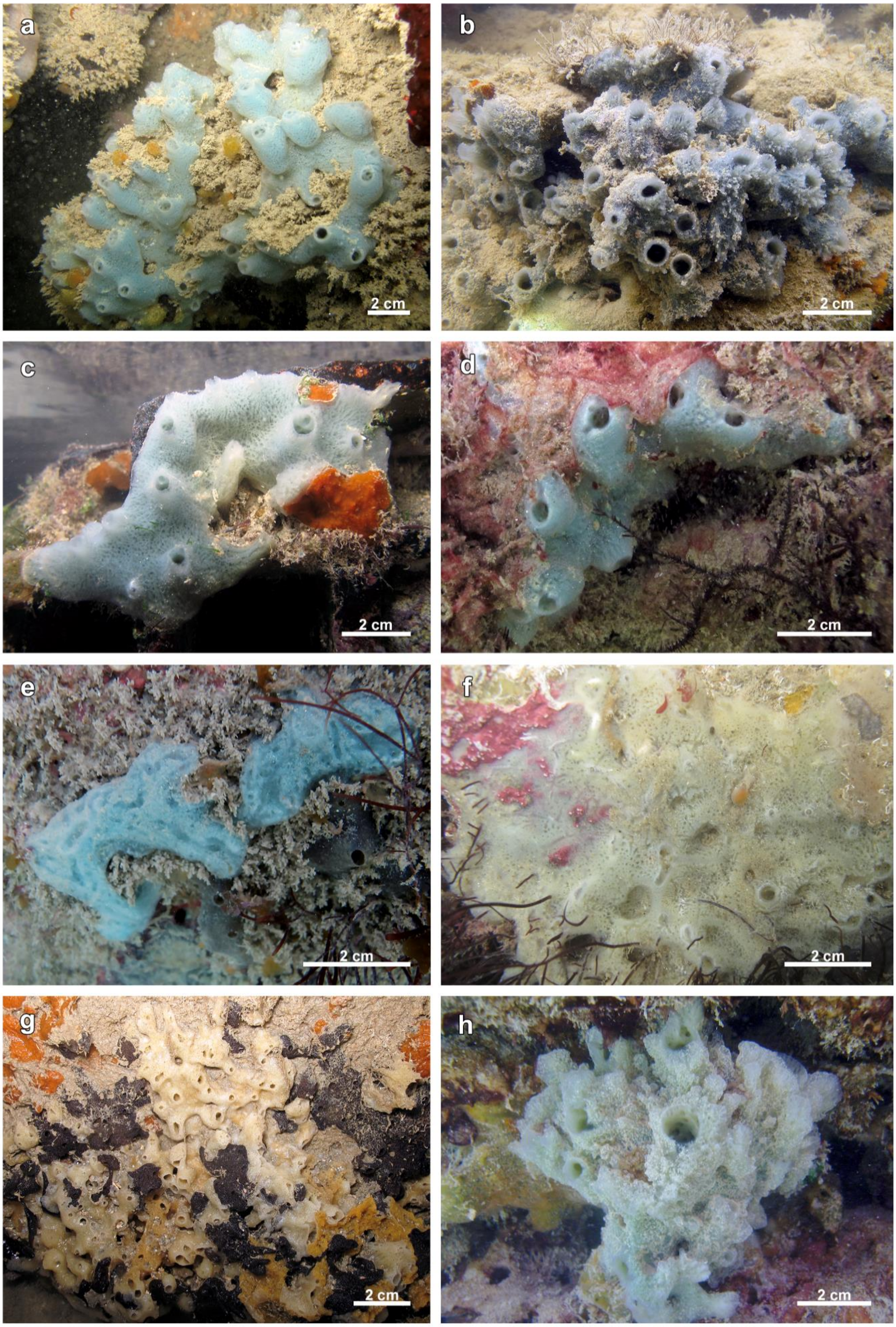


FIGURE 25. *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965), morphological variation. a. MNRJ 17795. b. MNRJ 17004. c. MNRJ 19215. d. MNRJ 17775. e. MNRJ 17771. f. MNRJ 18016. g. MNRJ 19216. h. MNRJ 17029.

Description (Fig. 25, 28a–b). Encrusting, cushion-shaped with elevated mounds, or with a massive base from where arise several thick-walled tubular projections that can be fused laterally. Oscules are circular, ca. 1.6–6.4 mm in diameter, in encrusting forms they are just slightly elevated, while in other specimens are found at the top of small mounds or thick-walled tubes. Surface is punctate in some specimens, smooth, but also slightly rough to the touch, it varies from regular to irregular, with some fistular projections in some specimens, and the ectosome is usually detachable. Consistency could vary from fragile to firm in the different specimens, compressible. Colour alive are commonly of different shades of blue, but some species were also greyish blue, grey, or even beige. Colour in spirit is beige.

Skeleton (Fig. 26, 28c–f). Ectosome: absent in some parts of the skeleton. When present, it varies from an isotropic or isodictyal unispicular reticulation to a reticulation of rounded paucispicular (1–10 spicula) meshes, following the pores of the surface. Choanosome: a dense reticulation, varying from isotropic to subanisotropic, with uni- to paucispicular (1–4 spicules) primary lines, but could also be a regular anisotropic reticulation of paucispicular (2–6 spicules) primary lines, (i)rregularly connected by unispicular secondary lines. There are some subectosomal spaces, and many choanosomal spaces, varying from 375–1875 µm in diameter. Spongin is scarce, present mainly at the nodes of the reticulation.

Spicules (Fig. 27). Oxeas, hastate or acerate, usually with a central curvature, but there are many straight also, 125–220 x 2.5–10.5 µm (Fig. 27a–b). MNRJ 19217, completely formed oxeas are intermixed with intermediate forms such as styles, strongyles, and blunt oxeas, but these are clearly recognized as an environmental effect, since the same specimen showed only oxeas in April and oxeas intermixed with strongyles and styles in October (MNRJ 19215 and 19216 are the same specimen). Sigmas, are C-shaped, slightly centrangulated, 11.5-25 um (Fig. 27c–d). Measurements in Table 8.

Ecology. In natural habitats, it was found in the intertidal zone of areas adjacent to freshwater input, such as river/lagoon mouths. While in anthropic areas (Figs. 27c, g; 28a–b) found in shaded pilasters in the intertidal zone, close to an area of pluvial water discharge.

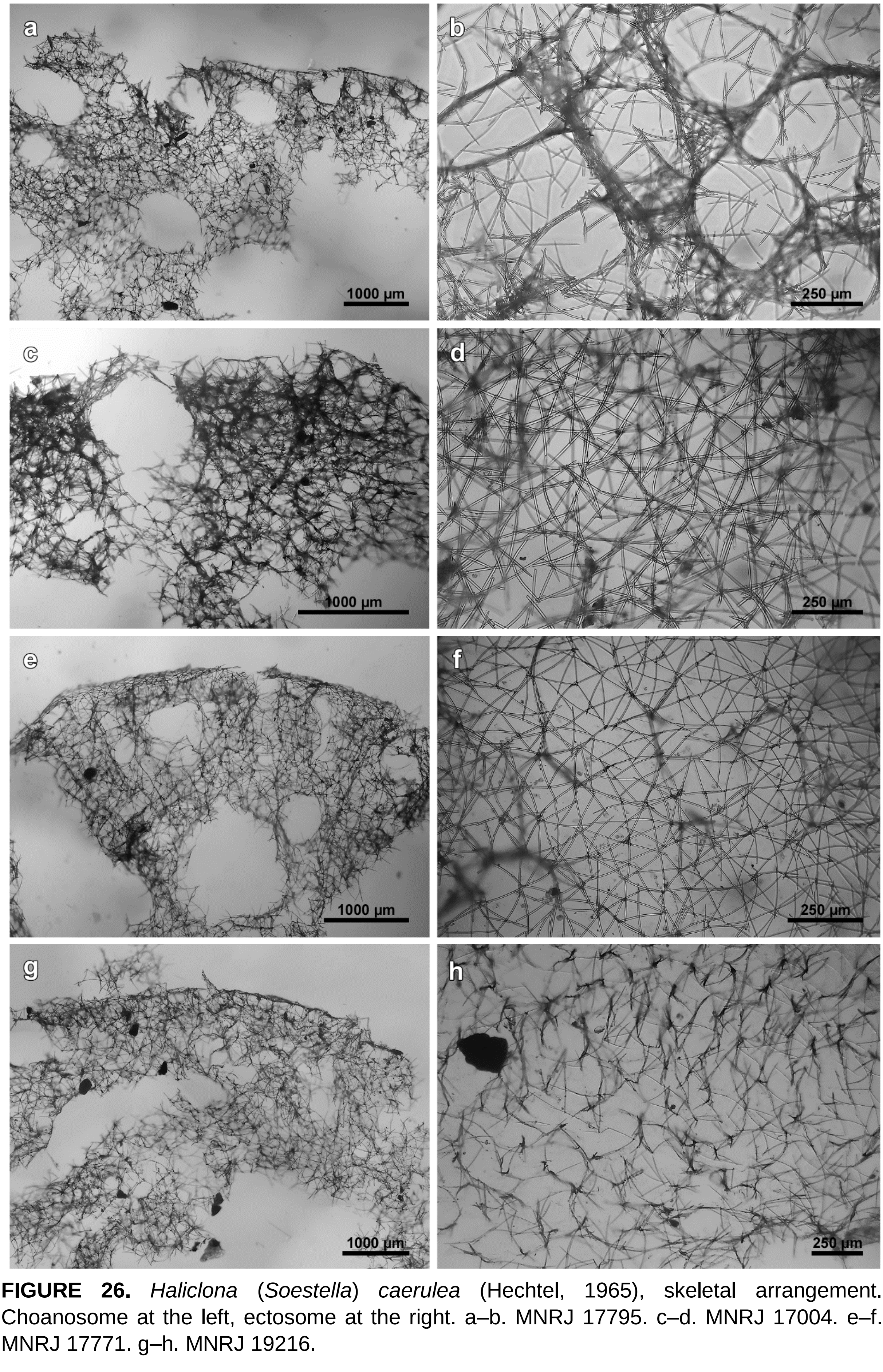


FIGURE 26. *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965), skeletal arrangement. Choanosome at the left, ectosome at the right. a–b. MNRJ 17795. c–d. MNRJ 17004. e–f. MNRJ 17771. g–h. MNRJ 19216.

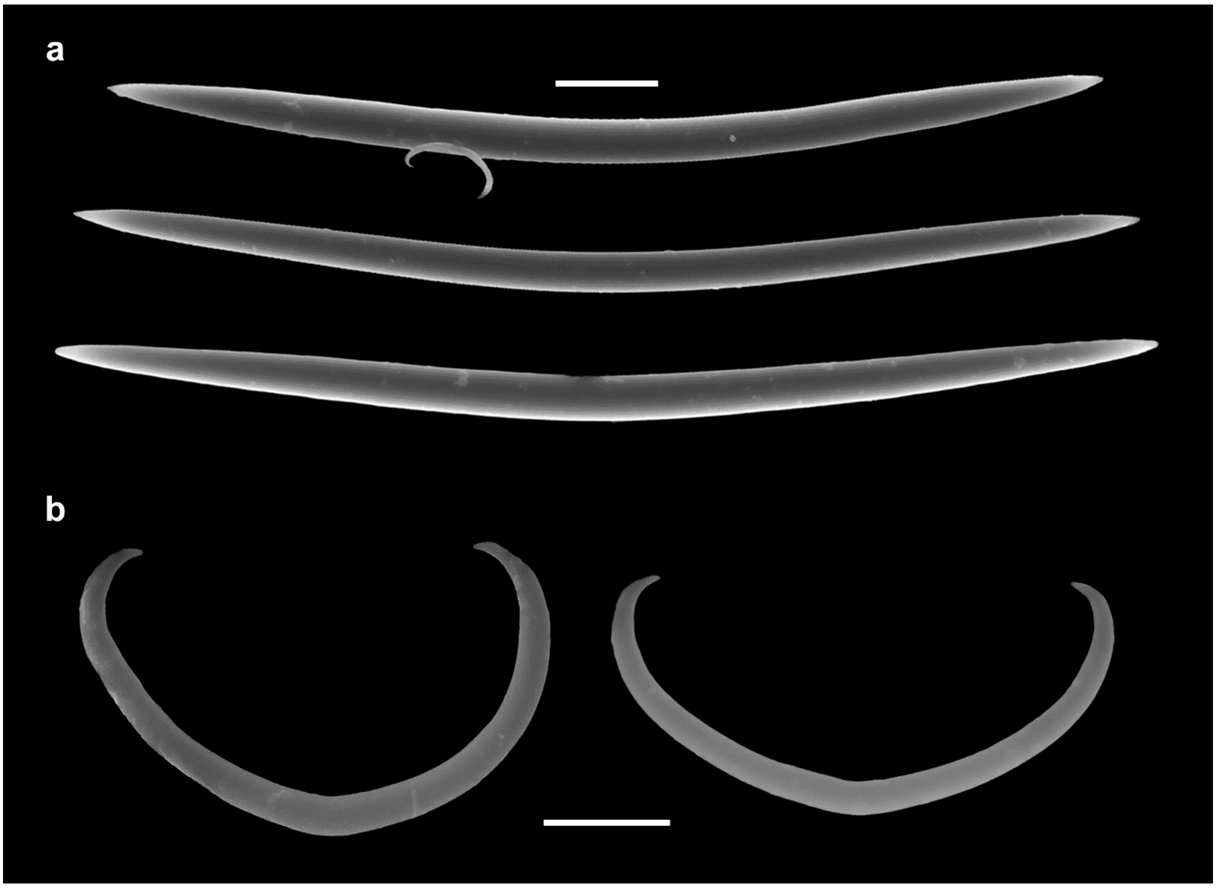


FIGURE 27. *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965), oxeas and sigmas from MNRJ 17004. a. oxeas. b. sigmas.

TABLE 8. Spicules measurements of *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965).

Specimen	**Brazilian State**	**Oxea (µm)**	**Sigma (µm)**
MNRJ 8333	Bahia	173–*193.5*–220 x 5.5–*9.0*–10.5	17–*19.4*–22.5
MNRJ 8381	Bahia	165–*178.4*–193 x 5.5–*7.2*–8	15–*19*–22.5
MNRJ 14623	Ceará	148–*167–185* x 4.5–*6.6*–8	16–*18.6*–20
MNRJ 17004	Alagoas	165–*197.4*–218 x 5.5–*8.6*–10	15–*17.8*–20
MNRJ 17005	Alagoas	182–*206.6*–220 x 5.5–*8.5*–10	15.5–*19.4*–22
MNRJ 17028	Alagoas	138–*179.6*–210 x 2.5–*6.6*–10	15–*19.6*–25
MNRJ 17029	Alagoas	150–*186.5*–210 x 2.8–*7.3*–10	15–*20*–23
MNRJ 17771	Ceará	140–*156.4*–170 x 3–4.8–5.5	15–*18.2*–22.5
MNRJ 17775	Ceará	145–*163.3*–182.5 x 3.5–*5.4–7*	15–*17.*8–20.5
MNRJ 17795	Ceará	143–*168.4*–183 x 3.5–*5.2*–6	15–*18.2*–20
MNRJ 18016	Ceará	125–*142.8*–160 x 3–*4.5*–5.5	11.5–*16.4*–20.5
MNRJ 19215	Alagoas	130–*149.6*–168 x 3–*3.6*–5	14–*17.1*–21.5
MNRJ 19216	Alagoas	150–*170*–208 x 3.5–*5.8*–7.5	13–*15.8*–18
MNRJ 19217	Alagoas	145–*183.7*–205 x 4.5–*7*–10	16–*19.7*–22.5

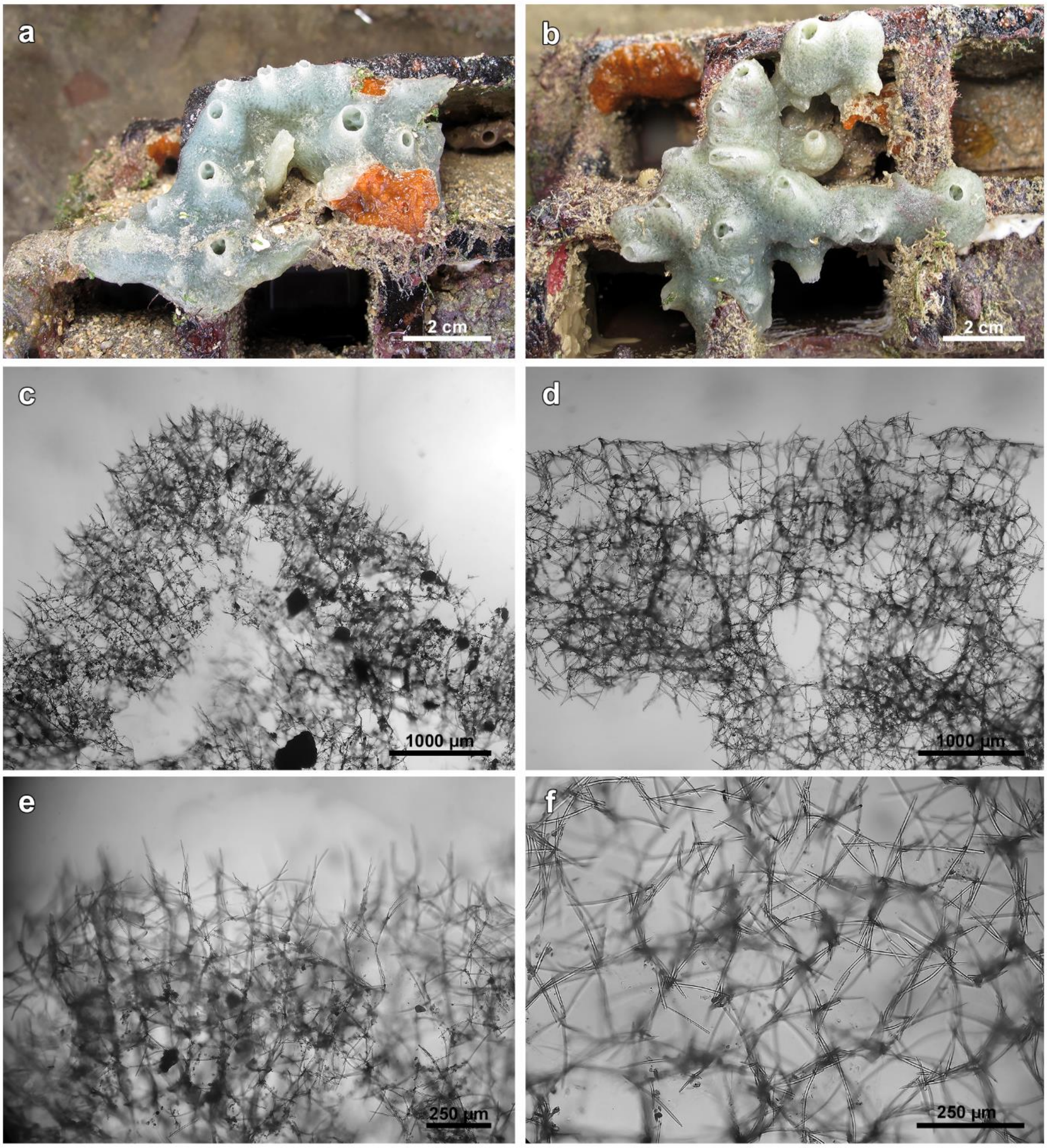


FIGURE 28. The morphological plasticity of the same individual of *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965). Pictures at the left are from MNRJ 19215, those at the right are from MNRJ 19217. a. specimen alive in situ. c–d. panoramic view of the choanosomal organization. e. choanosome in detail, showing the absence of a tangential ectosome. f. ectosomal skeleton.

