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LARISSA BETTCHER BRITO

INVENTÁRIO DOS PORÍFEROS DO ENTREMARÉS DA COSTA DO DESCOBRIMENTO (BAHIA)

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Dissertação apresentada à Coordenação do Programa de Pós-Graduação em Biologia Animal, da Universidade Federal de Pernambuco, como parte dos requisitos necessários à obtenção do título de Mestre em Biologia Animal

Orientador: Dr. Ulisses dos Santos Pinheiro

Co-orientador: Dr. Eduardo Carlos Meduna Hajdu

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“Todas as vitórias ocultam uma abdicação” (Simone de Beauvoir)

RESUMO

O Filo Porifera é considerado o grupo de metazoário mais antigo vivente. São encontrados tanto em ambientes dulciaquícolas como marinhos, da zona entremarés até a abissal, assim como das regiões polares às tropicais. Atualmente há mais de 9507 espécies de poríferos consideradas válidas. O grupo apresenta diversas funções ecológicas, fisiológicas e até mesmo servir de abrigo para outros animais. No Brasil há cerca de 603 registros válidos de espécies de poríferos, dos quais mais de 150 foram efetuados para o Estado da Bahia, mas acredita-se que esse número está subestimado. Para a Costa do Descobrimento há apenas 16 registros de espécies, estando nitidamente subamostrada. O presente trabalho tem como objetivo realizar o inventário de poríferos no entremarés dos recifes de Porto Seguro e Santa Cruz Cabrália. As coletas foram realizadas em quatro arrecifes localizados em Porto Seguro e Santa Cruz Cabrália. Foram coletados 205 espécimes, gerando um total de 101 espécies de esponjas, das quais 41 estão a nível de gênero. Além disso, foram identificados 6 novos registros de espécies para o Brasil sendo eles: *Prosuberites laughlini, Cliona amplicavata, Cliona* cf. *mucronata*, *Haliclona* (*Halichoclona*) *albifragilis, Haliclona* (*Reniera*) *tubífera* e *Halisarca caerulea*. Além de um registro de espécie criptogênica ocorrendo na costa brasileira, que também é registrada originalmente para o Havai, a *Haliclona* (*Reniera*) *laubelfelsi.* Concluímos o trabalho com a realização de um guia de identificação de esponjas para a Costa do Descobrimento, que será disponibilizado online. Esse estudo fornece dados para a gestão das unidades de conservação locais, e para o monitoramento ambiental das praias apontando a diversidade de espécies de poríferos presentes no entremarés.

Palavras-chave: Porifera; Costa do Descobrimento; águas rasas; faunística.

ABSTRACT

The Phylum Porifera is considered to be the oldest living metazoan group. They are found in both freshwater and marine environments, from the intertidal to the abyssal zone, as well as from the polar to tropical regions. Currently there are more than 9507 species of porifera considered valid. The group has several ecological and physiological functions, and even serves as shelter for other animals. In Brazil there are about 603 valid records of porifera species, of which than 150 were made for State of Bahia, but it is believed that this number is underestimated. For the Discovery Coast there are only 16 species records, being clearly under-sampled.which are understudied. The present work aims to make an inventory of porifera in the intertidal reefs of Porto Seguro and Santa Cruz Cabrália. The collections were done in four reefs located in Porto Seguro and Santa Cruz Cabrália. A total of 205 specimens were collected, generating a total of 101 sponge species, 41 of which are at the genus level. In addition, 6 new species records were identified for Brazil: *Prosuberites laughlini*, *Cliona amplicavata*, *Cliona* cf. *mucronata*, *Haliclona* (*Halichoclona*) *albifragilis*, *Haliclona* (*Reniera*) *tubifera* and *Halisarca caerulea*. Besides a record of a cryptogenic species occurring on the Brazilian coast, which is also originally recorded for Hawaii, *Haliclona* (*Reniera*) *laubelfelsi*. We concluded the work by producing a sponge identification guide for the Costa do Descobrimento, which will be made available online. This study provides data for the management of the local protected areas, and for the environmental monitoring of the beaches, pointing out the diversity of porifers species present in the intertidal area.

Keywords: Porifera; Discovery Coast; shallow waters; fauna.

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1 INTRODUÇÃO

As esponjas (Filo Porifera) são consideradas o grupo de metazoário mais antigo vivente (MÜLLER, 1998). Esses animais são encontrados tanto em ambientes dulciaquícolas como marinhos, da zona entremarés até a abissal, assim como das regiões polares às tropicais (HAJDU *et al*., 2011; VAN SOEST et al. 2012). Atualmente há mais de 9507 espécies (DE VOOGD et al., 2022) de poríferos consideradas válidas, divididas em quatro classes viventes: Calcarea, Demospongiae, Hexactinellida e Homoscleromorpha (HOOPER & VAN SOEST, 2002; GAVAZE et al., 2010; DE VOOGD et al., 2022). Dentre essas, Demospongiae é a mais diversa e abundante, abarcando cerca de 80% das espécies descritas até o presente (MURICY et al., 2008; VAN SOEST et al., 2012).

A taxonomia do grupo se dá a partir de estudos de sua morfologia, conjunto espicular e do esqueleto dos organismos (BOURY-ESNAULT & RÜTZLER 1997), outras características também são utilizadas como coloração in vivo, forma, consistência, superfície da esponja, entre outras características visíveis, porém com o avanço da tecnologia, novos estudos como genéticos e bioquímicos estão sendo feitos para testarem hipóteses da taxonômicas e confirmar a identificação ao nível de espécie desses organismos (HOOPER et al., 2021).

O filo possui muitas características fisiológicas diferentes de outros organismos, com apenas um sistema aquífero lhe é garantido alimentação, a partir da filtração de partículas em suspensão na água, excreção e absorção de oxigênio. Devido a esse mecanismo, as esponjas são consideradas peças chave na ciclagem de nutrientes, ao transformarem a matéria orgânica dissolvida (MOD) em matéria orgânica particulada (MOP), possibilitando que organismos detritívoros se alimentem dessas partículas, retendo nutrientes como carbono, nitrogênio e fósforo dentro do ambiente (FOLKERS & ROMBOUTS 2020).

O grupo das esponjas além de promover uma ligação dos ecossistemas bentônicos e pelágicos (HOOPER et al., 2021), também fornece um habitat para crustáceos, moluscos, ofiuróides, peixes e bactérias (DIAZ & RÜTZLER, 2001; WEISZ et al., 2007). Além do mais, são conhecidas por apresentarem uma grande importância ecológica no ambiente aquático, sendo muitas vezes consideradas ótimas biorremediadoras, capturando as partículas em suspensão na água (PEREZ et al., 2004). Algumas espécies suportam viver em ambientes poluídos (DIAZ & RÜTZLER, 2001), o que nos mostra a grande importância e abrangência de estudos que podem ser feitos com esses organismos.

Esponjas são os principais responsáveis pela bioerosão dos substratos calcários (principalmente espécies da família Clionaidae; RÜTZLER, 1975), sendo, portanto, elementos chave na dinâmica de recifes de coral, os quais não apenas fragilizam através da bioerosão, mas também cimentam pela aglutinação de detrito durante seu crescimento (DIAZ & RÜTZLER, 2001). O uso de poríferos como biomonitores de qualidade ambiental já foi proposto por alguns autores, onde notou-se o acúmulo de substâncias no tecido das esponjas (WULFF, 2001; PEREZ et al., 2004). E também é usada para extração de compostos químicos sintetizados para medicamentos humanos (MEHBUB et al., 2014).

A região de entremarés ou zona intertidal, região localizada entre a zona do supralitoral e infralitoral (COUTINHO & ZALMON 2009), é um ambiente que apresenta uma variação do nível da água do mar. Ou seja, é o local onde fica submersa em maré alta e depois essa maré diminui, expondo parcialmente ou totalmente o recife. Consequentemente, podendo ocorrer bruscas alterações na temperatura e salinidade. Sua diversidade é frequentemente alta nesses níveis médios de perturbação, com espécies adaptadas às condições (CONNEL 1978; MASI & ZALMON 2008). Muitos estudos são realizados neste tipo de ambiente, mas no geral não é elaborada uma lista de espécies que ocorrem em determinado recife, apenas são descritos registros ou espécies novas que são frequentemente encontradas e descritas, porém os trabalhos são publicados em manuscritos separados e não um checklist (por ex: SANTOS et al. 2014a, 2014b, 2018; CAVALCANTI et al. 2016, 2018, 2019).

O Brasil se destaca em número de autores, assim como um grande número de novas espécies descritas, registradas e catalogadas, aumentando assim a riqueza conhecida da espongiofauna do Atlântico Sudoeste Tropical (HOOPER et al., 2021). De acordo com MURICY (2022) há 603 registros válidos de espécies de poríferos para o Brasil, 122 dessas sendo endêmicas. Mais de 150 destes foram efetuados para o Estado da Bahia, porém estima-se que ocorram duas a três vezes mais espécies nesta área (MÁCOLA & MENEGOLA, 2018), o que se explica em parte pelas extensas formações coralíneas presentes neste segmento do litoral brasileiro (HAJDU et al., 2011).

O litoral da Bahia possui cerca de 1075 km de extensão (IBGE, 2021), sendo um dos maiores estados do Brasil e o maior litorâneo. É subdividido em setores: Norte, Salvador/Baía de Todos os Santos, e Sul.

A riqueza conhecida de poríferos de cada setor é de cerca de 120, 90 e 65 espécies, respectivamente. Há uma maior concentração de estudos na Bahia de Todos os Santos, deixando outros setores subamostrados quanto à espongiofauna local. O setor Sul inclui a Costa do Descobrimento (Belmonte, Santa Cruz Cabrália e Porto Seguro) e Costa das Baleias (Caravelas, Prado e Alcobaça). Apenas 22 espécies de poríferos estão registradas na Costa do Descobrimento (HAJDU et al., 2011; MURICY et al., 2011 CAVALCANTI *et al.* 2014; OLIVEIRA *et al.* 2015) estando nitidamente subamostrada. Nota-se assim uma grande necessidade de ampliação do esforço de coleta e identificação dos poríferos presentes nesta área, onde ocorrem as principais formações recifais da Costa do Descobrimento.

Há diversos rios que desembocam no litoral da Bahia, onde são destacados seis, sendo dois deles: Pardo e o Jequitinhonha grandes fontes de transporte de material siliciclástico e grandes quantidades de sedimentos. Os demais rios: Itapicuru, Paraguaçu, Contas e Mucuri, possuem vazões menores e a contribuição dos depósitos fluviais é ainda menor na região sul da Bahia (DOMINGUEZ et al., 2016).

As unidades municipais de conservação marinha em Santa Cruz Cabrália e Porto Seguro assim como as praias na costa são alvo de intensa visitação turística, bem como de pesca de subsistência, inclusive através de pisoteamento do recife por marisqueiros. Estudos concluíram que os recifes de Coroa Alta e Recife de Fora, bem como recifes adjacentes tais como Ponta Grande, apresentam contaminação por esgoto e metais pesados em diferentes graus de concentração (COSTA JR., 2007;), com maior relevância para chumbo (Pb) e cobre (Cu) nas áreas mais costeiras (MARQUES et al., 2019).

O estudo proposto aqui fornece dados para a gestão destas unidades de conservação, e monitoramento ambiental das praias apontando a riqueza de espécies de poríferos presentes no entremarés. Essa riqueza poderá ser contrastada àquela de outras localidades do Brasil e do exterior, em um programa de monitoramento de longo prazo de impactos antrópicos na área. Paralelamente permite uma melhor compreensão dos padrões de distribuição de espécies recifais de poríferos no nordeste brasileiro, essencial a programas de ciência aplicada, tais como os de bioprospecção de compostos naturais.

2 OBJETIVO GERAL

Realizar o inventário de poríferos no entremarés dos recifes de Porto Seguro e Santa Cruz Cabrália;

2.1. OBJETIVOS ESPECÍFICOS

(I) Identificar as espécies de poríferos encontradas na região;

(II) Caracterizar ou descrever novos registros para a Bahia;

(III) Elaborar um guia de identificação para as espécies encontradas;

3 MATERIAL E MÉTODOS

3.1. ÁREA DE ESTUDO

A Costa do Descobrimento, região litorânea, possui cerca de 100 km, menos de um décimo da extensão do estado, porém abriga os recifes de corais menos estudados da Bahia até o momento (COSTA JR et al., 2020a). O relevo da região é constituído por: embasamento, os tabuleiros costeiros e as planícies quaternárias, sendo as principais unidades geológicas – geomorfológicas. A zona costeira possui recifes de corais formados por terraços de abrasão que ocorrem adjacentes à praia e arenito também adjacentes à costa e frequentemente encontram-se submersos durante a maré alta, esses recifes muitas vezes abrigam uma diversidade de corais, bryozoa, esponjas e algas (SILVA, 2008; obs. pessoal). Já os sedimentos encontrados nas praias podem ser muito finos a grossos, predominando areia entre média e grossa.

Os recifes planos emergem durante o período de maré baixa (6-9 horas por dia), são aqueles recifes em que são formados de rochas fragmentadas (COSTA JR et al., 2000a). A região possui recifes em várias áreas ao longo de sua extensão, não sendo uma plataforma única.

Os principais recifes da Costa do Descobrimento situam-se nos municípios de Santa Cruz Cabrália e Porto Seguro, onde ocorrem estruturas costeiras (Recifes de Coroa Vermelha e de Arraial D'Ajuda), e bancos recifais afastados das praias (Recife da Coroa Alta e Recife de Fora) (FIGURA 1). O trabalho se concentrou nesses recifes, onde os dois afastados constituem unidades municipais de conservação e todos eles são pontos com visitação turística intensa.

Arraial D'Ajuda e Coroa Vermelha são recifes que ocorrem junto à praia, formando estruturas descontínuas paralelas à costa do litoral e que sofrem influência do rio Buranhém. Coroa Vermelha possui uma influência de uma aldeia local, que devido à falta de tratamento de esgoto, os resíduos são jogados em fossas sépticas que se encontram muito próximo ao mar, essa água indo de encontro ao mar e levando muita matéria orgânica, pode estar contaminando as águas subterrâneas (COSTA JR et al., 2000a; COSTA JR et al., 2000b). Em adição a isto ainda é um dos principais locais de captura de polvo por pescadores da Associação Indígena de Coroa Vermelha, ou por pescadores que moram nas proximidades de Santa Cruz Cabrália (ZILBERBERG et al., 2016).

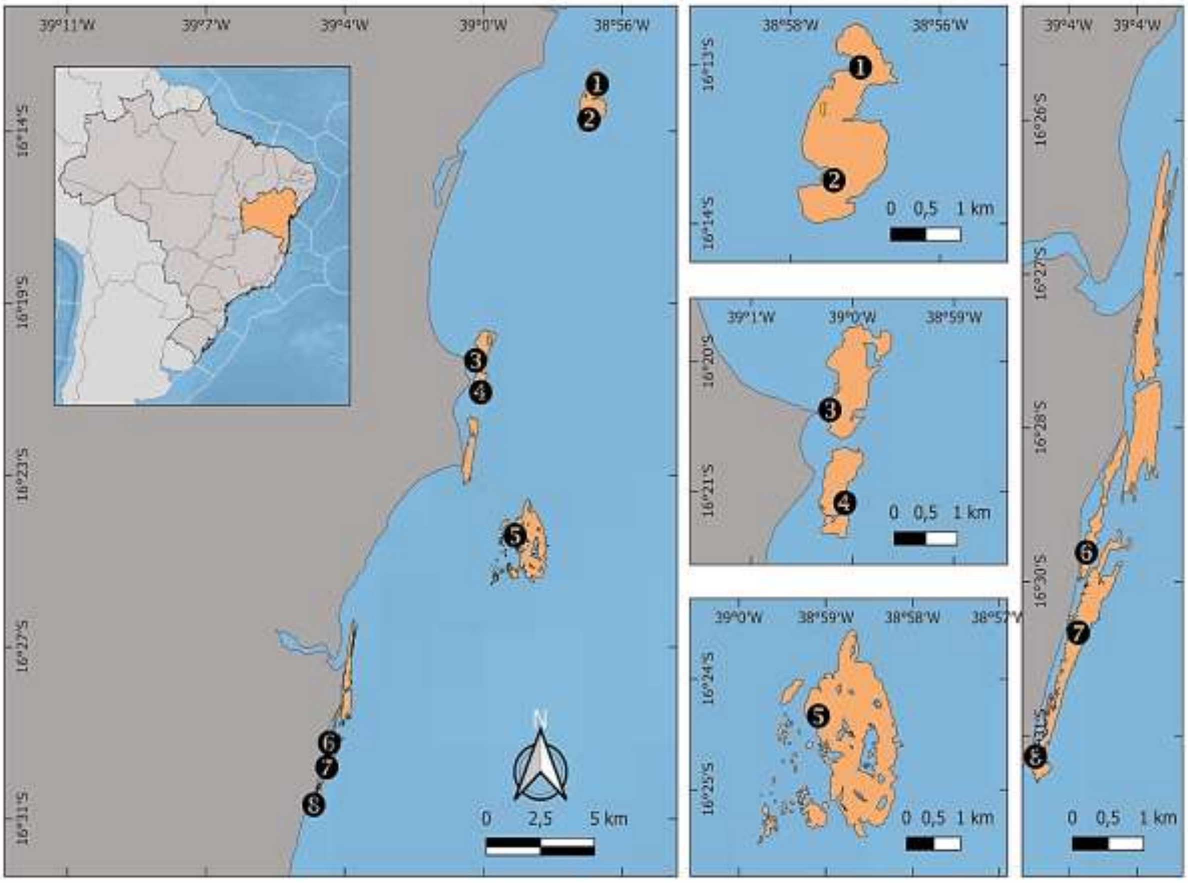
Os recifes de Coroa Vermelha e Mutá são platôs de recifes retangulares que excedem 6 km com profundidades de 10 m no setor mais externo, e cerca de 1 ou 2 m no entre os platôs. E ainda possui um canal de areia que os isola da costa, também com profundidade de 1 ou 2 m (LABOREL–DEGUEN et al., 2019).

O Parque Municipal Marinho da Coroa Alta (Santa Cruz Cabrália) foi criado em 1998, com uma área de 61,5 km², que incluem dois conjuntos de formações recifais principais; o recife da Coroa Alta e o recife do Araripe, ambos possuem descarga dos rios João de Tiba e Santo Antônio. Os recifes encontram-se a aproximadamente 3,5 km da praia, com uma frequente visitação turística. Este recife apresenta uma formação mista de recifes e bancos de areia (BRASIL, MMA 2018; ZILBERBERG et al., 2016).

O Parque Municipal Marinho do Recife de Fora localizado no litoral do município de Porto Seguro foi criado em 1997, engloba cerca de 17,5 km^2, com uma única formação recifal. Este recife possui influência direta da água doce e sedimentos oriundos do Rio Buranhém. Este parque se localiza a cerca de 6 km da praia ou 5 milhas náuticas com embarcação saindo do píer da cidade, sendo visitado por cerca de 400 turistas diariamente. Isso faz com que o local sofra de constante estresse físico, além de ser um dos locais onde pescadores cadastrados na Colônia de Pescadores frequentam (ZILBERBERG et al., 2016).

Recife de Fora pode ser dividido em oito feições: face abrigada voltada para o continente com alta declividade; face exposta onde sofre intensa influência das ondas e da maré; platô recifal a parte do topo da superfície, que sofre mudança de salinidade e temperatura devido a alteração das marés; lençóis de areia que ficam expostos durante a maré baixa geralmente protegidas da ação das ondas; piscinas de maré que são depressões ou descontinuidades do platô recifal que em maré baixa ficam expostas; canal localizado na porção sul representa um evento regressivo ao atual nível do mar; recife em manchas são áreas desprendidas do recife na porção abrigada e com habitat de diferentes formações; cabeço algálico é a porção composta por algas calcáreas e que contornam o recife principal, sendo mais predominante na face exposta (ZILBERBERG et al., 2016).

Figura 1 - Mapa mostrando a localização da Costa do Descobrimento no sul da Bahia (Brasil), e de todos os recifes inseridos neste estudo **1–2**, Parque Municipal Marinho (P.M.M.) Coroa Alta (CA); **3–4**, Coroa Vermelha/Mutá (CVM); **5**, P.M.M. Recife de Fora (RF); **6**, Praia dos Pescadores Beach, Arraial D’Ajuda (AA); **7**, Mucugê Beach, Arraial D’Ajuda (AA) and **8**, Pitinga Beach, Arraial D’Ajuda (AA).



Fonte: André Bispo (2022)

3.2. MATERIAL ESTUDADO

O material analisado encontra-se depositado na Coleção de Poríferos do Museu Nacional/UFRJ, coletados pela equipe do Laboratório de Taxonomia de Porifera (TAXPO) entre os meses de março e maio de 2019, na região de entremarés, em período em que a maré estivesse bem baixa (0,0; 0,1; 0,2). Os espécimes, 205 MNRJ’s, foram coletados com auxílio de facas/marretas no período de maré baixa, fotografados *in situ* com câmeras portáteis, fixados em etanol 96%, e preservados a 80% posteriormente em laboratório. Um fragmento dos exemplares foi retirado e fixado em RNALater (a -20ºC) para possíveis análises moleculares futuras.

Para análise de caracteres morfológicos das esponjas, foi retirado um fragmento dos espécimes incluindo ectossoma e coanossoma para a dissociação de espículas em microtubo com ácido nítrico e colocado em banho seco para esquentar, com a finalidade de dissolver toda a matéria orgânica e restarem apenas as espículas feitas de sílica. Outra forma utilizada foi em tubo de ensaio contendo as amostras de esponja, ácido nítrico e colocando na lamparina para esquentar o ácido e corroer o tecido da esponja. Após a obtenção das espículas, as mesmas foram lavadas utilizando uma centrífuga, sendo três vezes com água, posteriormente duas vezes com álcool 96% e uma com álcool absoluto. Em seguida, foi pingado a solução contendo álcool e as espículas na lâmina de microscopia e fechada com resina epóxi e lamínula.

Lâminas de seções anatômicas também foram preparadas realizando cortes transversais à mão livre ou em cubo de gelo e quando necessário foram feitos cortes ectossomais. No caso de esponjas sem espículas, utilizou-se hipoclorito para confecção de corte histológico do tecido da esponja, evidenciando as fibras de espongina, a metodologia da preparação das lâminas foi seguindo HAJDU et al. (2011). Adicionalmente, no caso de espécimes incrustantes foi utilizado a cortadora de precisão do TAXPO, valendo-se de um disco diamantado para corte de amostras inseridas em blocos de resina epóxi.

A identificação taxonômica foi feita através de comparação com descrições na literatura, utilizando-se critérios morfológicos como cor, forma, tamanho, superfície da esponja, assim como critérios internos de morfologia esquelética, forma e tamanho das espículas. Foi realizado as micrometrias e fotomicrografias no TAXPO, utilizando microscópio Zeiss e programa MOTIC para a realização de cerca de 30 medidas das espículas com objetivo de analisar as espécies que eram consideradas possivelmente novas. Para aquelas espécies conhecidas e com primeiros registros pro Brasil, ou espécies de interesse foram realizadas 20 medidas, exceto em casos que não foi possível realizar o N desejado de medidas. Para as espécies mais conhecidas foi realizado um menor número de medidas, a fim de se comparar com os dados da literatura.

As imagens de espículas de algumas espécies foram realizadas por eletromicrografias utilizando o microscópio de mesa Hitachi TM4000PLuS II de baixo vácuo do Departamento de Zoologia da Universidade Federal de Pernambuco, a fim de se obter uma melhor qualidade de imagem, da superfície das microscleras, assim como confirmar a identificação.

Com as fotos retiradas *in situ*, as esponjas foram selecionadas e identificadas em um guia contendo foto, local de ocorrência, o nome da espécie e alguns casos somente a nível de gênero.

As referências bibliográficas citadas no corpo da dissertação encontram-se listadas ao final da mesma, enquanto que as referências utilizadas nos capítulos, constam no final de cada um deles.

4 RESULTADOS

Os resultados desta dissertação serão apresentados em três capítulos. No primeiro é disponibilizada a lista de espécies da Costa do Descobrimento, com comentários taxonômicos e Caracterizações dos novos registros para o Brasil (Trabalho submetido para Zootaxa). No segundo capítulo apresentamos o registro da espécie criptogênica *Haliclona* (*Reniera*) *laubenfelsi*, que anteriormente era conhecida para o Havaí, o atol de Clipperton e o Oceano Índico e que pela primeira vez é registrada para o Brasil e Oceano Atlântico.

O estudo taxonômico foi feito de forma integrativa combinando taxonomia morfológica com molecular. Já no terceiro capítulo é disponibilizado o Guia das Esponjas da Costa do Descobrimento, fornecendo imagens de quase 100 espécies trabalhadas na localidade.

4.1. CAPÍTULO I

Bettcher-Brito *et al*. **Checklist, diversity descriptors and selected descriptions of a highly diverse intertidal sponge (Porifera) assemblage at Costa do Descobrimento (Bahia, Brazil)**

Submetido ao periódico internacional Zootaxa em 31/08/2022

Checklist, diversity descriptors and selected descriptions of a highly diverse intertidal sponge (Porifera) assemblage at Costa do Descobrimento (Bahia, Brazil)

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ABSTRACT

Costa do Descobrimento is located in southern Bahia, Brazil, and only 22 species of sponges (Porifera) were known from the area until now, despite its important reef formations. Hence, there was an obvious need to expand the collection and identification of the sponges present in this area. In the present study, we report a checklist of the sponges of Costa do Descobrimento and their distribution in the studied reefs, with several species illustrated in life. We also describe nine new sponge records for this region; *i.e.*, species not reported from the Brazilian coast and already reported as well, but in the latter case are ones poorly known or with remarkable taxonomy questions. We present alpha and beta diversity indices and compare the sponge assemblage of the sampled locations. Four reefs were considered: two fringing reefs (Arraial D'Ajuda – AA and Coroa Vermelha / Mutá – CVM) and two offshore Municipal Marine Park "Parque Municipal Marinho— (P.M.M. Coroa Alta – CA and P.M.M. Recife de Fora – RF). A total of 229 specimens were collected (224 Demospongiae, 2 Homoscleromorpha and 3 Calcarea). These were classified in 101 morphotypes. Although the resolution of this study was at species level, the species of many genera were not identified, which in several cases may be a consequence of them being new to science. Studied materials included representatives of 15 orders, 34 families and 48 genera. The richest orders are Haplosclerida

(29 spp.), Poecilosclerida (15 spp.) and Tetractinellida (11 spp.). The richest families were Chalinidae (24 spp.), Clionaidae (7 spp.) and Mycalidae and Suberitidae (6 spp. each). The richest genus is, by far, *Haliclona* (20 spp.). Only 13 species were shared among all four reefs surveyed, namely *Amphimedon viridis*, *Cinachyrella alloclada*, *C. apion*, *Cladocroce caelum*, *Cliona varians*, *Dysidea robusta*, *Mycale* (*Naviculina*) *diversisigmata*, *Niphates erecta*, *Spirastrella hartmani*, *Tedania* (*Tedania*) *ignis*, *Terpios fugax*, *Tethya bitylastra* and *T. maza*. The reefs with the highest richness were CA and CVM, and the lowest richness was observed in RF. The most similar reefs in terms of species composition were CA and CVM, while AA and RF were more dissimilar to the previous reefs, but also from each other. While the difference among CA, CVM and AA was mainly explained by species turnover, RF differed from the previous based on its lower richness (nestedness component). Even though CA and CVM were the richest reefs, AA presented the highest number of exclusive species, highlighting the uniqueness of this reef, and urging the inclusion of local beachrock fringing reefs in a more holistic conservation strategy at Costa do Descobrimento.

KEY-WORDS: *Acanthotetilla, Cliona, Haliclona, Halisarca, Placospongia, Prosuberites, Samus,* beachrock reefs, Coroa Vermelha, Coroa Alta, Recife de Fora

INTRODUCTION

Our current knowledge about Brazilian marine sponges (Porifera) has been growing steadily in the last decades (Zilberberg *et al.* 2010; Cárdenas *et al.* 2012). According to Muricy (2022) there are 545 valid species of marine sponges in Brazil, and 172 (31.5%) of them were recorded from Bahia (BA), northeastern Brazil. However, these quantities appear to be underestimated. Such underestimation could be explained – in part – by extensive coral reef formations in the northeast region of Brazil (Hajdu *et al.* 2011). Thus, the number of sponges from BA could be twice or three times bigger (Hajdu *et al.* 1996; Mácola & Menegola 2018).

Costa do Descobrimento is located in southern BA, and includes the municipalities of Belmonte, Santa Cruz Cabrália and Porto Seguro. Only 22 species of sponges had been recorded from there (Hajdu *et al.* 2011; Muricy *et al.* 2011; Cavalcanti *et al.* 2014; Oliveira *et al.* 2015). Therefore, there was an obvious need to expand the effort of collecting and identifying the sponges present in this area, especially in Santa Cruz Cabrália and Porto Seguro, where important reefs are located. An increased knowledge of the sponge biodiversity of Costa do Descobrimento will subsidise municipal reef conservation initiatives and open up research avenues given the already well-established local facilities for experimental reef research, traditionally focused primarily on corals (*e.g.*, Coral Vivo project, https://coralvivo.org.br). Further, Costa do Descobrimento is an important tourist hub in BA, and provides the livelihood for a large number of artisanal fishermen and octopus collectors (Cordell 2001; Dultra & Schiavelli 2016; Rüde & Vianna 2016).

In the present study we report a large checklist of intertidal sponges from reefs of Costa do Descobrimento, with several species illustrated in life and caracterization of selected species. We also analyse their distribution in the studied reefs, as well as the alpha and beta diversity.

MATERIALS AND METHODS

Study area. The survey was conducted at Costa do Descobrimento (Santa Cruz Cabrália and Porto Seguro municipalities), located between 17° and 15° S. Four sampling locations were considered in the present study (Fig. 1). Two are fringing reefs (reef areas off coastline), where one of them (ca. 6.9 km long) is located along the Santa Cruz Cabrália and Porto Seguro municipalities; collection points were Coroa Vermelha and Mutá beaches (3.1 km long of total length reef)—Santa Cruz Cabrália; named here as Coroa Vermelha / Mutá (CVM). The second fringing reef (ca. 8.5 km long) is located along the Arraial d'Ajuda district—Porto Seguro, and collection points were located in Praia dos Pescadores, Mucugê and Pitinga beaches (3.4 km long of total length reef); named here as Arraial d'Ajuda (AA). The other two sampling locations are offshore reefs, each one of them in a distinct conservation area; *viz.*, Municipal Marine Park "Parque Municipal Marinho—P.M.M.". These P.M.M. are Recife de Coroa Alta (CA) and Recife de Fora (RF). The first one is located in Santa Cruz Cabrália and was created in 1998, covering 50 km^2 of coastal marine area, including two coral reef formations named Coroa Alta and Araripe reefs, which are 3.5 km from the coast. The P.M.M. RF is located in Porto Seguro and was created in 1997, covering 17.5 km^2 of marine area and containing only one reef formation, which is located 5 km from the coast. Despite their status as conservation areas (*i.e.*, named as units of conservation by the Brazilian government), both marine parks present intense touristic pressure all year long, which nonetheless, is managed in a restricted area of the reef complex (Filgueiras *et al*. 2017; Paula *et al*. 2018; Calado *et al*. 2022).

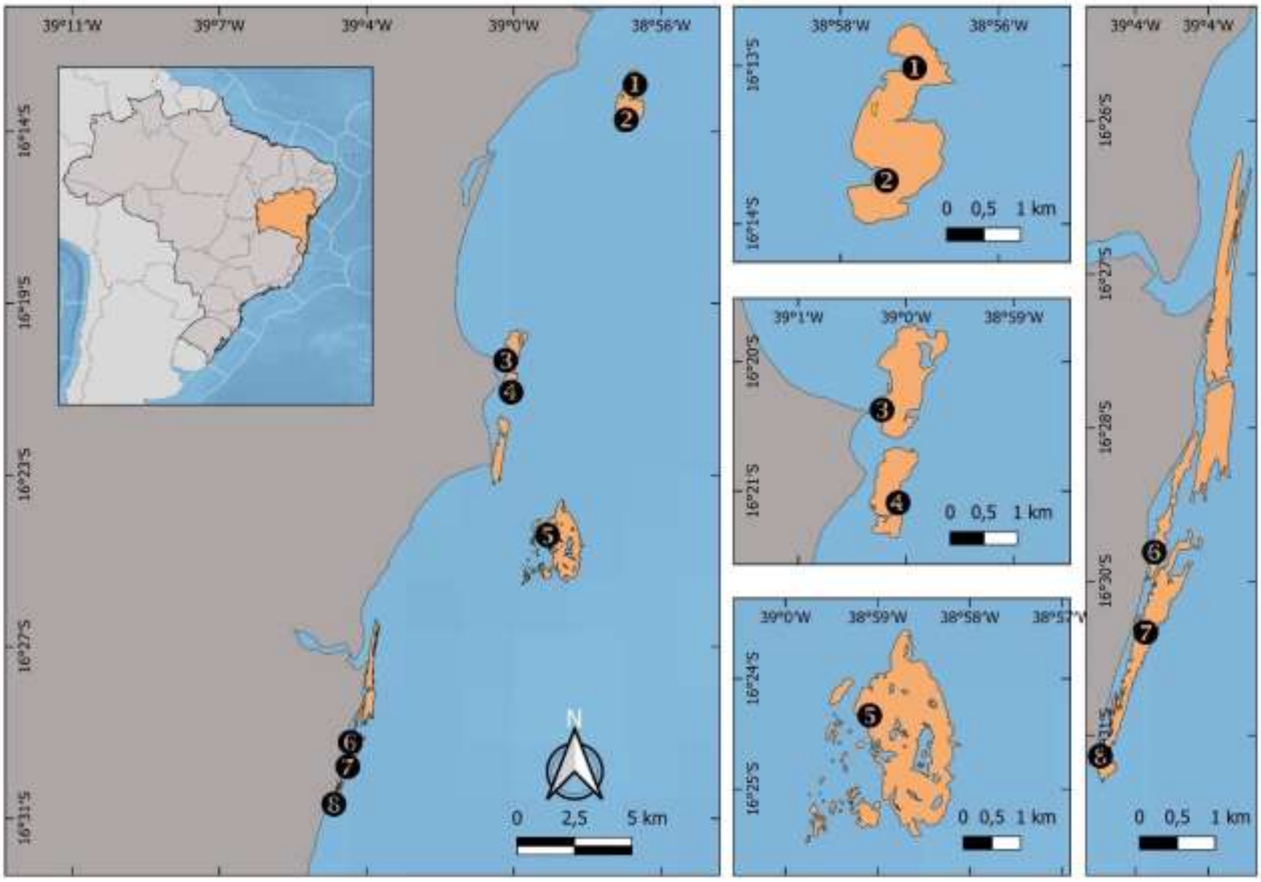

FIGURE 1. Map showing the location of Costa do Descobrimento in the southern coast of Bahia (Brazil), and all reefs surveyed in this study. **1–2**, Parque Municipal Marinho (P.M.M.) Coroa Alta (CA); **3–4**, Coroa Vermelha/Mutá (CVM); **5**, P.M.M. Recife de Fora (RF); **6**, Praia dos Pescadores Beach, Arraial D'Ajuda (AA); **7**, Mucugê Beach, Arraial D'Ajuda (AA) and **8**, Pitinga Beach, Arraial D'Ajuda (AA).