Distribution (Fig. 29). Widely distributed in the Tropical Western Atlantic, but also present in the Tropical Eastern Pacific (Pacific side of Panama and Mexico). Detailed distribution in Pacific*:* Pacific side of Panama (Wulff, 1996), and Pacific side of Mexico (Carballo *et al.*, 2006; Cruz-Barraza & Carballo, 2008). Detailed distribution in the Caribbean*:* Belize, Jamaica [type locality], Puerto Rico, Virgin Islands, Martinique, St. Vicent, Grenada, Bonaire, Curaçao, Venezuela, Colombia, Panama

(Van Soest, 1980; Zea 1987, De Weerdt, 2000). Detailed distribution in Brazil: Ceará State, Alagoas State, and Bahia State (Hajdu *et al.*, 2011; and present study). MEOW distribution: Tropical Eastern Pacific, Tropical Northwestern Atlantic, and Tropical Southwestern Atlantic (Northeastern Brazil Ecoregion).

Remarks. *Haliclona* (*Soestella*) *caerulea* is a widely distributed and highly plastic species. We found that even the same individual could exhibit different shape, consistency, colour, skeletal architecture, and spiculation when collected in different dates (Fig. 27, MNRJ 19215 and 19217). MNRJ 19215 has a much more fragile consistency, blue colour, a regular anisotropic skeleton, and oxeas as megascleres. While MNRJ 19217 was firmer, had a greyish blue colour, a more irregular subisotropic skeleton, and oxeas intermixed with styles and strongyles as megascleres. Jones (1987) also noted a marked temporal variability in skeletal features and oxeas' size in *Haliclona elegans*

Despite the great variability in shapes and colouration we found, we are confident that all the specimens we examined are correctly assigned to this species based on their consistency, skeletal architecture, and the morphology and morphometry of oxeas and sigmas (see Table 9 for a detailed comparison).

We believe that most of that variability we found was generated in response to environmental factors. MNRJ 17004, 17005, 17028, and 17029 were collected in an area with many suspended sediment and freshwater input. The first is known to induce the formation of surface protuberances that increases their inhalant surface area, forming an irregular surface (Rützler *et al.*, 2007). While the latter could produce thicker and longer spicules in response to the silica input (Mercurio *et al.*, 2000). MNRJ 18016 and MNRJ 19216 were collected in areas with low light exposition, such as under rocks and under a completely shaded area, respectively, which can explain its greyish or beige colouration. In addition, these suboptimal conditions are known to alter the colour of some specimens (De Weerdt & Van Soest, 2001).

The presence of this species in the Tropical Eastern Pacific, was reported by Wulff (1996), De Weerdt (2000), and Cruz-Barraza & Carballo (2008). However, De Weerdt (2000) prudently pointed that it was not possible at that moment to know if both populations were conspecific or consisted of geminate species isolated since the uplift of the Panamanian Isthmus. We believe that it is highly unlike that populations from

TABLE 9. Comparative morphological data of *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965).

Haliclona* (*S.*) *caerulea	**External morphology**	**Skeleton**	**Colour – locality, depth**
as ***Sigmadocia caerulea*** (from Hechtel, 1965)	Thickly encrust. to massive; oscs. at the apex of cylind. to volcan. thick-walled project. w. axial cloacae; oscs. up to 5 mm in diam.; surf. even, varying from smooth to rough, in some parts easily detach.; consis. soft, easily broken, some stiff to somewhat compress.	**Ectos.** - in part tangent., unispic., three- to four-sided netw.; pores may be inclosed with a mesh; small subectos. spaces present; in other parts, no tangent. skel., w. spics. project. beyond the surf. **Choan.** – unispic., confus., w. vague tracts, scatt. spics. Nodal spongin. **Oxeas**, slightly curved, fusif. to wedge-shaped, 117–200 x 5–9 um. **Sigmas**, thin, sharply curved in the middle, 13–28.	Light blue – Jamaica (Port Royal), 0-2.5 m depth.
as ***Sigmadocia coerulea*** (from Van Soest, 1980)	Massive to irregul. ramose, w. volcan. osc. lobes, w. fistular outcrops, branches (up to 2 cm in diam., up to 10 cm in lenght) slightly compressed in ramose specim., lobate specim. are 2-4 cm thick; oscs. w. slightly raised collar; consist. soft, limp, easily torn.	**Ectos.** – incompl., tangent. unispic. retic., often somewhat irregular or obsucred; pores 25 µm in diam.; subdermal canals present. **Choan.** – cavernous, prim. lines with 2–4 spics, and unispic. second. lines.; often this plan is obscured, the choan. having a confus. Subisodic. retic. of single spics. **Oxeas**, 137–198 x 3–8 µm. **Sigmas**, 12–29 µm.	Blue – Curaçao, mangrove and intertidal rocks.
as ***Sigmadocia caerulea*** (from Zea, 1987)	Encrust., 1-5 cm thick, 15 cm in diam., w. lobules reachi. up to 1.5 cm in diam., w. a collar, consist. firm, fragile, easily torn.	**Ectos.** – tangent., unispic., irregul., sometimes very dense and confused. **Choan.** – many subectos. and choan. canals, skeleton w. prim. lines with 1-4 spics, interconnec. irregularly by 1 spic; sometimes dense and subisodic. Nodal spongin. **Oxeas**, hastate, curved, short points, some telesc., 152–190 x 3.2–9 µm. **Sigmas**, slender, 17–22 µm.	Light blue, w. grayish tones – Colombia, 0.5-2 m depth.
Haliclona* (*Soestella*) *caerulea (from De Weerdt, 2000)	Irreg. cushion-shaped, ca. 8 cm high, w. osc. mounds or chimneys, also digitate, digitations, 0.3–1 cm in diam., often fused in the basal parts w. tend. to become laterally compressed, w. several thin, short prolifer. in the distal parts; oscs. not abund., irreg. scattered, 1–4 mm in diam., flush w. the surf. or slightly raised; surf. smooth, even, somewhat punctate; consist. soft to moderately firm, compress., rather fragile.	**Ectos.** – tangent., paucispic. retic., rounded to polygonal meshes, w. many spic. in confusion. **Choan.** – paucispic. retic., w. ill-defined prim. and second. lines, w. an intermediate amount of choan. spaces. Spongin scarce to moderately abundant, nodal. **Oxeas**, slender, slightly curved, hastate, sharp or blunt-pointed, rarely strongylote, 127.6–204.2 x 3–9.5µm. **Sigmas**, C-shaped, slightly centrangulated, or more weakly bent, 12.8–27.8 x 0.5–1.9 µm.	Yellowish green to sky blue, rarely light purplish brown – Wider Caribbean, Pacific side of Panama, in very shallow waters to 27 m.
as ***Haliclona caerulea*** (from Cruz-Barraza & Carballo, 2009)	Cushion-shaped to massive lobate, 2–15 cm high, w. oscs. at the top of lobules, circular or oval, 1.3-5.0 mm in diam., surround. by a transluc. membr.; surf. even to smooth, to lightly rough, w. fistules; consist. slightly compress., easily broken.	**Ectos.** – regul., tangent., unispic., isotrop. **Choan.** – confus., pauci- to multispic. primary lines, w. unispic. second. lines, w. many calcareous algae associated. Nodal spongin. **Oxeas**, slightly curved, fusiform to hastate, 82.5–210 x 2.5–11.3 µm. **Sigmas**, C-shaped, 17.5–30 µm.	Light blue to beige or white – Pacific side of Mexico, to 6 m depth.
Haliclona* (*Soestella*) *caerulea (present study)	Encrust., cushion-shaped or w. tubul. project. laterally fused; oscs., 1.6–6.4 mm in diam., just slightly elevated or at the top of small mounds or tubul. project.; surf. punctate, smooth, slightly rought to the touch, w. some fistular projections, detach. ectosome; consist. from fragile to firm, compress.	**Ectos.** – absent in some parts, isotrop. to isodic., unispic., some rounded paucispic. meshes. **Choan.** – dense, isotrop. to subanisotrop., uni- to paucispic. primary lines, or regul. anisotropic, w. subectos. and choan. spaces. Nodal spongin. **Oxeas**, hastate or acerate, mostly curved, 125–220 x 2.5–10.5 µm. **Sigmas**, C-shaped, slightly centrangulated, 11.5–25 µm.	Different shades of blue, some species greyish blue, grey, or even beige – Brazil, up to 2 m depth.

Atlantic and Pacific are conspecific, viz. the case of similar *Spirastrella* spp. living on both sides of the Isthmus of Panama that actually consisted of two species genetically and morphologically distinct (Boury-Esnault *et al.*, 1999). To solve this problem, Pacific and Atlantic populations, as well the Brazilian populations and morphotypes, must be further explored using molecular markers to assess their phylogeographical history.

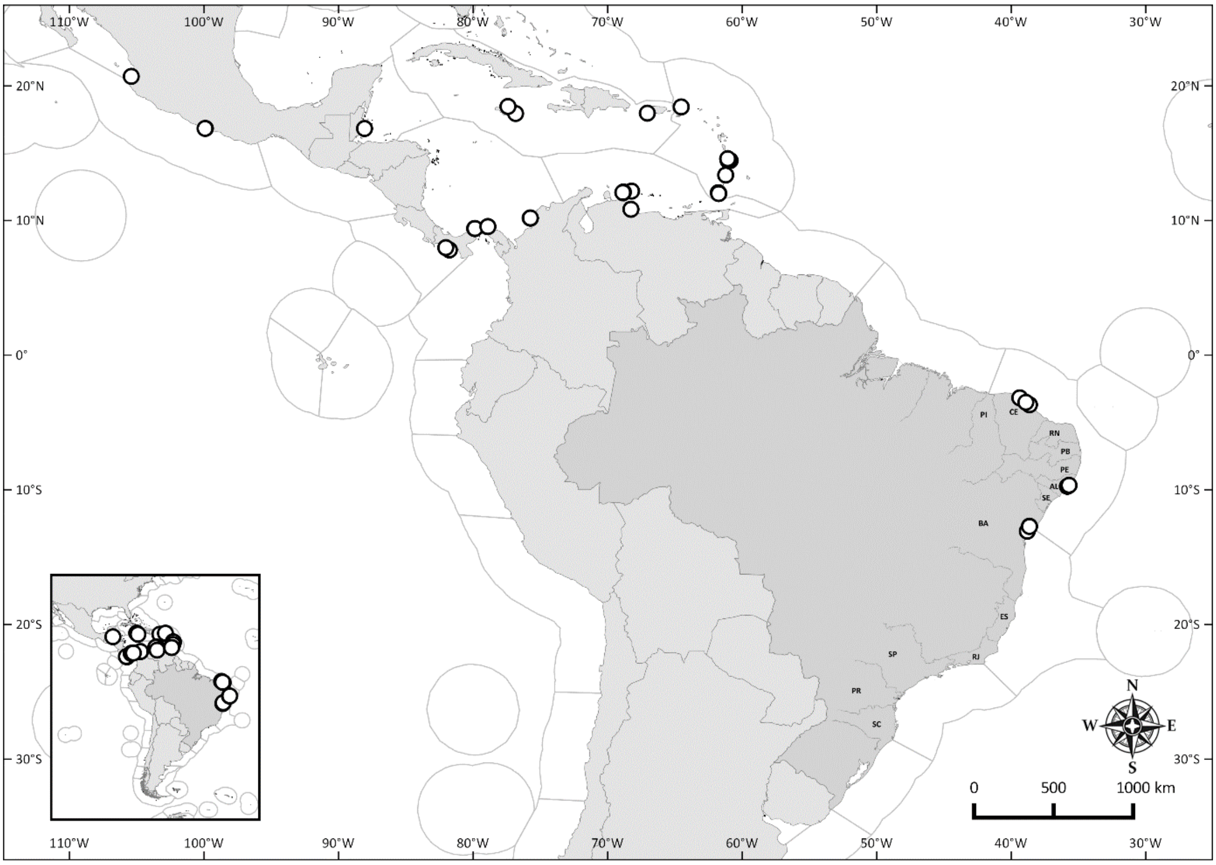


FIGURE 29. Geographic distribution of *Haliclona* (*Soestella*) *caerulea* (Hechtel, 1965).

***Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999**

(figs. 30a–d, 31a–d, 32a–e, table 10)

Haliclona melana Muricy & Ribeiro, 1999: 101, figs. 2E, 11–12; Muricy & Hajdu, 2006: 72; Hajdu *et al.* 2011: 186..

Haliclona (*Soestella*) *melana* De Weerdt, 2000: 35, figs. 3R, 21A–F.

For further synonyms, see Muricy *et al.*, 2011.

Diagnosis. The only *Haliclona* spp. in the Western Atlantic with the combination of dark brown to black colour, dark pigment grains in the skeleton, hastate oxeas and toxas.

Redescription of the type material

Material examined. Holotype: UFRJPOR 4269 – Ponta Leste, Angra dos Reis (Rio de Janeiro State, Brazil), 4 m depth, coll. E. Omena, 11 December 1987. Paratypes: UFRJPOR 3683 – Ponta dos Carneiros, Tamandaré (Pernambuco State, Brazil), 1 m depth, coll. E. Hajdu & Solange Peixinho, 30 January 1989.UFRJPOR 4751- Praia Vermelha, Rio de Janeiro (Rio de Janeiro State, Brazil), 3 m depth, coll. G. Muricy & R. Albano, 28 February 1998. UFRJPOR 3618 – Praia do Cabelo Gordo, São Sebastião (São Paulo State, Brazil), 0.5 m depth, coll. E. Hajdu, 05 December 1988.

Description (Fig. 30a). The holotype consists of a fragmented lobated specimen, with circular or oval oscules at the top of these lobes, reaching ca. 2.3 mm in diameter. Surface is smooth, but slightly uneven. Consistency is very fragile, compressible. Colour is dark brown.

Skeleton (Fig. 30b–c). Ectosome: a confused, unispicular, (sub)isotropic reticulation, with many dark pigment grains. Choanosome: varying from a delicate

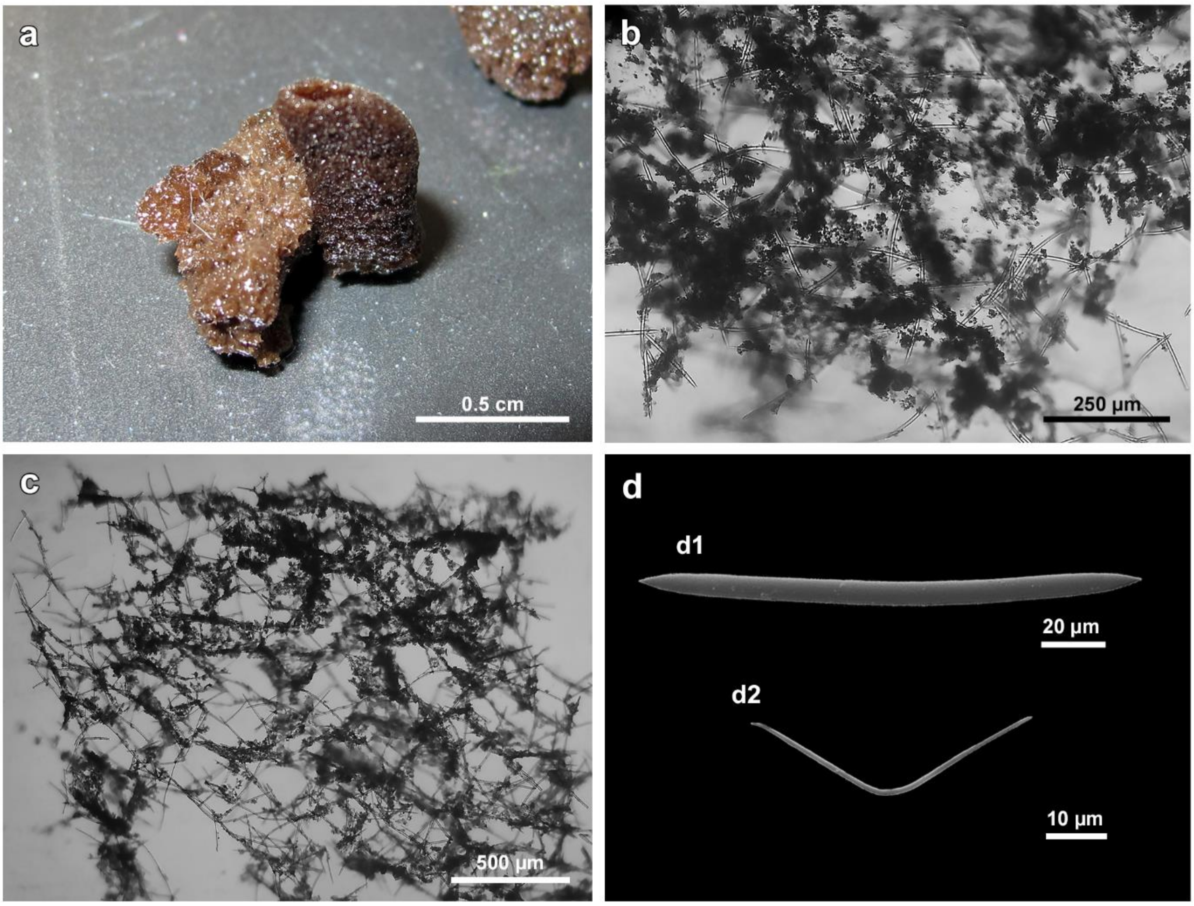


FIGURE 30. *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999, holotype UFRJPOR 4269. a. preserved specimen. b.ectosomal skeleton. c. choanosomal skeleton. d. oxea and toxas.