A
B
C
D
E
F
G
H

FIGURE 2. Studied reefs at Costa do Descobrimento (southern Bahia, Brazil) with their gross morphological aspect at low tide. **A**–**B**, Parque Municipal Marinho (P.M.M.) Coroa Alta (CA); **C**–**D**, Coroa Vermelha/Mutá (CVM); **E**, P.M.M. Recife de Fora (RF); **F**, Praia dos Pescadores Beach, Arraial D'Ajuda (AA); **G**, Mucugê Beach, Arraial D'Ajuda (AA) and **H**, Pitinga Beach, Arraial D'Ajuda (AA).

Collection. Samples were collected in March and April 2019. Both P.M.M. and the CVM reef were visited twice, while the AA reef was visited three times. Each sampling consisted of wading at low tide by three sponge experts during approximately three hours (duration of the workable low tide time frame) (Fig. 2), carefully searching, collecting and photographing representatives of the sponges present in the area in consecutive days (20–24/iii/2019 and 19–22/iv/2019). The survey included not only photophilous specimens, but above all sciophilous ones, revealed turning boulders and reef blocks upside down. Collection permits were issued by the Municipal Environment Secretary of Porto Seguro (N 05/2019) and Santa Cruz Cabrália (SCC 01_E/2019).

Specimens were fixed in ethanol (EtOH) 96% and preserved in EtOH 80% (fixative exchanged in 24h). A total of 205 samples were collected and deposited in the Porifera collection (MNRJ) of the Museu Nacional, Universidade Federal do Rio de Janeiro. In addition, subsamples with respective MNRJ codes were preserved in EtOH 99% and in RNAlater, both frozen at -18° C; for future studies.

Morphological analysis. Images *in situ* for most species in this study are supplied and were used to the taxonomic identifications. In addition, species level identifications were achieved by establishing the spicule set and measurements for every taxon, besides the type of skeletal architecture and external morphology; when spicules were not present, by looking exclusively at spongin fibers or choanocitary chambers (Hooper & van Soest 2002).

Dissociated spicules and thick-sections mounts were prepared following Hajdu *et al.* (2011). Additionally, for encrusting specimens, thick polished sections were obtained by sawing specimens embedded in low viscosity epoxy resin with a low–speed saw (Extec Labcut 150) using a diamond wafering blade (0.4 mm thick), and wet–ground on sand paper of decreasing grain size (Aguirre *et al.* 2011). Spicules were measured from photographs taken from light microscopy and SEM (Hitachi TM4000PLuS II, at Department of Zoology, Universidade Federal de Pernambuco); 20 measurements of each category per specimen, unless stated otherwise. Spicules measurements are in micrometres (µm) and presented as minimum–average–maximum of length x thickness; unless stated otherwise.

The classification used here is that adopted by the World Porifera Database—WPD (de Voogd *et al.* 2022), mostly derived from the revisions compiled in Hooper & van Soest (2002) and Morrow & Cárdenas (2015).

Diversity analysis (variation in species richness and composition among reefs). Species richness was calculated to estimate sponges α-diversity of the analyzed reefs. The β-diversity – change of species composition along the reefs – was estimated by Jaccard distance matrices and visualised through ordination plots (Kruskal's nMDS). We also calculated Jaccard Total Dissimilarity Index, along with its turnover and nestedness components. The turnover component refers to species replaced between reefs and nestedness to species lost from one reef to another. These two last components sum up to the Jaccard total dissimilarity (Baselga & Orme 2012).

The distance matrix was calculated with the dist() function from stat package (R Core Team 2020); the ordination plot was constructed using isoMDS() from the MASS package (Venables & Ripley 2002) and ggfortify package (Tang *et al*. 2016); Jaccard Total Dissimilarity Index was calculated with the betapart (Baselga & Orme 2012) and plots were constructed using ggplot2 package (Wickham 2016) using R software version 4.0.1 (R Core Team 2020).

RESULTS

Sponge diversity. A total of 205 samples were collected initially, subsequently yielding 229 specimens after careful examination in the lab (224 Demospongiae, 2 Homoscleromorpha and 3 Calcarea) (Tab. 1). These were classified in 101 species (see Annex 1, I–VI). Although the resolution of this study was at species level, only 64 taxas received full species names (including 5 spp nov in prep by Bispo and one by Fernandez). The remaining samples could not be attributed to previously known species, and include likely new species as well as, in many cases, demand further taxonomic study for a complete identification, which may often be ultimately impossible given the samples' minute dimensions. Table 1 presents the updated checklist of Porifera for Costa do Descobrimento, including previously known species, and newly generated records, organized according to the classification adopted by the WPD (de Voogd *et al.* 2022). Of this collected material, 184 sponges were found in the sciaphilic environment and 28 in the photophilic environment, both samples were mostly small sponges between 1cm and 7 cm long, in a few cases reaching about 15 cm and mostly encrusting sponges.

TABLE 1. Checklist of sponges (Porifera) from Costa do Descobrimento (Bahia, Brazil). Species in the present study and previous intertidal records (in bold), consulted in: [1]Cavalcanti *et al.* (2014), [2]Hajdu *et al.* (2011) and [3]Oliveira *et al.* (2015).

CLASS Order	Family	Species	MNRJ Vouchers
CALCAREA			
Clathrinida	Clathrinidae	*Clathrina* sp.	20470, 21901, 22228
Leucosolenida	Amphoriscidae	***Paraleucilla incomposita* Cavalcanti, Menegola & Lanna, 2014**[1]	
HOMOSCLEROMORPHA			
Homosclerophorida	Plakinidae	*Plakina* sp.	21901
		Plakortis sp.	20537
DEMOSPONGIAE			
Agelasida	Hymerhabdiidae	*Prosuberites laughlini* Diaz, Alvarez & van Soest, 1987	21505
Biemnida	Biemnidae	*Biemna caribea* Pulitzer-Finali, 1986	22091
Chondrillida	Chondrillidae	*Chondrilla* aff. *nucula* Schmidt, 1862	20517
	Halisarcidae	*Halisarca caerulea* Vacelet & Donadey, 1987	20520, 21169
Chondrosiida	Chondrosiidae	*Chondrosia reniformis* Nardo, 1847	20510
Clionaida	Clionaidae	*Cliona amplicavata* Rützler, 1974	20511
		Cliona aff. *celata* Grant, 1826	23326, 22230
		Cliona delitrix Pang, 1973	21417, 22102
		Cliona cf. mucronata Sollas, 1878	21505
		***Cliona varians* (Duchassaing & Michelotti, 1864)**[2]	20493
		Cliona vermifera Hancock, 1867	22243
		Cliona sp.	20494
	Spirastrellidae	*Diplastrella megastellata* Hechtel, 1965	21074, 20507, 20541, 20526, 20551, 21144, 22226
		Spirastrella hartmani Boury-Esnault, Klautau, Bézac, Wulff & Solé-Cava, 1999	21886, 20500, 21372, 22098, 22244
Dendroceratida	Darwinellidae	*Aplysilla* aff. *rosea* (Barrois, 1876)	21161, 21193
		Aplysilla aff. *sulfurea* Schulze, 1878	20549
Dictyoceratida	Dysideidae	*Dysidea etheria* Laubenfels, 1936	23427, 23425, 21887 21913, 22084, 22120

			22225, 22237
		Dysidea robusta Vilanova & Muricy, 2001	20469, 20546, 21454, 22110
		Dysidea sp.1	20552
		Dysidea sp.2	21497, 21893
	Irciniidae	***Ircinia* cf. *strobilina***[3]	
	Spongiidae	*Spongia* (*Heterofibria*) sp.	20556
		Hippospongia sp.	20558
Haplosclerida	Callyspongiidae	*Callyspongia* (*Callyspongia*) *pallida* Hechtel, 1965	20501
		Callyspongia sp. (Bispo sp. nov. in prep.)	20531
		Arenosclera sp.	20542
	Chalinidae	*Chalinula molitba* (de Laubenfels, 1949)	20497, 20477, 21140
		Chalinula sp. 1 (Bispo sp. nov. in prep.)	21195, 21197, 21155
		Chalinula sp.2	21188, 20474
		Cladocroce caelum Santos, da Silva, Alliz & Pinheiro, 2014	20522, 20529, 21373, 22232, 21157, 21518, 20479

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TABLE 1. Continued.

CLASS Order	Family	Species	MNRJ Vouchers
DEMOSPONGIAE			
Haplosclerida	Chalinidae	*Haliclona* (*Gellius*) *laubenfelsi* van Soest & Hooper, 2020	20478
		Haliclona (*Gellius*) sp.	22224, 22239
		Haliclona (*Halichoclona*) *albifragilis* Hechtel, 1965	22236, 21903
		Haliclona (*Halichoclona*) sp. 1	20496
		Haliclona (*Halichoclona*) sp. 2	20498
		Haliclona (*Halichoclona*) sp. 3	21908
		Haliclona (*Halichoclona*) sp. 4 (Bispo sp. nov. in prep.)	20464, 22105
		Haliclona (cf. *Halichoclona*) sp.	21896
		Haliclona (*Haliclona*) sp.	20488
		Haliclona (*Reniera*) *chlorilla* Bispo,	22229

		Correia & Hajdu, 2014	
		Haliclona (*Reniera*) *implexiformis* (Hechtel, 1965)	20484, 20539, 21104
		Haliclona (*Reniera*) *tubifera* (George & Wilson, 1919)	20562, 21160, 22235
		Haliclona (*Reniera*) sp. 1	21894
		Haliclona (*Reniera*) sp. 2	20549, 23427
		Haliclona (*Reniera*) sp. 3	21900, 22117
		Haliclona (*Reniera*) sp. 4	22240
		Haliclona (*Reniera*) sp. 5	20526
		Haliclona (*Soestella*) *melana* Muricy & Ribeiro, 1999	22231
		Haliclona (*Soestella*) sp. 1	20499
		Haliclona (*Soestella*) sp. 2 (Bispo sp. nov. in prep.)	22227
	Niphatidae	*Amphimedon viridis* Duchassaing & Michelotti, 1864	20512, 20540, 20545, 21889, 22111
		Niphates erecta Duchassaing & Michelotti, 1864	21158, 21416, 22085, 22251
Placospongida	Placospongiidae	*Placospongia cristata* Boury-Esnault, 1973	20489, 20508
		Placospongia ruetzleri Van Soest, 2017	21092, 21882, 22242, 22243, 20533
Poecilosclerida	Acarnidae	*Acarnus toxeata* Boury-Esnault, 1973	20487
		Acarnus (*Acarnus*) *innominatus* Gray, 1867a	20471
	Coelosphaeridae	*Lissodendoryx* (*Anomodoryx*) *sigmata* (de Laubenfels, 1949)	20549
		Lissodendoryx (*Lissodendoryx*) *isodictyalis* (Carter, 1882)	20485, 21149, 21897
	Hymedesmiidae	*Hymedesmia* (*Stylopus*) sp.	20498
	Microcionidae	*Clathria* (*Microciona*) *campecheae* Hooper, 1996	20530, 20532, 20481, 22106, 22108
		Clathria (*Thalysias*) sp.	20519, 20528
		Clathria (*Microciona*) sp.	20513, 20524, 20525
	Mycalidae	*Mycale* (*Aegogropila*) *americana* van Soest, 1984	20502, 20548, 21173
		Mycale (*Aegogropila*) *escarlatei* Hajdu,	21139, 20518, 20473,

		Zea, Kielman & Peixinho, 1995	20553, 21141, 21168, 21881, 22087, 22247
		Mycale (*Carmia*) *magnirhaphidifera* van Soest, 1984	20495

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TABLE 1. Continued.

CLASS Order	Family	Species	MNRJ Vouchers
DEMOSPONGIAE			
Poecilosclerida	Mycalidae	*Mycale* (*Carmia*) sp.	20514
		Mycale (*Grapelia*) sp.	20472
		Mycale (*Naviculina*) *diversisigmata* (van Soest, 1984)	20561, 22109
	Tedaniidae	***Tedania* (*Tedania*) *ignis* (Duchassaing & Michelotti, 1864)**[2]	20486, 20504, 20554, 21156, 21159, 21162, 21896
Scopalinida	Scopalinidae	*Scopalina ruetzleri* (Wiedenmayer, 1977)	2052, 20474
		Scopalina sp. (Fernandez sp. nov. in prep.)	20492
		cf. *Stylissa* sp.	20547
Suberitida	Halichondriidae	*Amorphinopsis atlantica* Carvalho, Hajdu, Mothes & van Soest, 2004	20465, 20475, 21919, 22089
		Halichondria (*Halichondria*) *marianae* Santos, Nascimento & Pinheiro, 2018	20563, 20510, 21143, 21414, 21359, 21139, 22121
	Suberitidae	*Aaptos* sp. 1	20480, 21878, 20555, 21889, 21501, 21503
		Aaptos sp. 2	21910
		***Aaptos* spp.**[2]	
		Protosuberites sp.1	20523, 20499, 21154
		Suberites aurantiacus (Duchassaing & Michelotti, 1864)	20491
		Terpios fugax Duchassaing & Michelotti, 1864	20509, 20544, 20559, 22242
		Terpios belindae Rützler & Smith, 1993	21188
Tethyida	Tethyidae	*Tethya bitylastra* Mácola & Menegola, 2018	20490, 20512, 20560, 22233
		Tethya maza Selenka, 1879	20482, 20506, 20538, 21180, 21516, 21871,

			22241
	Timeidae	*Timea berlincki* Leite, Fonseca, Leal & Hajdu, 2015	22090
		Timea stenosclera Hechtel, 1969	20535
	Hemiasterellidae	*Liosina* sp.	22090
Tetractinellida	Ancorinidae	*Dercitus* sp.	20535
		Stelletta anasteria Esteves & Muricy, 2005	22238, 20505
		Stelletta beae Hajdu & Carvalho, 2003	20496
		Stelletta sp.	21144
	Geodiidae	*Geodia gibberosa* Lamarck, 1815	20476, 20534, 20529, 21151, 21903, 22105
		Geodia papyracea Hechtel, 1965	22245
	Tetillidae	***Cinachyrella alloclada* (Uliczka, 1929)**[2]	20503, 21130, 21150, 21906, 20509, 22107, 22234
		Cinachyrella apion (Uliczka, 1929)	20564
		Cinachyrella kuekenthali (Uliczka, 1929)	20516, 22249
		Acanthotetilla walteri Peixinho, Fernandez, Oliveira, Caires & Hajdu, 2007	21180, 23318
	Samidae	*Samus anonymus* Gray, 1867a	22223
Trachycladida	Trachycladidae	*Trachycladus* sp.	20515
Verongida	Aplysinidae	*Aplysina fulva* (Pallas, 1766)	20557, 21183, 22250

Results presented here include, among fully identified species, a minimum of 57 new records for Costa do Descobrimento, of which 28 are new records for Bahia, southern Bahian records for *Acanthotetilla walteri* and *Samus anonymus*, an Eastern Brazil Marine Ecoregion record for *Placospongia cristata*, and six new Southwestern Atlantic (Brazil) records for *Cliona amplicavata* Rützler, 1974, *Cliona cf. mucronata* Sollas, 1878, *Haliclona* (*Halichoclona*) *albifragilis* (Hechtel, 1965), *Haliclona* (*Reniera*) *tubifera* (George & Wilson, 1919), *Halisarca caerulea* Vacelet & Donadey, 1987 and *Prosuberites laughlini* (Díaz, Alvarez & van Soest, 1987). These nine species are fully described below.

A few additional taxa appeared as dubious identifications, usually as small patches present in sections obtained from other sponges and their substrate, or merely as isolated spicules. These include *Arenosclera* sp., *Liosina* sp., *Stylissa* sp. and *Trachycladus* sp. In total 39 species were not fully identified and demand additional taxonomic effort, as well as, in several cases, additional material. The above highlight the need for further collecting in the study area, more so as the sublittoral has nearly not been sampled at all.

The identified samples include representatives of 15 orders, 34 families and 48 genera. The richest orders are Haplosclerida (29 spp), Poecilosclerida (15 spp) and Tetractinellida (11 spp). Richest families were Chalinidae (24 spp), Clionaidae (7 spp), Mycalidae and Suberitidae (6 spp each). The richest genus is by far *Haliclona* (20 spp). Figure 3 illustrates the numbers of species found for each order, family and genera collected, with the addition of previous literature records.

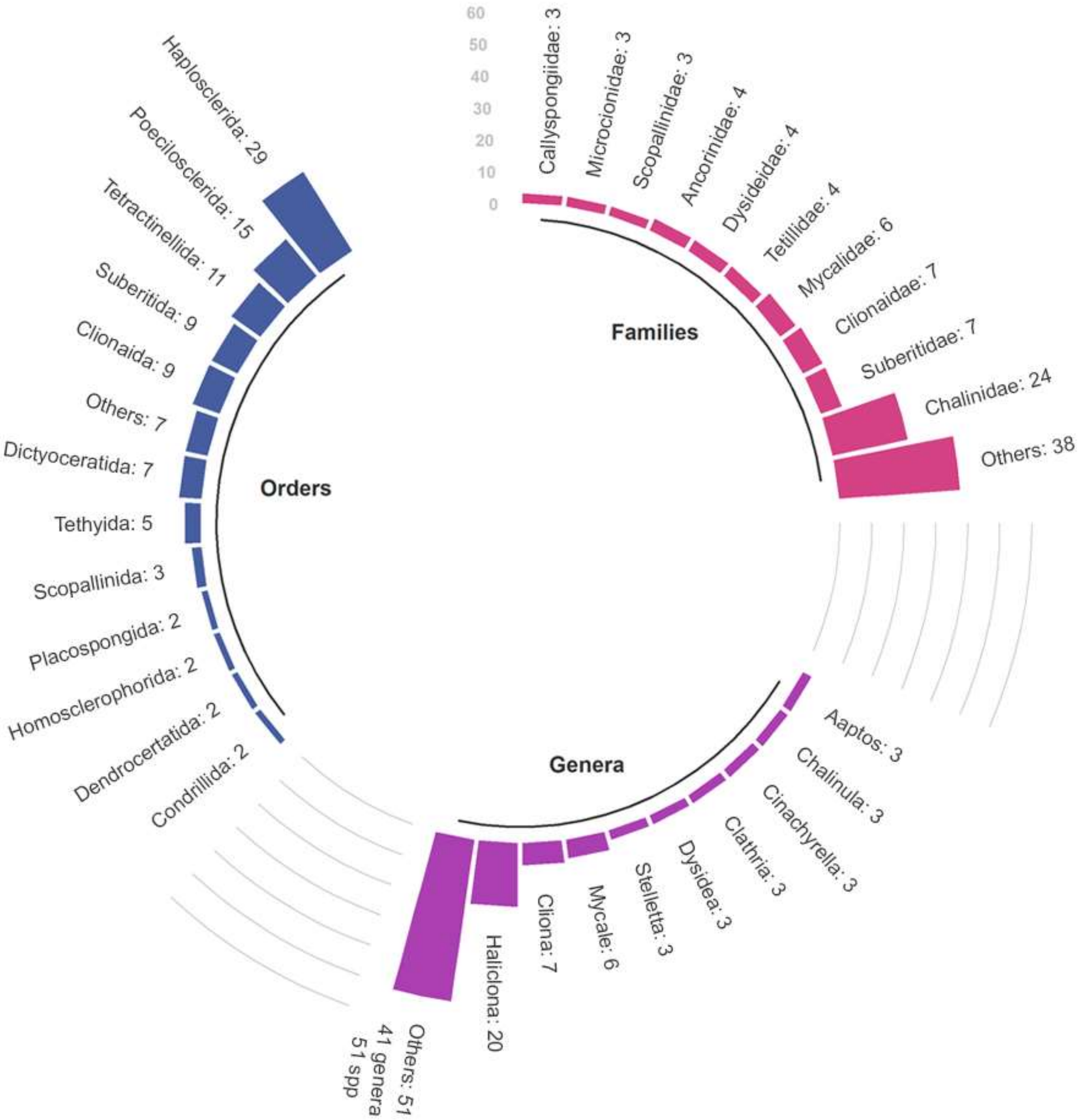

FIGURE 3. Pie charts highlighting the richest orders, families and genera represented in the intertidal sponge fauna at Costa do Descobrimento (Bahia, Brazil).

Variation in species richness and composition among reefs. The reefs with the highest richness were CA and CVM, with 58 and 57 species, respectively, and the lowest richness was observed in RF (41 species; Tab. 2; Fig. 4). Regarding species composition, CA and CVM reefs seem more closely related, while AA and RF reefs are more dissimilar to the previous reefs, but also from each other (Fig. 5). Similarly, the Jaccard dissimilarity shows that CA and CVM reefs were the most similar reefs and the difference between them was mainly explained by species turnover (97.5%). Instead, RF and AA were the most dissimilar reefs, and their differences were also due to the turnover component (94.9%). In addition, the dissimilarity between CA and CVM reefs, and RF presented high nestedness components (13.2 and 17.7% respectively) emphasising the reduced species richness in RF. The dissimilarity between CA and CVM, and AA were mainly explained by species turnover (95.4 and 96.8%), indicating that, although with a similar species number, their identities are different.

TABLE 2. Intertidal species (or taxa) of sponges from reefs of Costa do Descobrimento (Bahia, Brazil). Only from the material in the present study. AA, Arraial D'Ajuda; CVM, Coroa Vermelha/Mutá; RF, Parque Nacional Marinho—P.M.M. Recife de Fora; CA, P.M.M. Coroa Alta.

	Reefs			
Species	**CVM**	**AA**	**RF**	**CA**
Aaptos sp.1	X		X	X
Aaptos sp.2			X	
Acanthotetilla walteri	X			X
Acarnus innominatus			X	X
Acarnus toxeata	X			
Amorphinopsis atlantica	X		X	X
Amphimedon viridis	X	X	X	X
Aplysilla aff. *rosea*	X	X		X
Aplysilla aff. *sulfurea*	X	X		
Aplysina fulva			X	
Arenosclera sp.		X		
Biemna caribea	X			X
Callyspongia (*Callyspongia*) *pallida*			X	
Callyspongia sp.			X	
Chalinula molitba		X		
Chalinula sp.1	X	X		X
Chalinula sp.2	X			X
Chondrilla aff. *nucula*	X	X		X
Chondrosia reniformes	X	X		X
Cinachyrella alloclada	X	X	X	X
Cinachyrella apion	X	X	X	X
Cinachyrella kuekenthali	X	X		X
Cladocroce caelum	X	X	X	X
Clathria (*Microciona*) *campecheae*	X		X	X
Clathria (*Microciona*) sp.	X	X		X
Clathria (*Thalysias*) sp.		X	X	
Clathrina sp.	X			X
Cliona amplicavata		X		

Cliona aff. *celata*	X	X		X
Cliona delitrix	X		X	X
Cliona cf. mucronata			X	
Cliona varians	X	X	X	X
Cliona vermifera	X		X	X
Cliona sp.		X		
Dercitus sp.	X			
Diplastrella megastellata	X			X
Dysidea etheria	X		X	X
Dysidea robusta	X	X	X	X
Dysidea sp.1	X			X
Dysidea sp.2	X		X	
Geodia gibberosa	X		X	X
Geodia papyracea		X		X
Halichondria (*Halichondria*) *marianae*	X	X		X
Haliclona (Gellius) laubenfelsi		X		
Haliclona (*Gellius*) sp.		X		X
Haliclona (*Halichoclona*) *albifragilis*		X		X
Haliclona (*Halichoclona*) sp.1		X		
Haliclona (*Halichoclona*) sp.2				X
Haliclona (*Halichoclona*) sp.3		X		
Haliclona (*Halichoclona*) sp.4				X
Haliclona (cf. *Halichoclona*) sp.	X			
Haliclona (*Haliclona*) sp.		X		
Haliclona (*Reniera*) *chlorilla*				X

… continued on the next page

TABLE 2. Continued.

	Reefs			
Species	**CVM**	**AA**	**RF**	**CA**
Haliclona (*Reniera*) *implexiformes*	X			X
Haliclona (*Reniera*) *tubifera*	X	X		X
Haliclona (*Reniera*) sp.1		X		

Haliclona (*Reniera*) sp.2	X			
Haliclona (*Reniera*) sp.3			X	X
Haliclona (*Reniera*) sp.4	X		X	
Haliclona (*Reniera*) sp.5				X
Haliclona (*Soestella*) *melana*	X			X
Haliclona (*Soestella*) sp.1		X		
Haliclona (*Soestella*) sp.2				X
Halisarca caerulea			X	
Hippospongia sp.	X			X
Hymedesmia (*Stylopus*) sp.				X
Liosina sp.			X	
Lissodendoryx (*Anomodoryx*) *sigmata*			X	
Lissodendoryx (*Lissodendoryx*) *isodictyalis*	X	X		X
Mycale (*Aegogropila*) *americana*	X	X	X	
Mycale (*Aegogropila*) *escarlatei*	X	X	X	
Mycale (*Carmia*) *magnirhaphidifera*		X		
Mycale (*Carmia*) sp.		X		
Mycale (*Grapelia*) sp.		X		
Mycale (*Naviculina*) *diversisigmata*	X	X	X	X
Niphates erecta	X	X	X	X
Placospongia cristata	X	X		
Placospongia ruetzleri	X	X		X
Plakina sp.				X
Plakortis sp.		X	X	
Prosuberites laughlini			X	
Protosuberites sp.	X	X		
Samus anonymus				X
Scopalina ruetzleri	X	X		X
Scopalina sp.		X		
Spirastrella hartmani	X	X	X	X
Spongia sp.	X		X	X
Stelletta anasteria		X		X

Stelletta beae		X		
Stelletta sp.				X
cf. *Stylissa* sp.	X		X	
Suberites aurantiacus		X		
Tedania (*Tedania*) *ignis*	X	X	X	X
Terpios belindae	X			
Terpios fugax	X	X	X	X
Tethya bitylastra	X	X	X	X
Tethya maza	X	X	X	X
Timea berlinki	X		X	X
Timea stenosclera	X			
Timea sp.			X	
Trachycladus sp.		X		
Quantity of species per reef	**57**	**53**	**41**	**58**

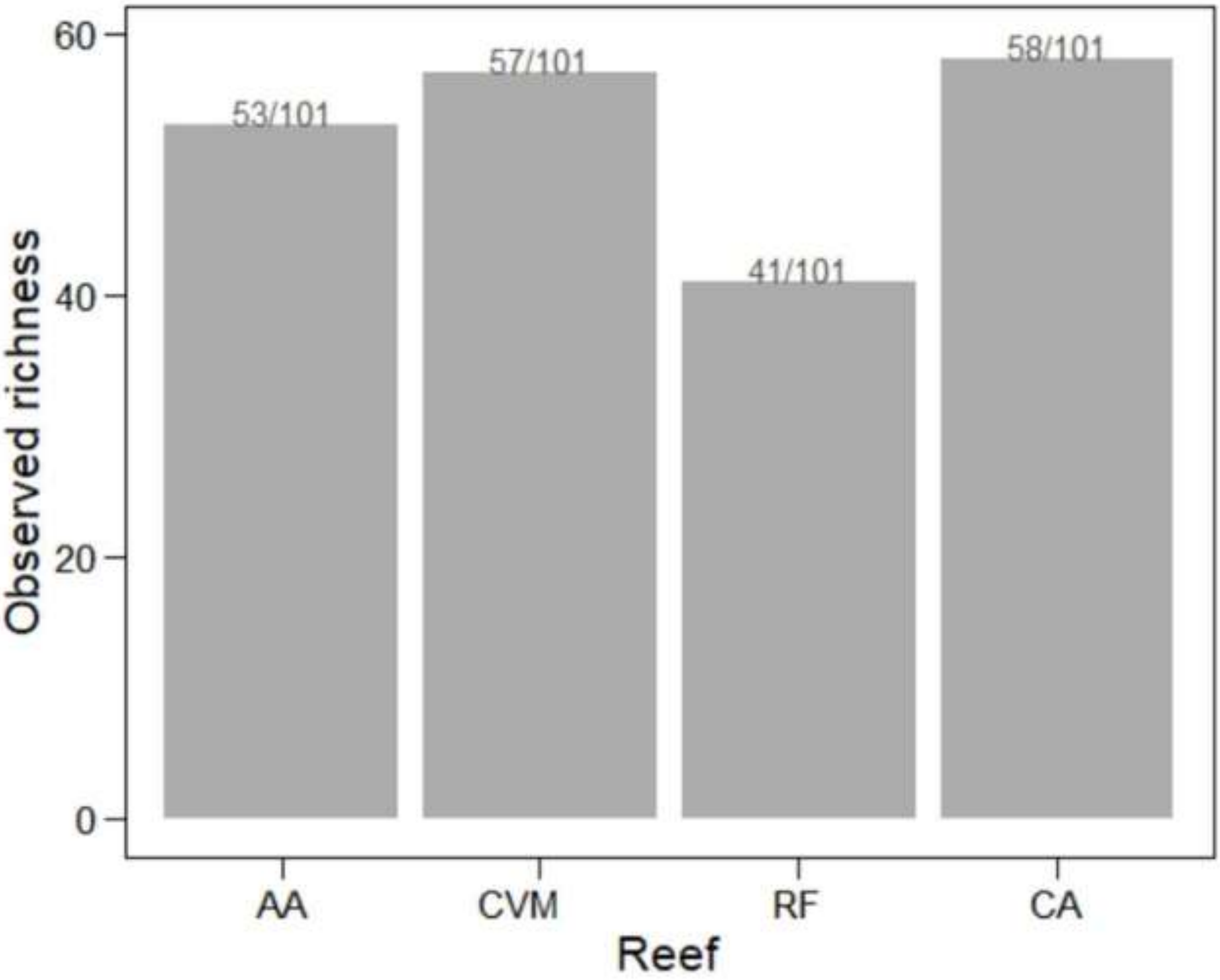

FIGURE 4. Bar plot illustrating each sampled reef's richness at Costa do Descobrimento (Bahia, Brazil), in comparison to the total number of collected species. **AA**, Arraial d'Ajuda; **CVM**, Coroa Vermelha/Mutá; **RF**, P.M.M. Recife de Fora; **CA**, P.M.M. Coroa Alta. Refer to Fig. 1 for each reef's location in southern Bahia, and to Table 2 for the species list for each surveyed reef.

TABLE 3. Jaccard total dissimilarity, turnover and nestedness for the sponge assemblage of each reef surveyed at Costa do Descobrimento (Bahia, Brazil), calculated from the species lists shown in Table 2. AA, Arraial D'Ajuda; CVM, Coroa Vermelha/Mutá; RF, Parque Nacional Marinho—P.M.M. Recife de Fora; CA, P.M.M. Coroa Alta.

JACCARD TOTAL DISSIMILARITY			
	CVM	**AA**	**RF**
AA	0.63		
RF	0.62	0.78	
CA	0.40	0.65	0.68
TURNOVER			
	CVM	**AA**	**RF**
AA	0.61 (96.8%)		
RF	0.51 (82.3%)	0.74 (94.9%)	
CA	0.39 (97.5%)	0.62 (95.4%)	0.59 (86.8%)
NESTEDNESS			
	CVM	**AA**	**RF**
AA	0.02 (3.2%)		
RF	0.11 (17.7%)	0.04 (5.1%)	
CA	0.01 (2.5%)	0.02 (4.6%)	0.09 (13.2%)

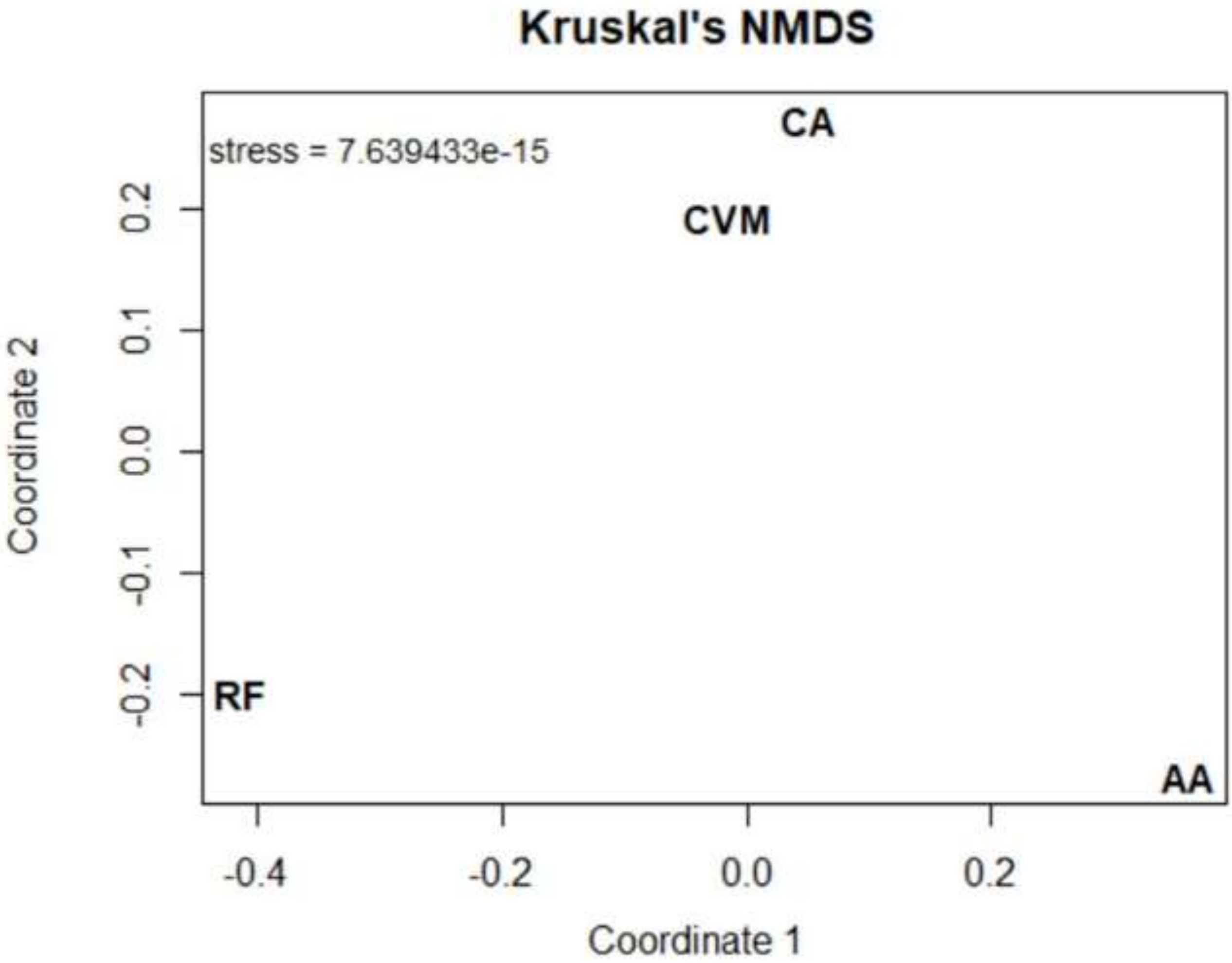

FIGURE 5. Ordination plot of sponge composition in the surveyed reefs at Costa do Descobrimento (Bahia, Brazil): P.M.M. Coroa Alta (CA), Coroa Vermelha/Mutá (CVM), Arraial D'Ajuda (AA) and P.M.M. Recife de Fora (RF). Refer to Fig. 1 for each reef's location in southern Bahia, and to Table 2 for the species list for each surveyed reef.