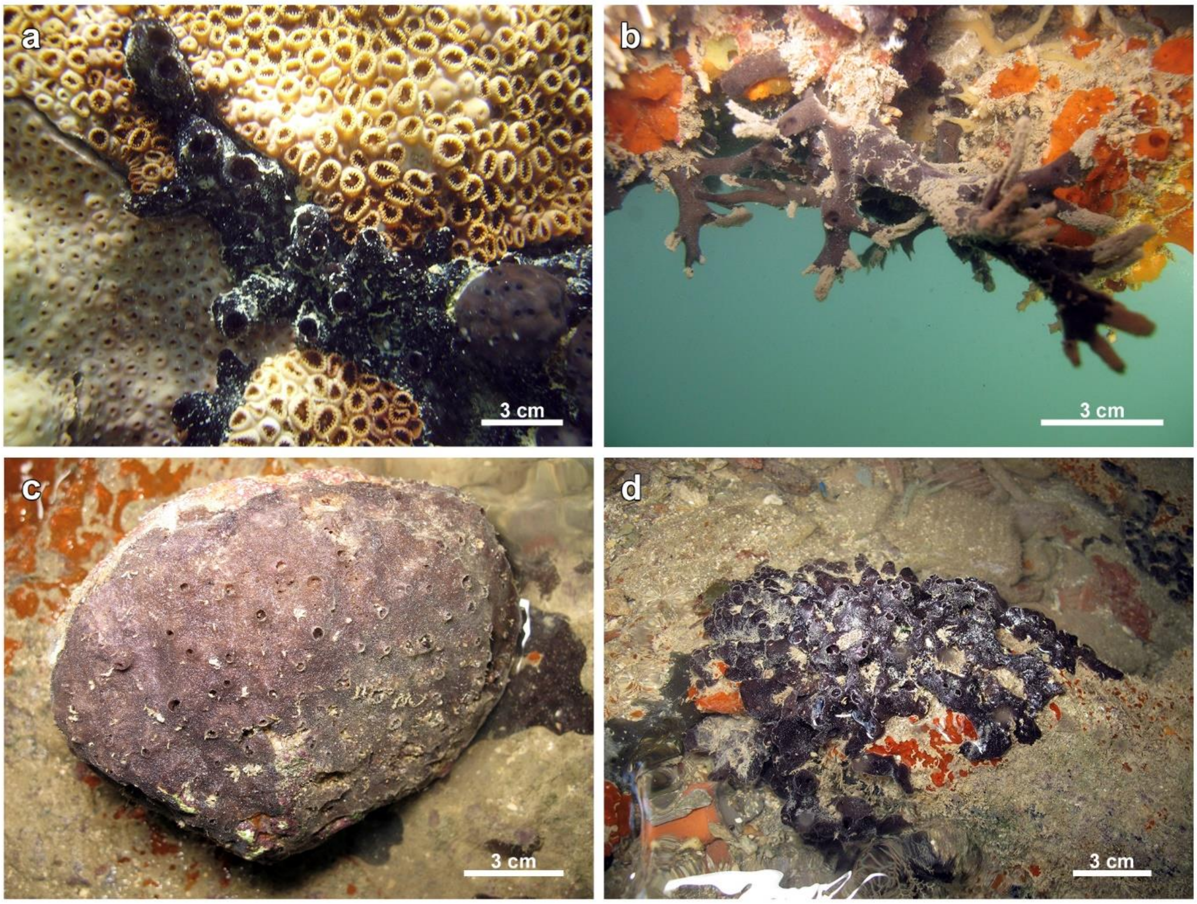


FIGURE 31. *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999, morphological variation in specimens from Northeastern Brazil. a. MNRJ 17033. b. MNRJ 18092. c. MNRJ 19218. d. not collected.

reticulation of ill-defined paucispicular (1-3 spicules) primary lines irregularly connected by unispicular secondary ones, with some isotropic areas (UFRJPOR 4269) to a reticulation confuser, mainly subisotropic, with only some ill-defined paucispicular (1-3 spicules) primary lines discernible (UFRJPOR 3618, 3683, 4751). There is a very slight tendency of the skeleton to form some rounded meshes. Many dark pigment grains dispersed through the choanosome.

Spicules (Fig. 30d). Oxeas, with hastate points, some acerate, most are slightly curved, but some are straight, 115-195 x 3.5-12 um (Fig. 30d1). Toxas, are rare, with a great variation in curvature, 35-63 um (Fig. 30d2). Measurements in Table 10.

Ecology. Found in rocky coast or in coral reefs.

Description of the material from Northeastern Brazil Ecoregion

Material examined. MNRJ 17010 – Praia do Saco da Pedra (sandstone reefs, ca. 9°44’33”S 35°49’06”W), Marechal Deodoro (Alagoas State, Brazil), ca. 1 m depth, coll. V.R. Cedro & A. Bispo, 22 June 2013. MNRJ 17033 – Praia do Francês (sandstone reefs, ca. 9°45’54”S 35°50’04”W), Marechal Deodoro (Alagoas State, Brazil), ca. 1 m depth, coll. A. Bispo, 21 April 2012. MNRJ 18092 – Guaramé Harbour (ca. 5°06’22.5”S 36°19’03.4”W), Guamaré (Rio Grande do Norte State, Brazil), coll. A. Bispo, 04 April 2014. MNRJ 19218 – Alagoas Iate Clube (pilasters next to a coral reef, ca. 9°39’57”S 35°41’43”W), Maceió (Alagoas State, Brazil), intertidal, coll. A. Bispo, 06 October 2014.

Description (Fig. 31). Commonly consisting of a massive base from which arise several rounded oscular mounds, but thinly encrusting specimens and those repent with lateral branches also occurs. Oscules are circular, ca. 2-9 mm in diameter, at the top of the rounded mounds, or flush with the surface in thinly encrusting or repent specimens. Surface is smooth, and regular. Consistency is very fragile, compressible. Colour alive vary from dark brown to black. Colour in spirit is dark or light brown.

Skeleton (Fig. 32). Ectosome: unispicular, mainly (sub)isotropic reticulation. In MNRJ 19218 there is a tendency of the ectosomal skeleton to form rounded meshes. Choanosome: varying from a unispicular, more confused and (sub)isotropic reticulation with some rounded meshes to a more regular (sub)anisotropic reticulation, with uni- to paucispicular (1-3 spicules) primary lines irregularly connected by unispicular secondary ones. There are many dark pigment grains dispersed through the choanosome. Spongin is scarce.

Spicules. Oxeas, mostly hastate points, but some acerate are also present, slightly curved in general, but with some straight, 115-165 x 4.5-9 um. Toxas are rare, only easier found in MNRJ 18092, with different degrees of curvature, 27.5-70 um. Measurements in Table 10.

Ecology. Found in shallow-water, either in well-lit or in cryptic habitats.

Distribution (Fig. 33). Distributed along the Tropical Western Atlantic. Detailed distribution in the Caribbean: St. Lucia (De Weerdt, 2000). Detailed distribution in Brazil: Rio Grande do Norte State, Pernambuco State, Alagoas State, Bahia State, Rio de Janeiro State (Muricy & Ribeiro, 1999; and present study). MEOW distribution:

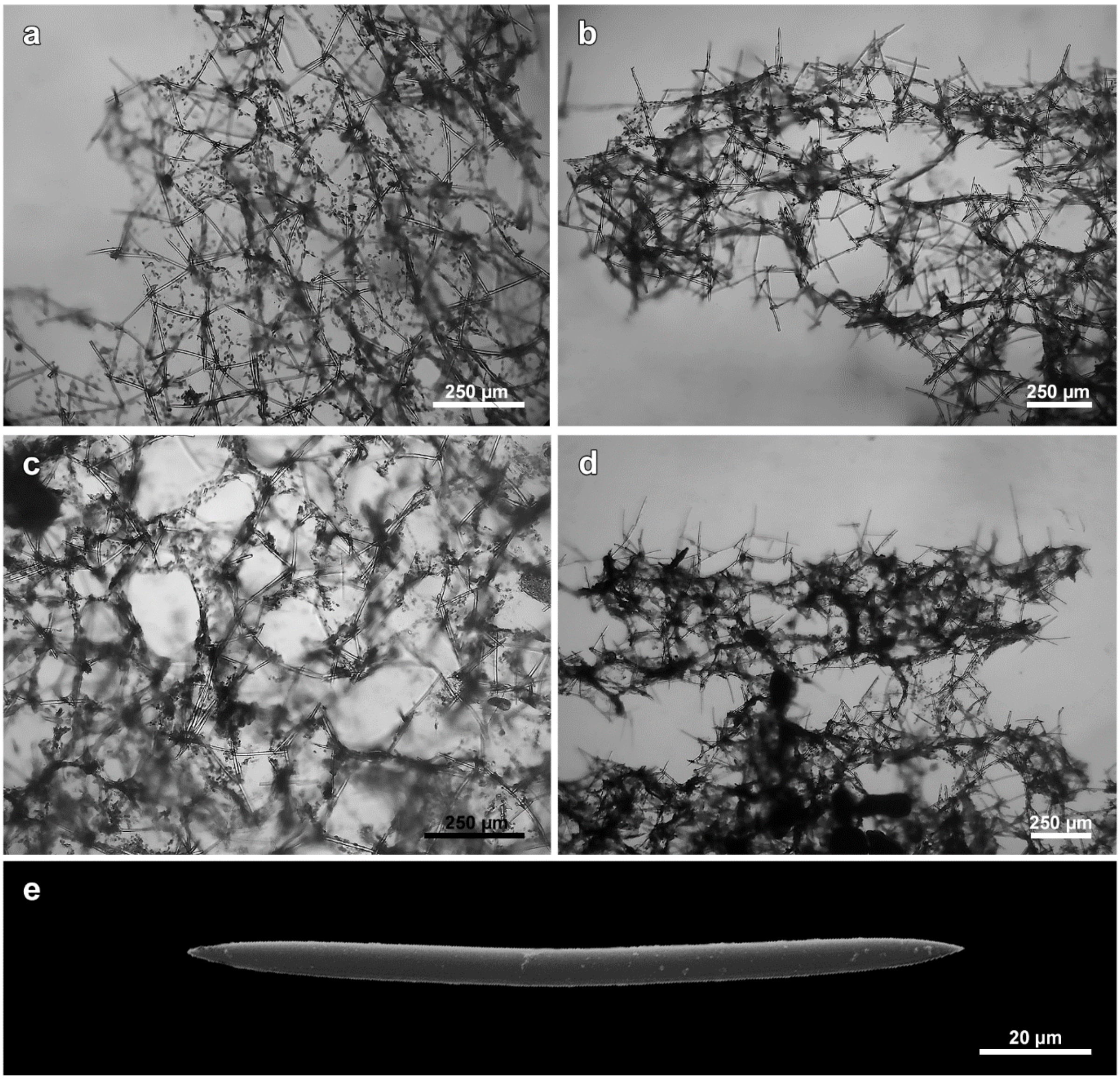


FIGURE 32. *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999, skeletal arrangement and oxea. a–b. MNRJ 18092, ectosome and choanosome, respectively. c–d. MNRJ 19218, ecctosome and choanosome, respectively. e. oxea from MNRJ 18092.

Tropical Northwestern Atlantic, Tropical Southwestern Atlantic (Northeastern and Eastern Brazil Ecoregions), Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

Remarks. *Haliclona* (*Soestella*) *melana* is easily distinguished from its congeners in the Tropical Western Atlantic by its shape, dark brown to black colour and the presence of toxas as microscleres. Only *H.* (*Soestella*) *luciensis* resembles *H.* (*S.*) *melana* in shape and colour, but the first differs by having raphids as microscleres.

TABLE 10. Spicules measurements of *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999.

Specimen	Brazilian State	Oxeas (µm)	Toxas (µm)
MNRJ 17033	Alagoas	132.5–*146.8*–165 x 4.5–*6.6*–7.5	27.5–*45*–57.5
MNRJ 18092	Rio Grande do Norte	132.5–*147.3*–155 x 5–6.9–7.5	37.4–*44.3*–70
MNRJ 19218	Alagoas	115–*143.2*–162.5 x 5–7.1–9	27.6–*40.3*–52.9
UFRJPOR 3618	São Paulo	132.5–*165.9*–195 x 5–8.6–10.5	35–*46.5*–57.5
UFRJPOR 3683	Pernambuco	137.5–*153.7*–172.5 x 5.5–8–10	45–*46*–47.5
UFRJPOR 4269	Rio de Janeiro	125–*145.2*–185 x 4–7.1–12	55–*60.9*–63
UFRJPOR 4751	Rio de Janeiro	115–*129.6*–145 x 3.5–4.6–6	40–*45*–47.5

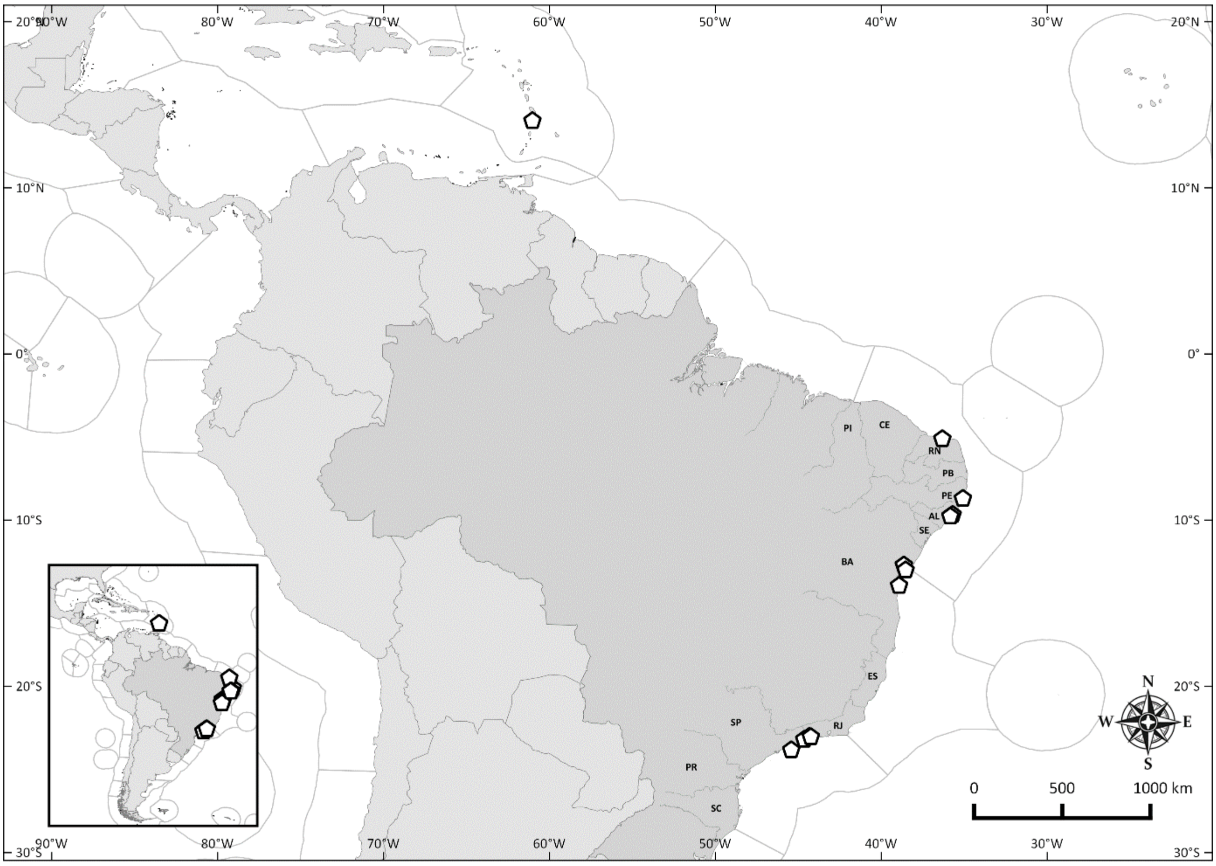


FIGURE 33. Geographic distribution of *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999.

In their description of the type material of *Haliclona* (*Soestella*) *melana*, Muricy & Ribeiro (1999) did not mentioned the presence of toxas as microscleres. This is understandable due to its rarity, we made several slides of the holotype and paratypes to find just a few of them. De Weerdt (2000) was the first to notice the presence of these microscleres in Brazilian specimens of *H.* (*S.*) *melana*, but only now we can confirm that toxas were present either in the holotype and paratypes of the species.

***Haliclona* (*Soestella*) *peixinhoae* Bispo, Correia & Hajdu, 2014**

(fig. 34a–d)

Haliclona sp. Hajdu, Peixinho & Fernandez, 2011
Haliclona (*Soestella*) *peixinhoae* Bispo *et al.*, 2014: 9, figs. 4–5.

Material examined. See Bispo *et al.* (2014).

Diagnosis. *Haliclona* (*Soestella*) *peixinhoae* is set apart from other Tropical Western Atlantic *Haliclona* spp. by a combination of its habit comprising a dense aggregation of erect tubes, mostly bearing large thorns, albeit very soft, and a conspicuous subsuperficial reticulation visible to the naked eye on live specimens (from Bispo *et al.*, 2014).

Distribution (Fig. 36). Brazil, only known for the coast of Bahia State (12°S–13°S, Bispo *et al*., 2014). MEOW distribution: Tropical Southwestern Brazil (Eastern Brazil Ecoregion).

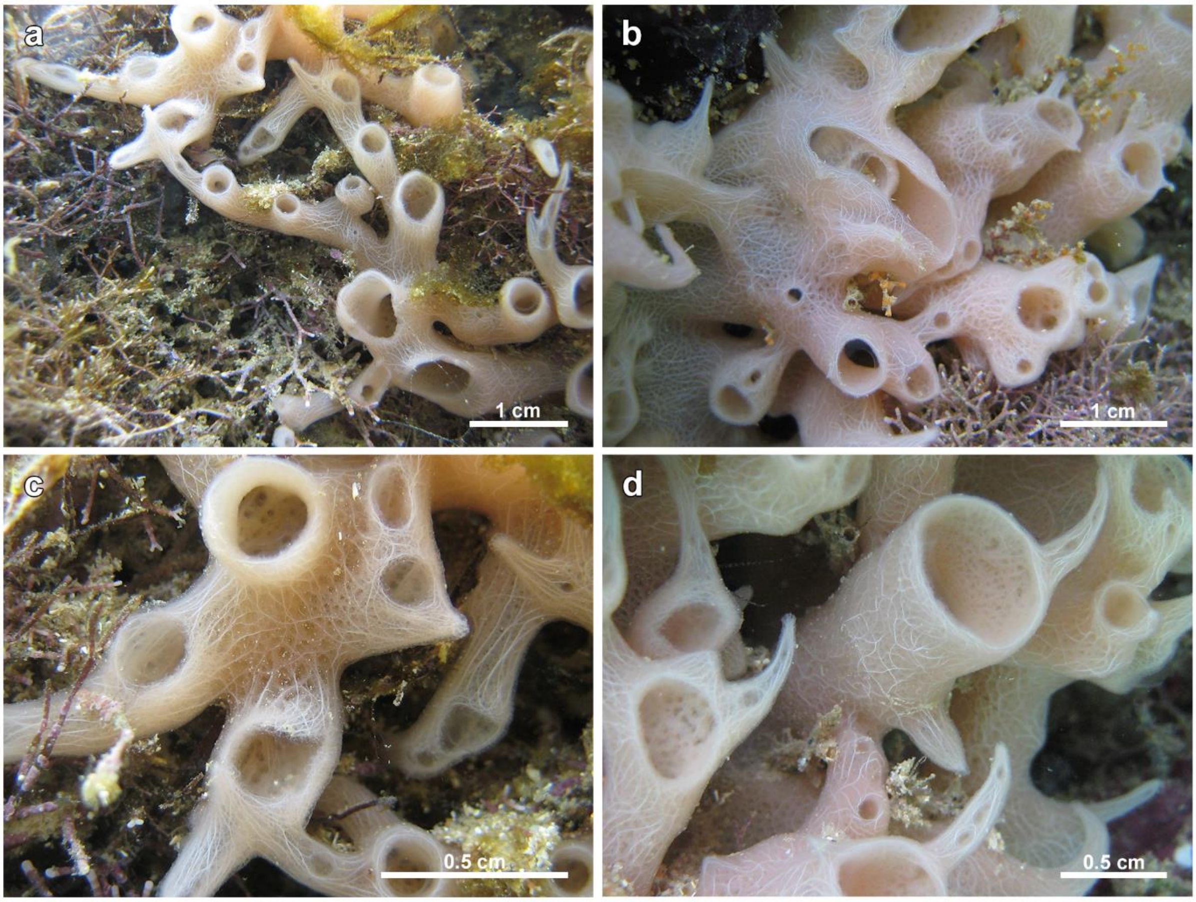


FIGURE 34. *Haliclona* (*Soestella*) *peixinhoae*, holotype MNRJ 13299. a–d. close up view of the holotype *in situ*.

Remarks. This is a remarkable species due to its shape of dense aggregations of tubes with a subsuperficial reticulation visible to the naked eye (Fig. 34). None of the species of *Haliclona* in the Tropical Western Atlantic approach this species.

***Haliclona* (*Soestella*) sp. nov.**

(fig. 35a–d)

Material examined. Holotype: MNRJ 1661 – Ponta do Urubu (rocky coast, ca. 23°50’56”S 45°24’49”W), São Sebastião (São Paulo State, Brazil), 9 m depth, coll. E. Hajdu, 20 April 1998.

Comparative material. *Haliclona* (*Soestella*) *walentinae* Diaz, Thacker, Rützler & Piantoni, 2007, MNRJ 15464, Bocasl del Toro, Panama.

Diagnosis. The only *Haliclona* in the Western Atlantic with the combination of a thinly encrusting shape, very fragile consistency, subsuperficial canals converging towards the oscules and purple colour.

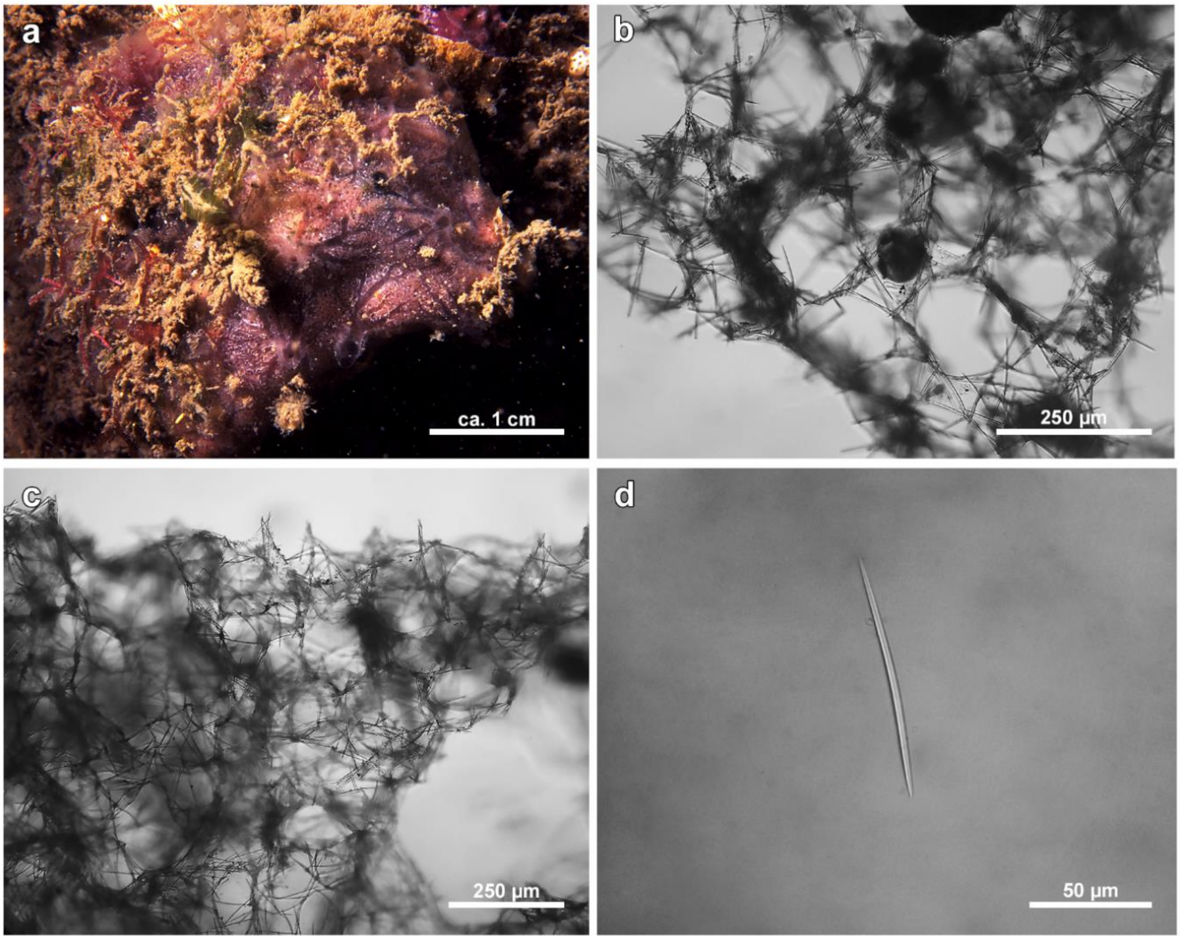


FIGURE 35. *Haliclona* (*Soestella*) sp. nov., holotype MNRJ 1661. a. specimen *in situ*. b. ectosome. c. choanosome. d. oxea.

Description (Fig. 35a). A thinly encrusting species, ca. 1 mm in thickness, epibiont on the tunicate *Herdmania* sp. The oscules are rare, circular, very small, with a estimated a diameter of 2 mm, with a slightly elevated transparent membrane, and only visible when alive. The surface is smooth, even, slightly punctate, with subsuperficial canals converging towards the oscules. Consistency is soft, fragile, compressible, and easily torn. Colour alive is purple, becoming beige in spirit.

Skeleton (Fig. 35b–c). Ectosome: open, discontinuos, tangential reticulation with many rounded paucispicular (2-6 spic) meshes. Choanosome: a dense, subanisotropic reticulation, with ill-defined paucispicular primary lines (2-5 spicules) irregularly connected by unispicular secondary lines. There is a consistent tendency of the skeleton to form rounded meshes. Spongin is scarce.

Spicules (Fig. 35d). Oxeas, with acerate and long points, most are slightly curved, but some straight are also present, 88–*101.3*–115 x 2.5–*3.5*–4.5 µm.

Ecology. Found at 9 m depth, in a rocky coast, as epibiont of a solitary tunicate of the genus *Herdmania*.

Distribution (Fig. 36). Brazil, only known for its type locality, São Sebastião (23°S, São Paulo State). MEOW distribution: Warm-Temperate Southwestern Atlantic (Southeastern Brazil Ecoregion).

Remarks. This species is included in the subgenus *Haliclona* (*Soestella*) due to its skeletal features, such as ill-defined paucispicular primary lines irregularly connected by unispicular secondary ones, with a marked tendency to form rounded meshes both in the ectosome and choanosome.

In the subgenus *Haliclona* (*Soestella*), only *H.* (*S.*) *walentinae* approaches the new species, by sharing a thinly encrusting habit and subsuperficial canals converging to the oscules. But both species differs in colour, with *H.* (*S*.) *walentinae* having a dark brown to purple colour outside and tan inside, while *Haliclona* (*Soestella*) sp. nov has only the purple colour both outside and inside. In addition, the species also differ in consistency, *H.* (*S.*) *walentinae* is resilient, instead of very fragile as *Haliclona* (*Soestella*) sp. nov. Another important difference is the pronounced tendency to form rounded meshes in the skeleton of *Haliclona* (*Soestella*) sp. nov, which is not observed in *H.* (*S.*) *walentinae.* We could examine material

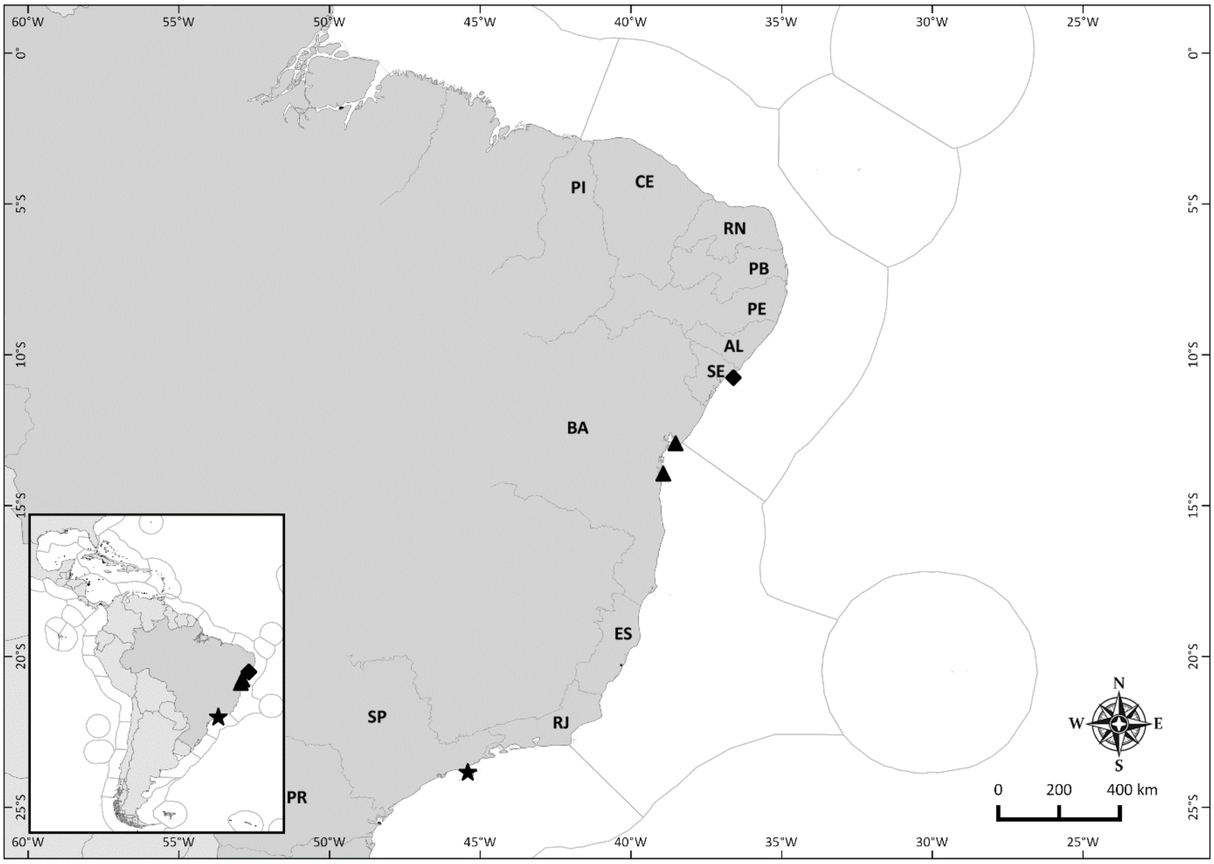


FIGURE 36. Geographic distribution of *Haliclona* (*Soestella*) *brassica* Sandes *et al.*, 2014 (orange rhombus), *Haliclona* (*Soestella*) *peixinhoae* Bispo *et al.*, 2014 (grey triangle), and *Haliclona* (*Soestella*) sp. nov.

of *H.* (*S.*) *walentinae* from Bocasl del Toro (Panama), from which we can conclude that both species are clearly distinct, being *Haliclona* (*Soestella*) sp. nov. a new species.

Key to the species of *Haliclona* occurring in shallow-waters along the Brazilian coast

01a. Microscleres present 2

b. Microscleres absent 4

02a. Sigmas as microscleres, bluish, greyish or beige colour .... *H.* (*S.*) *caerulea*

b. Microscleres toxas or raphids.. 3

03a. Toxas as microscleres, black or dark brown colour .... *H.* (*S.*) *melana*

b. Raphids as microscleres and strongyles as megascleres .... *H.* (*S.*) *brassica*

04a. Ectosomal skeleton present 5

b. Ectosomal skeleton absent 12

05a. Oscules surrounded by a silver collar...................................... *H.* (*Re.*) sp. nov. 2

b. Oscules not surrounded by a silver collar 6

06a. Ectosomal skeleton is a very dense crust, colour is dark brown externally and beige internally, consistency is hard ....*H.* (*Halich.*) *dura*

b Ectosomal skeleton with rounded meshes, isodictyal or isotropic 7

07a. Ectosomal skeleton with rounded meshes 8

b. Ectosomal and choanosomal skeleton isodictyal or isotropic..............................9

08a. A thinly encrusting sponge, purple colour, subsuperficial canals converging toward the oscules...*H.* (*S.*) sp. nov.

b. A tubular sponge, with a conspicuous subsuperficial reticulation, colour beige to light brown .... *H.* (*S.*) *peixinhoae*

09a. Sponge with cylindrical repent branches of dark green to black colour, and unispicular and isotropic skeleton .... *H.* (*Re.*) *chlorilla*

b. Sponge without cylindrical repent branches 10

10a. Oxeas with blunt points or modified to strongyles, purple to pinkish violet colour ....*H.* (*Re.*) *implexiformis*

b. Oxeas with sharp points...11

11a. Colour alive is white/beige, surface punctate, and regular unispicular skeleton ....*H.* (*Re.*) sp. nov. 1

b. Ectosome detachable, semi-transparent, choanosome with lilac, pink or white/beige colour, skeleton is a dense isotropic reticulation ....*H.* (*Halich.*) *vansoesti*

12a. Sponge with uni-paucispicular anisotropic choanosomal skeleton, connected by unispicular secondary lines, greyish white colour, punctate surface, with subsuperficial canals converging toward the oscules .... *H.* (*Halic.*) sp. nov.

b. Skeleton confused or (sub)anisotropic with pauci-multispicular primary lines...13

13a. Confused skeleton..14

b. (Sub)anisotropic skeleton with pauci-multispicular primary lines, irregularly connected by unispicular secondary ones 15

14a. Closed-packed tubular mounds topped by an oscule, with colour varying from white to beige...*H.* (*G.*) sp. nov.

b. Thinly encrusting sponge, grey with orange colour ....*H.* (*G.*) *catarinensis*

15a. Thinly encrusting sponge, lilac colour, skeleton with stouth primary lines .... *H.* (*Rh.*) *lilacea*

b. Sponge with small mounds or mammilliform projections, punctate surface, white to beige colour .... *H.* (*Rh.*) *mammillaris*

Discussion

Biodiversity

In the beginning of this taxonomic revision, there were 10 species of the genus *Haliclona* with records in the Brazilian coast, nominally: *Haliclona* (*Gellius*) *catarinensis*, *Haliclona* (*Rhizoniera*) *lilacea*, *Haliclona* (*Halichoclona*) *lernerae*, *Haliclona* (*Reniera*) *implexiformis*, *Haliclona* (*Re.*) *manglaris*, *Haliclona* (*Re.*) *tubifera*, *Haliclona* (*Rh.*) *curacaoensis*, *Haliclona* (*Rh.*) *mammillaris*, *Haliclona* (*Soestella*) *caerulea* and *Haliclona* (*S.*) *melana*.