The Fig. 6 shows the number of exclusive and shared species among the different surveyed reefs. From a total of 101 species found in this study, only 13 were shared among the four reefs (Tab. 2). These, seemingly more evenly distributed species are *Amphimedon viridis*, *Cinachyrella alloclada*, *C. apion*, *Cladocroce caelum*, *Cliona varians*, *Dysidea robusta*, *Mycale* (*Naviculina*) *diversisigmata*, *Niphates erecta*, *Spirastrella hartmani*, *Tedania* (*Tedania*) *ignis*, *Terpios fugax*, *Tethya bitylastra* and *T. maza*. Even though CA and CVM reefs were the richest, AA reef presented the highest number of exclusive species (17 spp), which, on the contrary, appear to have rather more patchy distributions. These include seven fully determined species, namely *Chalinula molitba*, *Cliona amplicavata*, *Haliclona* (*Gellius*) *laubenfelsi*, *H.* (*Haliclona*) *epiphytica*, *Mycale* (*Carmia*) *magnirhaphidifera*, *Stelletta beae* and *Suberites aurantiacus*. In addition, ten species were only identified to the genus level, and are potentially new. These are *Arenosclera*, *Cliona* sp., *Haliclona* (*Halichoclona*) sp. 1 and sp. 3, *H.* (*Reniera*) sp. 1, *H.* (*Soestella*) sp. 1, *Mycale* (*Carmia*) sp., *M.* (*Grapelia*) sp., *Scopalina* sp. and *Trachycladus* sp.

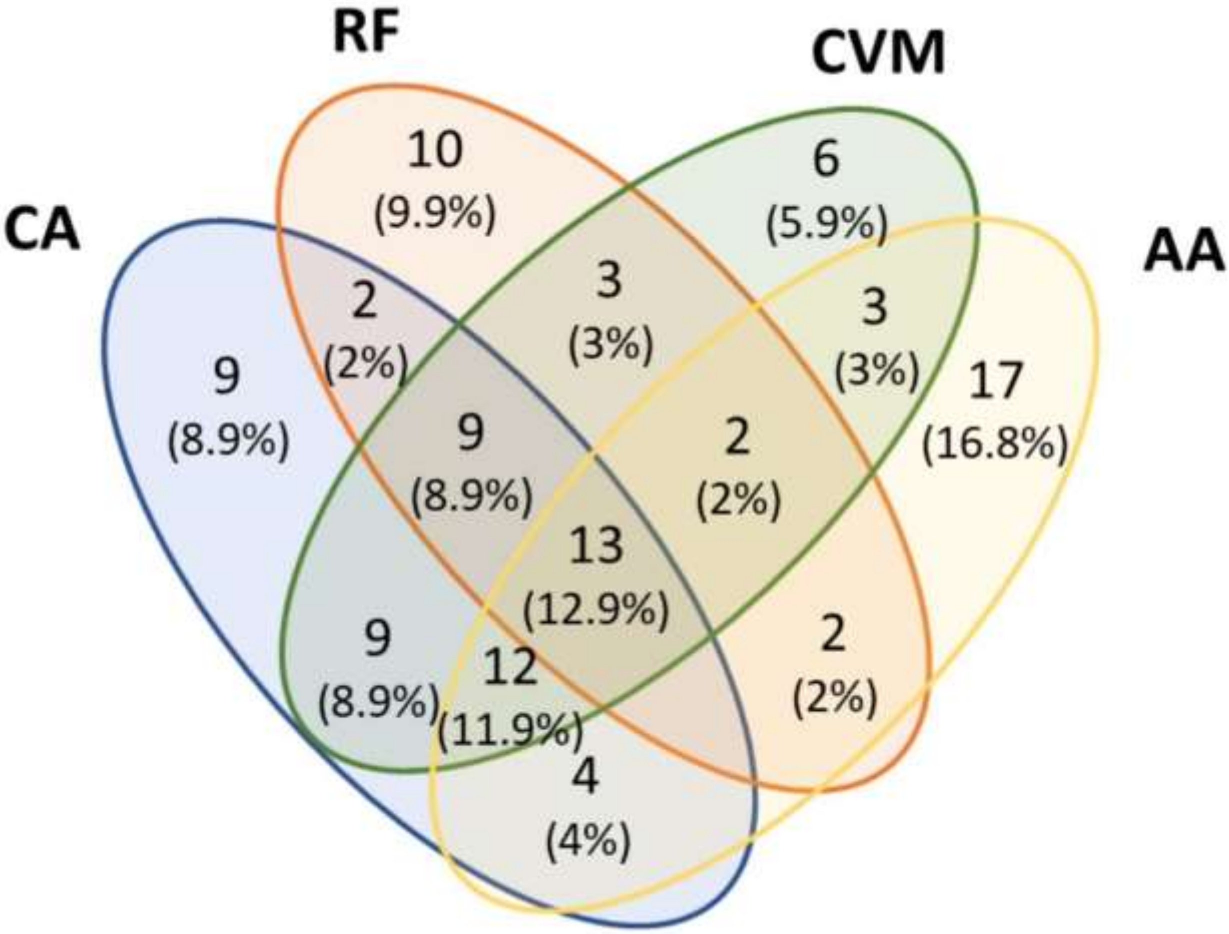

FIGURE 6. Venn diagram showing the numbers of unique and shared species among the reefs surveyed at Costa do Descobrimento (Bahia, Brazil). P.M.M. Coroa Alta (CA), Coroa Vermelha/Mutá (CVM), Arraial D'Ajuda (AA) and P.M.M. Recife de Fora (RF).

Systematics.

Phylum Porifera Grant, 1836

Class Demospongiae Sollas, 1885

Subclass Heteroscleromorpha Cárdenas, Pérez & Boury-Esnault, 2012

Order Agelasida Hartman, 1980

Family Hymerhabdiidae Morrow, Picton, Erpenbeck, Boury-Esnault, Maggs & Alcock, 2012

Genus *Prosuberites* Topsent, 1893

Prosuberites laughlini **(Díaz, Alvarez & van Soest, 1987)**

(Tab. 1–2, 4; Fig. 7A–E)

Synonymy. *Eurypon laughlini*, Díaz *et al.* (1987).

Studied material. MNRJ 21505, P.M.M. Recife de Fora (16°24.294' S, 38°59.143' W, Porto Seguro, BA, Brazil), intertidal, coll. Hajdu, E. & Avelino, D., 21/iv/2019.

Description. Thinly encrusting (< 1 mm thick); 4 cm in maximum diameter. Surface rugose, due to irregularities in the underlying substrate, pierced by apices of megascleres. Color *in vivo* orange-yellow, and beige in fixative (Tab. 4; Fig. 7A).

Skeleton. Unspecialized ectosome, pierced by large choanosomal megascleres. Choanosome with a basal layer of spongin, a little sediment (including sand grains) and megascleres erect on the substrate/basal layer of spongin, bases down. Some megascleres (smaller ones) totally embedded in the choanosomal region (Figs. 7B–C)

Spicules. Megascleres only (Tab. 4; Figs. 6D–E): tylostyles, slightly curved, pronounced head, with slight variation in overall shape, 231–431.1–1174 x 9.7–14.0–18.

Distribution. Previously, West Indies (Southern Caribbean – Diaz *et al.* 1987), Central America (Belize – Rützler *et al.* 2000; Panama – Diaz 2005), Suriname (van Soest 2017). New record – Southwestern Atlantic (Costa do Descobrimento, BA, Brazil).

Ecology. Spreading over calcareous substrate in a sciophilous microhabitat, next to a diverse assemblage of organisms comprising other sponges, polychaetes and bryozoans. The species appears to be rare in the study area as only a single specimen was collected in five expeditions. Study of the specimen in the lab revealed the presence of *Cliona cf. mucronata* Sollas, 1878 excavating its substrate (see below, description of this latter species).

Remarks. The specimen reported upon here perfectly matches the few available previous descriptions for the species. Live color, surface characteristics, shape and dimensions of spicules fit well with the description of Diaz *et al.* (1987) and van Soest (2017). The large apparent distribution gap between the southern Bahia / Brazil and Suriname records is most likely an artefact of insufficient sampling or taxonomic effort.

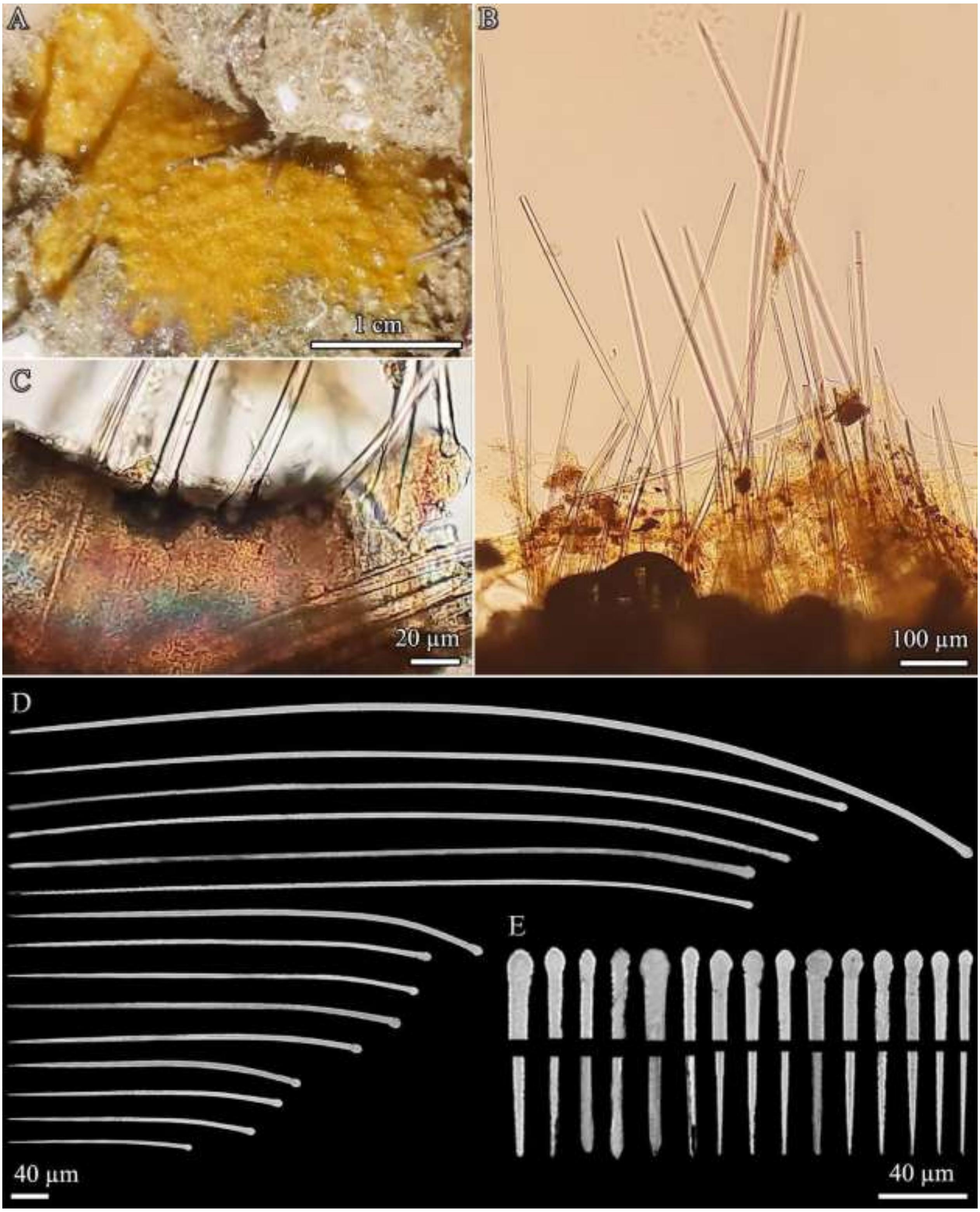

FIGURE 7. *Prosuberites laughlini* (Díaz, Alvarez & van Soest, 1987), MNRJ 21505: **A**, specimen in life; **B**, transverse sections showing tylostyles oriented perpendicularly to the substrate; **C**, detail of the heads embedded in a basal plate of spongin; **D**, tylostyles in different size and **E**, detail of the extremities of the tylostyles (from largest to smallest tylostyle, respectivelly).

TABLE 4. *Prosuberites laughlini* (Díaz, Alvarez & van Soest, 1987): comparative data on morphology, spicules and known distribution. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum) of length x thickness. Roman numerals represent categories of tylostyles.

sensu	**Morphology features**	**Megascleres (tylostyles)**	**Distribution (Depth)**
Díaz *et al.* (1987)	Habit thinly encrusting (up to 4 mm thick). Surface hispid. Consistency soft. Color light orange *in vivo*, and light brown in fixative (EtOH)	126–1855 x 3–24; head width, 9–28	Archipielago de Los Roques National Park, Venezuela, Caribbean / Atlantic (7–35 m)
van Soest (2017)	Habit thinly encrusting (1–2 mm thick). Surface microhispid. Consistency soft. Color *in vivo* n.r., and pale beige in fixative (EtOH)	I, 984–1148.0–1425 x 11–13.4–16 II, 402–555.0–719 x 11–11.9–14 III, 218–271.0–336 x 6–9.2–13	Suriname / Atlantic (64 m)
MNRJ 21505	Habit thinly encrusting (< 1 mm thick). Surface rugose and microhispid. Color orangy-yellow *in vivo*, and beige in fixatie (EtOH)	231–431.1–1174 x 10–14.0–18	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Order Clionaida Morrow & Cárdenas, 2015
Family Clionaidae d’Orbigny, 1851
Genus *Cliona* Grant, 1826

***Cliona amplicavata* Rützler, 1974**
(Tab. 1–2, 5; Fig. 8A–H)

Studied material. MNRJ 20511, Arraial D'Ajuda (16°29.861' S, 39°4.068' W, Porto Seguro, BA, Brazil), intertidal, coll. Leite, D. 20/iii/2019.

Description. Alfa growth stage, ca. 5 cm in maximum diameter, with circular oscular and ostial papillae, mostly 1–3 mm in diameter. Color *in vivo* light-yellow, and beige in fixative (Tab. 5; Fig. 8A).

Skeleton. Overall confused and in low density, except in papillae, where tylostyles may form dense feltworks or lay nearly as in a palisade, in inhalant and oscular papillae, respectively (Figs. 8B–D). Several colored rounded cells(?) throughout the ectosomal (maily) and choanosomal regions (Fig. 8E).

Spicules. Megascleres (Tab. 5; Figs. 8C–H): tylostyles, slightly curved, pronounced, usually subterminal head, 160–244.0–302 x 3–7.0–10. Microscleres (Tab. 5; Fig. 8H): raphides, slightly curved, 67–91.0–113.

Distribution. Previously Bermuda (Rützler 1974), Mediterranean (Spain – Rosell & Uriz 2002), Greater Caribbean (Western Carib. – Rützler *et al.* 2014; Southern Gulf of Mexico – Ugalde *et al.* 2015), Pacific Central America (Costa Rica, Nicaragua – Pacheco *et al.* 2018). New record – Southwestern Atlantic (Costa do Descobrimento, BA, Brazil).

Ecology. Excavating sciophilous limestone substrate amidst abundant silted filamentous organisms, mostly algae, hydroids and bryozoans.

Remarks. The species had already been collected in the southwestern Atlantic (Brazil), but had not been formally described (Leal, unpubl. res.). Data presented here perfectly match previous descriptions of the species. Its habit is virtually indistinguishable from the commoner at Costa do Descobrimento, *C.* aff. *celata* (Tab. 5).

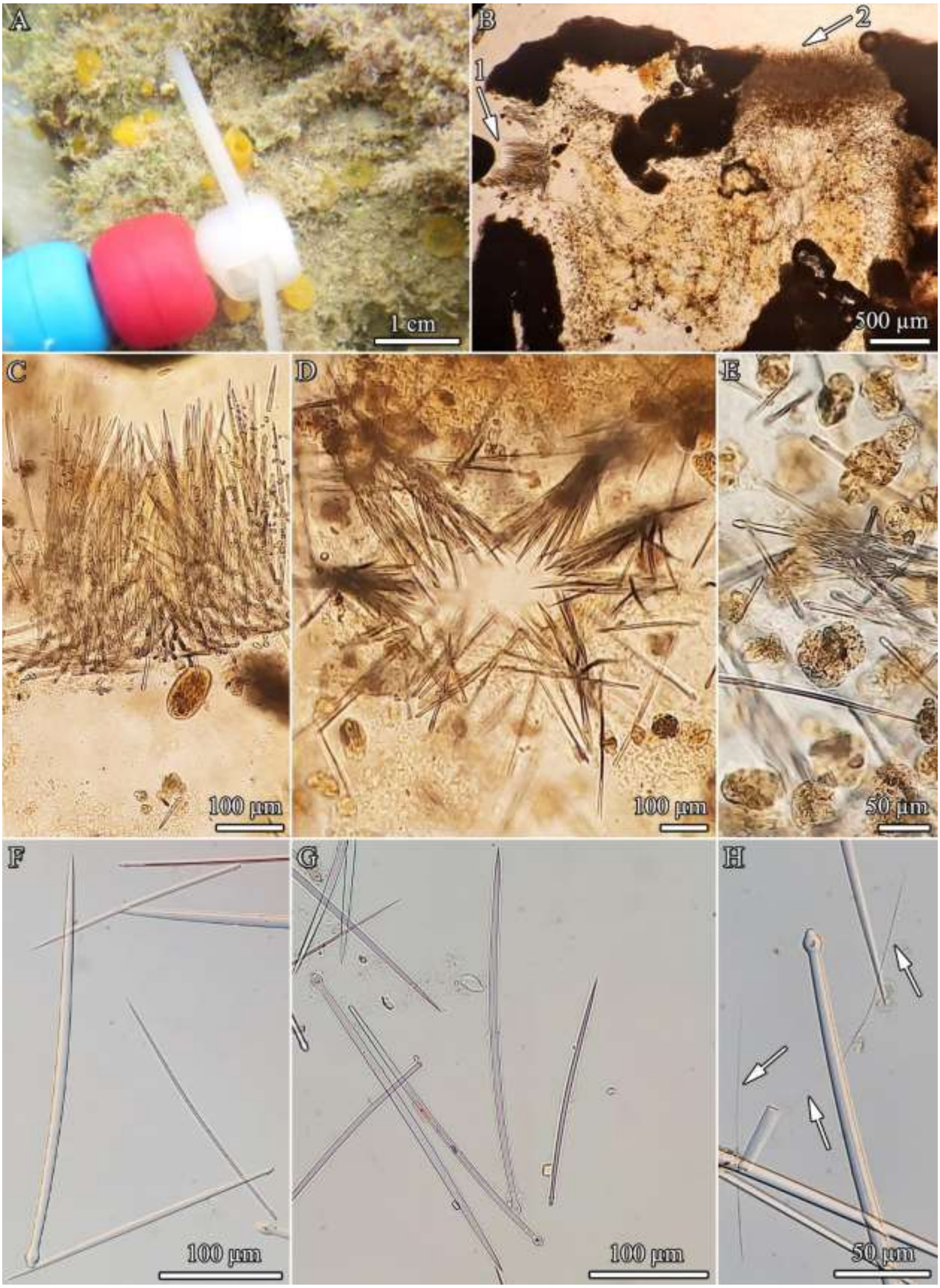

FIGURE 8. *Cliona amplicavata* Rützler, 1974, MNRJ 20511: **A**, specimen in life; **B**, transverse section—arrows point to an oscule (1) and a papillae (2); **C**, detail of the oscule (transverse section), with tylostyles disposed in vertical and paratangential way, similar to a plumoreticulate arrangement; **D**, detail of another oscules (view from

the top) with tylostyles disposed in bouquets disposed paratangentially; **E**, tylostyles and several colored rounded cells(?) scattered throughout choanosomal region; **F–G**, tylostyles; **H**, raphides.

TABLE 5. *Cliona amplicavata* Rützler, 1974: comparative data on morphology, spicules and known distribution. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum) of length x thickness. Only length of raphides is presented in part of the studies. Data not reported are represented as n.r.

		Spicules		
sensu	**Morphology features**	**Megascleres (tylostyles)**	**Microscleres (raphides)**	**Distribution (Depth)**
Rützler (1974)	Habit excavating / burrowing (excavation single, ovoid in form, 10 x 7 mm diameter—average), filled by soft, mucous tissue. Surface papillate (papillae circular, 1.4 mm diameter—average). Color yellow *in vivo*, and dull gray in fixative (EtOH) or dry	190–262.5–290 x 4.5–7.1–8; head, 4.8–10.1–12 x 4.8–9.4–10; neck (width), 3.2–5.0–6.4	118–129.8–150 x 0.8	Bermuda / Western Atlantic (0.5–10 m)
Rosell & Uriz (2002)	Habit n.r. Surface papillae (1–2–3 mm in diameter). Color orange-yellow (papillae and choanosome) *in vivo*, and olive green or brownish (papillae) and dark brown (choanosome) in fixative (formaldehyde)	230–386.0–460 x 6–10.0–12	120–250 x <1.0	Spain / Mediterranean (60–100 m)
Rützler *et al*. (2014)	Habit large excavation chambers (6–12 mm), filled with soft, slightly mucous tissue. Surface papillate (papillae circular, 1–4 mm in diameter). Color yellow (papillae and choanosome) *in vivo*, and n.r. in fixative	270–310.0–350 x 8–10.0–12	90–107.0–160 x <1.0	Belize, Caribbean / Atlantic (0.5–1 m; and 30 m)
Ugalde *et al*. (2015)	Habit alpha growth stage. Surface n.r. Color yellow *in vivo*, and yellowish brown in fixative (EtOH)	140–291 x 2.8–5.2 like styles, 165–192 x 1.3–3.9	70–125	Mexico, Gulf of Mexico / Atlantic (8 m)
Pacheco *et al*. (2018)	Habit alpha growth stage. Surface papillate (papillae circular, 0.5–1 mm in diameter). Color ochre *in vivo*, and n.r. in fixative	115–229.6–282 x 1–5.2–7.5; like styles, 80–121.0–156 x 2.5–3.7–4.5	65–89.6–140	Costa Rica and Nicaragua / Pacific (3–15 m)

MNRJ 20511	Habit alfa growth stage (ca. 5 cm in length). Surface papillate (papillae circular, mostly 1–3 mm in diameter). Color light-yellow *in vivo*, and beige in fixative (EtOH)	160–244.0–302 x 3–7.0–10	67–91.0–113	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Cliona cf. mucronata Sollas, 1878

(Tables 1–2, 6; Figures 9A–F)

Studied material: MNRJ 21505, P.M.M. Recife de Fora (16°24.294' S, 38°59.143' W, Porto Seguro, BA, Brazil), intertidal, coll: Hajdu, E. & Avelino, D., 21/iv/2019.

Description. Endolithic. Only a few rounded spots, up to 1.5 mm in diameter. Color *in vivo* not recorded, and beige in fixative (Tab. 6; Fig. 9A).

Skeleton. Overall confused and in low density of spicules, with the notable exception of dense, perioscular, palisade-like arrangements (Figs. 9B–C). Several colored rounded cells(?) throughout the ectosomal (mainly) and choanosomal regions (Fig. 9D).

Spicules. Megascleres only (Tab. 6; Figs. 9E–F): tylostyles I, larger, slender, with pronounced head and sharp apex, 77–135.1–162 x 2.3–5.0–7.6; and tylostyles II, smaller, stouter, with pronounced head and mucronated apex, 60–87.8–112 x 4.5–7.4–12.

Distribution. The type locality is unknown. Previously Indian Ocean (Gulf of Manaar – Thomas 1972, 1975; Madagascar – Vacelet *et al.* 1976; Mozambique – Thomas 1979), Indonesia (Desqueyroux-Faúndez 1981), Tropical Eastern Pacific (Mexico – Bautista-Guerrero *et al.* 2006), Caribbean (Belize – Rützler *et al.* 2014, as *C.* cf. *m.*), Pacific Central America (Costa Rica, Panama – Pacheco *et al.* 2018, as *C.* aff. *m.*). New record – Southwestern Atlantic (Costa do Descobrimento, BA, Brazil).

Ecology. Excavating limestone substrate underneath a specimen of *Prosuberites laughlini*, which has been described in the present study, see above.

Remarks. Study of the whole sample failed to spot the species on the substrate. Rather, it is visible in cavities in the substrate, analysed under light-microscopy. A few structures similar to oscules were observed (ca. 0.5–1.5 mm diam.), but these only appear in thick sections of the skeleton.

The species had been previously collected in the southwestern Atlantic (Brazil), but had not been formally described (Leal, unpubl. res.). The specimen reported upon here presents megascleres matching more closely Indian Ocean (Thomas 1972; Vacelet *et al.* 1976), Indonesian (Desqueyroux-Faúndez 1981) and Pacific Mexican (Bautista-Guerrero *et al.* 2006) specimens in dimensions, but the apparent absence of any microscleres is shared only with the latter two. Discontinuous distributions were already demonstrated for *Cliona celata* Grant, 1826 (Xavier *et al.* 2010; de Paula *et al.* 2012) and *C. viridis* (Schmidt 1862; in Leal *et al.* 2016), and are thus not entirely unlikely for the many *Cliona* spp. postulated to exhibit such distributions based solely on morphological similarity, as in the case of *C. cf. Mucronata*.

Pacheco et al. 2020 reports that C. cf. mucronata is a species complex, where in his work he observed in his molecular analysis three clearly consistent groups from different regions, where they would actually be three distinct species, two of them being new

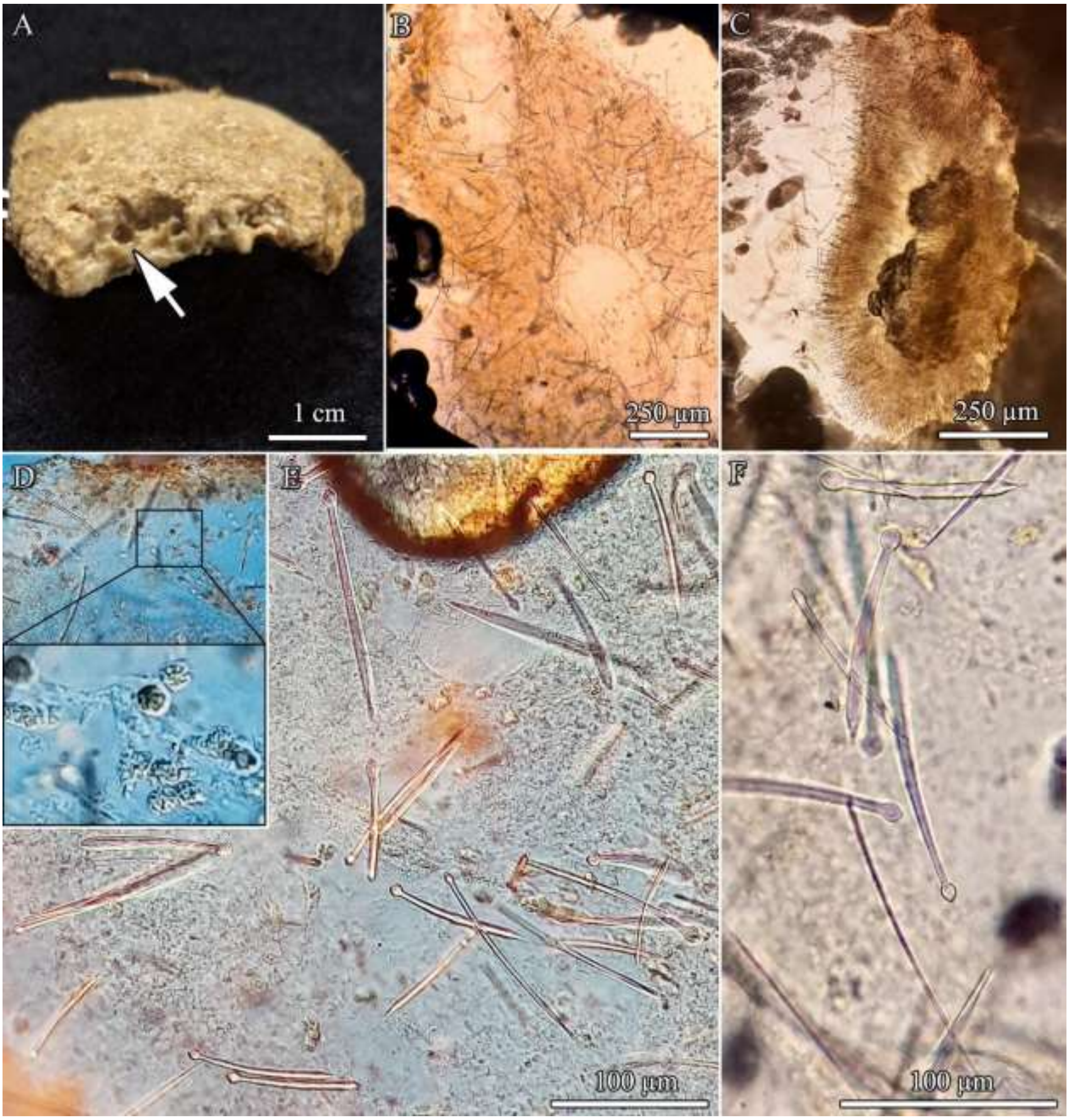

FIGURE 9. *Cliona cf. mucronata* Sollas, 1878, MNRJ 21505: **A**, specimen inhabiting the interior of a piece of coral; **B**, transverse section; **C** detail of an oscule (transverse section), with tylostyles disposed in vertical and paratangential way, similar to a palisade arrangement (choanosome in the left); **D**, several colored rounded cells(?) scattered throughout the ectosomal (mainly) and choanosomal regions—detail zoomed in; **E–F**, tylostyles.

TABLE 6. *Cliona cf. mucronata* Sollas, 1878: comparative data on morphology, spicules and known distribution. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum; or only maximum) of length x thickness. Only length is presented for spirasters and diameter for spherules in the studies. Roman numerals represent categories of tylostyles; and data not reported are represented as n.r.

		Spicules		
sensu	**Morphology features**	**Megascleres (tylostyles)**	**Microscleres**	**Distribution (Depth)**
Sollas (1878)	n.r.	I, 185 x 5 II, 102 x 10	Spirasters, 15.2 (sinuously curved, or straight, irregularly spined)	Type locality unknown (depth n.r); Caribbean, Indian Ocan and Indo-Oacific region (shallow waters)
Thomas (1972)	n.r.	I, 151–168.0–182 x 3–4.0–5 II, 63–70.0–84 x 6–18.0–25	Spherules, 8	Gulf of Mannar / Indian Ocean (2 m)
Vacelet *et al.* (1976)	n.r.	I, 130 x 5 II, 70–75 x 12	Spirasters, 30	Madagascar / Indian Ocean (14–22 m)
Thomas (1979)	n.r.	I, 128–167.0–182 x 3–4.0–7 II, 102–122.0–161 x 2–12.0–16	Spherules, 8	Inhaca Island, Mozambique / Indian Ocean (< 10 depth)
Desqueyroux-Faúndez (1981)	Habit encrusting (a small encrustation). Surface, consistency and color n.r.	I, 160 x 5 II, 45–90	Absent	Molucca, Indonesia / Indo-Pacific (< 10 m; *sensu* Topsent 1897)
Thomas (1985)	n.r.	I, 151–181 x 3–5 II, 63–84 x 6–25	Spirasters rare or absent Spherules, 2–8	Gulf of Mannar / Indian Ocean (shallow waters)

Bautista-Guerrero *et al.* (2006)	Habit boring. Surface with oval-shaped papillae (0.2–0.5 mm in diam.). Consistency n.r. Color red or red-orange *in vivo*, dark brown in fixative (EtOH)	I, 118–139.0–158 x 2.5–3.5–5 II, 55–68.0–85 x 5.0–6.4–8.8	Absent	Mexico /Pacific (6–7 m)
Rützler *et al.* (2014) as *C.* cf. *mucronata*	Habit n.r. Surface with small, circular and well-separated papillae. Consistency soft. Color grayish to dull yellow or orange yellow *in vivo*, and n.r. in fixative	I, 170–208.0–290 x 3–8.0–11 II, 110–132.0–190 x 9–12.0–18	Absent	Belize, Caribbean / Atlantic (8–30 m)
Pacheco *et al.* (2018) as *C.* aff. *mucronata*	Habit endolithic. Surface with circular papillae. Consistency n.r. Color orange *in vivo*, and n.r. in fixative	I, 170–208.0–290 x 3–8.0–11 II, 28–78.7–115 x 1.0–4.4–18	Absent	Costa Rica and Panama / Pacific (1–20 m)
MNRJ 21505	Habit endolithic. Surface and consistency n.r. Color beige in *vivo* n.r., and beige in fixative (EtOH)	I, 77–135.1–162 x 2.3–5.0–7.7 II, 60–87.7–112 x 4.5–7.4–12	Absent	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Family Placospongiidae Gray, 1867a

Genus *Placospongia* Gray, 1867b

Placospongia cristata **Boury-Esnault, 1973**

(Tables 1–2, 7; Figures 10A–J)

Synonymy. *Placospongia melobesioides*, *sensu* Schmidt (1870) [non *P. melobesioides* Gray, 1867b]. Detailed synonymy in van Soest (2009).