From those, *H. catarinensis* and *H. lilaceus* received subgenus assignment, and the latter had the name corrected to *Haliclona* (*Rh.*) *lilacea* to agree with the gender of the genus' name.

Haliclona (*Halich.*) *lernerae* is a deep-water species, from which it is not included in this synopsis, however we could study a small fragment of the holotype and it consists of a thinly encrusting species on a *Niphates* sp, but its skeleton was typical of the subgenus *Halichoclona*. In addition, the oxeas from *Niphates* sp. was always intermixed with those of *H.* (*Halich.*) *lernerae*, which make impossible new measurements.

Haliclona (*Rh.*) *curacaoensis* from Brazil was briefly revised by Bispo *et al.* (2014) that assigned it to what was known as *Haliclona* (*Re.*) *manglaris* in Brazil (see Hajdu *et al*., 2011: 184), however *Haliclona* (*Re.*) *manglaris* from the Brazilian coast actually correspond to another species of the genus *Cladocroce* (Bispo *et al*., in prep.)

Haliclona (*Re*.) *tubifera* is also an invalid record for the Brazilian coast, it was described for Santa Catarina State (Lerner, 1996), but De Weerdt (2000) firstly considered it to be a member of the subgenus *Haliclona* (*Halichoclona*), and we assign it to *Haliclona* (*Halichoclona*) *vansoesti*.

Haliclona (*Reniera*) *implexiformis*, *Haliclona* (*Rh.*) *mammillaris*, *Haliclona* (*S.*) *caerulea*, and *H.* (*S.*) *melana* are considered valid records for the Brazilian coast, and we provided new distributional records for these species.

Very recently, four new species of *Haliclona* were described in Eastern/Northeastern Brazil Ecoregion, viz. *Haliclona* (*Halichoclona*) *dura* Sandes *et al.*, 2014, *Haliclona* (*Reniera*) *chlorilla* Bispo *et al.*, 2014, *Haliclona* (*Soestella*) *brassica* Sandes *et al*, 2014, and *Haliclona* (*Soestella*) *peixinhoae* Bispo *et al*, 2014. And in this monograph, we further describe five new species of *Haliclona*, viz. *Haliclona* (*Gellius*) sp. nov, *Haliclona* (*Haliclona*) sp. nov, *Haliclona* (*Reniera*) sp. nov. 1, *Haliclona* (*Reniera*) sp. nov. 2,, *Haliclona* (*Soestella*) sp. nov., expanding to 16 the number of valid species of this genus occurring in shallow-waters of the Brazilian coast.

Although these five new species were described from a single – or two in the case of *Haliclona* (*Gellius*) sp. nov – specimen, they are all remarkable distinct species and well illustrated alive, making easy their posterior recognition in the field.

Biogeography

The number of *Haliclona* species occurring in shallow-waters of the Brazilian coast (16 spp.) is slightly smaller than in shallow-waters of the Caribbean region (22 spp. from De Weerdt, 2000; Jackson *et al.*, 2006; Diaz *et al.*, 2007). Nevertheless, only four species are shared between these biogeographic regions, they are *Haliclona* (*Halich.*) *vansoesti*, *Haliclona* (*Re.*) *implexiformis*, *Haliclona* (*S.*) *caerulea*, and *Haliclona* (*S.*) *melana*. All of them being widely-distributed species, occurring all along the Brazilian coast (down to Eastern Brazil Ecoregion for *H.* (*Re.*) *implexiformis* and *H.* (*S.*) *caerulea*) and in the Caribbean. Except for *H melana*, that in the Caribbean was only found at St. Lucia; and *Haliclona* (*Halich.*) *vansoesti* that exhibits a particular disjunct distribution, not being found in the Tropical Southwestern Atlantic.

The remaining 12 species are endemic or provisionally endemic. From those, only *H.* (*Rh.*) *mammillaris* is widely distributed in the Brazilian coast, originally described from Santa Catarina State (27°S), but now recorded up to Ceará State (3°S). Those endemic of the Northeastern Brazil Ecoregion are *Haliclona* (*G.*) sp. nov., *Haliclona* (*Halich.*) *dura*, *Haliclona* (*Re*.) *chlorilla, H.* (*Re.*) sp. nov. 1, and *H.* (*S.*) *brassica*. *Haliclona* (*Soestella*) *peixinhoae* is endemic from the Eastern Brazil Ecoregion. While *H.* (*G.*) *catarinensis*, *H.* (*Halic.*) sp. nov., *H.* (*Re*.) sp. nov. 2, *H.* (*Rh.*) *lilacea*, and *H.* (*S*.) sp. nov. are endemic from the Southeastern Brazil Ecoregion, with subtropical affinities.

The shallow-water *Haliclona* from the North Brazil Shelf Ecoregion remains unknown, creating a gap in the distribution those species known to occur in both the Caribbean and Brazil. If this gap is real or not is a matter to be further investigated. Although we expect an impoverished fauna due to dramatic changes in ecological parameters due to extreme freshwater discharge.

Species delimitation in *Haliclona*

The current characters used in *Haliclona* taxonomy were based on a sound review performed by De Weerdt (1985), they are mainly: growth form (shape), surface, consistency, colour, presence of slime strands, amount of spongin, spiculation and skeletal architecture.

Some of these characters are very variable, such as the shape, but even being variable this character is important and useful in discrimating species, especially for experienced people in studying alive sponges submitted to different ecological conditions or from different geographical localitities (De Weerdt, op. cit.).

The amount of spongin, skeletal architecture and spiculation are also very useful characters, being the kind and shape of the megasclere and the presence of microscleres reliable characters for species identification. Nevertheless, the dimensions reached by the spicules and even the skeleton could exhibit a great variability when subjected to different environmental conditions. Even the same individual (see *H.* (*S*) *caerulea* remarks) could develop distinct skeleton and spicules with different dimensions.

De Weerdt (op. cit.) considered larval structures and reproduction as of minor importance, but we disagree. These characters and those of ultrastructure and citology would expand the available dataset to use in taxonomy, and can consequently improve the classification of Haplosclerida (Cárdenas *et al.*, 2012; Langerbruch, 1991; Stephens *et al*., 2013).

Current and prospect systematics of *Haliclona*

The classification of *Haliclona*, as currently accepted, is based mainly on characteristics of the skeleton. And although some observable patterns, the skeleton is commonly highly variable, making the (sub)generic assignment very difficult and subjective sometimes, especially when the morphological variability of the species is ill-known. This became more evident when considering that even De Weerdt changed the subgeneric assignment of some species from a paper to another, for example, *H. curacaoensis* was considered a member of the *arenata* group (now *Soestella*) by De Weerdt (1989) and subsequently as a member of the *Rhizoniera* subgenus by De Weerdt (2000). Another example is *H. piscaderensis*, a member of the *angulata* group sensu De Weerdt, 1989 and of the *Soestella* subgenus sensu De Weerdt, 2000.

Although molecular markers recover a “Clade A” of the Haploscleromorpha where many *Haliclona* spp are members, neither the genus nor the subgenera were retrieved as monophyletic (Redmond et al. 2007, 2011, 2013), indicating that the current classification is not natural.

It is consensus that to solve the systematics problemas of the Haplosclerida, included *Haliclona* and other Chalinidae, is necessary to integrate different data sets of morphological and molecular information in order to find characters that are more informative (Cárdenas *et al*., 2012). For example, the ultrastructure of the choanocyte chambers was never used in an integrative approach for understand the systematics of the Haplosclerida, spite knowning that these chambers show different organization in distinct *Haliclona* spp. (Langenbruch, 1991; Langenbruch & Jones, 1990).

Acknowledgments

The authors are especially thankful to the colleagues Dr. Mariana Carvalho, MSc Sula Salani Mota, MSc Camille Leal and MSc Cristiana Castello Branco for their unvaluable help with the MNRJ database and collections. Dra. Maria da Conceição Tavares Frigo is thanked for donating fragments of the holotypes of *H. catarinensis*, *H. lilacea* and *H. mammillaris*. Dr. Eric Lazo-Wasem is thanked for his solicitude in providing digital images of the holotypes of *H. albifragilis, H. caerulea* and *H. implexiformis*. Ana Rúbia Ribeiro and the OPTMA team are thanked for providing SEM facilities. Prof. Dr. Leandro M. Vieira is thanked for identifying a Bryozoa associated with *H.* catarinensis. Thamires G. Ferreira is thanked for identifying the ascidian where *H.* (*S.*) sp. nov. was overgrowing.Prof. Dr. Guilherme Muricy is thanked for providing access tohis preliminary results. Prof. Dr. Helena Matthews-Cascon, Lorraine Cavalcante and MSc. Sula Salani Mota are thanked for donating a specimen of *H. chlorilla* from Piauí. The Dive Center ECOSCUBA is thanked for providing SCUBA facilities at Praia do Francês (Alagoas). CAPES and CNPq are thanked for providing scholarship to AB and JLC..

References

Bergquist, P.R. & Warne, K.P. (1980) The Marine Fauna of New Zealand: Porifera, Demospongiae, Part 3 (Haplosclerida and Nepheliospongida). *New Zealand Oceanographic Institute Memoir*, 87, 1–77.

Bispo, A., Correia, M.D. & Hajdu, E. (2014) Two new shallow-water species of Haliclona from the north-eastern Brazil (Demospongiae: Haplosclerida: Chalinidae).

Journal of the Marine Biological Association of the United Kingdom, 13 pp. http://dx.doi.org/10.1017/S0025315414000344

Boury-Esnault, N.; Klautau, M.; Bézac, C.; Wulff, J. & Solé-Cava, A.M. (1999) Comparative study of putative conspecific sponge populations from both sides of the Isthmus of Panama. *Journal of the Marine Biological Association of the United Kingdom*, 79 (1), 39–50.

Burton, M. (1954) Sponges. *In*: The 'Rosaura' Expedition. Part 5. Bulletin of the British Museum (Natural History) Zoology, 2(6), 215–239, pl. 9.

Campos, M., Mothes, B., Eckert, M. & Van Soest, R.W.M. (2005) Haplosclerida (Porifera: Demospongiae) from the coast of Maranhão State, Brazil, Southwestern Atlantic. *Zootaxa*, 963, 1–22.

Carballo, J.L., Ávila, E., Enríquez, S. & Camacho, L. (2006) Phenotypic plasticity in a mutualistic association between the sponge *Haliclona caerulea* and the calcareous macroalga *Jania adherens* induced by transplanting experiments. I: morphological response of the sponge. *Marine Biology*, 148, 467–478.

Cárdenas, P., Pérez, T.& Boury-Esnault, N. (2012) Chapter two – Sponge Systematics Facing New Challenges. In: Becerro, M.A., Uriz, M.J, Maldonado, M & Turon, X (Eds), *Advances in Sponge Science: Phylogeny, Systematics, Ecology*. Elsevier: Oxford, pp. 79–209.

Cruz-Barraza, J.A. & Carballo, J.L. (2006). A new species of *Haliclona* (Demospongiae: Haplosclerida) living in association with *Geodia media* Bowerbank (Mexican Pacific coast). *Zootaxa*, 1343, 43–54.

Cruz-Barraza, J.A. & Carballo, J.L. (2008). Taxonomy of Sponges (Porifera) Associated with Corals from the Mexican Pacific Ocean. *Zoological Studies*, 47(6), 741–758.

De Laubenfels, M.W. (1932) The marine and fresh-water sponges of California. *Proceedings of the United States National Museum*, 81 (2927), 1–140.

De Weerdt, W.H. (1985) A systematic revision of the north-eastern Atlantic shallow-water Haplosclerida (Porifera, Demospongiae): 1. Introduction, Oceanapiidae and Petrosiidae. *Beaufortia*, 35(5), 61–91.

De Weerdt, W.H. (1986) A systematic revision of the north-eastern Atlantic shallow-water Haplosclerida (Porifera, Demospongiae): 2. Chalinidae. *Beaufortia*, 36(6), 81–165.
De Weerdt, W.H. (1989) Phylogeny and vicariance biogeography of North Atlantic Chalinidae (Haplosclerida, Demospongiae). *Beaufortia*, 39(3), 55–90.

De Weerdt, W.H. (2000) A monograph of the shallow-water Chalinidae (Porifera, Haplosclerida) of the Caribbean. *Beaufortia*, 50(1), 1–67.

De Weerdt, W.H. (2002) Family Chalinidae Gray, 1867. *In*: Hooper, J.N.A. & Van Soest, R.W.M. (Eds*) Systema Porifera. A guide to the classification of sponges. 1* Kluwer Academic/ Plenum Publishers: New York, Boston, Dordrecht, London, Moscow, pp. 852–873.

De Weerdt, W.H. & Van Soest, R.W.M. (2001) *Haliclona (Halichoclona) vanderlandi* spec.nov. (Porifera: Demospongiae: Haplosclerida) from Indonesia. *Zoologische Verhandelingen Leiden*, 334, 189–194.

De Weerdt, W.H.; De Kluijver, M.J. & Gomez, R. (1999) *Haliclona* (*Halichoclona*) *vansoesti* n.sp., a new chalinid sponge species (Porifera, Demospongiae, Haplosclerida) from the Caribbean. *Beaufortia* 49(6), 47–64.

Díaz, M.C., Thacker, R.W., Rützler, K. & Piantoni, C. (2007) Two new haplosclerid sponges from Caribbean Panama with symbiotic filamentous cyanobacteria, and an overview of sponge–cyanobacteria associations. *In*: Custódio, M.R., Lôbo-Hajdu, G., Hajdu, E. & Muricy, G. (Eds) *Porifera research: biodiversity, innovation and sustainability*. Rio de Janeiro: Museu Nacional, pp. 31–39.

Fromont, J. & Abdo, D.A. (2014) New species of *Haliclona* (Demospongiae: Haplosclerida: Chalinidae) from Western Australia. *Zootaxa*, 3835 (1), 97–109.
Fromont, J. (1993) Descriptions of species of the Haplosclerida (Porifera: Demospongiae) occurring in tropical waters of the Great Barrier Reef. *The Beagle, Records of the Northern Territory Museum of Arts and Sciences*, 10(1), 7–40.

George, W.C. & Wilson, H.V. (1919) Sponges of Beaufort (N.C.) Harbor and Vicinity. Bulletin of the Bureau of Fisheries, Washington, 36, 129–179, pls. LVI–LXVI.

Grant, R.E. (1835–41) Porifera. *In*: Bailliere, H. (Eds) *Outlines of comparative anatomy. 1*. London, pp. 5–9, 310–313, pls II–IV.

Gray, J.E. (1867) Notes on the Arrangement of Sponges, with the Descriptions of some New Genera. *Proceedings of the Zoological Society of London*, 1867(2), 492–558, pls XXVII–XXVIII.

Griessinger, J.M. (1971) Etude des Réniérides de Méditerranée (Démosponges Haplosclérides). *Bulletin du Muséum national d'Histoire naturelle*. 3(3), 97–182.

Hajdu, E., Peixinho, S. & Fernandez, J.C.C. (2011) *Esponjas marinhas da Bahia: guia de campo e laboratório*. Museu Nacional, Rio de Janeiro, 276 pp. [Série Livros, nº 45.]

Hechtel, G.J. (1965) A systematic study of the Demospongiae of Port Royal, Jamaica. *Bulletin of the Peabody Museum of Natural History*, 20, 1–103.

Hechtel, G.J. (1969) New species and records of shallow water Demospongiae from Barbados, West Indies. *Postilla*, 132, 1–38.

Hechtel, G.J. 1976. Zoogeography of Brazilian Marine Demospongiae. *In*: Harrison, F.W. & Cowden, R.R. (Eds), *Aspects of Sponge Biology*. Academic Press: New York & London, pp. 237-260.

Jackson, C.P.J.; De Weerdt, W.H. & Webber, M.K. (2006) *Haliclona* (*Reniera*) *portroyalensis* n. sp., a new chalinid sponge (Porifera, Demospongiae, Haplosclerida) from the southeast coast of Jamaica. *Zootaxa*, 1319, 59–68.

Jones, W.C. 1987. Seasonal variations in the skeleton and spicule dimensions of Haliclona elegans (Bowerbank) sensu Topsent (1887) from two sites in North Wales. *In*: Jones, W.C. (Ed) *European Contributions to the taxonomy of sponges*. Publications of the Sherkin Island marine Station, 1, 109–129.

Langenbruch, P.F. (1991) Histological Indications of the Phylogenesis of the Haplosclerida (Demospongiae, Porifera). *In*: Reitner, J. & Keupp, H. (Eds). *Fossil and Recent Sponges*. Springer-Verlag: Berlin, Heidelberg, New York, London, Paris, Tokyo, Hong Kong, Barcelona, Budapest, pp. 289–298.

Langenbruch, P.F. & Jones, W.C. (1990) Body Structure of Marine Sponges. VI. Choanocyte Chamber Structure in the Haplosclerida (Porifera, Demospongiae) and its Relevance to the Phylogenesis of the Group. *Journal of Morphology*, 204, 1–8.

Lehnert, H. & Van Soest, R.W.M. (1996) North Jamaican deep fore-reef sponges. *Beaufortia* 46(4), 53–81.

Lerner, C.B. (1996) Esponjas da Ilha da Galé, Reserva Marinha Biológica do Arvoredo, Santa Catarina, Brasil (Porifera: Demospongiae). Biociências, 4 (2), 101-129.

McDonald, J.I., Hooper, J.N.A. & McGuinness, K.A. (2002) Environmentally influenced variability in the morphology of *Cinachyrella australiensis* (Carter 1886) (Porifera: Spirophorida: Tetillidae). *Marine and Freshwater Research*, 53, 79–84.

Mercurio, M., Corriero, G., Scalera-Liaci, L. & Gaino, E. (2000) Silica content and spicule size variations in *Pellina semitubulosa* (Porifera: Demospongiae). *Marine Biology*, 137, 87–92.

Meroz-Fine, E., Shefer, S. & Ilan, M. (2005) Changes in morphology and physiology of an East Mediterranean sponge in different habitats. *Marine Biology*, 147, 243-250.

Mothes, B. & Lerner, C.B. (1994) Esponjas marinhas do infralitoral de Bombinhas (Santa Catarina, Brasil) com descrição de três espécies novas (Porifera: Calcarea e Demospongiae). *Biociências*, 2, 47–62.

Mothes, B., Lerner, C.B. & Silva, C.M.M. (2003) *Guia Ilustrado - Esponjas Marinhas - Costa Sul-Brasileira*. 1st ed. USEB, Pelotas, 83 pp.

Mothes, B., Lerner, C.B. & Silva, C.M.M. (2006) *Illustrated guide of the marine sponges from the southern coast of Brazil / Guia ilustrado de esponjas marinhas da costa sul-brasileira*. 2nd ed. USEB, Pelotas, 119 pp.

Muricy, G. & Hajdu, E. (2006) *Porifera Brasilis. Guia de identificação das esponjas mais comuns do Sudeste do Brasil*. Eclesiarte, Rio de Janeiro, 104 pp.

Muricy, G. & Ribeiro, S.M. (1999) Shallow-water Haplosclerida (Porifera, Demospongiae) from Rio de Janeiro State, Brazil (Southwestern Atlantic). *Beaufortia*, 49, 83–108.

Muricy, G., Lopes, D.A., Hajdu, E., Carvalho, M.S., Moraes, F.C., Klautau, M., Menegola, C. & Pinheiro, U. (2011) *Catalogue of Brazilian Porifera* (Série Livros 46). Rio de Janeiro: Museu Nacional, 299 pp.

Muricy, G., Esteves, E.L., Rodrigues, B.R., Monteiro, L. & Albano, R.M. (in press) A new species of *Haliclona* (Demospongiae: Haplosclerida: Chalinidae) from southeastern Brazil and the first record of *Haliclona vansoesti* from the Brazilian coast. *Zootaxa*.

Olavo, G., Costa, P.A.S., Martins, A.S. & Ferreira, B.P. (2011) Shelf-edge reefs as priority areas for conservation of reef fish diversity in the tropical Atlantic. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 21, 199–209.

Redmond, N.E., Van Soest, R.W.M., Kelly, M., Raleigh, J., Travers, S.A.A. & McCormack, G.P. (2007) Reassessment of the classification of the Order Haplosclerida (Class Demospongiae, Phylum Porifera) using 18S rRNA gene sequence data. *Molecular Phylogenetics and Evolution*, 43, 344–352.

Redmond, N.E., Raleigh, J., Van Soest, R.W.M., Kelly, M. & Travers, S.A.A. (2011) Phylogenetic Relationships of the Marine Haplosclerida (Phylum Porifera) Employing Ribosomal (28S rRNA) and Mitochondrial (cox1, nad1) Gene Sequence Data. *PLoS ONE*, 6 (9), e24344.

Redmond, N.E., Morrow, C.C., Thacker, R.W., Diaz, M.C., Boury-Esnault, N., Cárdenas, P., Hajdu, E., Lôbo-Hajdu, G., Picton, B.E., Pomponi, S.A., Kayal, E. & Collins, A.G. (2013) Phylogeny and Systematics of Demospongiae in Light of New Small-Subunit Ribosomal DNA (18S) Sequences. *Integrative and Comparative Biology*, 53 (3), 388–415.

Rützler, K., Duran, S. & Piantoni, C. (2007) Adaptation of reef and mangrove sponges to stress: evidence for ecological speciation exemplified by *Chondrilla caribensis* new species (Demospongiae, Chondrosida). *Marine Ecology*, 28, 95–111.

Rütler, K., Piantoni, C., Van Soest, R.W.M. & DÍAZ, M.C. (2014) Diversity of sponges (Porifera) from cyptic habitats on the Belize barrier reef near Carrie Bow Cay. *Zootaxa*, 3805 (1), 1–129.

Sandes, J., Bispo, A. & Pinheiro, U. (2014) Two new species of *Haliclona* Grant, 1836 (Haplosclerida: Chalinidae) from Sergipe State, Brazil. *Zootaxa*, 3793 (2), 273–280.

Schmidt, O. (1862) *Die Spongien des adriatischen Meeres*. Wilhelm Engelmann: Leipzig, i–viii, p. 1–88, pls 1–7.

Sollas, W.J. (1885) A Classification of the Sponges. *Annals and Magazine of Natural History* (5) 16(95), 395.

Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A., Finlayson, M., Halpern, B.S., Jorge, M.A., Lombana, A., Lourie, S.A., Martin, K.D., McManus, E., Molnar, J., Recchia, C.A. & Robertson, J. (2007) Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. BioScience, 57(7), 573–583.

Stephens, K.M., Ereskovsky, A., Lalor, P. & McCormack, G.P. (2013) Ultrastructure of the Ciliated Cells of the Free-Swimming Larva, and Sessile Stages, of the Marine Sponge *Haliclona indistincta* (Demospongiae: Haplosclerida). *Journal of Morphology*, 274 (11), 1263-1276.

Sullivan-Sealey, K. & Bustamante, G. (1999) *Setting geographic priorities for marine conservation in Latin America and the Caribbean*. The Nature Conservancy, Arlington, Virginia, 125pp.

Topsent, E. (1928) Spongiaires de l'Atlantique et de la Méditerranée provenant des croisières du Prince Albert ler de Monaco. *Résultats des campagnes scientifiques accomplies par le Prince Albert I. Monaco*, 74, 1–376, pls I–XI.

Valderrama, D. & Zea, S. (2013) Annotated checklsit of sponges (Porifera) from the southernmost Caribbean reefs (north-west Gulf of Urabá), with description of new records for the Colombian Caribbean. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturale*s, 37 (144), 353–378.

Van Soest, R.W.M, Boury-Esnault, N., Hooper, J.N.A., Rützler, K., De Voogd, N.J., Alvarez de Glasby, B., Hajdu, E., Pisera, A.B., Manconi, R., Schoenberg, C., Janussen, D., Tabachnick, K.R., Klautau, M., Picton, B., Kelly, M., Vacelet, J., Dohrmann, M., Díaz, M.C., & Cárdenas, P. (2015) *World Porifera database*. Available from: http://www.marinespecies.org/porifera (2015-01-26)

Van Soest, R.W.M. (1984) Marine sponges from Curaçao and other Caribbean localities. Part III. Poecilosclerida. *In*: Hummelinck, P.W. & Van der Steen, L.J. (Eds), Uitgaven van de Natuurwetenschappelijke Studiekring voor Suriname en de Nederlandse Antillen. No. 112*. Studies on the Fauna of Curaçao and other Caribbean Islands*, 66 (199), 1–167.

Wulff, J.L. (1996) Do the same sponge species live on both the Caribbean and eastern Pacific sides of the Isthmus of Panama? *Bulletin of the Royal Belgian Institute for Natural Sciences*, 66, 165–173.

Zea, S. (1987) Esponjas del Caribe Colombiano. Catálogo Cientifico: Bogotá, Colombia, 286 pp.

Zea, S. & De Weerdt, W.H. (1999) *Haliclona* (*Haliclona*) *epiphytica* n.sp. (Porifera, Demospongiae, Haplosclerida), a seaweed-dwelling sponge from the Colombian Caribbean. *Beaufortia* 49 (13), 171–176.

6 ARTIGO 4: *Cladocroce caeulum* in the Brazilian coast: new records and morphological data, with the invalidation of previous records of *Haliclona manglaris* and *Haliclona curacaoensis*

ANDRÉ BISPO, MONICA D. CORREIA AND EDUARDO HAJDU

To be submitted to
Marine Biology Research[1]

Abstract

Haliclona curacaoensis and *Haliclona manglaris* were originally described from the Caribbean, but were subsequently recorded from the Brazilian coast. The exam of the material of *H. manglaris* and *H. curacaoensis* from Brazil led us to conclude that both actually correspond to *Cladocroce caelum*, a species recently described from Brazil. *Cladocroce caelum* is now considered to be widespread in the Brazilian coast and its morphological variability is better known. In addition, the previous records of *H. curacaoensis* and *H. manglaris* from Brazil are considered invalid, being these species restricted to the Caribbean.

Keywords: Chalinidae, Porifera, taxonomy, biodiversity

Introduction

Cladocroce Topsent, 1892 is a genus included within the family Chalinidae. It was described after the species *Cladocroce fibrosa* (Topsent, 1890), from deep-waters off the Azores (North Atlantic). Species of this genus are characterized by having a (sub)isotropic choanosomal skeleton, mainly uni-paucispicular but reinforced with multispicular anastomosing fibres (Fromont, 1993; De Weerdt, 2002; Putchakarn et al., 2004).

17 species of *Cladocroce* are known worldwide (Van Soest, 2014), most of them found in deep waters, being *Cladocroce aculeata* Pulitzer-Finali, 1982; *C. caelum* Santos et al., 2014; *C. burapha* Putchakarn et al., 20014; *C. reina* Aguilar-Camacho & Carballo, 2010 and *C. tubulosa* Pulitzer-Finali, 1993 the shallow-water representatives.

Cladocroce caelum is the solely species of the genus in the Tropical Western Atlantic (Table1, from Santos et al., 2014). It was very recently described based on

---

[1] A estrutura e os critérios de citação deste capítulo seguem as normas do periódico **Marine Biology Research**

material from shallow-water coastal reefs in the Northeastern Brazil (Santos et al., op cit.).

Haliclona (*Reniera*) *manglaris* Alcolado, 1984 *and Haliclona* (*Rhizoniera*) *curacaoensis* (Van Soest, 1980) are chalinids, originally described from the Caribbean, that shows some resemblance with *Cladocroce caelum* in terms of shape and colour (see De Weerdt et al., 1991; De Weerdt, 2000). These species were firstly reported from the Brazilian coast by Cedro *et al* (2007) examining specimens from Alagoas State, and subsequently Hajdu et al. (2011) described *Haliclona manglaris* for the Bahia State.

As part of a taxonomic revision of the *Haliclona* spp. from Brazil, we were able to examine the material of Cedro et al. (2007) and also fresh material of specimens similar to those illustrated by Cedro et al. (2007) and Hajdu et al. (2011), from which we observed resemblances with *Cladocroce caelum*.

In this paper we investigated if *Haliclona* (*Reniera*) *manglaris* and *Haliclona* (*Rhizoniera*) *curacaoensis* from the Brazilian coast are conspecific with *Cladocroce caelum*.

Material and Methods

From 2012-2014 we had collected specimens corresponding to *Haliclona manglaris* sensu *Cedro* et al. (2007) and Hajdu et al. (2011) in the coasts of Ceará State, Rio Grande do Norte State, Alagoas State, and Rio de Janeiro State. Specimens of *Haliclona curacaoensis* sensu Cedro et al. (2007) were collected at the coast of Alagoas. In addition, several specimens previously identified by Cedro et al. (2007) were examined at both MNRJ and UFALPOR Porifera collections. Additional material from the coast of Bahia State were obtained in MNRJ and UFPEPOR Porifera collections. Fragments of UFPEPOR specimens were deposited in the MNRJ Porifera collections.

In order to establish the conspecificity of our material with *Haliclona manglaris* sensu Alcolado, 1984 or *Cladocroce caelum* sensu Santos et al., 2014 we examined fragments of the holotype of both species.

The species descriptions were based solely on the morphology, and took in account the external morphology (shape, size, colour, consistency, surface), as well as the internal morphology (skeletal architecture, shape and size of the spicula). We follow Hajdu et al. (2011) to prepare spicula for light microscopy, as well as for thick sections of the skeleton.

Maps of species geographic distribution were elaborated using the open software QGIS v. 2.6.1. We identify the distinct ecoregions where the species occur using the Marine Ecoregions of the World (MEOW, from Spalding et al. 2007 and Sealey & Bustamante, 1999).

Abbreviations of the institutions cited in the text:

MNRJ – Porifera Collection of Museu Nacional da Universidade Federal do Rio de Janeiro, Brazil
UFALPOR – Porifera Collection of Universidade Federal de Alagoas, Brazil
UFPEPOR – Porifera Collection of Universidade Federal de Pernambuco, Brazil
IdO – Instituto de Oceanología de la Academia de Ciencias de Cuba, Cuba

Results

Haliclona (*Reniera*) *manglaris* [sensu Cedro et al., 2007; Hajdu et al. 2011] and *Haliclona* (*Rhizoniera*) *curacaoensis* [sensu Cedro et al., 2007] are invalid records for the Brazilian coast, both corresponding to *Cladocroce caelum*. See description below.

Systematics

Class Demospongiae Sollas, 1885

Order Haplosclerida Topsent, 1928

Family Chalinidae Gray, 1867

Genus *Cladocroce* Topsent, 1982

Diagnosis

Sponges lamellate, tube- or cushion-shaped. Choanosomal skeleton a (sub)isotropic, uni-paucispicular reticulation, reinforced by ocasionally anastomosing multispicular fibres. Ectosomal skeleton, if present, a tangential, uni- or paucispicular, iso- or subisotropic reticulation, sometimes with multispicular anastomosing tracts. Megascleres smooth oxeas. Microscleres, if present, toxas or sigmas. Consistency firm but elastic, compressible. In the lamellate forms, the oscules are circular, flush with the surface, rather small, not abundant; they may occur at both sides of the lamellae (modified from De Weerdt, 2002, Putchakarn et al. 2004, Aguilar-Camacho & Carballo, 2010 and Lehnert & Sone, 2013).

Cladocroce caelum **Santos, Silva, Alliz & Pinheiro, 2014**

(Fig. 1a–h, 2a–b, 3a–h)

Cladocroce caelum Santos, Silva, Alliz & Pinheiro, 2014: 297, fig. 1.

Haliclona curacaoensis Cedro et al. 2007 [Non *Haliclona* (*Rhizoniera*) *curacaoensis* (Van Soest, 1980)]

Haliclona manglaris Cedro et al.: 2007: 235, fig. 2H; Hajdu et al. 2011: 184. [Non *Haliclona* (*Reniera*) *manglaris* Alcolado, 1984; Nec *Haliclona manglaris* Cedro et al. 2007 MNRJ 10289 = *Haliclona* (*Reniera*) *chlorilla* Bispo et al., 2014]

Material examined

UFPEPOR 1450 (holotype) – Enseada dos Corais Beach (8°19’23”S 34°56’57”W), Cabo de Santo Agostinho (Pernambuco State, Brazil), 1 m depth, coll. U. Pinheiro & G.G. Santos, 26 November 2012. MNRJ 4165 – Iate Clube de Salvador (Todos os Santos Bay, ca. 13°00’01”S 38°31’54”W), Salvador (Bahia State, Brazil), ca. 3 m depth, coll. E. Hajdu, 06 July 2011. MNRJ 8394 – Pedra Grande, Off Jiribatuba, Ilha de Itaparica (ca. 13°04’22”S 38°47’52”W), Vera Cruz (Bahia State, Brazil), ca 0.5–2 m depth, coll. E. Hajdu, C. Santos & E. Esteves, 05 June 2004. MNRJ 10280 – Praia de Ponta Verde (coral reef, ca. 9°40’01”S 35°41’43’W), intertidal, coll. V.R. Cedro, 22 April 2005. MNRJ 17015 – Praia do Saco da Pedra (sandstone reefs, ca. 9°44’33”S 35°49’06”W), Marechal Deodoro (Alagoas State, Brazil), ca. 1 m depth, coll. V.R. Cedro & A. Bispo, 22 June 2013. MNRJ 17030 – Praia do Francês (sandstone reefs, ca. 9°45’54”S 35°50’04”W), Marechal Deodoro (Alagoas State, Brazil), ca. 0.5 m depth, coll. A. Bispo, 08 February 2012. MNRJ 17032 – Ponta do Prego (coral reef, ca. 9°31’48”S 35°35’30”W), Maceió (Alagoas State, Brazil), ca. 0.5 m depth, coll. A. Bispo, 11 January 2012. MNRJ 17230 – Angra dos Reis (coastal island, ca. 23°03’30”S 44°19’26”W), Angra dos Reis (Rio de Janeiro State, Brazil), 5 m depth, coll. E. Hajdu, 19 July 2013. MNRJ 17770 – Praia de Mundaú (sandstone reefs, ca. 3°10’21”S 39°21’22”), Trairi (Ceará State, Brazil), 0.5 m depth, coll. A. Bispo, 29 March 2014. MNRJ 18087 – Guamaré Harbour (ca. 5°06’22.5”S 36°19’03.4”W), Guamaré (Rio Grande do Norte State, Brazil), coll. A. Bispo, 04 April 2014. MNRJ 18109, 18133 –

Guamaré Harbour (ca. 5°06’22.5”S 36°19’03.4”W), Guamaré (Rio Grande do Norte State, Brazil), coll. E. Hajdu, 04 April 2014. UFALPOR 0157 – Jatiúca Reef (coral reef, ca. 9°39’14.56”S 35°41’50.05”W), Maceió (Alagoas State, Brazil), ca. 0.5 m depth, coll. V.R. Cedro, 05 May 2004. UFALPOR 0241 – Pajuçara Reef (coral reef, ca. 9°41’00.27”S 35°43’19.78”W), Maceió (Alagoas State, Brazil), ca. 0.5 m depth, coll. M.D. Correia, 08 March 2005. UFALPOR 0270 – Praia de Ponta Verde (coral reef, ca. 9°40’01”S 35°41’43’W), Maceió (Alagoas State, Brazil), 0.5 m depth, coll. V.R. Cedro, 22 April 2005. UFALPOR 0538 – Sauaçuí Reef (coral reef, ca. 9°29’32”S 35°33’16.5”W), Maceió (Alagoas State, Brazil), ca. 0.5 m depth, coll. M.D. Correia, 10 April 2009. UFALPOR 0769 – Ponta do Meirim (coral reef, ca. 9°32’35”S 35°36’49”W), Maceió (Alagoas State, Brazil), ca. 0.5 m depth, coll. A. Bispo, 10 January 2012. UFALPOR 0966 – Praia do Francês (sandstone reefs, ca. 9°45’54”S 35°50’04”W), Marechal Deodoro (Alagoas State, Brazil), ca. 0.5 m depth, coll. A. Bispo, 21 August 2013. UFALPOR 1028 – Galés de Maragogi (coral reefs, ca. 9°01'09.5"W 35°11'15"W), Maragogi (Alagoas State, Brazil), ca. 0.5 m depth, coll. M.D. Correia, 14 August 2014. UFPEPOR 680 – Camamu Bay (ca. 13°53'04"S 38°56'42"W), at Barra Grande (Bahia State, Brazil), collected at the beach-cast, coll. M. Amorim, U. Pinheiro & L. Docio, 18 May 2005. UFPEPOR 702 – Ilha do Contrato, Camamu Bay (ca. 13°51’19”S 39°00’15”W), Igrapiúna (Bahia State, Brazil), coll. L. Docio, depth and collection date unknown. UFPEPOR 708 – Ponta do Contrato, Camamu Bay (ca. 13°51’19”S 39°00’15”W), Igrapiúna (Bahia State, Brazil), collector, depth and collection data unknown.