Studied material. MNRJ 20489, Mucugê (16°29.861' S, 39°4.068' W, Arraial D'Ajuda, Porto Seguro, BA, Brazil), intertidal, coll. Leite, D. 20/iii/2019; MNRJ 20508, Coroa Vermelha Reef (16°19.384' S, 38°59.927' W, Santa Cruz Cabrália, BA, Brazil), intertidal, coll. Hajdu, E. & Fioravanso, A. 21/iii/2019.

Description. Thickly encrusting (less than 1 mm thick), 2.8 cm longer length, with slender plates (< 1 mm thick) and grooves (ca. 1 mm wide) on the surface. Consistency hard, but plates feel like crunchy flakes. Color *in vivo* orangey-brown overall, dull on plates and brighter in the grooves. Dark beige in fixative (Fig. 10A).

Skeleton. Ectosome with cortical plates of selenasters and smaller tylostyles. The choanosome with abundant dispersed spicules of every kind, aside the larger tylostyles, organised in tracs beneath the cortical plates (Figs. 10B–D).

Spicules. Megascleres (Tab. 7; Figs. 10E–F): tylostyles, 251–480.1–797 x 6–10.1–15. Microscleres (Tab. 6; Figs. 9G–J): selenasters, 54–61.8–71 x 39–49.0–55 (larger diameter x smaller diameter); spherasters, 15–17.9–25; and microrhabds, ca. 1.4–2.3 (n= 2).

Distribution. Previously Pernambuco (Brazil – Boury-Esnault 1973), Caribbean (Curaçao – Arndt 1927; Barbados – Hechtel 1969). New record – Costa do Descobrimento, BA, Brazil. The species had been previously recorded for BA (Todos os Santos Bay, Salvador), but without any accompanying description (Bispo *et al.* 2006).

Ecology. Spreading over calcareous substrate in a sciophilous microhabitat, next to a diverse assemblage of organisms comprising other sponges, and abundant filamentous organisms. This species appears rarer than *P. ruetzleri* in the study area (our observations) as well as from other areas of BA (Macola & Menegola 2021).

Remarks. Currently, the distinction between the Western Atlantic *P. cristata* and the Indo-Western Pacific *P. melobesioides* rests on the tylostyles of the latter reaching larger dimensions. On the other hand, van Soest (2009) mentions microspherasters (= acanthomicrorhabds in the present study) could be present in the type material of *P. cristata*, but such microscleres need to be demonstrated. Microspherastes are indeed present in the type specimen of *P. cristata*, which is confirmed by J. Sandes (pers. com.), who has analysed such type material and observed these microscleres (*i.e*,, microspined microspherasaters). We checked the SEM images of Sandes *et al.* (manuscript in prep.) and agree with them. In addition, our examined material presents microspherasters, sometimes as microamphiasters and microspirasters, which are microspined too. Moreover, we found a few spirasters in specimen MNRJ 20489; ca. 20 µm long.

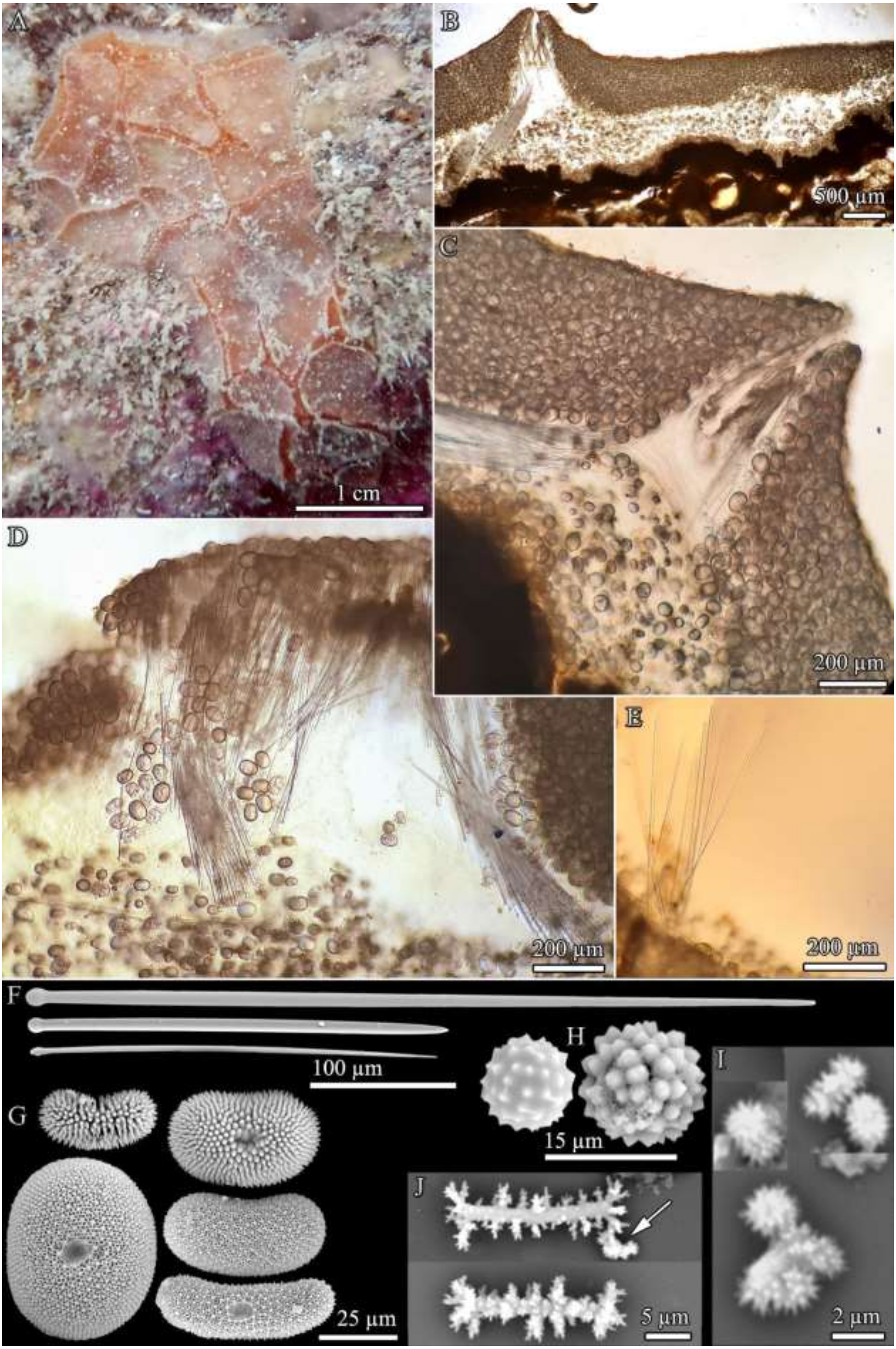
A
1 cm
B
500 µm
C
200 µm
D
200 µm
E
200 µm
F
100 µm
G
25 µm
H
15 µm
I
2 µm
J
5 µm

FIGURE 10. *Placospongia cristata* Boury-Esnault, 1973, MNRJ 20508: **A**, specimen in life; **B**, transverse sections showing a wide and elongated cavity in the choanosomal region and an oscule; **C**, detail of the oscule; **D**, bundles of tylostyles running to the ectosomal region throughout the choanosome; **E**, bundles of tylostyles piercing the surface; **F**, tylostyles; **G**, selenasters; **H**, spherasters; **I**, acanthomicrorhabds and **J**, spirasters from another specimen (MNRJ 20489), arrow point to acanthomicrorhabds.

TABLE 7. *Placospongia cristata* Boury-Esnault, 1973: comparative data on morphology, spicules and known distribution. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum; or only maximum) of length x thickness; or longer length x shorter length (selenasters), or length (microhabds); or diameter (spherasters and spherules). Roman numerals represent categories of tylostyles; and data not reported are represented as n.r.

		Spicules		
sensu	**Morphology features**	**Megascleres (tylostyles)**	**Microscleres**	**Distribution (Depth)**
Boury-Esnault (1973)	Habit thinly encrusting. Surface hispid.	560–990 x 6–12	Selenasters, 44–50 x 28–34 “Sterraspires” (= young forms of selenasters), 22–34 x 16–22 Spherasters, 9–19	Pernambuco, Brazil / Atlantic (25 m)
Arndt (1927) as *P. melobesioides*	Habit encrusting. Surface, oscules and consistency n.r. Color chocolate brown *in vivo*, and preserved n.r.	I, 764–794 x 12–14 II, 363–426	Selenasters, 38.4–67 x 43 Spherasters, 15–18 (*sensu* van Soest, 2009) Spherules, 6	Curaçao, Caribbean / Atlantic (depth n.r.)
Hechtel (1969) as *P. melobesioides*	Habit encrusting (up to 3 mm in thickness). Surface, oscules and consistency n.r. Color dark brown (cortex) and yellowish (endosome) *in vivo*, and the same colors preserved (fixative n.r.)	252–577.0–845 x 4.7–7.5–12.9	Selenasters, 40–55.0–64 x 26–45.2–56 Spherasters, 12–13 Spherules, 1.2–1.4–1.7	Barbados, Caribbean / Atlantic (3–5 m)
MNRJ 20508	Habit thickly encrusting (less than 1 mm thock). Surface with slender plates and grooves. Consistency hard, but plates feel like crunchy flakes. Color orangy-brown overall (dull on plates and brighter in the grooves) *in vivo*, and dark beige in fixative (EtHO)	251–480.1–797 x 6–10.1–15	Selenasters, 54–61.8–71 x 39–49.0–55 µm (growth stages, 24–33.7–42 x 17–19.3–24) Spherasters, 15–17.9–25 Microrhabds, 1.4–2.0–2.3	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Order Haplosclerida Topsent, 1928

Family Chalinidae Gray, 1867a

Genus *Haliclona* Grant, 1841

***Haliclona* (*Halichoclona*) *albifragilis* (Hechtel, 1965)**

(Tab. 1–2, 8; Fig. 11A–J)

Synonymy. *Adocia albifragilis*, Hechtel (1965).

Studied material. MNRJ 22236, P.M.M. Coroa Alta (16°13.200' S, 38°57.038' W, Santa Cruz Cabrália, BA, Brazil), intertidal, coll. Fioravanso, A. & Gastaldi, M., 22/iv/2019. MNRJ 21903, Recife do Mutá (16°20.721' S, 39°0.067' W, Porto Seguro, BA, Brazil), intertidal, coll. Fioravanso, A. & Gastaldi, M., 20/iv/2019.

Description. Encrusting (0.2 cm thick), 2.0 cm in larger length. Surface rugose, with a few scattered oscules, 0.2 cm in diameter. Consistency compressible, but easily torn. Color *in vivo* beige translucent, and beige in fixative (Tab. 8; Figs. 11A–B).

Skeleton. Ectosome with an isodictyal reticulation, moderate spongin and paucispicular tracts. Choanosome with an irregular subisodictyal reticulation, paucispicular tracts and occasional reinforcing spongin (Figs. 11C–D).

Spicules. Megascleres only (Tab. 8; Fig. 11E): oxeas, smooth, slightly curved or straight, mostly acerate, with pointy or roundish terminations: 112–<u>133.5</u>–158 x 2.4–<u>3.8</u>–7.3.

Distribution. Previously, West Indies (Jamaica – Hechtel 1965; Barbados, Curaçao, Bonaire – de Weerdt 2000); Venezuela, Florida (de Weerdt 2000). New record – Costa do Descobrimento (BA, Brazil).

Ecology. The specimen MNRJ 21903 was growing on a *Geodia gibberosa* and the specimen MNRJ 22236 was growing next to polychaete tubes, tunicates and algae. Both materials were in sciophilous microhabitat.

Remarks. Our specimens are very similar – in terms of habit, skeleton, spicules and ecology – to the original (Hechtel, 1965) and subsequent descriptions (Pulitzer-Finali, 1986; de Weerdt, 2000) of *H.* (*Halich.*) *albifragilis* from the Caribbean. However, we could notice that the skeletal architecture in Caribbean counterparts is slightly denser than what was observed in Brazilian specimens by us. Nevertheless, this is interpreted here as morphological plasticity given the great similarity in other morphological features when Caribbean and Brazilian *H.* (*Halich.*) *albifragilis* are compared.

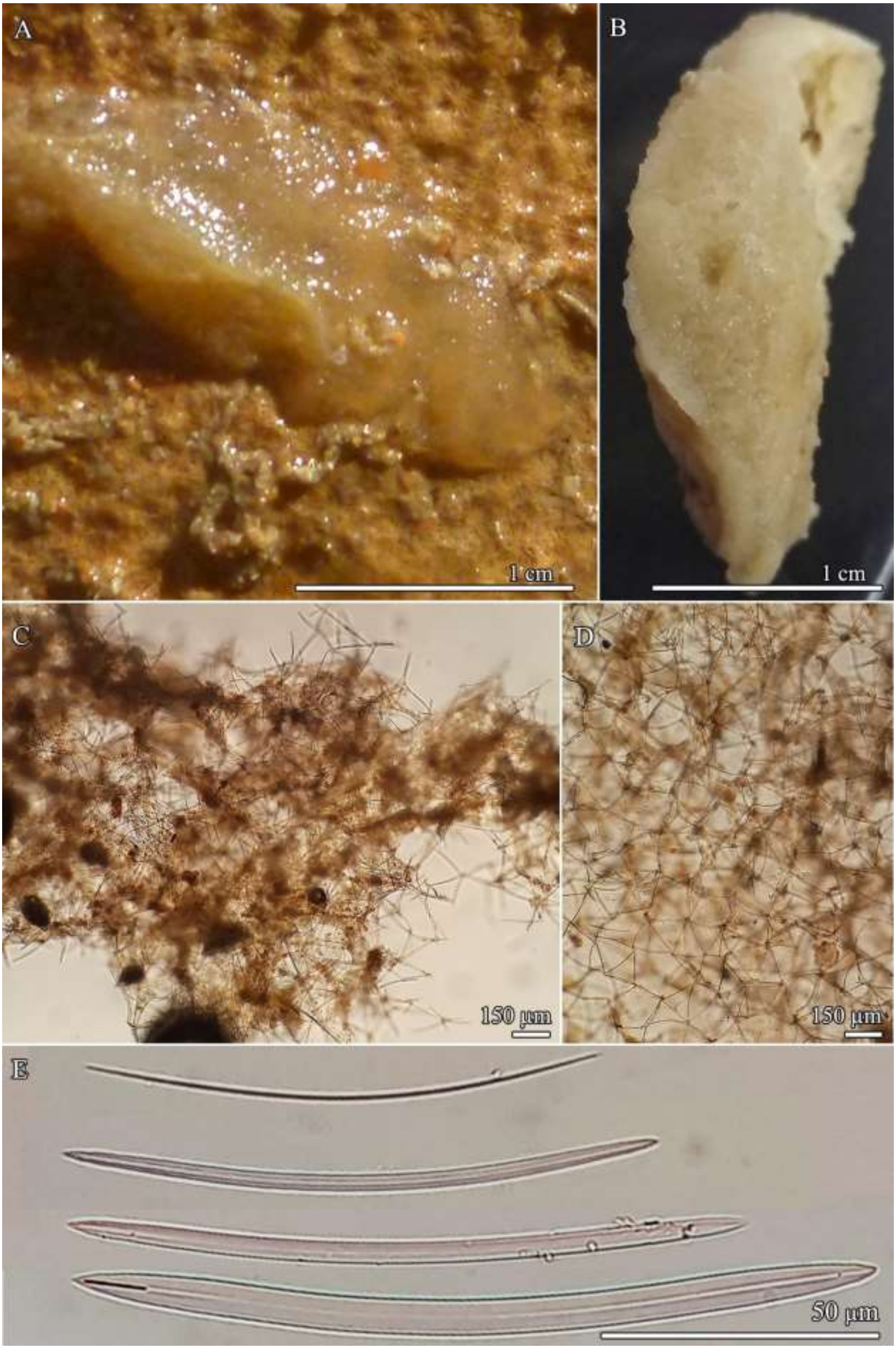
A
1 cm
B
1 cm
C
150 µm
D
150 µm
E
50 µm

FIGURE 11. *Haliclona* (*Halichoclona*) *albifragilis* (Hechtel, 1965), MNRJ 21903: **A**, another specimen (MNRJ 22236) in life; **B**, fixed specimen; **C**, longitudinal section of the surface showing a isodictyal reticulation in the ectosomal region; **D**, transverse section showing an irregular subisodictyal reticulation in the choanosomal region; **E**, oxeas.

TABLE 8. *Haliclona* (*Halichoclona*) *albifragilis* (Hechtel, 1965): comparative data on morphology, spicules and known distribution. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum) of length x thickness.

sensu	**Morphology features**	**Megascleres (oxeas)**	**Distribution (Depth)**
Hechtel (1965)	Habit thinly encrusting (2–3 mm thick). Surface even, microtuberculate, but not hispid. Oscules n.r. Consistency compressible, but easily torn. Color white *in vivo*, and pale (nearly white) in fixative (EtOH)	145–174 x 3–5	Jamaica / Caribbean (depth few feet of water)
Little (1963) as *Adocia neens* (Topsent, 1918)	Habit encrusting (3–4 mm thick). Surface, oscules and consistency n.r. Color white *in vivo*, and in fixative (EtOH)	98–134 x 3–6	Florida, Gulf of Mexico / Atlantic (2.5 m)
de Weerdt (2000)	Habit thinly encrusting patches (less than 1 mm thick). Surface very even and smooth. Oscules not apparent. Consistency friable, slightly brittle. Color opaque white or light cream *in vivo*, and n.r. in fixative	63–117.8–168 x 2.1–4.0–8.4 (standard deviations, 21.6 x 1.5)	Caribbean / Atlantic (up to 74 m)
MNRJ 21903; MNRJ 22236	Habit thinly encrusting (up to 2 mm thick). Surface rugose. Oscules apparent (2 mm in diameter). Consistency compressible, but easily torn. Color beige translucent *in vivo*, and beige in fixative (EtOH)	respectively: 112–132.6–158 x 2.4–3.9–7.3; 120–134.3–153 x 3.1–3.7–4.9	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Haliclona (*Reniera*) *tubifera* (George & Wilson, 1919)

(Tab. 1–2, 9; Fig. 12A–E)

Synonymy. *Reniera tubifera*, George & Wilson (1919). *Haliclona hogarthi*, Hechtel (1965). Detailed synonymy in de Weerdt (2000).

Studied material. MNRJ 20562, P.M.M. Recife de Coroa Alta (16°14.056' S, 38°57.252' W, Santa Cruz Cabrália, BA, Brazil), intertidal, coll. Leite, D., 25/iii/2019; MNRJ 21160, Praia dos Pescadores (16°29.073' S, 39°3.999' W, Arraial D'Ajuda, Porto Seguro, BA, Brazil), intertidal, coll. Fioravanso, A. & Gastaldi, M., 19/iv/2019; MNRJ 22235, P.M.M. Recife de Coroa Alta (16°13.200' S, 38°57.038' W, Santa Cruz Cabrália, BA, Brazil), intertidal, coll. Fioravanso, A. & Gastaldi, M., 22/iv/2019.

Description. Thinly to thickly encrusting, ca. 3 cm in maximum diameter, sometimes like a tubular structure laying parallel to the substrate, ending in a circular oscule (3 mm in diameter), or bearing short lobate or volcaniform projections (< 1 cm high) topped by oscula alike. Fistular projections as a reptating extention (MNRJ 22235) or as a free biphid digitiform one (MNRJ 22235). Surface visually rough and punctate. Consistency compressible and soft. Color *in vivo* varies from yellowish-beige to light-purple; light beige in fixative (Tab. 9; Figs. 12A–B)

Skeleton. Ectosomal skeleton renieroid, from a strictly unispicular to an isotropic reticulum, with variable amounts of spongin. Choanosomal architecture a unispicular, isotropic reticulation, similar to the ectosome, but with loose round meshes; reminiscent of the *H.* (*Soestella*) pattern. Spongin more frequently in the choanosome than the ectosome. Sediment present in low amounts in the choanosome too (Figs. 12C–D).

Spicules. Megascleres only (Fig. 12E): oxeas, stout, with conical, mucronated or roundish points, 101–139.6–147 x 1.5–4.8–8.2.

Ecology. Sciophilous, under calcareous substrate in the intertidal, growing in direct contact with *Cladocroce caelum*, near additional sponges and diverse filamentous organisms.

Distribution. Previously Virginian (George & Wilson 1919), the Greater Caribbean (Florida – van Soest 1980. Greater Antilles – Pulitzer-Finali 1986; de Weerdt 2000; Alcolado 2007. Eastern Carib. – de Weerdt 2000; Pérez *et al.* 2017. Western Carib. – de Weerdt 2000; Rützler *et al.* 2000; Díaz *et al.* 2004. Southwestern Carib. – Zea 1987; de Weerdt 2000; Díaz 2005. Southern Carib. – Sutherland 1980; de Weerdt 2000), Northern Gulf of Mexico (de Weerdt 2000). New record – Southwestern Atlantic (Costa do Descobrimento, BA, Brazil).

Remarks. This species had been recorded from southern Brazil by Lerner (1996), but this identification has been questioned by de Weerdt (2000), who suggested the record should be classified in *H.* (*Halichoclona*) instead. This record was reviewed in Bispo (2019), who considered Lerner (1996) record to be *H.* (*Halich.*) *vansoesti*. The specimens reported here match well the species concept in terms of habit, architecture and spicule geometry and dimensions, confirming its occurrence in the Southwestern Atlantic.

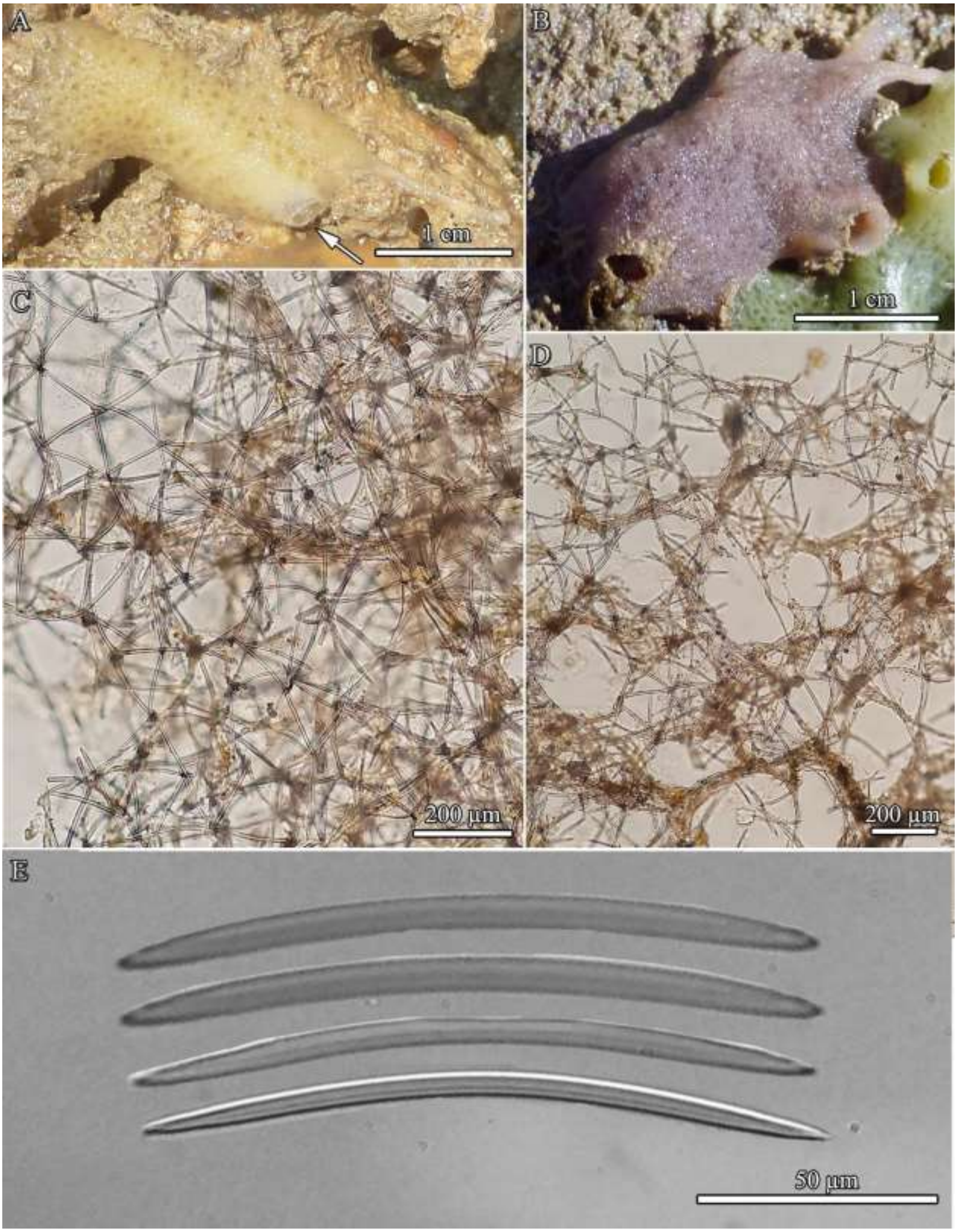

FIGURE 12. *Haliclona* (*Reniera*) *tubifera* (George & Wilson, 1919), MNRJ 22235: **A**, specimen in life, with arrow pointing to an oscule; **B**, another specimen (MNRJ 21160) in life; **C**, longitudinal section of the surface showing a iso- to subisodictyal reticulation in the ectosomal region; **D**, transverse section showing an irregular iso- to subisodictyal reticulation and rounded channels in the choanosomal region; **E**, oxeas.

TABLE 9. *Haliclona* (*Reniera*) *tubifera* (George & Wilson, 1919): comparative data on morphology, spicules and known distribution. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum) of length x thickness. Data not reported are represented as n.r.

Sensu	**Morphology features**	**Megascleres (oxeas)**	**Distribution (Depth)**
George & Wilson, (1919) as *Reniera tubifera*	Habit irregular (reticular system of anastomosing cylindrical branches with oscules at their tips. Surface nr. Consistency quite fragile (not soft). Color pink or reddish purple, varying to brown *in vivo,* and fading quickly in (EtOH)	125–170 x 3–8	North Carolina (USA) / Atlantic (low tide)
Hechtel (1965) as *H. hogarthi*	Habit branched (numerous, slender, anastomosing branches). Surface microtuberculate (even but wrinkled) and punctiform. Oscules n.r. Consistency limp, soft, compressible and somewhat resilient. Light reddish-purple *in vivo*, and pale to dark drab in fixative (EtOH)	117–157 x 5–9	Jamaica, Caribbean / Atlantic (0.3–0.6 m)
de Weerdt (2000)	Habit very variable, commonly cushion-shaped base with several oscular elevation (volcano or chimney). Surface smooth, even, slightly punctate. Consistency soft, compressible and fragile. Color different shades of purple and pink *in vivo*, and in fixative n.r.	ranging from 67.3–90.5 x 2.8–4.6 to 143.8–178.6 x 6.9–9.3 in different individuals	North and South Carolina (USA), Gulf of Mexico and Caribbean / Atlantic; and Panama / Pacific (0.5–10 m)
MNRJ 20562; MNRJ 21160; MNRJ 22235	Habit thinly to thickly encrusting, occasion. like tubular structure laying parallel to substrate, or lobate. Surface slightly rough and punctate. Oscules at the apex of the tubular structure, or at the short lobate or volcano elevations (< 1 cm high). Consistency soft and compressible. Color beige to light-purple *in vivo*, and light beige in fixative (EtOH).	respectively: 101.2–126.5–147 x 1.5–5.5–8; 90.8–118.2–137 x 2.4–5.0–8.2; 101–128.1–144.6 x 2.1–5.1–7.8	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Order Tetractinellida Marshall, 1876
Family Tetillidae Sollas, 1886
Genus *Acanthotetilla* Burton, 1959

Acanthotetilla walteri **Peixinho, Fernandez, Oliveira, Caíres & Hajdu, 2007**

(Tab. 1–2, 10; Fig. 13A–G)

Studied material. MNRJ 21180 – P.M.M. Recife de Coroa Alta (16°14.056' S, 38°57.252' W, Santa Cruz Cabrália, BA, Brazil), intertidal, coll. Leite, D., 25/iii/2019.

Additional material. MNRJ 23318 – Recife do Mutá (16°34.49117’ S, 39°00.40300’ W), Santa Cruz Cabrália, BA, Brazil), intertidal, coll. Fernandez, J.C. & Clerier, P., 12/xii/2020.

Description. Encrusting (1 cm x 2 cm x 0.1 cm) to endolithic. Surface irregular, abundantly pierced by spicules. Consistence firm, but compressible. Color *in vivo* not recorded, and light beige in fixative (Tab. 10).

Skeleton. Ectosomal skeleton unspecialized, merely a radial arrangement of abundantly triaenes (protriaenes and prodiaenes) and oxeas piercing the surface (Figs. 13A–B). Sigmaspires concentrated slightly underneath the surface (Fig. 13C); some acanthoxeas scattered too. Choanosomal architecture radially organized by oxeas and rhabdome of protriaenes, with abundantly and scattered acanthoxeas and sigmaspires (Figs. 13A, E).

Spicules. Megascleres (Tab. 10; Figs. 13A–G): protriaenes or prodiaenes (Figs. 13A–B), rhabdomes slightly stouter right beneath the cladome, gradually thinning to the apex (mostly broken), > 290–524.4–972 x 1–2.1–4 (n=7), cladi 30–44.7–59 x 1–2.0–3.8 (n=10); acanthoxeas (Figs. 13C, E–G), slightly curved centrally, sharp points, heavily spined, 233–272.6–371 x 9–15.4–21; and oxeas (Fig. 13F), slightly curved, sharply pointed, 704–972.5–1180 x 6–9.3– 12 (n=9). Microscleres (Tab. 10; Figs. 13C): sigmaspires, 9–12.0–14.

Reproduction. A small bud made of spicules and spongin is projecting to the surface (Fig. 13D).

Distribution. Only known from northeast Brazil: Camaçari (type locality), the northern sector of the BA, and Santa Cruz Cabrália, the southern sector of BA—new record.

Ecology. The specimen was growing in a piece of hard coral (*viz.*, not in live), which is associated with calcareous algae and hydrozoans.

Remarks. Our material matches the original description of *A. walteri* by Peixinho *et al.* (2007), as amended in Fernandez *et al.* (2012). The species was originally described from northern Bahia (22 to 35 m depth) and had not yet been reported again. Here we are recording it from an intertidal area in southern Bahia. The endolithic/cryptic habit of *A. walteri* likely explains the few records of the species this far, which is absent from large taxonomic inventories such as those by Muricy *et al.* (2006, 2011), Moraes (2011) and Moura *et al.* (2016).

So far, a similar reproductive specialisation (*i.e.*, bud growing on the surface) found in the examined material has not been reported from other known species of *Acanthotetilla* (cf. van Soest 1977, Peixinho *et al*. 2007, Fernandez *et al.* 2012). However, surface buds were reported from other tetillid sponges, for instance: *Cinachyrella apion* (Uliczka, 1929) from the western Atlantic (Rützler & Smith 1992), *C. australiensis* (Carter, 1886) from the Indopacific (*cf.* Rützler & Smith 1992) and *C. anatriaenilla* Fernandez, Kelly & Bell, 2017 from the west Pacific (Fernandez *et al.* 2017). The latter two species share spined microxeas, which resemble acanthoxeas of *Acanthotetilla* species. Although acanthoxeas and microxeas are acanthose monaxons spicules (Fernandez *et al*. 2012), the origin of both them (as homologous or not) has still not been determined by phylogenetic analysis (Szitenberg *et al.* 2013).

Some important observations about spicules of *A. walteri* should be made here, a consequence of imprecisions later detected in the original description of the species. In regard to protriaenes, a single category is present, with rhabdome thickness of 3.6–3.8–7.2 µm, as already pointed out in Fernandez *et al.* (2012). As for the acanthoxeas, also only a single category is present, the smaller ones shown in Peixinho *et al.* (2007) being misinterpreted due to the angle of the spicules in the SEM image. Micrometric values for these spicules are 238–297.1–378/28–28.0–28 µm as mentioned in Fernandez *et al.* (2012), and reproduced in Table 10.