Comparative material

Haliclona (*Reniera*) *manglaris*, fragment of the holotype IdO-403.

Diagnosis

The only *Cladocroce* with the combination of a tubulo-ramose or repent-branching shape, with a turquoise colour varying from shades of green to blue, and multispicular tracts (20-70 um in thickness) reinforcing both the ectosome and the choanosome, which is pierced by choanosomal spaces.

Description (Fig. 1)

A rather polymorphic species. Could exhibit a tubulo-ramose shape, with many rounded mounds/tubes, up to ca. 5 cm in height, with apices slightly swollen and an apical oscule, some of these tubes are laterally fused, and usually with lateral thorn-like prolongations in the distal parts (Fig. 1a–d, g). Other specimens are repent, with some small cylindrical branches usually anastomosing (Fig.1h, and MNRJ 17015), with oscula aligned in row, and flush with the surface or just slightly elevated. Many specimens produces long, thin branches proliferating from the main body (Fig. 1d, f, g). Oscula are circular to oval, 0.8–5.0 mm in diameter. Surface is smooth, even, slightly punctate in some specimens (Fig. 1c, d, g, h), some of the stout multispicular tracts are visible at the naked eye when the sponge is fragmented. Consistency vary from soft to slightly firm, but compressible. Colour alive is of different shades of turquoise (Fig. 1), varying from the green (Fig. 1d) to the ciano (Fig. f) side of the spectrum, with some specimens exhibiting both green and blue turquoise colours concomitantly (Fig. 1c, e, e1, g).

Skeleton (Fig. 1, 2)

Ectosome (Fig 1a, c, e, g): isotropic, unispicular, forming tri- to polygonal meshes, although in some specimens the spicules are mostly arranged in a confused manner (Fig. 1e). Multispicular tracts are also present in most of the sections, usually anastomosing (Fig. 1c, e). Choanosome (Fig. 1b, d, f, h): isotropic, confused, mostly unispicular, forming tri- to polygonal meshes, usually dense, although in some specimens it is more delicate. Stout multispicular tracts (usually more than 10 spicula, and varying from 20–70 µm in thickness) are also present in the choanosome, they could run paralell to the surface (Fig. 1d) in those specimens with lateral growing, or they could be loosely organized running towards the surface (Fig. 1b, h) or without a clear orientation (Fig. 1f). Also, some pauci-multispicular tracts occur as layer of growth. Choanosomal spaces are rather common.

Spicules (Fig. 3)

Oxeas, acerate or hastate, usually slightly curved, but straight forms are also present, 70–110 x 2.5–6.5 µm (Table 1).

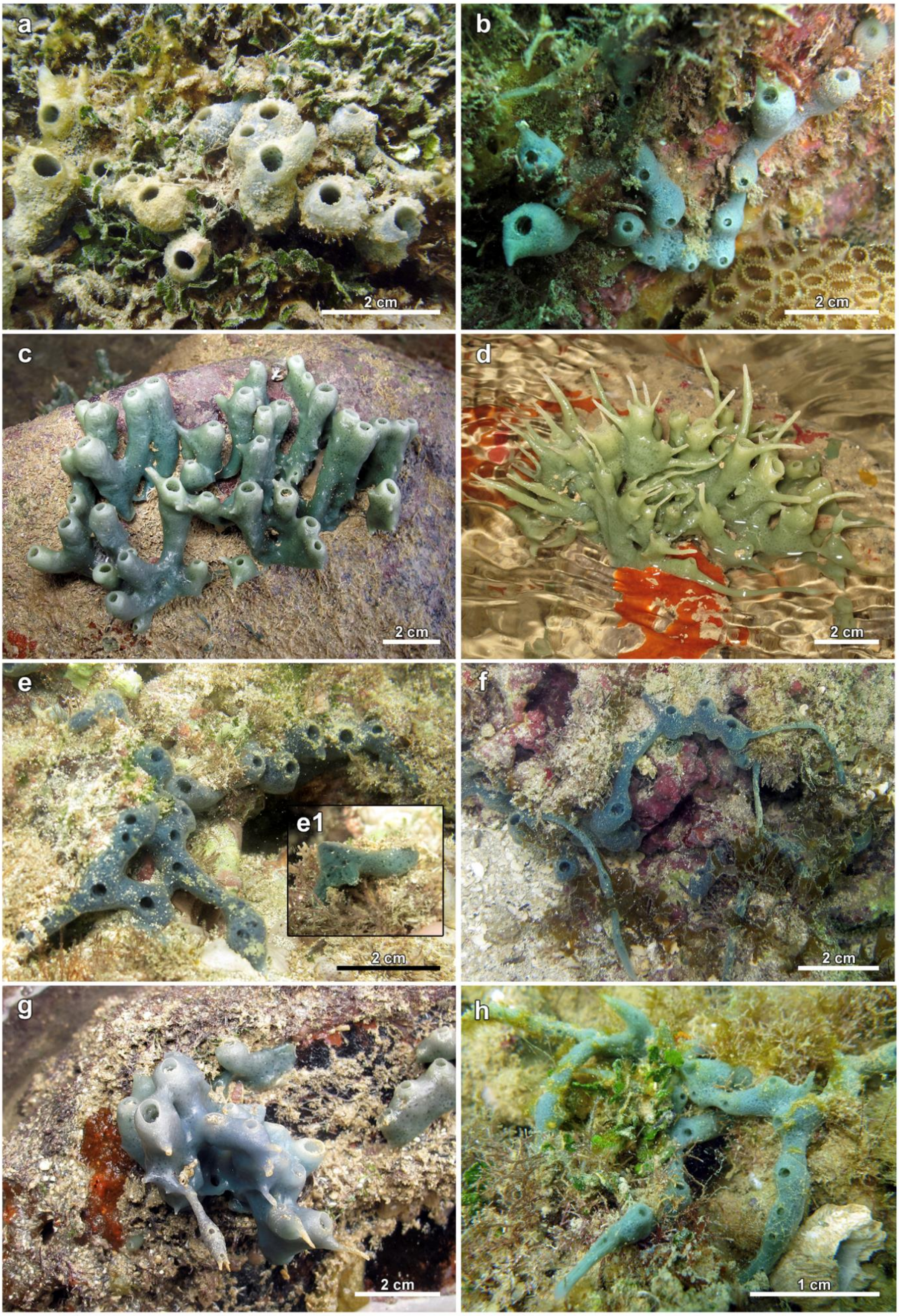


Figure 1. Morphological variability of *Cladocroce caelum* Santos, Silva, Alliz & Pinheiro, 2014. a–g. tubulo-ramose specimens (a, MNRJ 17032; b, MNRJ 17230; e, UFALPOR 1028) . h. branching/repent specimen (h, UFALPOR 0966).

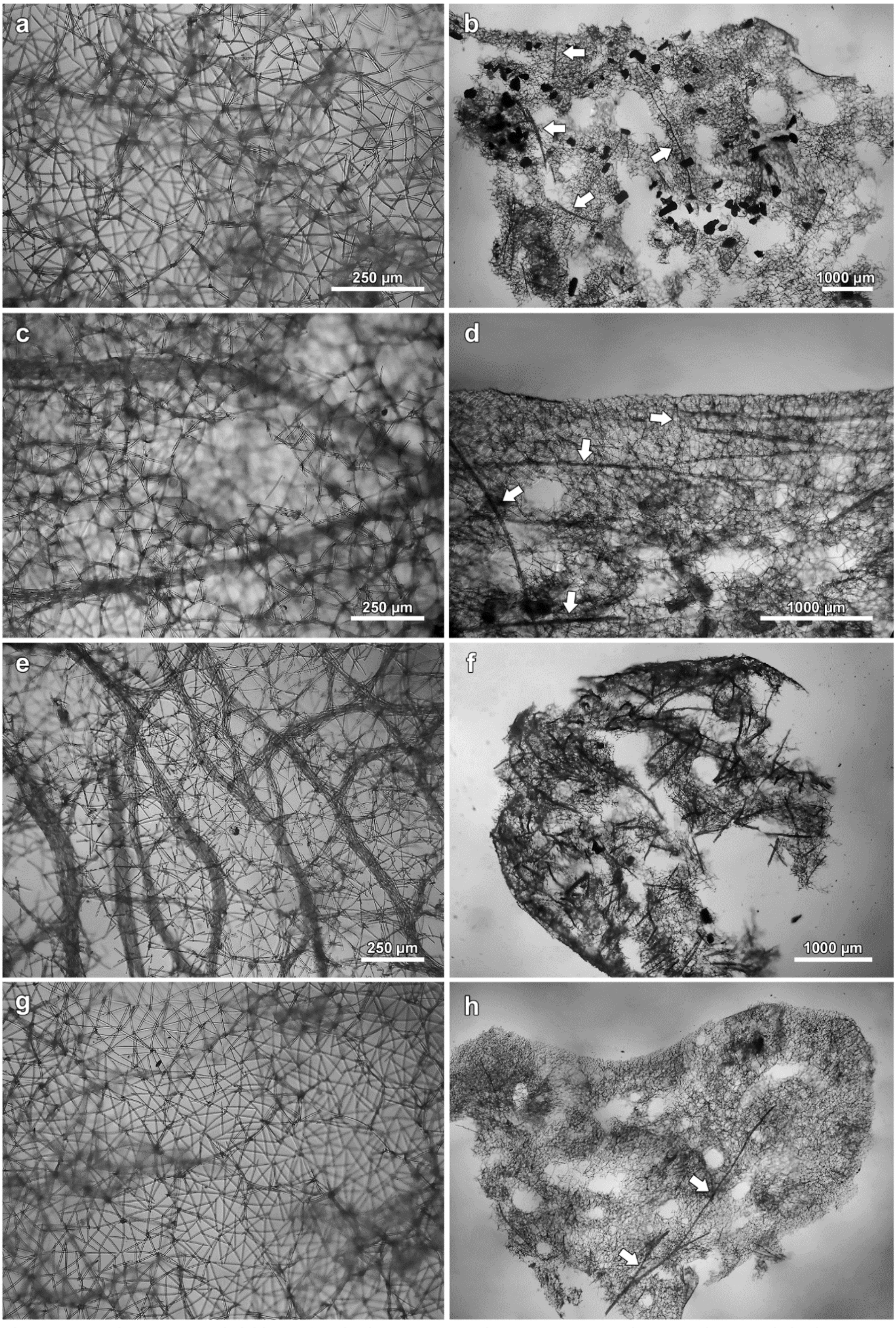


Figure 2. Skeletal variability of *Cladocroce caelum* Santos, Silva, Alliz & Pinheiro, 2014, sections at the left are from the ectosome, at the right are from the choanosome. a–b. UFALPOR 0769. c–d. UFALPOR 0966. e–f. UFPEPOR 680. g–h. MNRJ 17230.

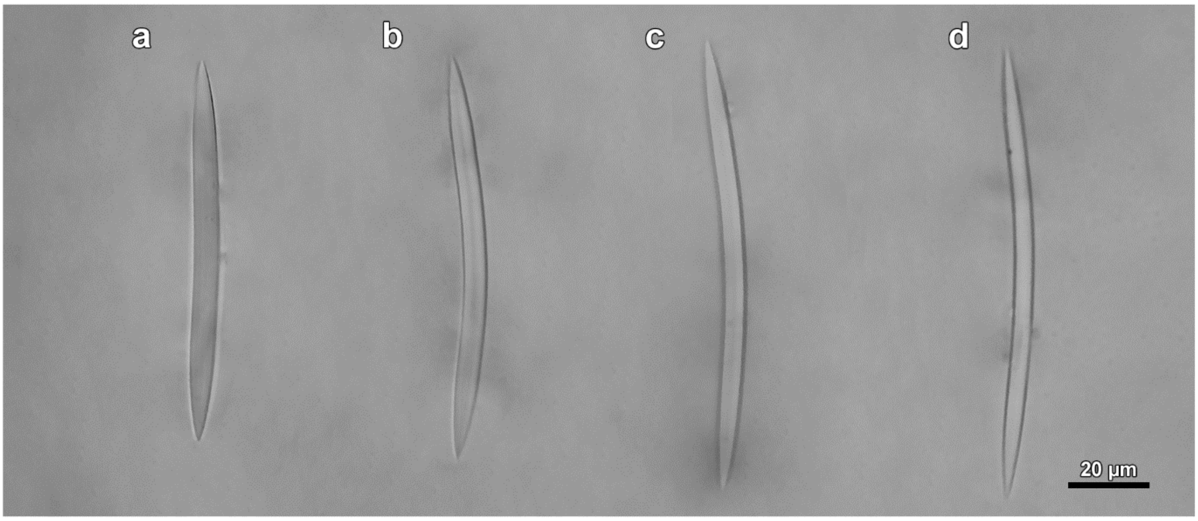


Figure 3. *Cladocroce caelum* Santos, Silva, Alliz & Pinheiro, 2014, oxeas. a. UFPEPOR 1450, holotype. b. UFALPOR 0966. c. MNRJ 17032. d. MNRJ 17230.

Table 1. *Cladocroce caelum* Santos, Silva, Alliz & Pinheiro, 2014, oxeas measurements.

Specimen	**Brazilian State**	**Oxea (µm)**
UFPEPOR 1450, holotype	Pernambuco	75–*84.8*–97.5 x 3.5–*4.5*–5.5
MNRJ 4165	Bahia	75–*79.7*–88 x 2.5–*3.1*–3.5
MNRJ 8394	Bahia	90–*95.8*–105 x 3–*4.6*–5.5
MNRJ 10280	Alagoas	80–*84.1*–90 x 2.5–*3.0*–4
MNRJ 17030	Alagoas	90–*98*–108 x 4–*4.8*–5
MNRJ 17032	Alagoas	88–*95.2*–103 x 2.5–*4.1*–5
MNRJ 17230	Rio de Janeiro	82.8–*90.9*–98.9 x 3.7–*4.4*–5.1
UFALPOR 0241	Alagoas	70–*78.1*–88 x 2.5–*3.3*–4.5
UFALPOR 0270	Alagoas	75–*86.4*–90 x 2.5–*3.3*–4
UFALPOR 0538	Alagoas	83–*88.9*–95 x 3–*4.1*–5.5
UFALPOR 0769	Alagoas	88–*97.4*–108 x 2.5–*4.6*–6
UFALPOR 0966	Alagoas	80–*95.8*–108 x 4.5–*5.4*–6.5
UFALPOR 1028	Alagoas	78.2–*86.5*–94.3 x 3.7–*4.2*–4.6
UFPEPOR 680	Bahia	85–*97.5*–110 x 3.5–*4.8*–5
UFPEPOR 702	Bahia	90–*97*–103 x 3–*4.4*–5
UFPEPOR 708	Bahia	88–*97.3*–110 x 3–*4.7*–5.5

Ecology

This species is a rather common in very shallow waters, at least in the Northeastern Brazil Ecoregion, occurring both in well-lit or shaded habitats in coral or sandstone reefs, as well as anthropogenic substrata.

Distribution (Fig. 4)

Widespread in the Brazilian coast, from 3°S to 27°S, in the following States: Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Bahia, and Rio de Janeiro. MEOW distribution: Northeastern Brazil Ecoregion, Eastern Brazil Ecoregion, and Southeastern Brazil Ecoregion.

Remarks

The boundaries between *Haliclona* and *Cladocroce* are subtle, both being only distinguished by the presence of multispicular tracts in the latter. Although, some species of *Haliclona* develop in variable degrees pauci- multispicular reinforcing tracts, such as *Haliclona* (*Reniera*) *tubifera* (*sensu* De Weerdt, et al., 1991; De Weerdt, 2000) and *Haliclona* (*Haliclona*) *urceolus* (*sensu* De Weerdt, 1986, 1987), these tracts does not reach the expected stoutness of *Cladocroce*'s tracts.

When studying the material identified by Cedro et al. (2007) as *Haliclona manglaris* and *Haliclona curacaoensis*, we noted the constant presence of stout multispicular tracts, a feature also observed in the fresh material we collected and in the additional material we studied in UFPEPOR.

For this reason, we were compelled to compare our specimens with the holotypes of *Cladocroce caelum* and *Haliclona* (*Reniera*) *manglaris*, and also with previous descriptions of *Haliclona* (*Reniera*) *manglaris* and *Haliclona* (*Rhizoniera*) *curacaoensis*. From our comparison, we concluded that our specimens are conspecific with *Cladocroce caelum* (see above).

Despite *H. curacaoensis* having paucispicular tracts, they are inserted in a (sub)anisotropic reticulation and connected by unispicular secondary lines, in contrast with the isotropic reticulation of *Cladocroce caelum* reinforced by stout multispicular tracts.