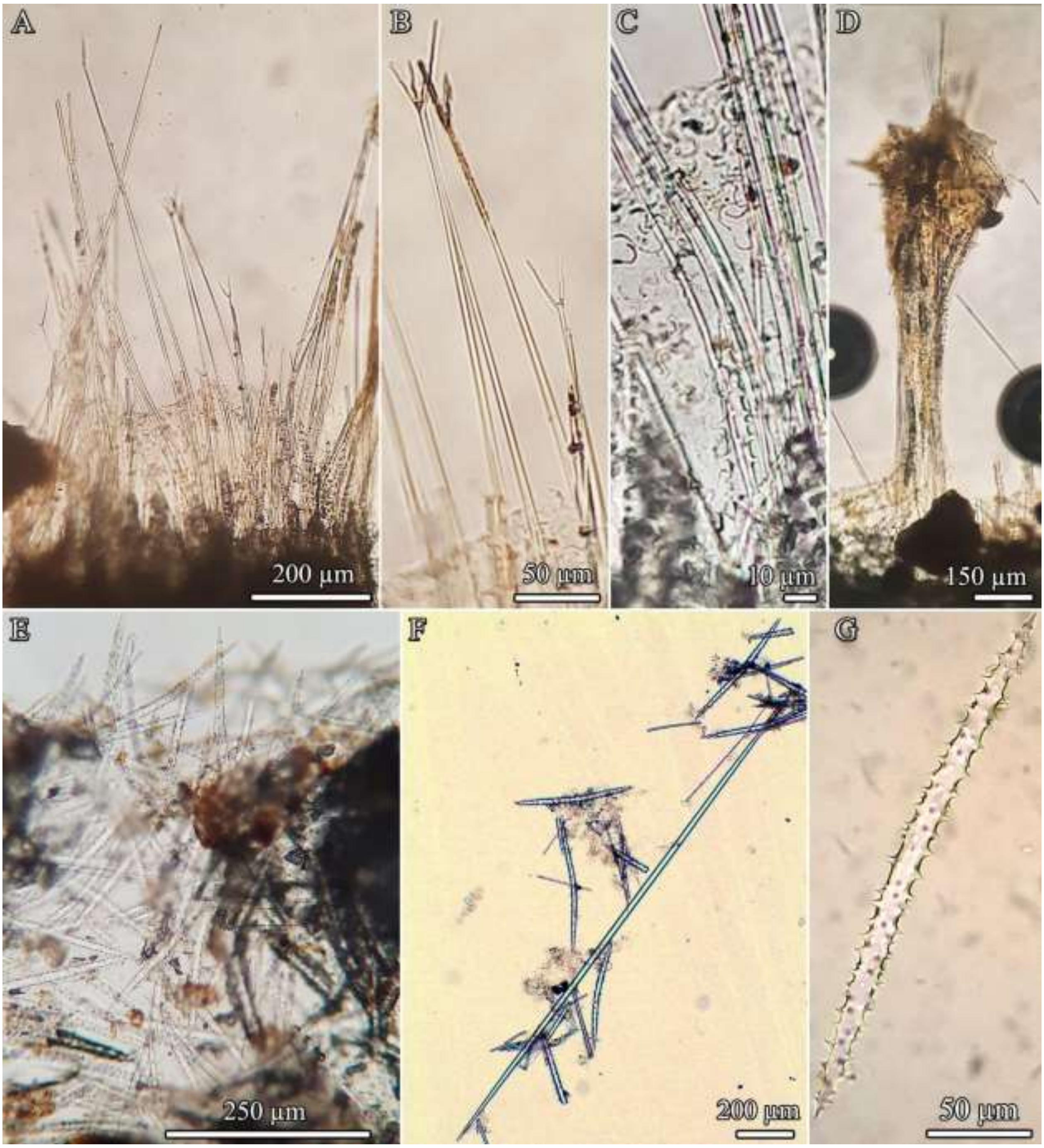

FIGURE 13. *Acanthotetilla walteri* Peixinho, Fernandez, Oliveira, Caires & Hajdu, 2007, MNRJ 21180: **A**, transverse sections showing megascleres (protriaenes and oxeas) radially and piercing to the surface; **B**, detail of protriaenes; **C**, ectosomal region with several sigmaspires; **D**, a reproductive bud on the surface and **E**, several acanthoxeas scattered throughout the choanosomal region; **F**, a large smooth oxea and acanthoxeas; **G**, an acanthoxeas in detail.

TABLE 10. *Acanthotetilla walteri* Peixinho, Fernandez, Oliveira, Caires & Hajdu, 2007: comparative data on morphology, spicules and known distribution. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum) of length x thickness. Only length is presented for sigmaspires.

		Spicules		
sensu	**Morphology features**	**Megascleres**	**Microscleres (sigmaspires)**	**Distribution (Depth)**
Fernandez *et al.* (2012); review of the type material	Habit encrusting (up to 3.5 mm thick) to endolithic. Surface irregular and smooth to slightly hispid. Consistency slightly compressible. Color *in vivo* n.r., and dark to light gray in fixative (EtOH)	Oxeas, 742–995.1–1232 x 5.4–13.0–21 Acanthoxeas, 238–297.1–378 x 28–28.0–28 Protriaenes (rhabdome; cladi) 308–722.7–1372 x 3.6–3.8–7.2; 18–40.5–58 x 1.8–3.6–7.2	7–10.2–18	Camaçari (northern Bahia), Brazil / Atlantic (22–35 m)
MNRJ 21180	Habit encrusting (up to 1 mm thick) to endolithic. Consistency firm, but compressible. Surface irregular and mostly pierced by megascleres. Color *in vivo* not observed, and light beige in fixative (EtOH)	Oxeas, 704–972.5–1180 x 6–9.6–13 Acanthoxeas: 233–272.8–371 x 8.7–15.7–21.4 Protriaenes (rhabdome, cladi), 290–540.1–972 x 1–2.1–4; 30–44.7–59 x 1–2.0–3.8	9–12.0–14	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Family Samidae Sollas, 1888
Genus *Samus* Gray, 1867a

***Samus anonymus* Gray, 1867a**
(Tab.1–2, 11; Fig. 14A–G)

Studied material. MNRJ 22223, P.M.M. Coroa Alta (16°13.200' S, 38°57.038' W, Santa Cruz Cabrália, BA, Brazil), intertidal, coll. Hajdu, E. & Avelino, D., 22/iv/2019.

Description. Endolithic. Surface, consistency and color (*in vivo*) not recorded; yellowish-beige in fixative (Tab. 11; Figs. 14A–B).

Skeleton. The ectosome absent or not differ from the choanosome. In the latter, scattered megascleres and relatively abundant microscleres. Choanosome in a compact appearance, but with a few rounded channels (up to 170 µm in diameter) and points of attachment to the substrate. Presence of several large flattened spaces adjacent to the substrate (Figs. 14C–F).

Spicules. Megascleres (Tab. 11; Figs. 14C–E): smooth short-shafted amphitriaenes in the shape of amphipro- or amphiplagiotriaenes and symmetrical amphitrichotriaenes, with dichotomous or trichotomous cladi, but both arrangements can be present in a same spicule; total length, 40–81.3–120 (n=8), rhabdome, 10–20.9–23 x 2.5–8.2–18 (n=8), protocladi, 5–14.5–38 (n=10), and deuterocladi, 20–24.3–30 (n= 9). Microscleres (Tab. 11; Fig. 14F): sigmaspires, 10–10.8–13.

Distribution. Previously Bermuda (de Laubenfels 1950), the Greater Caribbean [Florida (de Laubenfels 1936); Western Carib. (Macintyre *et al.* 1982; Rützler *et al.* 2014); Southwestern Carib. (Wintermann-Kilian & Kilian 1984; Łukowiak 2016)], Gulf of Guinea (Lévi 1959), Mediterranean (Vacelet 1976; Pulitzer-Finali 1983; Voultsiadou 2005), Southwestern Atlantic [off Salvador, BA, Brazil (Sollas, 1888)]. New record – Costa do Descobrimento, BA, Brazil.

Ecology. The specimen was growing in calcareous substrate (coral piece).

Remarks. The species was found unexpectedly while sectioning a piece of coral. Despite the sponge seemingly inhabiting a canal leading to the outer medium, it could not be spotted after careful examination of the whole substrate in light-microscopy (stereoscope). Light-microscopy did not allow the verification of whether sigmaspires of the examined material carry a lot of or a few spines. However, the spiculation observed fits well in *S. anonymu*s (see revision in van Soest & Hooper 2002), despite the smaller dimensions of the cladi and rhabdomes of the amphitriaenes (Tab. 11).

The various records of *S. anonymus* from all over the world (the Indo-Pacific—Siri Lanka, Seychelles, Singapore and Palau Islands; Atlantic—Florida, Colombia, Curaçao and West Africa; and the Mediterranean—several localities) describe similar spicule sizes and forms, but such records are suspect from a genetic point of view, since populations are widely separated (van Soest & Hooper 2002). Currently, the

World Porifera Database (de Voogd *et al.* 2022) only accepts as likely conspecific Atlanto-Mediterranean records of this species, but in our opinion the Amphi-Atlantic distribution already demands corroboration from additional data sources. Previous records from the Indo-Pacific are deemed inaccurate, and a further justification for an integrative treatment of the problem. Given the species' cryptic habit (*i.e.*, endolithic / excavating—van Soest & Hooper 2002), this will demand a concerted effort to gather a minimum number of samples of reasonable dimensions.

This ocean basin classification of identification likelihood has been a guiding principle in the World Porifera Database, but care should be exercised not to mask invasive/cryptogenic species, as well as potential conservative taxonomy. Rützler *et al.* (2014) have reported microspined amphitriaenes in Belizean materials identified as *S. anonymus*, besides the normal smooth ones. The latter authors argued that the microspined forms are possibly developmental stages of the mature forms, despite recognizing that these spined forms had not been mentioned in the previous taxonomic literature on the species, which included the *Systema Porifera* review of the type material of the species by van Soest & Hooper (2002). Might Rützler *et al.*'s (2014) material belong to an unknown species of *Samus*? These suspicions further support the need for an integrative review of the species as argued for above.

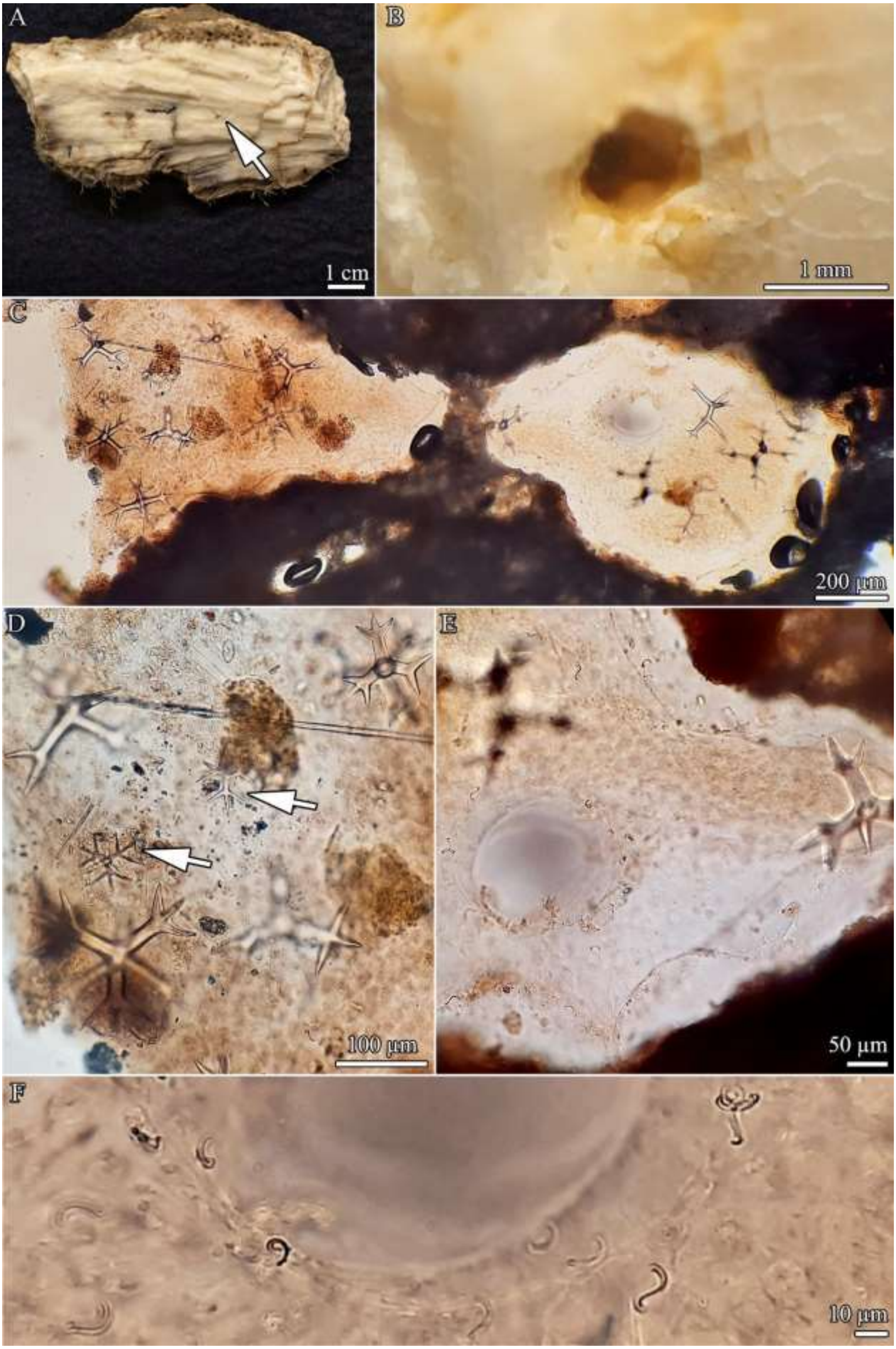
A
1 cm
B
1 mm
C
200 µm
D
100 µm
E
50 µm
F
10 µm

FIGURE 14. *Samus anonymus* Gray, 1867a, MNRJ 22223: **A–B**, substrate where the specimen was found; **B**, gallery where arrow is pointing in **A**. Skeleton and spicules: **C**, transverse sections showing amphitriaenes beneath the surface and scattered throughout the choanosomal region; **D**, maller amphitriaenes—arrows pointing to them; **E**, channels in the choanosome as well bordering it and **F**, sigmaspires bordering a channel.

Table 11. *Samus anonymus* Gray, 1867a: comparative data on spicules and known distribution of records from West Atlantic. Spicule measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum; or only maximum) of length x thickness; or longer length or diameter. Only length is presented for sigmaspires; and data not reported are represented as n.r.

	Spicules		
sensu	**Megascleres (smooth amphitriaenes)**	**Microscleres (sigmaspires)**	**Distribution (Depth)**
van Soest & Hooper (2002); review of the type material	total length (including cladi), 150 or (including cladome) 160; rhabdome, 20–80 x 38; protocladi and deuterocladi, 15–75	10–14	Bahia, Brazil / Atlantic (depth n.r.)
Sollas (1888) as *S. anonyma*	the author mentions “heteropolar amphitriaene” to the smaller forms. Measures of smaller and larger forms merged here: total length (as chord), 160; rhabdome, 19.7–80 x 37.5; simple cladi, 24; protocladi, 16–43; deuterocladi, 16–75	12	off Salvador, Bahia, Brazil / Atlantic (depth n.r.)
Laubenfels (1936) as *S. anonyma*	total length (as trichoamphitriaenes), 150	n.r.	Dry Tortugas, Caribbean / Atlantic (17 m)
Laubenfels (1950) as *S. anonyma*	total length from drawing, 48–88	presumably present	Bermuda / Atlantic
Łukowiak (2016); spicules from sediment	total length > 400; rhabdome, 30–50 x 20–75	not observed	Bocas del Toro, Panama / Atlantic (ca. 8 m)
MNRJ 22223	total length, 40–81.3–120; rhabdome, 10–20.9–25 x 2.5–8.2–18; protocladi, 5–14.5–38; deuterocladi, 20–24.3–30	7.5–10.8–13	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

Subclass Verongimorpha Erpenbeck, Sutcliffe, De Cook, Dietzel, Maldonado, van Soest, Hooper & Wörheide, 2012

Order Chondrillida Redmond, Morrow, Thacker, Diaz, Boury-Esnault, Cárdenas, Hajdu, Lôbo-Hajdu, Picton, Pomponi, Kayal & Collins, 2013

Family Halisarcidae Smith, 1862

Genus *Halisarca* Johnston, 1842

***Halisarca caerulea* Vacelet & Donadey, 1987**

(Tab. 1–2, 12; Fig. 15A–G)

Studied material. MNRJ 20520, P.M.M. Recife de Fora (16°24.433' S, 38°58.929' W, Porto Seguro, BA, Brazil), intertidal, coll. Hajdu, E. & Fioravanso, A., 22/iii/2019. MNRJ 21169, Recife do Mutá (16°20.721' S 39°0.067' W, Porto Seguro, BA, Brazil), intertidal, coll. Hajdu, E. & Avelino, D., 20/iv/2019.

Description. Thinly encrusting (ca. 2.5 mm thick), oscules contracted in the live material due to exposure to the air during *in situ* photo; contracted in fixative too. Surface very smooth, shiny, with conspicuous and very regular distributed star-shaped channels; channels contracted too. Consistency firm and cartilaginous. Color from beige to pink and lilac *in vivo* (Fig. 15A), and lighter or darker beige in fixative.

Skeleton. Ectosomal region with a colageneous cortex, ca. 25–80 µm thick. Rounded and flattened channels present in both ectosomal (up to 200 µm long) and choanosomal (up to 125 µm long) regions; average of 70 µm long to both regions (Figs. 15B–E).

Distribution. Previously the Greater Caribbean (Eastern Carib. – Vacelet & Donadey 1987; Vacelet 1990; Alcolado & Busutil 2012; Pérez *et al.* 2017. Western Carib. – Rützler *et al.* 2000. Southwestern Carib. – Diaz 2005), Southwestern Atlantic (Fernando de Noronha and Atol das Rocas – Moraes 2011). New record – Eastern Brazil (Costa do Descobrimento, BA, Brazil).

Ecology. Growing over calcareous substrate, in a sciophilous and intertidal microhabitat, next to other sponges, sea-urchins, algae (*Caulerpa racemosa*), and abundant filamentous organisms.

Remarks. Habit and anatomy of the specimens reported here are entirely compatible with the original description of this species by Vacelet & Donadey (1987), but deviate somewhat from aspects provided in Moraes' (2011) description. The latter study has reported specimens with a thicker collagen cortex (250–500 µm thick) than the one found in the present study as well as in the original description by Vacelet & Donadey (1987; 25–80 µm thick; Tab. 12).

FIGURE 15. *Halisarca caerulea* Vacelet & Donadey, 1987, MNRJ 20520: **A**, specimen in life; **B**, transverse sections showing a wide flattened channel into the choanoseme; **C**, several rounded to flattened channels occurring between the ectosome and choanosome; **D**, a region with denser choanosome—no channels; **E**, and detail of choanosome with flattened and elongated choanocyte chambers.

TABLE 12. *Halisarca caerulea* Vacelet & Donadey, 1987: comparative data on morphology, internal anatomy and known distribution. Choanocyte chambers measurements in micrometers (µm) are presented as minimum–average–maximum (or minimum–maximum; or only maximum) of length x thickness (or only length).

sensu	**Morphology features**	**Choanocitary chambers**	**Distribution (Depth)**
Vacelet & Donadey (1987)	Habit thinly encrust. (1.2–1.5 mm thick). Surface smooth, with star-shaped canal system. Oscules (2.5–3.5 mm in diameter). Consistency fleshy. Collagen cortex (25–80 µm thick). Color blue *in vivo*, and yellowish grey in fixative (spirit)	tubular (mainly) or branched, 200 x 25	Martinique, Caribbean / Atlantic (3–9 m)
Moraes (2011)	Habit encrusting (3 mm thick). Surface smooth, irregular, with star-shaped subectosomal canals. Oscules circular (1–2 mm in diameter). Consistency firm and non-elastic. Collagen cortex (250–500 µm thick). Color lilac blue to pinkish *in vivo*, and beige in fixative (EtOH)	elongated, 37–55	Fernando de Noronha Archipellago, Brazil / Atlantic (3–10 m)
MNRJ 20520	Habit thickly encrusting (ca. 2.5 mm thick). Surface Very smooth, shiny. Oscules contracted. Consistency firm and cartilaginous. Collagen cortex (ca. 25–80 µm thick). Color beige to pink and lilac *in vivo*, and lighter or darker beige in fixative (EtOH)	oval or elongated and flattened, 41.6– 70.9–87.3	Costa do Descobrimento, Bahia, Brazil / Atlantic (intertidal)

DISCUSSION

This is the most comprehensive study of the sponges of the intertidal in any sector of the Southwest Atlantic so far. There are no equivalent studies allowing a comparison of results obtained here. Working on a similar area, the state of Bahia, but with a totally distinct strategy, Hajdu *et al.* (2011) reported 19 out of 70 species listed in a field guide to occur also in the intertidal. Independent evidence for the richness observable in the intertidal of these tropical Southwest Atlantic reefs comes from the series of publications on new species from the Brazilian reefs in Paraíba, Pernambuco and Alagoas states (6°41'–9°45' S), where 19 new species were described in less than a decade (Cedro *et al.* 2011, 2013; Santos & Pinheiro 2013, 2014, 2016; Bispo *et al.* 2014; Galindo *et al.* 2014; Santos *et al.* 2014a, 2014b, 2018; Cavalcanti *et al.* 2016, 2018, 2019). Unfortunately, these studies were not concerned with generating a comprehensive species list for the surveyed localities, and accordingly, are not directly comparable to our results.

Inventories of the intertidal sponge fauna have been conducted at various parts of the world since over half a century (Bergquist & Tizard 1967; Juniper & Steele 1969; Hofknecht 1978). Not many though were carried in Tropical waters, as for instance the study by Bergquist & Tizard (1967) reporting 19 spp from the Darwin area in northern Australia, although highlighting the collection included mainly large sponges, being thus biased against the always richer encrusting component. Barnes (1999) reported 33 spp from Mozambique. Barnes & Bell (2002) reported between 12 and 28 spp from several localities in the Western Indian Ocean, counting soft, as well as hard substrate dwellers. Lim *et al.* (2012) reported 99 spp from Singapore, although collected over a period of five years. This is the only intertidal sponge fauna known to date as comparably rich as the one reported here from Costa do Descobrimento. More recently, Lakwal *et al.* (2018) found only 12 species in the intertidal of Ratnagiri (Central Western India, Arabian Sea), considering three stations visited over two years.

Inventories conducted in temperate zones always returned considerably poorer sponge lists. Juniper & Steele (1969), despite reporting on 22 years of observations, compiled a list of only 21 intertidal sponge species for the Portsmouth area (English Channel). Hofknecht (1978) found only 14 spp in the Puerto Peñasco area (Sea of Cortez, Mexico). Only 13 sponge species were reported from intertidal California by Sim & Bakus (2008), and six from San Antonio Bay in northern Patagonia (Argentina) by Gastaldi *et al.* (2018), which at the time, appeared to represent a comprehensive sample of the local sponge fauna. Regueiras *et al.* (2019) found 31 species in the intertidal of western Portugal's coast, where 12 stations were visited during four years, most of which only once. Borges da Silva (2019) visited 14 stations in South-eastern Australian intertidal rocky reefs and found only 22 sponge species, despite 18 months of observations. And this meagre intertidal fauna is irrespective of how rich the local subtidal is (Picton 1991, in Barnes 1999).

Collection at Costa do Descobrimento continued during 2020 and 2021, and the taxonomic study of these samples is ongoing. It is already clear that further new records for the area will be revealed, thus confirming its status as one of the world's richest known intertidal sponge faunas. It is important to highlight that this picture would not come out without a detailed study of cryptic, sciophilous forms. In our case, 90% of collected samples were cryptic / sciophilous (184 / 204). Barnes (1999) argued that the under-surfaces of boulders and caves alike offer sponges some protection against temperature, current extremes, reduced desiccation and shifts in salinity (through trapping pools which reduce evaporation). The search for sciophilous specimens has also been the main reason offered by Lim *et al.* (2012) for the similarly rich list of sponges for the Singapore intertidal. These “little critters”, encrusting, cryptic, sciophilous, are not just baby sponges, but may actually represent a particular fauna, adapted to a specific microhabitat (Meesters *et al.* 1991; van Soest 2009). It is worth noting that Lim *et al.* (2012) dealt with an intertidal portion of the Coral Triangle, the world’s richest coral ecosystems, while Costa do Descobrimento belongs in a so called peripheral region for corals, with an impoverished list of West Indian genera and species (Laborel 1967; Stehli & Wells 1971; in Hechtel 1976). This is in contrast to Briggs’ (1974) assertion that “the richest shore fauna should be found along the northeastern South American coast and perhaps up into the Lesser Antilles”, on account of the area’s more stable temperature and sufficient variety of habitats. In winter, the surface temperature of the ocean remains significantly higher in this area than it does further north, in the Caribbean Sea.

One particular aspect of this checklist concerns the richness of *Haliclona* in the study area. There are 20 species sorted, only six of which are associated with previously described species. A comparably rich list of *Haliclona* spp. had been provided by Rützler *et al.* (2000) for Belizean mangroves, where 24 species were listed, only nine of which named with previously available names. In a more recent study, Perez *et al.* (2017) reported only nine species of *Haliclona* from Martinique Island mangroves. Biogeographically closely related areas may apparently yield contrasting numbers of *Haliclona* spp. It is important to mention that both studies quoted above had a relatively large number of experts involved in collection and identification. In contrast, the Coral Triangle spot analysed by Lim *et al.* (2012), the Singapore intertidal, yielded only nine species of *Haliclona* too, in spite of the five years of observations. The large number of species of *Haliclona* just described by Bispo *et al.* (2022) for the Peruvian coast, ten, comprises only two intertidal species. So, data presently gathered may corroborate the findings by Rützler *et al.* (2000) and support the idea of a hotspot, or multiple hotspots of *Haliclona* spp in the Western Atlantic, both in the shallow subtidal, as well as in the intertidal.

The Haplosclerida represented the largest share of species here (28 %), as well as in Barnes (1999, 21 %), Lakwal *et al.* (2018, 25 %) and Borges da Silva (2019, 36 %). The second richest order in all four studies was Poecilosclerida, respectively with 14, 15, 17 and 18 % of all species reported here and by these authors. The Costa do Descobrimento is particular in respect to the third richest order being the Tetractinellida (10 %), while the other three studies had the Suberitida, respectively with 15, 17 and 14 %. At Costa do Descobrimento the Suberitida and the Clionaida both share the same number of species, 9 % of the total.

Spatial variability is not a new phenomenon. It has been reported by Chapman & Underwood (1998) at scales of metres, tens of metres and kilometres, and no surprise, is known at much larger scales as well (Hooper *et* *al.* 2002). The reefs studied at Costa do Descobrimento were located between 8 and 32 km apart. At this scale, we have observed RF and AA to be the most dissimilar reefs, which derived mainly from the difference in the species composition of both reefs (nearly 95% from their turnover component). Rather, the dissimilarity between RF and CA and between the former and CVM reefs came from the lower richness found in RF (see nestedness component in table 3). Lastly, the dissimilarity between AA and CA and between AA and CVM reefs derives mainly from the different species composition (see turnover component in table 3), thus highlighting the fact that despite being similarly rich, these reefs harbour unique assemblages. This is made clear in Fig. 6, where the numbers of species shared between each reef are shown: AA–CA, 29 spp; AA–CVM, 30 spp. Numbers of shared species may seem high, but consider the 24 and 23 spp occurring in AA, but not shared with the other two reefs (respectively), a clearer view on its uniqueness. More outstanding, among the 101 morphotypes recognized in this study, only 13 were shared among the four reefs. Yet, Borges da Silva (2019) did not find a single species shared among all five surveyed South-eastern Australian intertidal rocky reefs spread over a comparable stretch of coastline (40 km), also remarking upon their very high levels of dissimilarity. The results reported here also highlight the singularity of each of the reefs studied. Although two of the reefs are partially protected as marine parks, our results suggest the need to establish protective measures on the AA reef as well, given the uniqueness of its sponge fauna. The inclusion of beachrock fringing reefs in a more holistic conservation strategy at Costa do Descobrimento is likely to result in more effective preservation of local genetic resources.

While the occurrence of depauperate intertidal assemblages next to rich subtidal faunas are known (Barnes 1999), and to be expected as a consequence of the more stressful environment the former are subjected to, there is no reason for the opposite to be also true. However, the Costa do Descobrimento holds only 16 records for its subtidal, the majority of which from three oceanographic stations off Belmonte (40–83 m depth, BA, Brazil), reported by Boury-Esnault (1973, Calypso Stn. 70) and Muricy *et al*. (2006, REVIZEE Stns. C5–7R and C6–R3#1). Three among those species also occur in the intertidal and were listed in Table 1, namely *Aplysina fulva*, *Cinachyrella kuekenthali* and *Diplastrella megastellata*. So far, records exclusive to the subtidal of Costa do Descobrimento are those of *Agelas schmidtii* Wilson, 1902, *A. tubulata* Lehnert & van Soest, 1996, *Aiolochroia crassa* (Hyatt, 1875), *Aplysina cauliformis* (Carter, 1882), *A. lacunosa* (Lamarck, 1814), *A. orthoreticulata* Pinheiro, Hajdu & Custódio, 2007, *Geodia glariosa* (Sollas, 1888), *Grantia kempfi* Borojevic & Peixinho, 1976, *Hyattella cavernosa* (Pallas, 1766), *Iotrochota birotulata* (Higgin, 1877), *Monanchora arbuscula* (Duchassaing & Michelotti, 1864), *Paraleucilla incomposita* Cavalcanti, Menegola & Lanna, 2014 and *Tribrachium schmidtii* Weltner, 1882. These 16 species are an obviously underrepresented list of species, and a strong evidence that a greater taxonomic effort is still necessary before the poriferan fauna at Costa do Descobrimento can be considered satisfactorily known. In total, intertidal and subtidal, 116 species of sponges are known from the area now. The present checklist is an important step toward a sharper picture of sponge diversity in this sector of the Bahia State coastline by facilitating the recognition of species which are more easily accessible to benthic ecologists, thus enabling a multitude of additional studies to be conducted. Much remains to be done though, both in terms of completing the taxonomic study of collected samples, as well as in moving the collecting effort to the subtidal.

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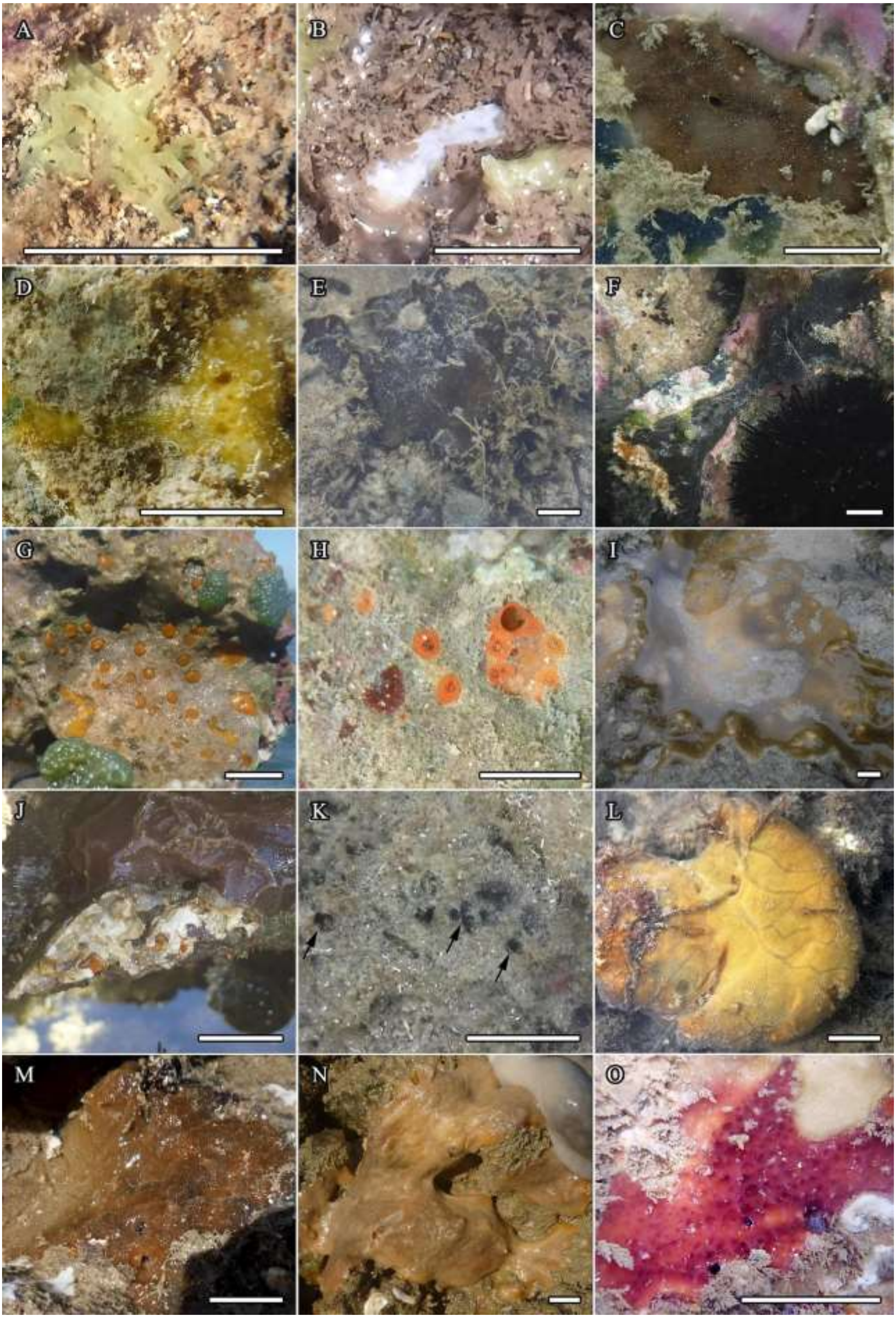
Anexos

SUPPLEMENTARY FILES (I–VI) – In situ images of selected sponge species (Porifera) collected in intertidal reef habitats at Costa do Descobrimento (BA, Brazil), with their identification and registration codes in the MNRJ collection (Museu Nacional / UFRJ, Rio de Janeiro, RJ, Brazil).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SUPPLEMENTARY FILE I – A, *Clathrina* sp. (MNRJ 22228); **B**, *Plakina* sp. (MNRJ 21901); **C**, *Plakortis* sp. (MNRJ 20537); **D**, *Biemna caribea* Pulitzer-Finali, 1986 (MNRJ 22091); **E**, *Chondrilla* aff. *nucula* Schmidt, 1862 (MNRJ 20517); **F**, *Chondrosia reniformis* Nardo, 1847 (MNRJ 20510); **G**, *Cliona* aff. *celata* Grant, 1826 (MNRJ 22230); **H**, *Cliona delitrix* Pang, 1973 (MNRJ 21417); **I**, *Cliona varians* (Duchassaing & Michelotti, 1864) (MNRJ 20493); **J**, *Cliona vermifera* Hancock, 1867 (MNRJ 22243); **K**, *Cliona* sp. (MNRJ 20494); **L**, *Diplastrella megastellata* Hechtel, 1965 (MNRJ 20507); **M**, *Diplastrella megastellata* Hechtel, 1965 (MNRJ 20551); **N**, *Spirastrella hartmani* Boury-Esnault, Klautau, Bézac, Wulff & Solé-Cava, 1999 (MNRJ 22244); **O**, *Aplysilla* aff. *rosea* (Barrois, 1876) (MNRJ 21193).


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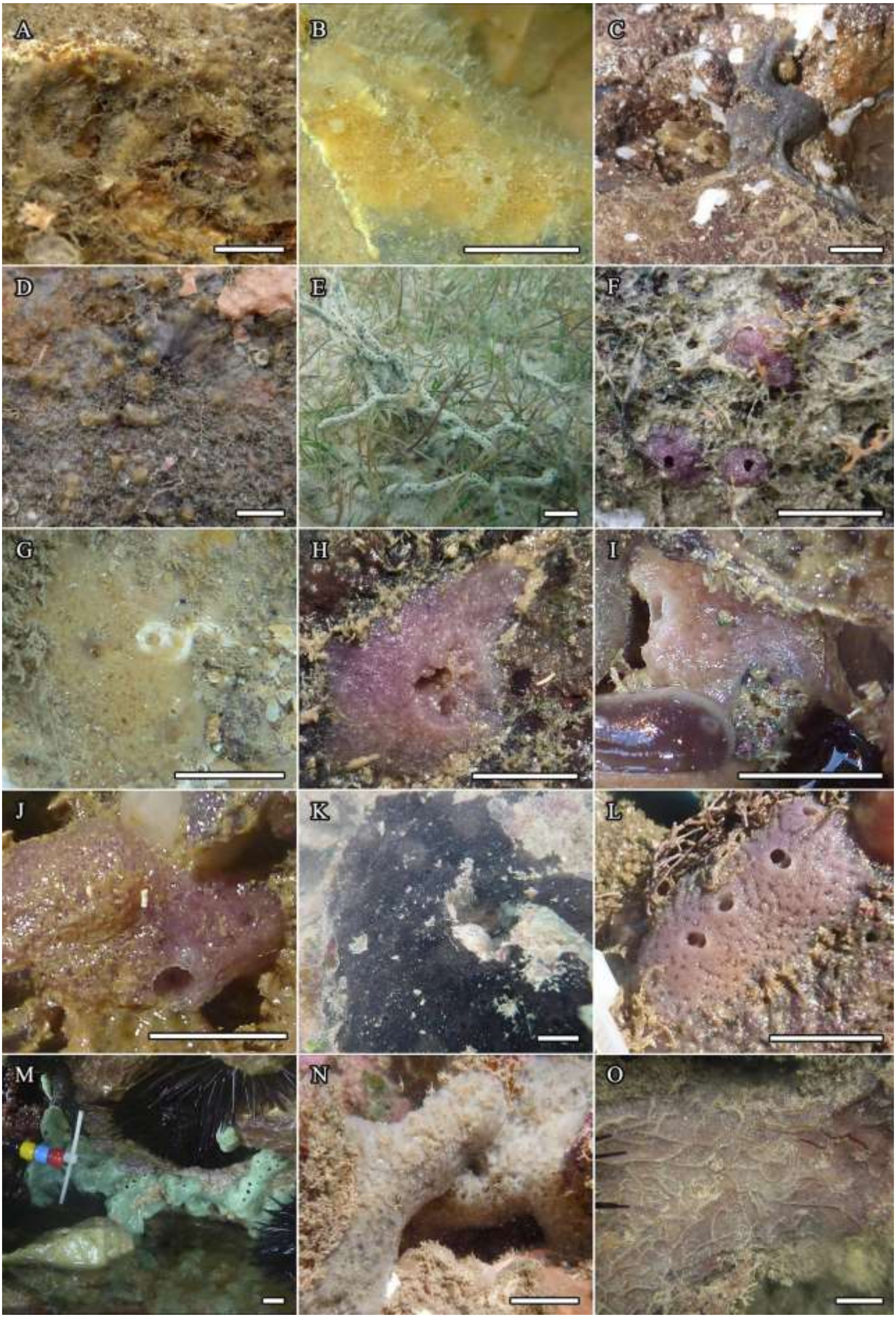
SUPPLEMENTARY FILE II – A, *Aplysilla* aff. *sulfurea* Schulze, 1878 (MNRJ); **B**, *Dysidea etheria* Laubenfels, 1936 (MNRJ 21887); **C**, *Dysidea robusta* Vilanova & Muricy, 2001 (MNRJ 20469); **D**, Dysidea sp.1 (MNRJ 20552); **E**, *Spongia* (*Heterofibria*) sp. (MNRJ 20556); **F**, *Hippospongia* sp. (MNRJ 20558); **G**, *Callyspongia* (*Callyspongia*) *pallida* Hechtel, 1965 (MNRJ 20501); **H**, *Callyspongia* sp. (Bispo sp. nov. in prep.) (MNRJ 20531); **I**, Arenosclera sp. (MNRJ 20542); **J**, *Chalinula molitba* (de Laubenfels, 1949) (MNRJ 21140); **K**, Chalinula sp.1(Bispo sp. nov. in prep.) (MNRJ 21197); **L**, *Cladocroce caelum* Santos, da Silva, Alliz & Pinheiro, 2014 (MNRJ 21157); **M**, *Cladocroce caelum* Santos, da Silva, Alliz & Pinheiro, 2014 (MNRJ 21518); **N**, *Haliclona* (*Gellius*) *laubenfelsi* van Soest & Hooper, 2020 (MNRJ 20478); **O**, *Haliclona* (*Gellius*) sp. (MNRJ 22239).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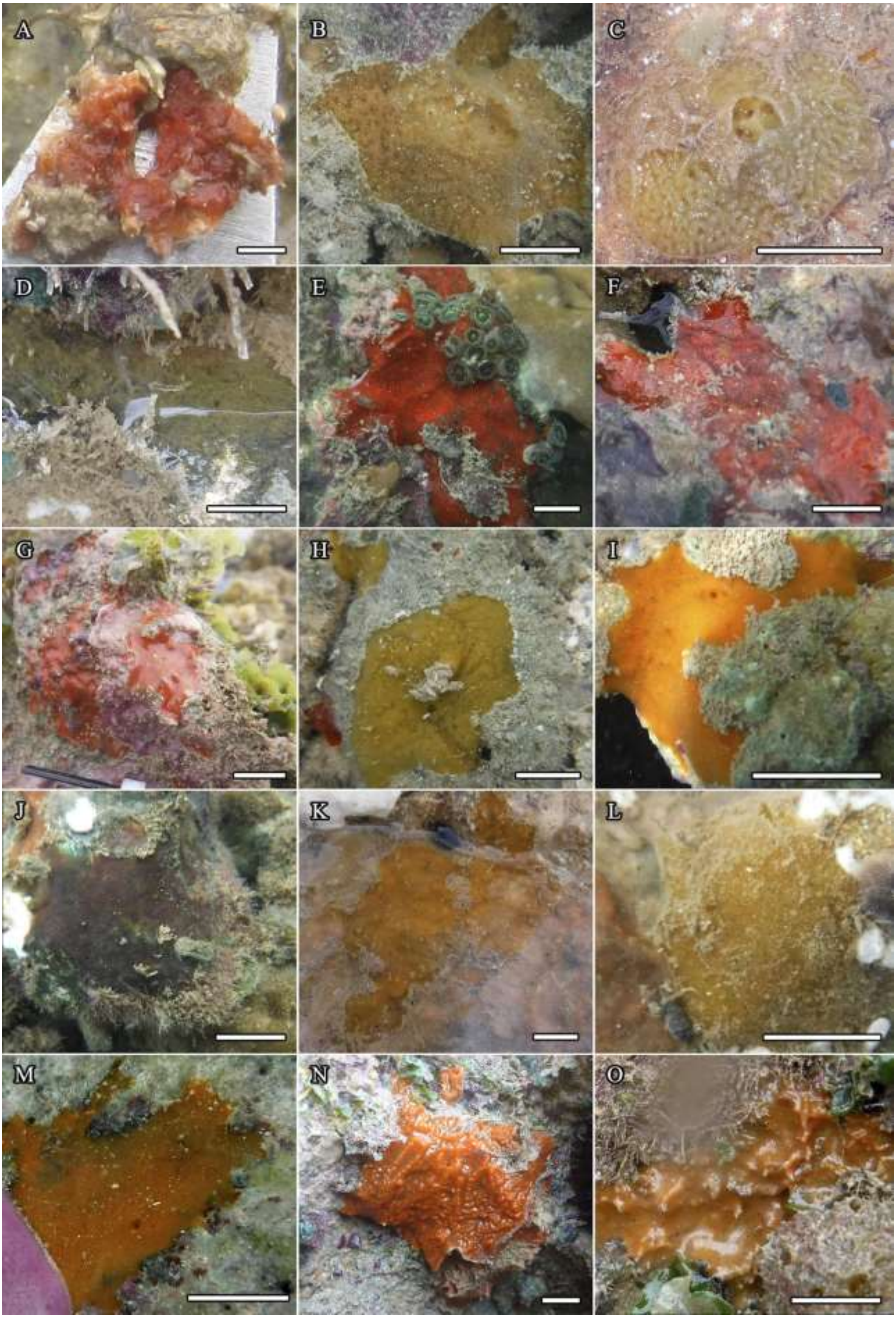
SUPPLEMENTARY FILE III – A, *Haliclona* (*Halichoclona*) sp. 1 (MNRJ 20496); **B**, *Haliclona* (*Halichoclona*) sp.3 (MNRJ 21908); **C**, *Haliclona* (*Halichoclona*) sp. 4 (Bispo sp. nov. in prep.) (MNRJ 20464); **D**, *Haliclona* (*Haliclona*) sp. (MNRJ 20488); **E**, *Haliclona* (*Reniera*) *chlorilla* Bispo, Correia & Hajdu, 2016 (MNRJ 22229); **F**, *Haliclona* (*Reniera*) *implexiformis* (Hechtel, 1965) (MNRJ 20539); **G**, *Haliclona* (*Reniera*) sp. 1 (MNRJ 21894); **H**, *Haliclona* (*Reniera*) sp. 2 (MNRJ 23427); **I**, *Haliclona* (*Reniera*) sp. 3 (MNRJ 22117); **J**, *Haliclona* (*Reniera*) sp. 4 (MNRJ 22240); **K**, *Haliclona* (*Soestella*) *melana* Muricy & Ribeiro, 1999 (MNRJ 222231); **L**, *Haliclona* (*Soestella*) sp. 2 (Bispo sp. nov. in prep.) (MNRJ 22227); **M**, *Amphimedon viridis* Duchassaing & Michelotti, 1864 (MNRJ 20545); **N**, *Niphates erecta* Duchassaing & Michelotti, 1864 (MNRJ 21416); **O**, *Placospongia ruetzleri* Van Soest, 2017 (MNRJ 21092).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SUPPLEMENTARY FILE IV – A, *Acarnus toxeata* Boury-Esnault, 1973 (MNRJ 20487); **B**, *Acarnus* (*Acarnus*) *innominatus* Gray, 1867a (MNRJ 20471); **C**, *Lissodendoryx* (*Lissodendoryx*) *isodictyalis* (Carter, 1882) (MNRJ 21897); **D**, *Hymedesmia* (*Stylopus*) sp. (MNRJ 20498); **E**, *Clathria* (*Microciona*) *campecheae* Hooper, 1996 (MNRJ 20532); **F**, *Clathria* (*Thalysias*) sp. (MNRJ 20528); **G**, *Clathria* (*Microciona*) sp. (MNRJ 20525); **H**, *Mycale* (*Aegogropila*) *americana* van Soest, 1984 (MNRJ 20548); **I**, *Mycale* (*Aegogropila*) *escarlatei* Hajdu, Zea, Kielman & Peixinho, 1995 (MNRJ 20473); **J**, *Mycale* (*Carmia*) *magnirhaphidifera* van Soest, 1984 (MNRRJ 20495); **K**, *Mycale* (*Carmia*) sp. (MNRJ 20514); **L**, *Mycale* (*Grapelia*) sp. (MNRJ 20472); **M**, *Mycale* (*Naviculina*) *diversisigmata* (van Soest, 1984) (MNRJ 20561); **N**, *Tedania* (*Tedania*) *ignis* (Duchassaing & Michelotti, 1864) (MNRJ 21159); **O**, *Scopalina* sp. (Fernandez sp. nov. in prep.) (MNRJ 20492).


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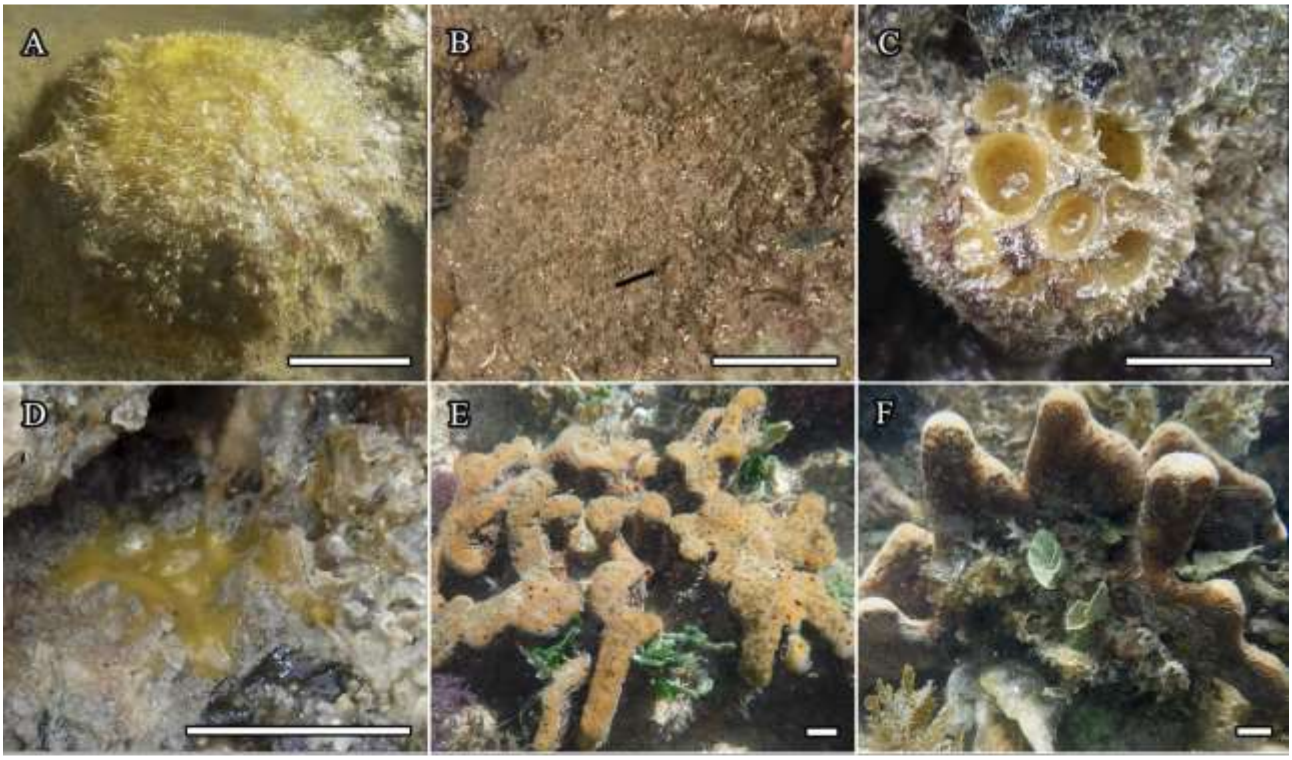
SUPPLEMENTARY FILE V – A, cf. *Stylissa* sp. (MNRJ 20547); **B**, *Amorphinopsis atlantica* Carvalho, Hajdu, Mothes & van Soest, 2004 (MNRJ 20475); **C**, *Halichondria* (*Halichondria*) *marianae* Santos, Nascimento & Pinheiro, 2018 (MNRJ 21143); **D**, Aaptos sp. 1 (MNRJ 20480); **E**, *Aaptos* sp. 2 (MNRJ 21910); **F**, *Protosuberites* sp.1 (MNRJ 20499); **G**, *Suberites aurantiacus* (Duchassaing & Michelotti, 1864) (MNRJ 20491); **H**, *Terpios fugax* Duchassaing & Michelotti, 1864 (MNRJ 20544); **I**, *Terpios belindae* Rützler & Smith, 1993 (MNRJ 21188); **J**, *Tethya bitylastra* Mácola & Menegola, 2018 (MNRJ 22233); **K**, *Tethya maza* Selenka, 1879 (MNRJ 21871); **L**, *Timea berlincki* Leite, Fonseca, Leal & Hajdu, 2015 (MNRJ 22090); **M**, *Dercitus* sp. (MNRJ 20535); **N**, *Stelletta anasteria* Esteves & Muricy, 2005 (MNRJ 20505); **O**, *Geodia gibberosa* Lamarck, 1815 (MNRJ 21903).



SUPPLEMENTARY FILE VI – A, *Cinachyrella alloclada* (Uliczka, 1929) (MNRJ 21130); **B**, *Cinachyrella apion* (Uliczka, 1929) (MNRJ 20564); **C**, *Cinachyrella kuekenthali* (Uliczka, 1929) (MNRJ 20516); **D**, *Trachycladus* sp. (MNRJ 20515); **E**, *Aplysina fulva* (Pallas, 1766) (MNRJ 21183); **F**, *Aplysina fulva* (Pallas, 1766) (MNRJ 20557).

4.2. CAPITULO II

Bettcher-Brito et al – ***Haliclona* (*Reniera*) *laubenfelsi*, a morpho-molecular approach detects an cryptic sponge occurring in Pacific and Atlantic Oceans**

Haliclona (*Reniera*) *laubenfelsi*, a morpho-molecular approach detects an cryptic sponge occurring in Pacific and Atlantic Oceans

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Abstract

Recent collecting in the extreme south of Bahia yielded an *Haliclona* species preliminarily identified as a new species. However, DNA sequencing of the 28S C2–D2 marker showed the conspecificity (99.4 – 99.6 % similarity) of our specimens with a *Haliclona* sp. from Hawaii (GenBank MW016137–MW016139). In order to obtain a correct identification, we proceeded with a thorough taxonomic study of our material. Specimens were collected under rocks in the intertidal zone, photographed in situ, preserved in 80% EtOH and RNA later. Morphological study followed standard procedures. Specimens were very soft, fragile, light yellow to beige in live colour and in the fixative, repent, with a few clathroid areas. Its skeleton is renieroid and spicules are oxeas (67–*108.4*–131 x 0.8–*4.6*–6.6 µm) and toxas (32–*51*–68 x 0.8–*1.0*–1.2 µm). It was compared with congeners from both the Atlantic and Pacific Oceans, where the single *Haliclona* sharing similar morphology and spiculation with our specimens is *H.* (*Gellius*) *laubenfelsi*, a species that has oxeas (120–140 x 4–7 µm) and toxas (60 x 1 µm), and whose type locality is Kaneohe Bay (Hawaii). Considering the similar morphology and the presence of genetically identical specimens from Hawaii, we argue that our specimens are better identified as *H.* ("*G*".) *laubenfelsi*, postulating this species to be cryptogenic or exotic in the Brazilian coast. Furthermore, the skeletal architecture previously reported for this species and that observed in the present study, point to its better accommodation in *H.* (*Reniera*). Some of the most important Southwestern Atlantic reef environments are in the extreme south of Bahia, and the presence of exotic/cryptogenic species reinforces the urge for a detailed taxonomic inventory of the sponge fauna in this region, still very scarcely sampled.

Introduction

Marine bioinvasion is largely recognized as a major threat to the health of marine ecosystems (Ojaveer *et al.*, 2014; Firn *et al.*, 2015; Tanasovici *et al.*, 2020). Several non-native species (NNS) have the potential to become invasive in a new area, when they reach high abundance, potentially displacing native species, modifying the structure of the community, and the functioning of the invaded ecosystem (Mack *et al.*, 2000, Bax *et al.,* 2003, Rocha *et al*., 2013). Ultimate consequences of invasive species are the loss of biodiversity and impacts on economic activities that are dependent upon healthy ecosystems, like fisheries (Bax *et al*., 2003). Luckily, many of the non-native species are not able to cope with native species and their already established biotic interactions (Kennedy *et al*., 2002), staying restricted mainly to disturbed areas with available (artificial) substrate to colonization.

Although it is almost impossible to track the dispersal vector in events of introduction, the main accepted vectors of introduction of marine exotic species are ballast water (Carlton & Geller, 1993), vessel fouling (Godwin 2003, Carballo *et al*., 2013; Ribeiro *et al*., 2022), oil platforms (Capel et al. 2019), aquaculture (Henkel & Janussen, 2011), in less extent, bad management of marine aquaria (Mantelatto et al. 2018; Menezes *et al*., 2022), and rafting (Thiel & Gutow, *et al*., 2005 a, b). Rafting occurs largely on anthropogenic sources as on various kinds of litter (notably plastic) and tar lumps. There are also natural routes of introduction, such as rafting on floating *Sargassum*, pumice-rock, wood, and other natural materials, and the biological communities attached to these substrates (Thiel & Gutow, 2005; Bryan *et al*., 2012).

Alidoost Salimi *et al*. (2021) listed 34 marine non-native sponges in tropical areas worldwide compiled from the literature. We can add to their list *Celtodoryx ciocalyptoides* in Henkel & Janussen (2011), *Paraleucilla magna* in Guardiola *et al.* (2016), *Hymeniacidon perlevis* in Gastaldi *et al.* (2018) and Turner (2020), and *Haliclona (Halichoclona) vansoesti* in Bertolino *et al.* (2022). The above numbers are very likely underestimated as they do not account for cryptogenic or pseudoindigenous species (Carlton, 2009). Cryptogenic species are those that cannot be firmly demonstrated to be native or exotic in their distribution, while pseudoindigenous are introduced species misunderstood as native (Carlton, 2009). From those non-native sponges, we can highlight the coral-killing sponges *Mycale grandis* and *Chalinula nematifera* for their large known ecological impacts. The study of non-native species of sponges is nevertheless, a theme still little explored and hard to tackle, especially because the taxonomy of these organisms is often difficult, and there is a large gap in the knowledge of their distributions, hampering the detection of invaders. When this is not so, and good baseline studies exist, the situation can differ. For example, the invasion of *Mycale grandis* in Hawaii was likely easier to detect because of previous thorough faunistic surveys were already available for this area, and the very conspicuous *Mycale grandis* would have been included in these studies, were it present at the time (de Laubenfels, 1950; Bergquist, 1967).

In contrast, in many other areas worldwide, early detection of exotic species is almost impossible, especially due to the lack of baseline inventory of the local biodiversity. Examples of pseudoindigenous species are usually found in these areas, where several species could be described as new and native, when it is actually a taxonomically ill-known exotic species. This is the case of *Heteropia glomerosa*, exotic species in the Brazilian coast that was previously thought to be a native new species. However, its preference for artificial substrate, subsequent increase in local abundance and secondary dispersion along the Brazilian coast raised the possibility of its exotic condition (Klautau *et al*., 2020). Such a delay in the detection of introductions results in a late response to introduction events, when effectivity of the mitigatory efforts is usually reduced. In this sense, the regular, systematic use of coupled morphological and molecular data in species inventories could speed up the detection of introductions, as similar Molecular Operational Taxonomic Units (MOTUs) from disjunct localities can easily be detected in this way.

Originally designated *Toxadocia violacea* de Laubenfels, 1950 when the species was described from Hawaii, subsequent records were made for Micronesia (Bergquist, 1965) and Madagascar (Vacelet & Vasseur, 1971). De Weerdt (2002) synonymized *Toxadocia* with *Haliclona (Reniera)*, but van Soest et al., (2011), in reporting *violacea* from the Clipperton Atoll, preferred to classify it in *Haliclona (Gellius)* instead. De Voogd *et al.* (2022) noted the synonymy between *Haliclona (Gellius) violacea* (de Laubenfels, 1950) and *Haliclona* (*Haliclona*) *violacea* (Keller, 1883), and proposed to rename the junior synonym as *Haliclona* (*Gellius*) *laubenfelsi* van Soest & Hooper, 2020.

When studying a purportedly new species of *Haliclona* from the Brazilian coast, we discovered that our material was genetically identical to other sequences from Hawaii. Thus, we comparatively assessed their morphology and molecular data to answer the following questions: 1) are Brazilian and Hawaiian materials conspecific? 2) Is this a new species or an already described one? 3) Is this exotic in Hawaii or in Brazil?

Materials and methods

Sampling

Figure 1 illustrates the collecting localities for the studied materials, the Discovery Coast (South Bahia, Brazil), São Sebastião Channel (North São Paulo State, Brazil), Oahu (Hawaii, U.S.A.). In Brazil, collections were undertaken by wading at low tide and snorkeling at tide pools, using knifes, a small sledge hammer and chiesel. Specimens were photographed *in situ*, underwater, whenever possible. Upon arrival at the beach or the house, specimens were subsampled at EtOH 99%, and kept at -15–18ºC for subsequent molecular work. In the lab they were transferred to appropriate jars completed with 80% ethanol, and deposited in the ZUEC (Museu de Zoologia da Universidade Estadual de Campinas), FMNH (Field Museum of Natural History) and MNRJ (Museu Nacional da Universidade Federal do Rio de Janeiro) sponge collection. Taxonomic identification was achieved by the usual procedures for sponges as outlined in Hajdu *et al.,* (2011), including the preparation of thick anatomical sections and dissociated spicules. Data gathered in this way was contrasted to that available in the specialized literature. Lists of comparative taxa were assembled from recent revisions (Bispo, 2019) and the World Porifera Database (de Voogh *et al*., 2022).

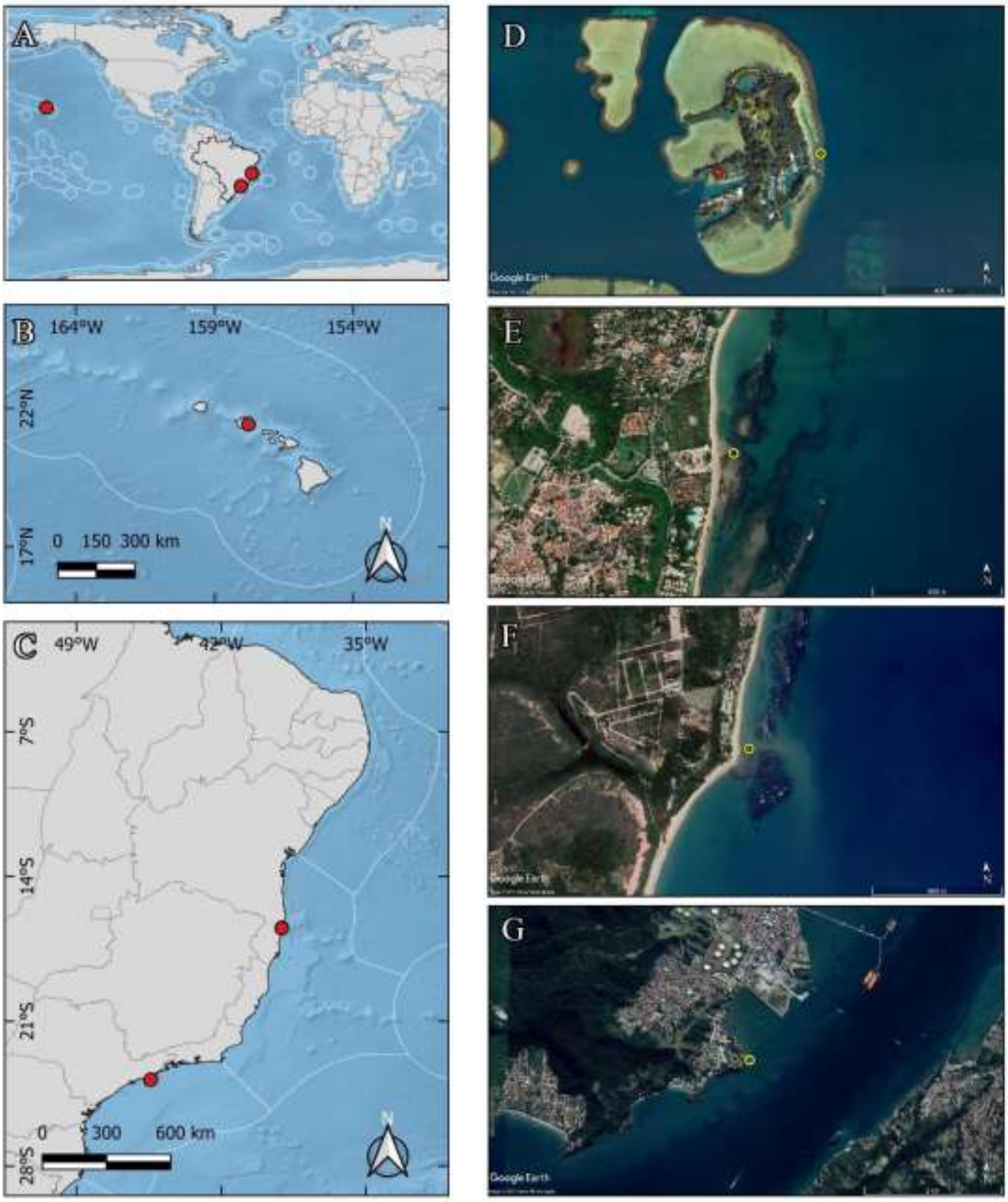

FIGURE 1. Collection sites of *Haliclona* (*Reniera*) *laubenfelsi*. A – Map showing the collection sites in Hawaii and Brazil; B – Hawaii archipelago, with a red point indicating where the species was collected; C – Brazilian coast, with red points indicating where the species was collected; D – Detail of Kane'ohe Bay (Oahu, Hawaii), indicating the type locality (red point) and the collection site (yellow point); E – Detail of Praia dos Pescadores (Arraial D'Ajuda, Porto Seguro BA), indicating the collecting site (yellow point); F – Pitinga Beach (Arraial D'Ajuda, Porto Seguro BA), indicating the collecting site (yellow point); G – Araça Bay (São Sebastião SP), indicating the collecting site (yellow point).

Molecular genetics

Genomic DNA was extracted through a modified phenol-chloroform protocol (Sambrook & Russell 2001), with a lysis buffer containing Tris-HCl 10 mM (pH 8.0), EDTA 50 mM, NaCl 0.1 M, 0.5% SDS and Proteinase K (20 mg/mL) or using the E-Z 96 Tissue DNA Kit (Promega Bio-Tek, Norcross, GA, USA) following the manufacturer protocols. We checked the concentration and quality (260/280 absorbance) of extracted DNA through nanospectrophotometer.

A fragment of the nuclear 28S rRNA was amplified through PCR using the primer pair F63mod (ACC CGC TGA AYT TAA GCA TAT HAN TMA G) and 1072RV (GCT ATC CTG AGG GAA ACT TCG G) (ca. 1050 bp) (Medina *et al.*, 2001), 28S–C2–fwd (GAA AAG AAC TTT GRA RAG AGA GT) and 28S–D2–rev (TCC GTG TTT CAA GAC GGG) (ca. 480 bp (Chombard *et al.*, 1998; Erpenbeck *et al.*, 2016). PCR amplifications were performed in 25 or 40 µL reactions consisting of DNA (up to 50 µg/mL), 0.5–0.8 µL of each primer (10 µM), PCR SuperMix (Invitrogen™) supplemented with 200 µg of BSA and, when necessary, H2O. The PCR reactions were submitted to the following thermocycling profile: initial denaturation at 94 °C for 3', followed by 35 cycles of 30" denaturation at 94 °C, 20–30" annealing at 50 °C, 60" elongation at 72 °C, and a final elongation at 72 °C for 5'. An attempt was made to amplify the Folmer COI, but because it did not amplify and did not generate any sequences, it was not possible to use two markers as a base.

The amplicons were then purified using a standard ammonium acetate-ethanol precipitation (Sambrook & Russell 2001) or using ExoFAP (Exonuclease I and FastAP–Life Technologies, Carlsbad, (CA); then both strands were sequenced using the Big Dye ™ terminator v. 3.1 reaction performed on ABI Genetic Analyzer 3500/3730 automated sequencers. The electropherograms were assembled and edited using Geneious Prime 10 or 2021. Ambiguous bases were coded with IUPAC ambiguity codes. Those sequences with high quality had their poriferan origin checked using the BLAST tool of NCBI (https://blast.ncbi.nlm.nih.gov).

The 28S sequences obtained in this study and other haplosclerid sequences available at GenBank were aligned using the MAFFT v.7 (Katoh *et al.*, 2019) online service using the L–INS–i algorithm. Uncorrected p-distance (pairwise deletion and 500 bootstrap replicates) within and among species were calculated in MEGA 7 (Kumar *et al.*, 2016). The phylogenetic analyses were conducted using the Maximum Likelihood (ML) framework in RAxML v.8.2.10 (Stamatakis 2014) software implemented in the CIPRES Science Gateway (https://www.phylo.org/portal2), using the GTRGAMMA model and 1,000 rapid bootstrap pseudoreplications (BST) to assess the confidence of the topology. Only bootstrap values above 70 are exhibited in the trees. The Blast of our specimens showed their close relationship with members of Clade A of Haplosclerida, this why we choosed as outgroup sequences of Clade C representants *Dasychalina melior* (KC869455) and *Amphimedon compressa* (KY825184), members. The aligned dataset included 25 terminals and 501 bp after trimming.

Results

Molecular phylogeny

The studied specimens is positioned within Clade A of Haplosclerida. Our specimens clustered in a monophyletic and highly supported clade (98 BS), that is closely related to *H.* (*Reniera) tubifera* and *H.* (*G.*) *toxia* (Fig. 2). The *p*-distance within sequences of *Haliclona laubenfelsi* ranged from 0 to 0.4%. There was no correlation between geographic and genetic distances, as identical sequences were shared between Brazil (Bahia and São Paulo) and Hawaii (MNRJ 23911 and MNRJ 22807). Samples MNRJ 23723 and ZUEC-POR 23 were those with greater differences in nucleotide composition to remaining samples, with a *p*-distance of 0.2 to 0.4% (Anexx).