We found some loose multispicular tracts (ca. 20 µm in thickness) in the holotype of *H.* (*Re.*) *manglaris* (Fig. 5), but they never reach the length of the tracts of *Cladocroce caelum.* It is noteworth that the presence of multispicular tracts in *H. manglaris* had never been metioned in descriptions of the species in the Caribbean (De Weerdt et al., 1991; De Weerdt, 2000; Rützler et al., 2014), from which we can conclude that they are not conspicuous nor common. In addition, the skeleton of *H.* (*Re.*) *manglaris* is less regular than that of *C. caelum* (Fig. 6) and the oxeas thinner, although reaching similar lengths (71.3–85.1 x 1.4–2.8 µm in *H. manglaris*). Moreover,

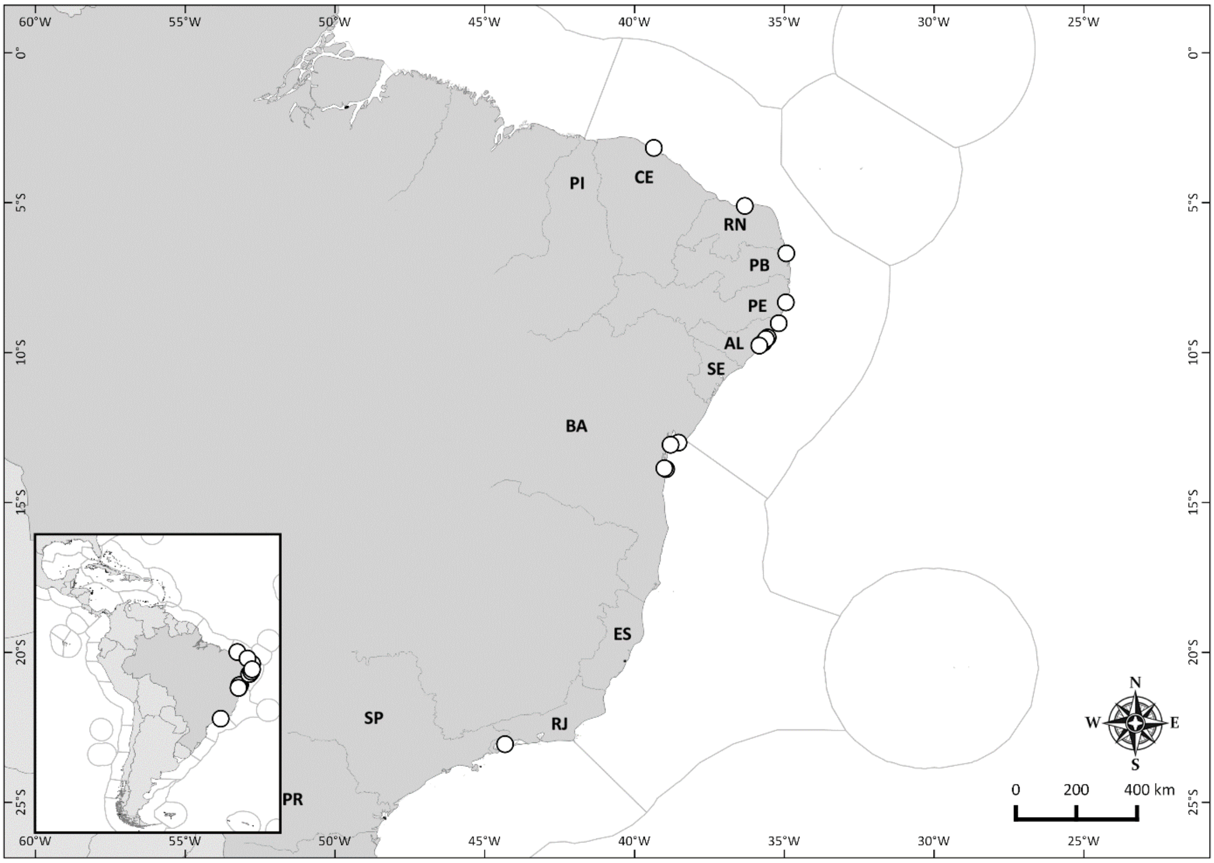


Figure 4. Geographic distribution of *Cladocroce caelum* Santos, Silva, Alliz & Pinheiro, 2014 in the Brazilian coast.

both species differs in shape and habit: being *H. manglaris* a predominantly thinly encrusting sponge, and with some low oscular elevations (up to 1.5 cm), while our material of *Cladocroce caelum* can exhibit a repent shape of cylindrical branches, and tubular mounds that can reach up to 5 cm. The preserved holotype of *H.* (*Re.*) *manglaris* also had a brown colour vs. the beige colour of preserved *Cladocroce caelum*, but we cannot state if this colour in *H. manglaris* is real or due to preservation problems.

We also examined a fragment of the holotype of *Cladocroce caelum*, that presents an isodictyal to isotropic ectosomal and choanosomal skeleton, being the latter reinforced by multispicular tracts that sometimes anastomose (Fig. 6), the spicula measurement also fits very well with our specimens. From which we concluded that both species are clearly conspecific.

Discussion

Our results demonstrated that both records of *Haliclona* (*Reniera*) *manglaris* and *Haliclona* (*Rhizoniera*) *curacaoensis* from the Brazilian coast are not valid. Indeed, they correspond to the recently described *Cladocroce caelum*.

If previously thought to be a species with distribution restricted to the shallow reefs off the coast of Paraíba and Pernambuco States (Northeastern Brazil Ecoregion), *Cladocroce caelum* is now considered to be a species widely distributed in the Brazilian coast, occurring from Ceará State (3°S) down to Rio de Janeiro State (23°S).

The known morphological variability of *Cladocroce caelum* is also expanded, showing a greater variation in colour and shape. For a detailed comparison of *Cladocroce caelum* with its congeners, see Santos & Pinheiro (2014).

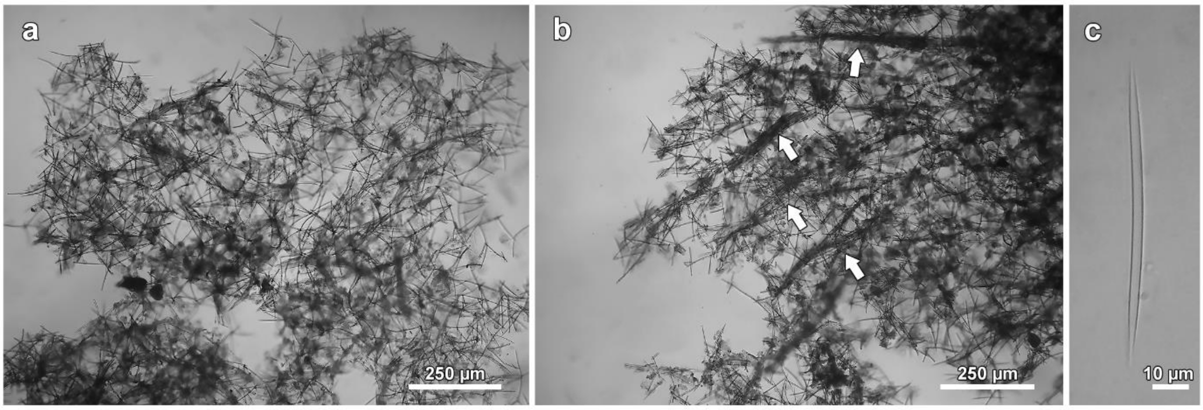


Figure 5. *Haliclona* (*Reniera*) *manglaris* Alcolado, 1984, holotype. a. ectosomal skeleton. b. choanosomal skeleton, with white arrow indicating the loose multispicular tracts.. c oxea.

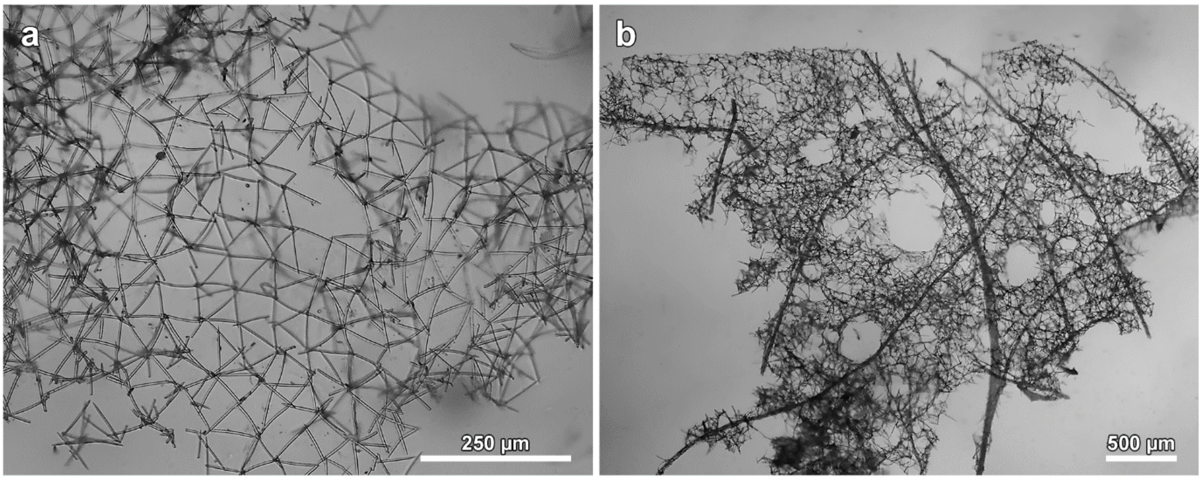


Figure 6. *Cladocroce caelum* Santos, Silva, Alliz & Pinheiro, 2014, holotype. a. ectosomal skeleton. b. choanosomal skeleton, showing the conspicuous multispicular tracts.

Acknowledgments

The authors would like to express their gratitude to Prof. Pedro Alcolado and Prof. Carla Menegola for kindly provide a fragment of the holotype of *H. manglaris*, while Prof. Ulisses Pinheiro and MSc George Santos are also thanked by donating a fragment of the holotype of *C. caelum* and for their hospitality during the visit of AB in the UFPEPOR. MSc Camille Leal and MSc Cristiana Castello Branco are also thanked for their valuable help for consulting the database of MNRJ Porifera Collection. CAPES is thanked for providing a master scholarship for AB.

References

Aguilar-Camacho JM, Carballo JL. 2010. First record of *Cladocroce* (Porifera: Haplosclerida: Chalinidae) from the Eastern Pacific ocean with the description of *Cladocroce reina* sp. nov.. Zootaxa 2603:65-68.

Alcolado PM. 1984. Nuevas especies de esponjas encontradas en Cuba. Poeyana 271:1-22.

Bispo A., Correia MD, Hajdu E. 2014. Two new shallow-water species of *Haliclona* from the north-eastern Brazil (Demospongiae: Haplosclerida: Chalinidae). Journal of the Marine Biological Association of the United Kingdom, 1–13. http://dx.doi.org/10.1017/S0025315414000344

Cedro VR, Hajdu E, Sovierzosky HH, Correia MD. 2007. Demospongiae (Porifera) of the shallow coral reefs of Maceió, Alagoas State, Brazil. In: Custódio MR, Lôbo-Hajdu G, Hajdu E, Muricy G, editors. Porifera research: biodiversity, innovation and sustainability. Rio de Janeiro: Museu Nacional, p 233–237.

De Weerdt WH. 2000. A monograph of the shallow-water Chalinidae (Porifera, Haplosclerida) of the Caribbean. Beaufortia 50:1-67.

De Weerdt WH. 2002. Family Chalinidae. In: Hooper JNA, Van Soest RWM, editors. Systema Porifera: A guide to the supraspecific classification of the phylum Porifera. New York: Kluwer Academic/Plenum Publishers, p 852-873.

De Weerdt WH, Rützler K, Smith KP. 1991. The Chalinidae (Porifera) of Twin Cays, Belize, and adjacent waters. Proceedings of the Biological Society of Washington 104:189-205.

Fromont J. 1993. Descriptions of species of the Haplosclerida (Porifera: Demospongiae) occurring in tropical waters of the Great Barrier Reef. The Beagle, Records of the Northern Territory Museum of Arts and Sciences 10(1):7-40.

Hajdu E, Peixinho S, Fernandez JCC. 2011. Esponjas marinhas da Bahia: guia de campo e laboratório (Série Livros 45). Rio de Janeiro: Museu Nacional. 276 pages.

Lehnert H, Stone RP. 2013. Four new species of Haplosclerida (Porifera, Demospongiae) from the Aleutian Islands, Alaska. Zootaxa 3700(4):573-582.

Pulitzer-Finali G. 1982. Some new or little-known sponges from the Great Barrier Reef of Australia. Bollettino dei Musei e degli Istituti Biologici della (R.) Università di Genova 48-49:87-141.

Pulitzer-Finali G. 1993. A collection of marine sponges from East Africa. Annales Museo Civico Storia Naturale "Giacomo Doria" 89:247-350.
Putchakarn S, De Weerdt WH, Sonchaeng P, Van Soest RWM. 2004. A new species of *Cladocroce* Topsent, 1892 (Porifera, Haplosclerida) from the Gulf of Thailand. Beaufortia 54(9):113-116.
Santos GG, Silva LP, Alliz A, Pinheiro U. 2014. *Cladocroce caelum* sp. nov. from the Brazilian coast; first record of the genus in the South Atlantic. Zootaxa 3847(2):297-300.

Sullivan-Sealey K, Bustamante G. 1999. Setting Geographic Priorities for Marine Conservation in Latin American and the Caribbean. Arlington (VA): The Nature Conservancy. 125 pages.

Spalding MD, Fox HE, Allen GR, Davidson N, Ferdaña ZA, Finlayson M et al. 2007. Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. BioScience 57(7):573-583.

Topsent, E. 1890. Notice préliminaire sur les spongiaires recueillis durant les campagnes de l'Hirondelle. Bulletin de la Société zoologique de France 15: 26-32, 65-71.

Topsent E. 1892. Contribution à l’étude des Spongiaires de l’Atlantique Nord (Golfe de Gascogne, Terre-Neuve, Açores). Résultats des campagnes scientifiques accomplies par le Prince Albert I. Monaco 2:1-165, pls I-XI.

Van Soest RWM, Boury-Esnault N, Hooper JNA, Rützler K, De Voogd NJ, Alvarez de Glasby B et al. (2014) World Porifera database http://www.marinespecies.org/porifera/porifera.php?p=taxdetails&id=131832
(accessed 23 January 2015).

Van Soest RWM. 1980. Marine sponges from Curaçao and other Caribbean localities. Part II. Haplosclerida. Studies on the Fauna of Curaçao and other Caribbean Islands 62:1-173.

6 DISCUSSÃO GERAL[1]

O presente trabalho representa uma importante contribuição para a taxonomia das esponjas do gênero *Haliclona* no Brasil.

Enquanto que no início desta pesquisa havia apenas 9 espécies desse gênero formalmente conhecidas para as águas rasas brasileiras (CEDRO *et al.*, 2007; MOTHES & LERNER, 1994; MURICY & RIBEIRO, 1999; MURICY *et al*. 2011). Hoje, esse número subiu para 16 espécies.

Os artigos 1, 2 e 3 são contribuições que juntas apresentam a descrição de 9 novas espécies de *Haliclona*. O artigo 3 também apresenta descrições detalhadas de todas as espécies conhecidas para as águas rasas brasileiras, incluindo a redescrição do material tipo de espécies pouco conhecidas, descrição e ilustração da variabilidade morfológica, mapas de distribuição e uma chave para a identificação de todas espécies estudadas. Várias espécies tiveram área conhecida de distribuição ampliada, como é o caso de *H.* (*Rhizoniera*) *mammillaris*, que pensava-se ser endêmica da costa de Santa Catarina (MOTHES & LERNER, 1994; MURICY *et al*. 2011), porém agora passa a ter registro até a costa do Ceará. As espécies *Haliclona catarinensis* e *Haliclona lilacea* passaram a ser incluídas no subgênero *Rhizoniera* Os artigos 1 e 3 também superam um pouco do impedimento taxonômico, pois em razão da falta de especialistas dedicados à taxonomia de Chalinidae, diversas espécies coletadas há vários anos somente agora receberam ou receberão um nome formal, como é o caso de *Haliclona* (*Haliclona*) sp. nov, *H.* (*Reniera*) *chlorilla* Bispo *et al*. 2014, *Haliclona* (*Soestella*) sp. nov., e *H.* (*Soestella*) *peixinhoae* Bispo *et al.* 2014

O artigo 4 invalida os registros anteriores de *H. curacaoensis* e *H. manglaris* para a costa brasileira, concluindo que ambos pertencem a uma mesma espécie de um gênero próximo: *Cladocroce caelum* Santos *et al.*, 2014. Em consequência, ampliou-se a distribuição geográfica e a variabilidade morfológica conhecida dessa espécie.

---

[1] A estrutura e normas de citação deste capítulo seguem mas normas do periódico **Zoologia**.

REFERÊNCIAS

BISPO, A.; CORREIA, M.D. & HAJDU, E. 2014.Two new shallow-water species of Haliclona from the north-eastern Brazil (Demospongiae: Haplosclerida: Chalinidae). **Journal of the Marine Biological Association of the United Kingdom**, 13 pp. http://dx.doi.org/10.1017/S0025315414000344

CEDRO, V.R.; HAJDU, E.; SOVIERZOSKY, H.H. & CORREIA, M.D. 2007. Demospongiae (Porifera) of the shallow coral reefs of Maceió, Alagoas State, Brazil, p. 233-237. *In*: M.R. CUSTÓDIO, G. LÔBO-HAJDU, E. HAJDU & G. MURICY (Eds.). Porifera research: biodiversity, innovation and sustainability. Rio de Janeiro: Museu Nacional.

MOTHES, B. & LERNER, C.B. 1994. Esponjas marinhas do infralitoral de Bombinhas (Santa Catarina, Brasil) com descrição de três espécies novas (Porifera: Calcarea e Demospongiae). **Biociências 2**: 47-62.

MURICY, G. & RIBEIRO, S.M. 1999. Shallow-water Haplosclerida (Porifera, Demospongiae) from Rio de Janeiro State, Brazil (Southwestern Atlantic). **Beaufortia 49**: 83-108.

MURICY, G.; LOPES, D.A.; HAJDU, E.; CARVALHO, M.S.; MORAES, F.C.; KLAUTAU, M.; MENEGOLA, C. & PINHEIRO, U. (2011) Catalogue of Brazilian Porifera. Rio de Janeiro: Museu Nacional, 299 pp. [Série Livros n°46]

SANDES, J.; BISPO, A. & PINHEIRO, U. 2014. Two new species of *Haliclona* Grant, 1836 (Haplosclerida: Chalinidae) from Sergipe State, Brazil. **Zootaxa 3793** (2): 273-280.