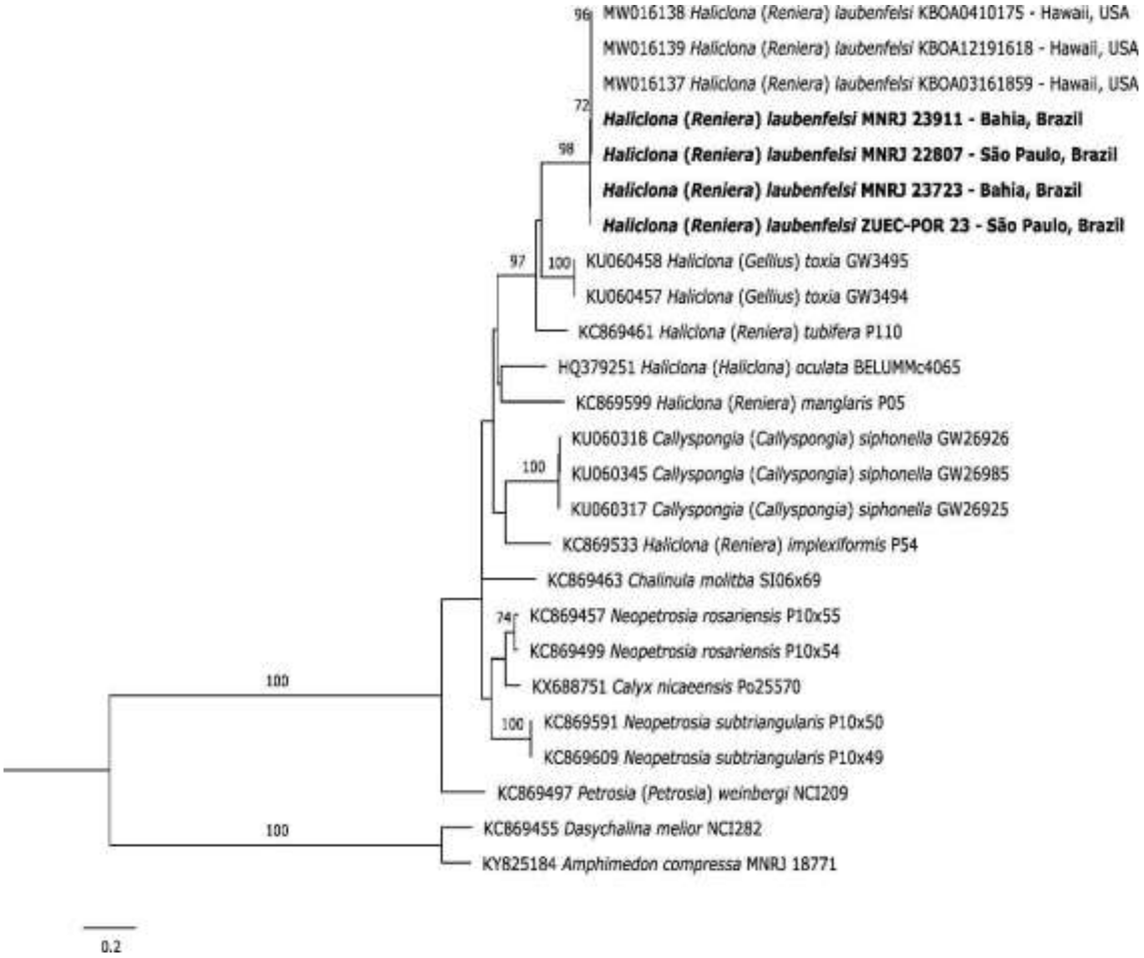

FIGURE 2. Phylogeny of Haplosclerida based on partial 28S rDNA (C2-D2). Bootstrap values >70 is given on the branches.

Haliclona laubenfelsi sequences showed genetic distances to *H.* (*G.*) *toxia* and *H.* (*Re.*) *tubifera* that were greater than 2% in *p*-distance, values much greater than those observed within this species (Anexx).

Systematics

Class DEMOSPONGIAE Sollas, 1885

Order HAPLOSCLERIDA Topsent, 1928

Family CHALINIDAE Gray, 1867

Genus *Haliclona* Grant, 1841

Subgenus *Reniera*

Haliclona (Reniera) laubenfelsi van Soest & Hooper, 2020
Figs. 3, 4, 5

Haliclona enamela sensu de Laubenfels, 1939 (Non *Haliclona enamela* de Laubenfels, 1930)

Toxadocia violacea de Laubenfels, 1950 – de Laubenfels, 1950: 16, Fig 9; Bergquist, 1965: 154, Fig 17; non Vacelet & Vassaur, 1971: 113, Fig. 74

Haliclona (*Gellius*) *violacea* van Soest *et al*., 2009 – van Soest *et al*., 2009: 31, Fig 14.

Haliclona (*Gellius*) *laubenfelsi* van Soest & Hooper, 2020 – van Soest *et al*., 2020: 66.

? *Neoadocia mokuoloe* de Laubenfels, 1950 – Bergquist, 1967: 159; Bergquist, 1977: 65.

? *Kaneohea poni* de Laubenfels, 1950 – Bergquist, 1967: 159; Bergquist, 1977: 65.

Studied material

São Paulo, Brazil: MNRJ 22807, Araçá Bay entrance, São Sebastião, depth not recorded, coll. G. Dias, 2012/10/01. Fragment preserved in ethanol 80%. ZUEC-POR 23, Araçá Bay entrance, São Sebastião, depth not decorded, coll. F. Dutra, 2013/01/01. Fragment preserved in ethanol 80%, fragment deposited under MNRJ 22759.

Bahia, Brazil: MNRJ 20478, Praia da Pitinga (-16.5133333, - 39.0733283); Arraial D'Ajuda, Porto Seguro, intertidal, coll. E. Hajdu & A. Fioravanso, 2019 03 23. Fragment preserved in ethanol 80%, subsampled in RNAlater and preserved at -20º C. MNRJ 23620 (PODER 2-10) and MNRJ 23723 (PODER 2-118), Praia da Pitinga (-16.5133333, - 39.0733283); Arraial D'Ajuda, Porto Seguro, intertidal, coll. L. Bettcher, J. C.C. Fernandez & E. Hajdu, 2021 08 22. MNRJ 23911 Praia dos Pescadores (- 16.488109, - 39.066645), Arraial D'Ajuda, Porto Seguro, intertidal, coll. A. Bispo, A. Lage & D. Rezende, 2021 11 05. Preserved in ethanol 99% at -20º C.

Hawai'i, EUA: BPBM C1473 and BPBM C1474, Kāne'ohe Bay, O'ahu (-21.4335, - 157.7864); 0.3 m, Hawai'i Institute of Marine Biology (HIMB) on Autonomous Reef Monitoring Structure (ARMS) point lab, coll. Jan Vicente, 2018 03 16. BPBM C1471 or UF 3956, Kāne'ohe Bay, O'ahu (21.4335, - 157.7864); 0.3 m, HIMB ARMS point lab mesocosm, coll. Jan Vicente, 2017 06 07. BPBM C1470, Kāne'ohe Bay, O'ahu (21.4335, - 157.7864); 0.3 m, HIMB ARMS point lab mesocosm, coll. Jan Vicente, 2016 12 19. BPBM C1472, Kāne'ohe Bay, O'ahu (21.4335, - 157.7864); 0.3 m, HIMB ARMS point lab mesocosm, coll. Jan Vicente, 2017 04 19.

Diagnosis

Only *Haliclona* with the combination of encrusting base with irregular creeping projections, without release of mucus, beige to purplish colour, oxeas 67–131 µm, and toxas as microscleres.

Description of the Brazilian material

The sponge presents a variable morphology, frequently reptating with encrusting base, up to 0.3–1.0 cm thick, with irregular, slender, digitiform projections, 4–5 mm in diameter. Oscula circular to oval, 0.5–2.0 mm in diameter, flush with the surface or at the top of low mounds when crust is thicker. Surface smooth. Consistency is soft and fragile. Colour alive pinkish beige to beige with a purplish hue, and beige in ethanol (Fig. 3).

Description of Hawaiian material

Encrusting digitate morphology expanding both laterally as mounds, and vertically with multiple, oscular digitiform projections (1- 5 mm thick), which can occasionally grow in-line. Long thin branches stem from encrusting mounds. Oscula circular (1- 4 mm in diameter), flush with the surface or apical on in-line digitate projections. Surface is smooth. Consistency is soft and fragile. Color in situ can vary between dull beige, pink, purple, and beige in ethanol.

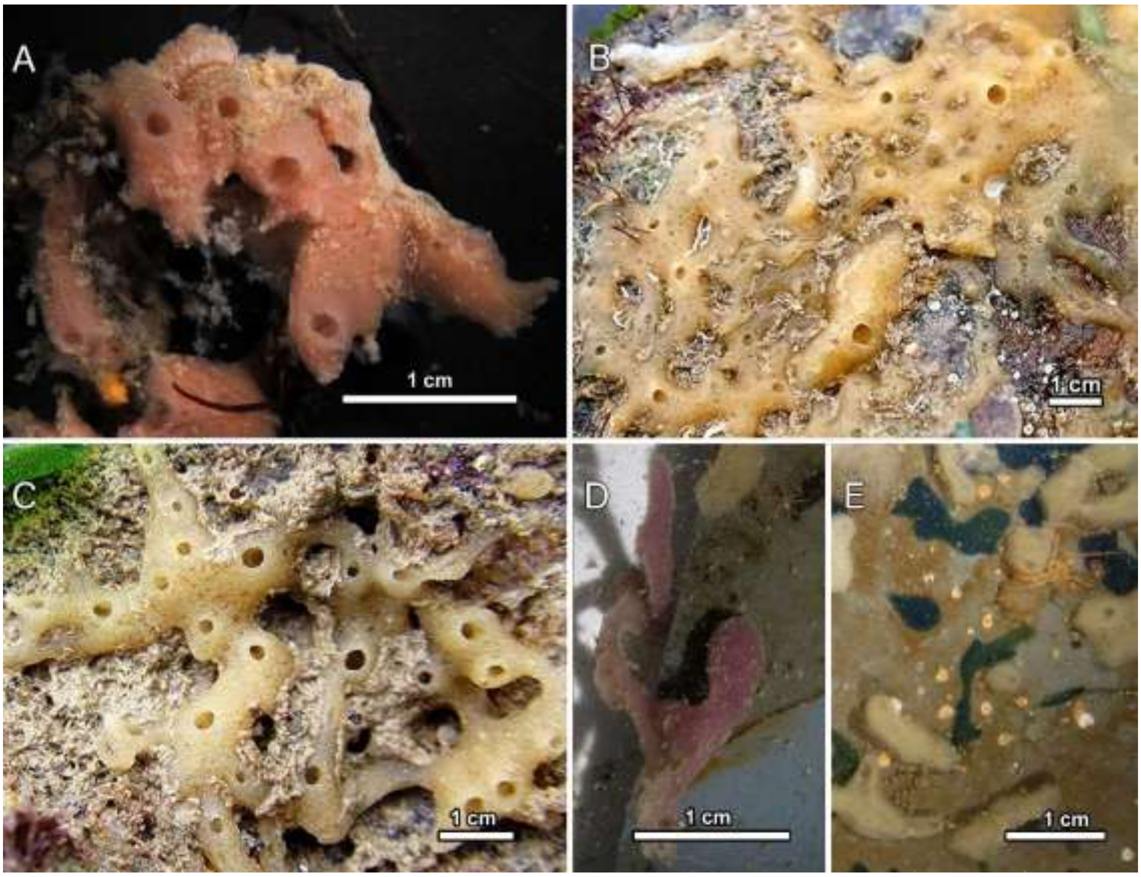

FIGURE 3. Morphological variability of *Haliclona* (*Reniera*) *laubenfelsi* in situ. (A–C) Material from Brazil. (D–E) Material from Hawaii. (A) MNRJ 22807 from São Paulo. (B) MNRJ 20478 from Bahia. (C) MNRJ 23723 from Bahia. (D) UF 3956 from Oahu. (E) BPBM C1470 from Oahu.

Skeleton

Ectosome a delicate, slightly regular, unispicular, isodictyal reticulation, forming three- to four-sided meshes, or confused. Choanosome of the same structure. Both ectosome and choanosome with some pauci- to multispicular reinforcing tracts without a clear orientation in MNRJ 22807. Spongin scarce to abundant, mainly at the nodes of the reticulation. Specimens from the mesocosm tanks in Hawaii have very scarce spongin, creating a more loose/confused reticulation, while specimens from Bahia are more spongin-reinforced, also presenting some gemmule-like bodies (65-82 um in diameter) and isolated grains. In turn, specimens from São Paulo are more spicule-reinforced, including development of pauci- to multispicular tracts, where pigmentation is darker (Fig. 4).

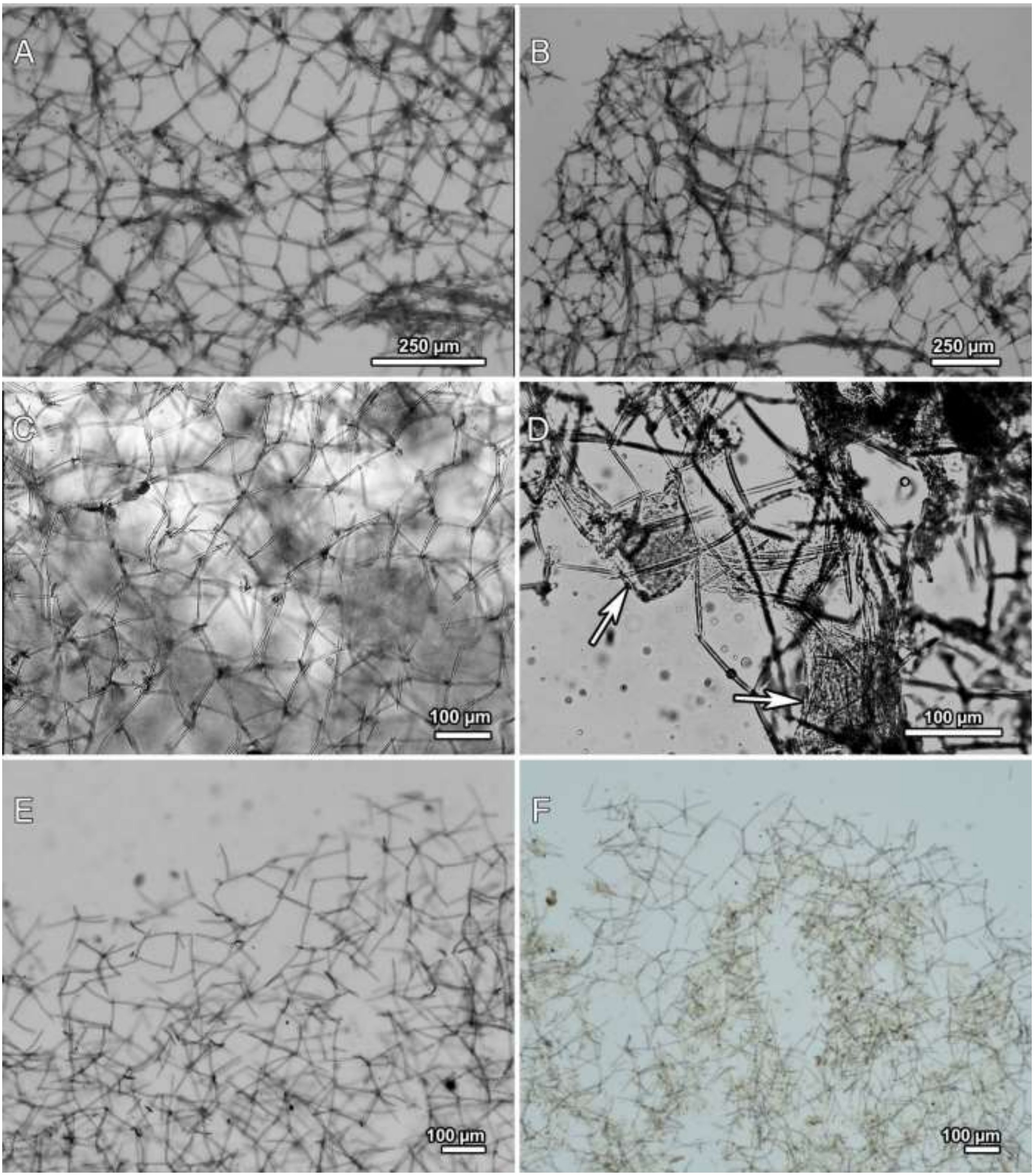

FIGURE 4. Variability on skeleton architecture. (A, C, E) ectossome. (B, D, F) choanosome. (A–B) MNRJ 22807. (C–D) MNRJ 20478, indicating the presence of gemmule-like body in D with the arrows. (E–F) BPBM C1470.

Spicules

Oxeas, mainly hastate, abruptly tapering to a sharp point, some modified to styles or strongyles, most slightly curved, 67–*105.6*–130.7 x 0.8–*3.7*–6.8 µm. Toxas, in a single, deeply curved category, 32–*53.9*–71.2 x 0.8–

1.6–2.9 µm. Only a single toxa was found in ZUEC-POR 23, ca. 50 x 1.0 um. Abundant small oxeote spicules were considered as immature oxeas, ZUEC-POR 23: 46–*67.3*–83 x 0.8–*1.4*–1.9 um (n=30); MNRJ 22807: 69–*79.8*–93 x 1.1–*1.8*–2.5 um (n=21); MNRJ 20478: 44–*57*–67.7 x 0.8–*1.6*–2.3 (n=22). Oxeote spicules measured directly from gemmule-like bodies, 36.6–*4.8*–55.4 µm (n=10) (Fig. 5)(Tab. 1).

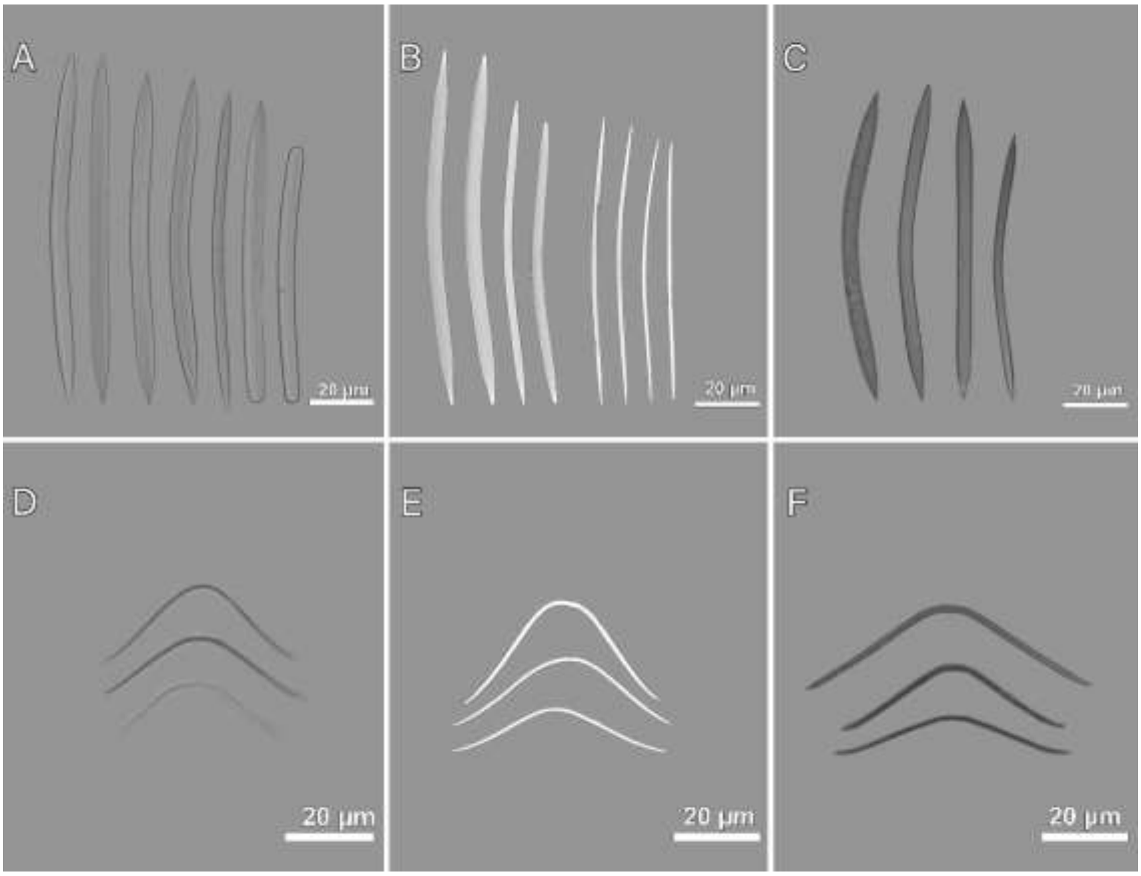

FIGURE 5. Spicules variability in *Haliclona* (*Reniera*) *laubenfelsi*. (A–C) oxeas. (D–F) toxas. (A, D) MNRJ 22807. (B, E) MNRJ 20478. (C, F) BPBM C1470.

	Locality	**Oxeas**	**Toxas**
MNRJ 22759 **ZUEC 23**	Araçá Bay, São Sebastião – São Paulo, BR	92.7–*103.4*–111.3/ 2.9–*5.2*–6.6 µm	–
MNRJ 22807 **ZUEC 28**	Araçá Bay, São Sebastião – São Paulo, BR	109.7–*119.4*–130.7/ 2.4–*5.6*–6.6 µm	43.8–*52.4*–66.4 / 0.8–*1*–1.8 µm
MNRJ 20478	Pitinga Beach, Arraial D’Ajuda, Porto Seguro – Bahia, BR	67–*91.4*–120.3/ 0.8–*3.8*–5.6 µm	32–*48.7*–67.7 µm
MNRJ 23620	Pitinga Beach, Arraial D’Ajuda, Porto Seguro – Bahia, BR	69.7–*105.6*–120.3/ 1–*3.9*–6.3 µm	37.7–*50*–62.3 µm
MNRJ 23723	Pitinga Beach, Arraial D’Ajuda, Porto Seguro – Bahia, BR	70–*95.5*–118.3/ 0.8–*3.3*–5.6 µm	37–*46.5*–59.2 µm
MNRJ 23911	Fisherman's Beach, Arraial D’Ajuda, Porto Seguro – Bahia, BR	95–*96.6*–122.5/ 2–*3.8*–5.3 µm	47.7–*52.4*–66 µm
BPBM C1470	Kāne‘ohe Bay, O‘ahu - Hawai‘i, EUA	75.7–*108*–121.7/ 1.1–*3.7*–5.6 µm	45.2–*59*–63.7 / 1.3–*2*–2.8 µm
BPBM C1471 UF 3956	Kāne‘ohe Bay, O‘ahu - Hawai‘i, EUA	81.2–*107.7*–119.7/ 1.1–*3.7*–5.6 µm	–
BPBM C1472	Kāne‘ohe Bay, O‘ahu - Hawai‘i, EUA	75.7–*108*–121.7/ 1.1–*3.9*–6.1 µm	55.3–*59.7*–65.7/ 1.4–*2.2*–2.9 µm
BPBM C1473	Kāne‘ohe Bay, O‘ahu - Hawai‘i, EUA	94–*111.2*–124.6/ 1.7–*3.3*–4.3 µm	45.8–*56.2*–69.4/ 0.9–*1.2*–1.7 µm
BPBM C1474	Kāne‘ohe Bay, O‘ahu - Hawai‘i, EUA	100.3–*114.4*–121.9/ 1.1–*4*–6.8 µm	41.9–*59.9*–71.2/1.5–*1.8*–2.1 µm

Table 1. Comparative table of the specimens under study from *Haliclona* (*Reniera*) *laubenfelsi*.

Ecology and distribution

It is a rare species along the Brazilian coast, found in rocky shores (São Paulo state) close to São Sebastião Harbor, or in sciophilous areas of a sandstone reef (Bahia state) close to Porto Seguro. In spite of intense collecting on several reefs of South Bahia, only four specimens were collected in a single reef. In Hawaii, our specimens were recruited in Autonomous Reef Monitoring Structures (ARMS) placed in mesocosm tanks supplied with water from Kāne‘ohe Bay. This species is known from the Central Pacific (Hawaii; de Laubenfels 1950), the East Pacific (Clipperton Atoll; van Soest *et al.,* 2011) and the Indo-Pacific (Palau; Bergquist 1965). A previous record from the Indian Ocean (Madagascar; Vacelet & Vasseur 1971) is considered doubtful (see below) (Fig. 6).

FIGURE 6. Map showing the distribution of *Haliclona* (*Reniera*) *laubenfelsi*. The yellow star represents the type locality of the species that has no DNA sequence. Green are the locations studied here with sequences in GenBank and the black star represents the doubtful record for Madagascar Island.

Discussion

Taxonomy

Our morphological and molecular analyses of the 28S rDNA gene indicated the conspecificity of Brazilian (Southwestern Atlantic) and Hawaiian samples (Central Pacific Ocean). The latter were identified as *Haliclona* sp. in Genbank (Acc. # MW016137–MW016139). We thus compared our specimens with *Haliclona* spp. from the Central Pacific, from which *Haliclona* (*Reniera*) *laubenfelsi* van Soest & Hooper, 2020 stood out by the presence of toxas and oxeas of similar shape to that observed in our material. This species was originally described by de Laubenfels (1950, as *Toxadocia v.*) from Oahu (Hawaii).

Although we could not examine type material of this species, our specimens conform to its original description in shape, skeleton, and spicules' composition and dimensions. The only small deviation regards the vivid violet colour in the holotype, and the presence of loose, pauci- to multispicular reinforcing tracts in Brazilian material. Nevertheless, this is within the acceptable intraspecific variability. For example, pauci- to multispicular tracts were also observed in conspecific Palau materials (Bergquist, 1965). Irrespective of this reinforcement, in our opinion, the prevailing isodictyal reticulation of this species renders it best allocated in *H.* (*Reniera*) than in *H.* (*Gellius*).

Another toxa-bearing species in the Pacific is *H.* (*Gellius*) *toxia*. It is a very closely-related species to *H. (R.) laubenfelsi*, as we could observe from its phylogenetic relationship and morphological similarities. Both species can develop similar shape, share the same spiculation and skeletal architecture, and may have a similar colour (Topsent, 1897; Desqueyroux-Faúndez, 1981; Pulitzer-Finali, 1993). Desqueyroux-Faúndez (1981) reported an isodictyal, seemingly mostly unispicular reticulation, with occasional 3–5 spicule-thick tracts in her Indonesian material of *toxia* (as *Toxadocia toxius*) which fits smoothly in *H. (Reniera)* as did *H. (R.) laubenfelsi*. The only small difference apparent between both species regards the dimensions of the oxeas, which are slightly longer in *H.* (*R.*) *toxia* (145–180 um), while the longest oxea already reported for *H.* (*R.*) *laubenfelsi* was 158 um (Bergquist, 1965). Nevertheless, usual common upper limits for the oxeas in *H.* (*R.*) *laubenfelsi* are usually close to 130–140 um (de Laubenfels, 1950; this study).

Two Genbank samples (Acc. # KU060457 and KU060458) identified as *H. toxia*, from the Red Sea, nested as a sister taxon to *H. (R.) laubenfelsi* (Fig. 1). It is important to note though that *H. toxia*'s type locality is in Indonesia, and topotypical material, if not the type itself, should be sequenced, before we can be 100% confident that both species are not conspecific, especially given both species purportedly overlapping distributions.

Non-indigenous species

Bioinvasion by marine sponges is still an understudied topic, despite the increasing attention it has received. Some cases of invasive species currently stand out, such as: *Haliclona* (*Reniera*) *caerulea*, *Hymeniacidon perlevis*, *Tedania* (*Tedania*) *ignis* and the recently discovered *Haliclona* (*Halichoclona*) *vansoesti* in Faro Lake (Italy), previously known in the Caribbean and Brazil only (Oricchio *et al*., 2019; Turner 2020; Alidoost Salimi *et al.*, 2021; Bertolino *et al*., 2022). Another example is the invasive sponge *Mycale* (*Mycale*) *grandis*, which has been harming corals after its invasion and the spread of its population, affecting coral cover (Coles *et al*., 2007).

In Brazil, there are already records of three species of calcareous sponges which are also found in the Mediterranean or in the Red Sea, that were considered exotic: *Sycettusa hastifera*, (Azevedo & Klautau, 2007); *Borojevia aspina* Klautau, Sole-Cava & Borojevic, 1994, (Voigt *et al*., 2017); and *Paraleucilla magna* Klautau, Monteiro & Borojevic, 2004 (Guardiola *et al*., 2016). Another sponge, the demosponge *Tedania* (*Tedania*) *ignis* is considered cryptic in Brazil (Oricchio *et al*., 2019).

The identification of the sponge studied in Brazil with morphological characteristics similar to another already described in the literature for Hawaii collected in 1947, but until then not known for Brazil, raised questions about its origin and about a possible bioinvasion. In 1947 it was collected in Hawaii in a natural substrate. However, it has great attraction to colonize artificial substrates, such as the ARMS where they were collected in 2016 and 2017, thus likely having an ability to invade environments. On the other hand, the

Brazilian materials were collected in natural substrates in 2015. Initially, in an area close to a large Brazilian port. Then, additional materials were found on sandstone reefs at the coast of Bahia. It is worth mentioning that the area where it was found for the first time in Brazil has already been widely inventoried, not having been found in this collection (Bispo *et al*. in prep.).

Specimens of *H*. (*Re*.) *laubenfelsi* are here confidently identified from Brazilian and Hawaiian materials based on the morphology and dimensions of their oxeas, toxas and architecture, as well as by the high similarity of their C2–D2 fragment of the 28S ribosomal gene. The species has a postulated distribution including the Pacific, Indian and Atlantic oceans. This is in marked contrast to most sponges expected low dispersal ability, consequence of their short-lived larvae (Maldonado 2006). For example, in *Haliclona* (*Gellius*) *amboinesis* and *H*. (*Soestella*) *xena*, larval settlement can occur within about 2 h after larval release into the water column (Wapstra & van Soest, 1987; Nada *et al*., 2020). In other species, larval settlement may take longer, as in *H*. (*Rhizoniera*) *indistincta*, where the larvae take at least 25 hours to settle (Stephens *et al*., 2013), which is still considered a short time.

Thus, sponges have “difficulty” in carrying out long-distance dispersion and the larvae of surviving in ballast water (Cariton & Geller 1993). However, there are other possible ways of introducing the species into a new environment, such as the accidental or voluntary release of exotic species by aquarists, as is the case of the octocoral *Carijoa riisei*, which may have been introduced outside its native range by the aquarium market (Concepcion *et al*., 2010). Furthermore, several encrusting animals could be together with shellfish and shells of other organisms used in aquaculture and thus be transported and possibly introduced into new areas, as was possibly the case with the sponge *Celtodoryx ciocalyptoides* (Henkel & Janussen, 2011), or even as in the case of *Gelliodes wilsoni* which occurs in the Western, Central and Eastern Pacific coast, where its dispersion was due to clogging of ship hulls (Carballo *et al*., 2013). Another possible vector in the introduction of species is rafting on garbage and other floating debris of human origin that can be biofouled and end up transporting living organisms over long distances (Carlton *et al*., 2007; 2017). The latter authors argue that shallow-water fauna, such as the species studied here, is naturally more apt to survive longer on these substrates in long-distance dispersion.

According to our data, it is not possible to state the original natural distribution of this species, which hampers the recognition of where it was subsequently introduced. In Brazil, in spite of found only in natural environments (rocky shores and sandstone reefs), its abundance still seems to be very low. Only four individuals were observed in Bahia, one of which collected in 2019, the others in 2021. Despite a significant sampling effort aiming at a faunistic inventory of the area (Bettcher-Brito *et al*., submitted), in 2019 the species was found in only one location, while in 2021 it was observed in two locations. In inventories carried out between 1997 and 2001 on the coast of São Paulo (SP), this species was not found (Custódio & Hajdu, 2011, Bispo *et al*. in prep.), which suggests that it arrived at the site later. The single specimen from that area was collected in 2015.

In addition, the ease of colonizing artificial environments, such as ARMS, may indicate that the species has invasive potential. So, the species is categorized as cryptic in Brazil and Hawaii. Furthermore, this archipelago was once characterized by being the center of maritime traffic and biological invasions in the Pacific Ocean (Carlton 1987, Concepcion *et al*., 2010) and there are many native Indo-Pacific species that were later introduced there, such as *Mycale* (*Mycale*) *grandis* and *Halichondria coerulea*. The same is true for other benthic invertebrates, such as *Carijoa riisei*. Therefore, it is not possible to refute an Indo-Pacific origin of *H.* (*Re.*) *laubenfelsi,* which may have invaded Hawaii and the Atlantic. These hypotheses regarding the routes of introduction of this species should be tested in the future with greater geographic sampling, preferably using population markers such as microsatellites or next-generation sequencing.

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Anexx – *Haliclona laubenfelsi* sequences with genetic distances of *H. (G.) toxia* and *H. (Re.) tubifera*, greater than 2% at p.

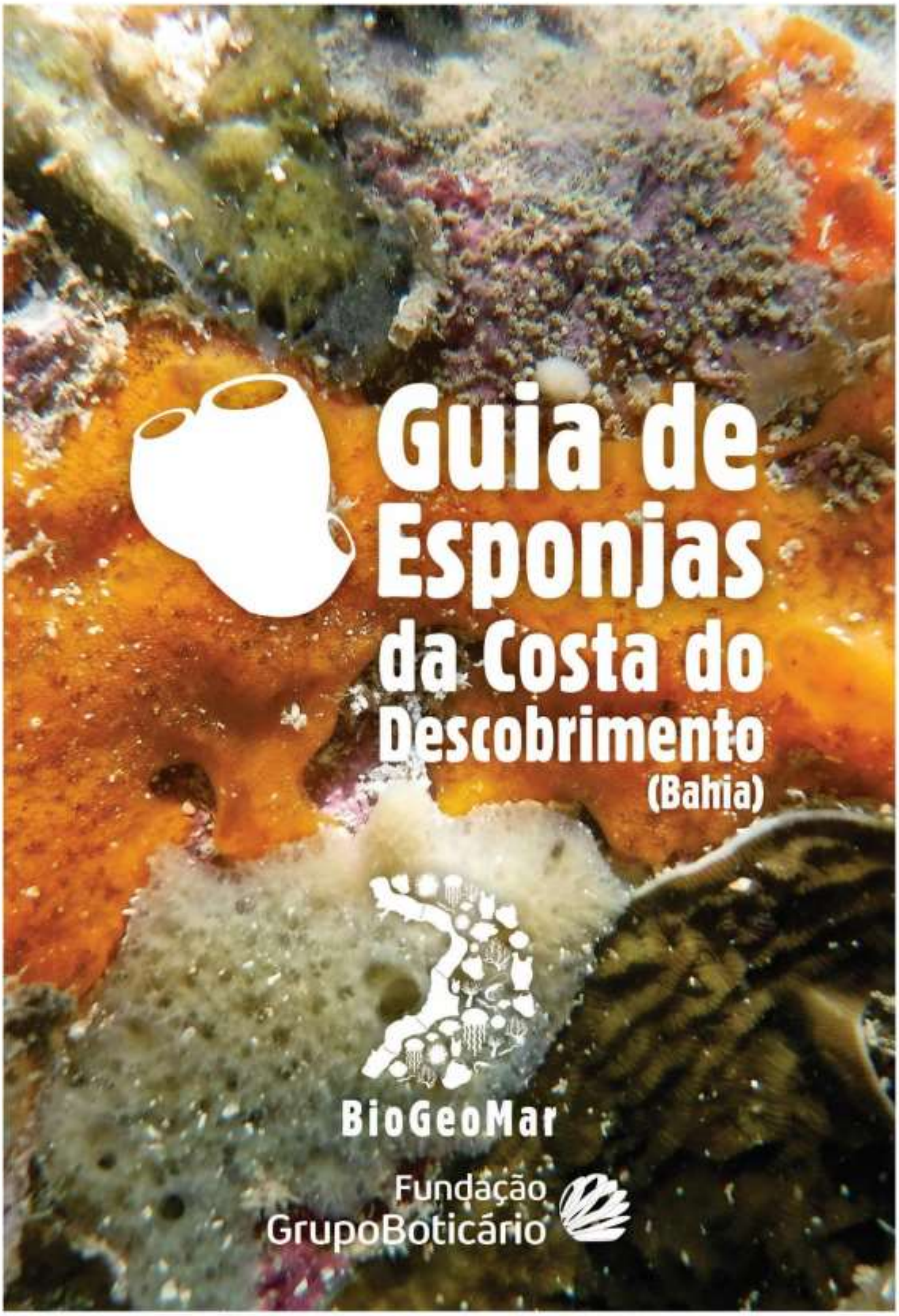
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. MW016138 *H. laubenfelsi*																								
2. MW016139 *H. laubenfelsi*	0																							
3. MW016137 *H. laubenfelsi*	0	0																						
4. *H. laubenfelsi* MNRJ 23911	0	0	0																					
5. *H. laubenfelsi* MNRJ 22807	0	0	0	0																				
6. *H. laubenfelsi* MNRJ 23723	0.004	0.004	0.004	0.004	0.002																			
7. *H. laubenfelsi* ZUEC-POR 23	0.002	0.002	0.002	0.002	0	0																		
8. KU060457 *H. toxia*	0.229	0.229	0.232	0.237	0.226	0.223	0.231																	

9. KU060458 *H. toxia*	0.229	0.229	0.232	0.237	0.226	0.223	0.231	0																
10. KC869461 *H. tubifera*	0.21	0.21	0.212	0.227	0.206	0.211	0.213	0.192	0.192															
11. HQ379251 *H. oculata*	0.273	0.273	0.273	0.294	0.272	0.276	0.276	0.282	0.282	0.247														
12. KC869599 *H. manglaris*	0.33	0.33	0.334	0.364	0.324	0.33	0.339	0.305	0.305	0.268	0.221													
13. KU060317 *C. siphonella*	0.367	0.367	0.367	0.363	0.362	0.364	0.369	0.329	0.329	0.329	0.297	0.276												
14. KU060318 *C. siphonella*	0.345	0.345	0.349	0.354	0.339	0.342	0.36	0.307	0.307	0.307	0.287	0.264	0.002											
15. KU060345 *C. siphonella*	0.371	0.371	0.371	0.367	0.365	0.368	0.372	0.332	0.332	0.333	0.301	0.273	0.002	0										
16. KC869533 *H. implexiformis*	0.293	0.293	0.297	0.319	0.29	0.29	0.301	0.336	0.336	0.284	0.257	0.286	0.271	0.253	0.274									
17. KC869463 *C. molitba*	0.309	0.309	0.312	0.331	0.299	0.312	0.317	0.321	0.321	0.287	0.228	0.237	0.316	0.313	0.32	0.24								
18. KC869457 *N. rosariensis*	0.291	0.291	0.292	0.313	0.285	0.291	0.295	0.279	0.279	0.248	0.215	0.281	0.284	0.271	0.287	0.236	0.223							

19. KC869499 *N. rosariensis*	0.282	0.282	0.282	0.299	0.275	0.281	0.285	0.278	0.278	0.247	0.218	0.264	0.283	0.27	0.286	0.232	0.215	0.02						
20. KX688751 *C. nicaeensis*	0.314	0.314	0.318	0.342	0.308	0.31	0.316	0.281	0.281	0.252	0.24	0.291	0.321	0.301	0.325	0.239	0.216	0.077	0.079					
21. KC869591 *N. subtriangularis*	0.316	0.316	0.317	0.341	0.31	0.315	0.321	0.294	0.294	0.264	0.237	0.259	0.302	0.287	0.305	0.241	0.266	0.178	0.166	0.194				
22. KC869609 *N. subtriangularis*	0.316	0.316	0.317	0.341	0.31	0.315	0.321	0.294	0.294	0.264	0.237	0.259	0.302	0.287	0.305	0.241	0.266	0.178	0.166	0.194	0			
23. KC869497 *P. weinbergi*	0.363	0.363	0.368	0.406	0.36	0.362	0.374	0.4	0.4	0.337	0.289	0.352	0.408	0.387	0.411	0.312	0.321	0.253	0.248	0.255	0.284	0.284		
24. KC869455 *D. melior*	0.86	0.86	0.857	0.91	0.836	0.863	0.848	1.08	1.08	0.876	0.869	0.806	0.992	1.027	1.001	0.843	0.858	0.794	0.793	0.831	0.788	0.788	0.861	
25. KY825184 *A. compressa*	0.887	0.887	0.884	0.941	0.868	0.891	0.875	1.069	1.069	0.874	0.882	0.817	0.952	0.972	0.96	0.863	0.891	0.802	0.795	0.863	0.83	0.83	0.913	0.129

4.3. CAPITULO III

Bettcher- Brito et al – **Guia de Identificação de esponjas da Costa do Descobrimento (Bahia)**


Guia de
Esponjas
da Costa do
Descobrimento
(Bahia)
BioGeoMar
Fundação
GrupoBoticário

Guia de Esponjas

As esponjas foram os primeiros animais a surgirem no planeta literalmente sem pé nem cabeça. Sua estrutura corporal é bem simples, já que não possuem órgãos, músculos ou neurônios. Justamente por estas características, raramente são percebidos como animais pela população. No entanto, uma das características que às fazem serem consideradas animais são por não serem capazes de produzir o próprio alimento. Elas vivem presas aos substratos dos ambientes aquáticos e todas suas atividades vitais dependem de sua capacidade de filtração da água, pois é dali que vão retirar seu alimento e oxigênio, sendo a água também o veículo utilizado para sua reprodução sexuada. Essa filtração é tão eficiente que as esponjas de um recife de coral têm a capacidade de filtrar toda a coluna de água sobre o recife em poucos dias. As esponjas possuem grande variação de tamanho, coloração e forma. Há indivíduos com apenas 1 mm de diâmetro e outros com mais de 2 metros. Já sua coloração pode parecer uma verdadeira aquarela de cores, indo dos tons mais discretos até os mais chamativos. Quanto à sua forma podem ser finas crostas em pedras, tubulares, globulares, entre outras, e sua consistência varia de firmes, mais flexíveis ou mais duras, podendo ser também quebradiças ou macias. Esponjas possuem geralmente um esqueleto que pode ser composto por colágeno ou por estruturas chamadas de espículas, que podem ser de sílica (como o vidro) ou carbonato de cálcio. A forma e a densidade do esqueleto das esponjas podem variar conforme as condições hidrodinâmicas, com maior movimentação da água demandando estruturas mais flexíveis, ou mais compactas. A sua cor também pode variar, dependendo do grau de exposição à luz e de compostos químicos presentes em seu organismo. Esponjas também servem de abrigo para diversos animais pequenos, como peixes, camarões, moluscos entre outros, contribuindo assim para o aumento da biodiversidade local, sendo ainda ambientes onde vivem uma infinidade de microrganismos.

Atualmente, estima-se que existam pelo menos 15.000 espécies de esponjas ao nível mundial, das quais apenas cerca de 10.000 estão descritas na literatura. A sua maior diversidade ocorre em águas tropicais e subtropicais pouco profundas, mas são conhecidas espécies de até 8.800 m de profundidade. Atualmente estão registradas para o Estado da Bahia cerca de 180 espécies, com aproximadamente 80 destas ocorrendo na Costa do Descobrimento. Devido ao modo de vida desses organismos, que não têm como fugir de predadores ou da infecção de microrganismos, ao longo do processo evolutivo desenvolveram junto com outros organismos associados vários compostos químicos utilizados como defesa antipredatória e antibiótica. Essas substâncias hoje são usadas em estudos para a fabricação de medicamentos, havendo remédios em uso no mercado, derivadas de compostos isolados de esponjas, utilizadas no tratamento de câncer, AIDS, Alzheimer, e outras terríveis enfermidades. A proteção das esponjas de ser uma prioridade nas estratégias de conservação do ambiente marinho, tendo em vista sua grande importância ecológica, assim como seu potencial biotecnológico.

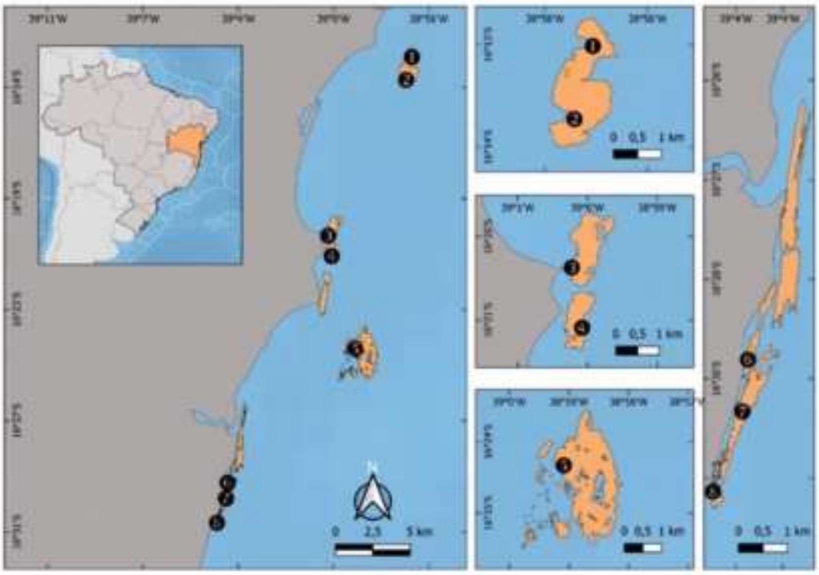


Figura 1. Mapa com detalhe da área de estudo, com os quatro conjuntos recifais amostrados. 1–2. Parque Municipal Marinho Coroa Alta; 3–4. Coroa Vermelha/ Mutá; 5 Recife de Fora; 6. Praia dos Pescadores, Arraial D'Ajuda; 7. Mucugê, Arraial D'Ajuda e 8. Pitinga, Arraial D'Ajuda.

Figura 2. Recifes da Costa do Descobrimento (sul da Bahia, Brasil) durante a maré baixa. A-B, Parque Municipal Marinho (P.M.M.) Coroa Alta (CA); C-D, Coroa Vermelha/Mutá (CVM); E, P.M.M. Recife de Fora (RF); F, Praia dos Pescadores, Arraial D'Ajuda (AA); G, Praia Mucugê, Arraial D'Ajuda (AA) e H, Praia de Pitinga, Arraial D'Ajuda (AA).

04

Sumário

01 *Aaptos sp. 1*

02 *Aaptos sp. 1*

03 *Aaptos sp. 2*

04 *Stelletta anasteria*

05 *Stelletta anasteria*

06 *Cinachyrella alloclada*

08

07 *Cinachyrella apion*

08 *Cinachyrella kuekenthali*

09 *Tethya bitylastra*

10 *Tethya bitylastra*

11 *Tethya maza*

12 *Tethya maza*


13 *Diplastrella megastellata*


14 *Diplastrella megastellata*


15 *Suberites aurantiacus*


16 cf *Stylissa* sp


17 *Spirastrella hartmani*


18 *Spirastrella hartmani*

19 *Placospongia ruetzleri*

20 *Placospongia ruetzleri*

21 *Placospongia cristata*

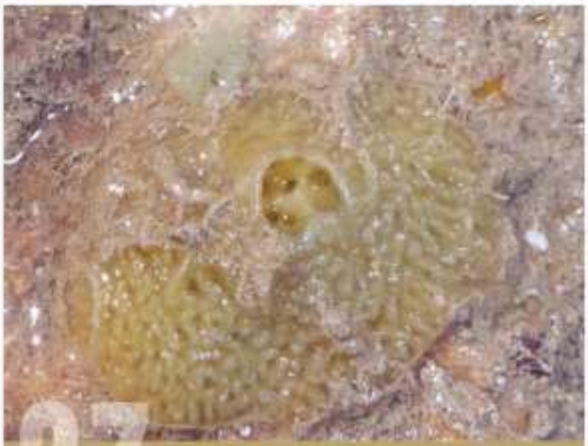
22 *Biemna caribea*

23 *Amorphinopsis atlantica*

24 *Amorphinopsis atlantica*

25 *Geodia gibberosa*

26 *Geodia gibberosa*



27 *Lissodendoryx (Lissodendoryx) isodictyalis*

28 *Hymedesmia (Stylopus) sp.*

29 *Terpios fugax*

30 *Terpios belindae*

31 *Trachycladus* sp.

32 *Timea stenosclera*

33 *Cliona varians*

34 *Cliona delitrix*

35 *Cliona* aff. *celata*

36 *Cliona amplicavata*

37 *Cliona* sp.

38 *Prosuberites laughlini*

39 *Protosuberites* sp.1

40 *Protosuberites* sp.1

41 *Acarnus (Acarnus) innominatus*

42 *Acarnus toxeata*

43 *Tedania (Tedania) ignis*

44 *Scopalina sp.*

45 *Timea berlincki*

46 cf. *Arenosclera*

47 *Niphates erecta*

48 *Niphates erecta*

49 *Mycale (Grapelia)* sp.

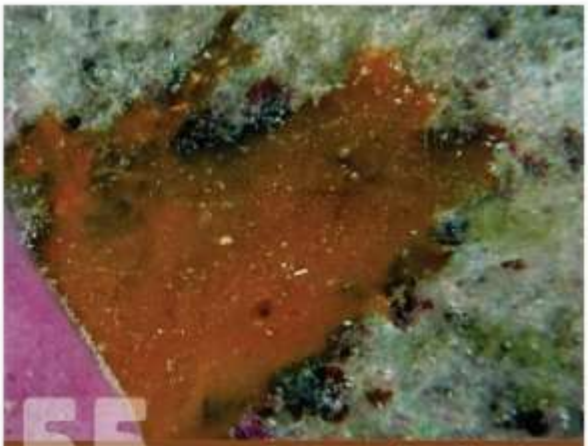
50 *Mycale (Carmia)* sp.

51 *Mycale (Aegogropila) escarlatei*

52 *Mycale (Aegogropila) escarlatei*

53 *Mycale (Aegogropila) escarlatei*

54 *Mycale (Carmia) magnirhaphidifera*



55 *Mycale (Naviculina) diversisigmata*

56 *Mycale (Aegogropila) americana*

57 *Clathria (Microciona) campecheae*

58 *Clathria (Microciona) campecheae*

59 *Clathria (Microciona) sp.*

60 *Clathria (Thalysias) sp.*

61 *Cladocroce caelum*

62 *Cladocroce caelum*

63 *Amphimedon viridis*

64 *Amphimedon viridis*

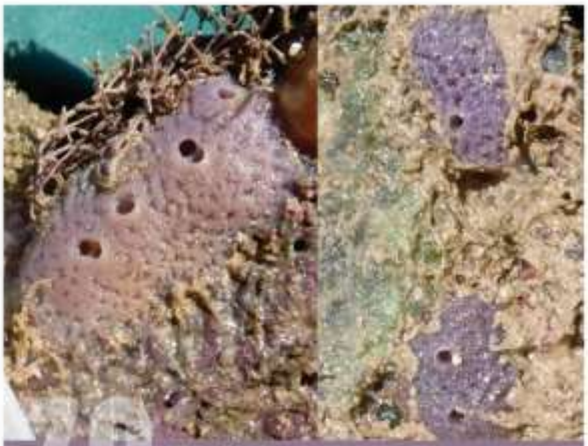
65 *Halichondria (Halichondria) marianae*

66 *Halichondria (Halichondria) marianae*

67 *Chalinula molitba*

68 *Chalinula molitba*

69 *Chalinula* sp. 1



70 ***Haliclona (Soestella) sp. 2***

71 ***Haliclona (Haliclona)***

72 ***Haliclona (Reniera) chlorilla***

73 ***Haliclona (Reniera) implexiformis***

74 ***Haliclona (Reniera) tubifera***

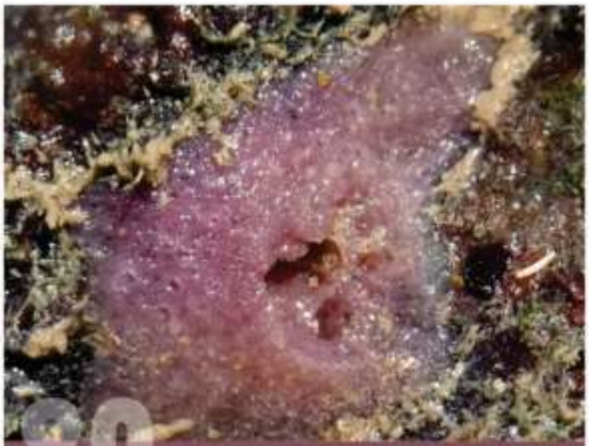
75 ***Haliclona (Reniera) tubifera***

76 ***Chalinula* sp. 1**

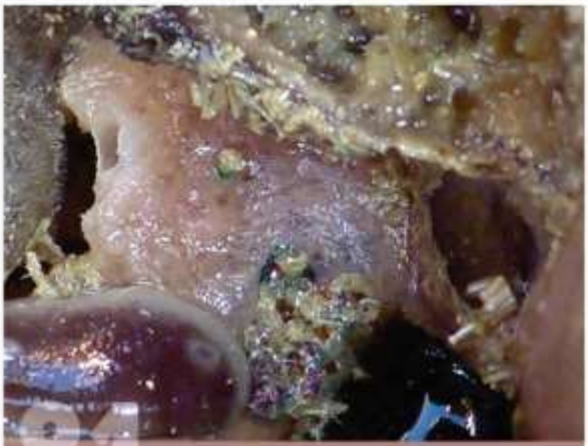
77 ***Callyspongia (Callyspongia) pallida***

78 ***Haliclona (Soestella) melana***

79 *Haliclona (Reniera) sp.1*



80 *Haliclona (Reniera) sp.2*



81 *Haliclona (Reniera) sp.3*

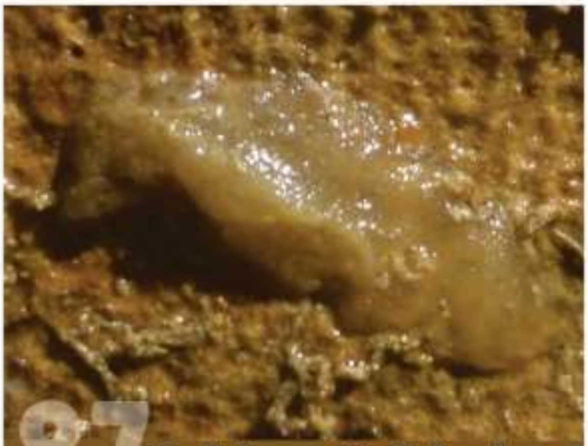
82 *Haliclona (Reniera) sp.4*

83 *Haliclona (Reniera) laubenfelsi*

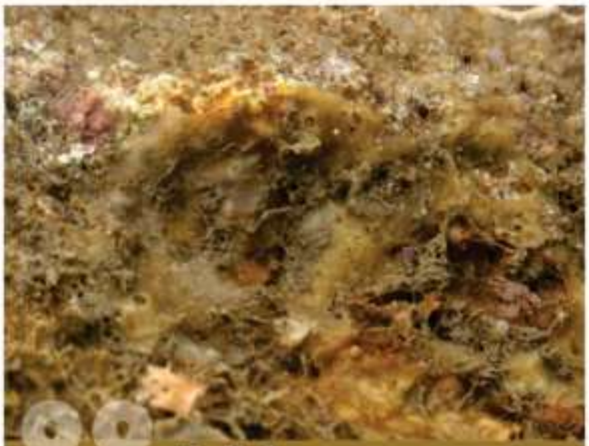
84 *Haliclona (Gellius) sp.*

85 *Haliclona (Gellius)* sp.

86 *Haliclona (Halichoclona)* sp.4



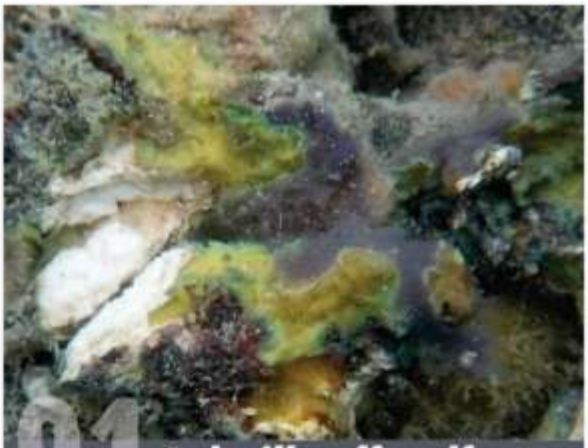
87 *Haliclona (Halichoclona) albifragilis*



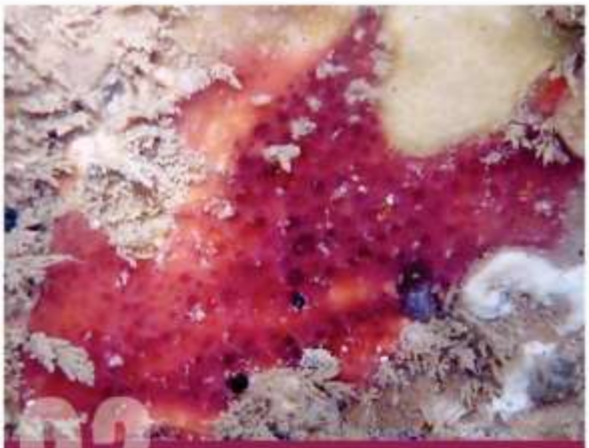
88 *Haliclona (Halichoclona)* sp.1

89 *Haliclona (Halichoclona)* sp. 3

90 *Halicona (Halichoclona)* sp. 4



91 Aplysilla aff. sulfurea & Haliclona (Reniera)



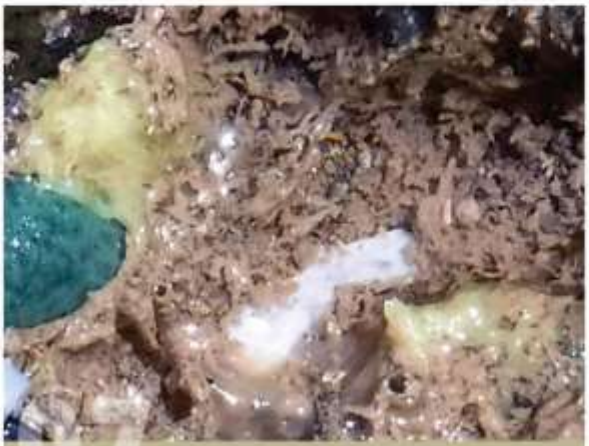
92 Aplysilla aff. rosea

93 Halisarca caerulea

94 *Chondrilla aff. nucula*

95 *Chondrosia reniformis*

96 *Plakortis sp.*



97 *Clathrina sp.*

98 *Clathrina sp.*

99 *Dysidea robusta*

100 *Dysidea robusta*

101 *Dysidea sp.1*

102 *Dysidea sp.2*

103 *Spongia (Heterofibria) sp.*

104 *Dysidea etheria*

105 *Aplysina fulva*

106 *Aplysina fulva*

Sumário Taxonômico

CLASS Order	**Family**	**Species**	**Fotos**
CALCAREA			
Clathrinida	Clathrinidae	*Clathrina* sp.	97/98
HOMOSCLEROMORPHA			
Homosclerophorida	Plakinidae	*Plakortis* sp.	96
DEMOSPONGIAE			
Agelasida	Hymerhabdiidae	*Prosuberites laughlini* Diaz, Alvarez & van Soest, 1987	38
Biemnida	Biemnidae	*Biemna caribea* Pulitzer-Finali, 1986	22
Chondrillida	Chondrillidae	*Chondrilla aff. nucula* Schmidt, 1862	94
	Halisarcidae	*Halisarca caerulea* Vacelet & Donadey, 1987	93
Chondrosiida	Chondrosiidae	*Chondrosia reniformis* Nardo, 1847	95
Clionaida	Clionaidae	*Cliona amplicavata* Rützler, 1974	36
		Cliona aff. celata Grant, 1826	35
		Cliona delitrix Pang, 1973	34
		Cliona varians (Duchassaing & Michelotti, 1864)	33
		Cliona sp.	37

Sumário Taxonômico

CLASS Order	Family	Species	Fotos
DEMOSPONGIAE			
Clionaida	Spirastrellidae	*Diplastrella megastellata* Hechtel, 1965	13/14
		Spirastrella hartmani Boury-Esnault, Klautau, Bézac, Wulff & Solé-Cava, 1999	17/18
		Aplysilla aff. rosea (Barrois, 1876)	92
Dendroceratida	Darwinellidae	*Aplysilla aff. sulfurea* Schulze, 1878	91
		Dysidea etheria Laubenfels, 1936	104
Dictyoceratida	Dysideidae	*Dysidea robusta* Vilanova & Muricy, 2001	99/100
		Dysidea sp.1	101
		Dysidea sp.2	102
	Spongiidae	*Spongia (Heterofibria) sp.*	103
Haplosclerida	Callyspongiidae	*Callyspongia (Callyspongia) pallida* Hechtel, 1965	77
		cf. *Arenosclera* sp.	46
	Chalinidae	*Chalinula molitba* (de Laubenfels, 1949)	67/68
		Chalinula sp. 1	69/76
		Cladocroce caelum Santos, da Silva, Alliz & Pinheiro, 2014	61/62
		Haliclona (Gellius) laubenfelsi van Soest & Hooper, 2020	83
		Haliclona (Gellius) sp.	84/85
		Haliclona (Halichoclona) albifragilis Hechtel, 1965	87

Sumário Taxonômico

CLASS Order **DEMOSPONGIAE**	**Family**	**Species**	**Fotos**
Haplosclerida	Chalinidae	*Haliclona (Halichoclona)* sp.1	88
		Haliclona (Halichoclona) sp. 3	89
		Haliclona (Halichoclona) sp. 4	86/90
		Haliclona (Haliclona) sp.	71
		Haliclona (Reniera) chlorilla Bispo, Correia & Hajdu, 2014	72
		Haliclona (Reniera) implexiformis (Hechtel,1965)	73
		Haliclona (Reniera) tubifera (George & Wilson, 1919)	74/75
		Haliclona (Reniera) sp.1	79
		Haliclona (Reniera) sp. 2	80
		Haliclona (Reniera) sp. 3	81
		Haliclona (Reniera) sp. 4	82
		Haliclona (Soestella) melana Muricy & Ribeiro, 1999	78
		Haliclona (Soestella) sp.2	70
	Niphatidae	*Amphimedon viridis* Duchassaing & Michelotti, 1864	63/64
		Niphates erecta Duchassaing & Michelotti, 1864	47/48
Placospongida	Placospongiidae	*Placospongia cristata* Boury-Esnault, 1973	21
		Placospongia ruetzleri Van Soest, 2017	19/20

Sumário Taxonômico

CLASS Order DEMOSPONGIAE	Family	Species	Fotos
Poecilosclerida	Acarnidae	*Acarnus toxeata* Boury-Esnault, 1973	42
		Acarnus (Acarnus) innominatus Gray, 1867a	41
	Coelosphaeridae	*Lissodendoryx (Lissodendoryx) isodictyalis* (Carter, 1882)	27
	Hymedesmiidae	*Hymedesmia (Stylopus)*sp.	28
	Microcionidae	*Clathria (Microciona) campecheae* Hooper, 1996	56
		Clathria (Thalysias) sp.	60
		Clathria (Microciona) sp.	59
	Mycalidae	*Mycale (Aegogropila) americana* van Soest, 1984	56
		Mycale (Aegogropila) escarlatei Hajdu, Zea, Kielman & Peixinho,1995	51/52/53
		Mycale (Carmia) magnirhaphidifera van Soest, 1984	54
Poecilosclerida	Mycalidae	*Mycale (Carmia)* sp.	50
		Mycale (Grapelia) sp.	49
		Mycale (Naviculina) diversisigmata (van Soest, 1984)	55
	Tedaniidae	*Tedania (Tedania) ignis* (Duchassaing & Michelotti, 1864)	43
		Scopalina sp.	44
		cf. *Stylissa* sp.	16

Sumário Taxonômico

CLASS Order DEMOSPONGIAE	Family	Species	Fotos
Suberitida	Halichondriidae	*Amorphinopsis atlantica* Carvalho, Hajdu, Mothes & van Soest, 2004	23/24
		Halichondria (Halichondria) marianae Santos, Nascimento & Pinheiro, 2018	65/66
	Suberitidae	*Aaptos* sp. 1	1/2
		Aaptos sp. 2	3
		Protosuberites sp.1	39/40
		Suberites aurantiacus (Duchassaing & Michelotti, 1864)	15
		Terpios fugax Duchassaing & Michelotti, 1864	29
		Terpios belindae Rützler & Smith, 1993	30
Tethyida	Tethyidae	*Tethya bitylastra* Mácola & Menegola, 2018	9/10
		Tethya maza Selenka, 1879	11/12
		Timea stenosclera Hechtel, 1969	20/35
Tetractinellida	Ancorinidae	*Stelletta anasteria* Esteves & Muricy, 2005	4/5
	Geodiidae	*Geodia gibberosa* Lamarck, 1815	25/26
	Tetillidae	*Cinachyrella alloclada* (Uliczka, 1929)	6
		Cinachyrella apion (Uliczka, 1929)	7
		Cinachyrella kuekenthali (Uliczka, 1929)	8

Sumário Taxonômico

CLASS Order **DEMOSPONGIAE**	**Family**	**Species**	**Fotos**
Trachycladida	Trachycladidae	*Trachycladus* sp.	31
Verongida	Aplysinidae	*Aplysina fulva* (Pallas, 1766)	105/ 106

Autores

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Julio C. C. Fernandez é biólogo (bacharel) e especialista em taxonomia, sistemática, biogeografia e genética do filo Porifera. Em 2005, iniciou seus estudos com esponjas marinhas na Universidade Federal da Bahia (UFBA) por meio de trabalhos de iniciação científica com esponjas da região. Obteve grau de mestre em zoologia pelo Programa de Pós Graduação em Diversidade Animal (Zoologia) da UFBA (2011). Em seguida, no Museu Nacional (MN)—Rio de Janei-ro, obteve grau de doutor em zoologia pelo Programa de Pós Graduação em Zoologia da Universidade Federal do Rio de Janeiro (2015). Vem realizando estágio pós-doutoral no Brasil e no exterior desde 2017, atualmente no MN. Admira os invertebrados e adora observá-los enquanto mergulha.

Autores

Ulisses Pinheiro possui Bacharelado e Licenciatura em Ciências Biológicas pela UNIRIO (2000/2001) é Mestre em Zoologia pela USP (2003) e Doutor em Zoologia pelo Museu Nacional/UFRJ (2007). Iniciou os estudos das esponjas em Outubro de 1997, quando ingressou na Iniciação Científica no Museu Nacional/UFRJ sob orientação de Eduardo Hajdu. Foi Professor da UESB - Campus de Jequié (2003-2008) e desde 2008 é Professor na UFPE. Atualmente integra o Departa-mento de Zoologia e atua no Curso de Pós Graduação em Biologia Animal. Orientou dezenas de alunos de graduação, mestrado e doutorado e publicou cerca de 100 artigos científicos, 1 livro e capítulos de livro, onde o principal tema é a Taxonomia de Esponjas. Sua área de estudo se concentra principalmente nos estados do Norte e Nordeste do Brasil. Sua relação com o mar e a taxonomia vem desde a infância quando já praticava mergulho livre e tinha curiosidade em conhecer todas as espécies com as quais se deparava.

Eduardo Hajdu graduou-se em Biologia pela UFRJ em 1987, obteve o título de mestre em Ciências Biológicas pela USP em 1991, e o de doutor em Biologia pela Universiteit van Amsterdam em 1995. Eduardo realizou estágio de pós-doutoramento pela USP entre 1995 e 1997, ano em que entrou para o quadro docente do Departamento de Invertebrados da UFRJ. Eduardo é especialista em esponjas (Phylum Porifera), já tendo descrito mais de 200 novos táxons. Além de dar nome às esponjas, Eduardo também estuda sua filogenia e biogeografia, colaborando ainda no estudo de sua química e farmacologia. Suas principais áreas de trabalho estão no Brasil, Antártida, Argentina, Chile e Peru. Já publicou 200 trabalhos e orientou cerca de 30 alunos de pós-graduação. Uma das principais responsabilidades de Eduardo é a curadoria da coleção de esponjas do Museu Nacional, que se aproxima de 30000 espécimes registrados.

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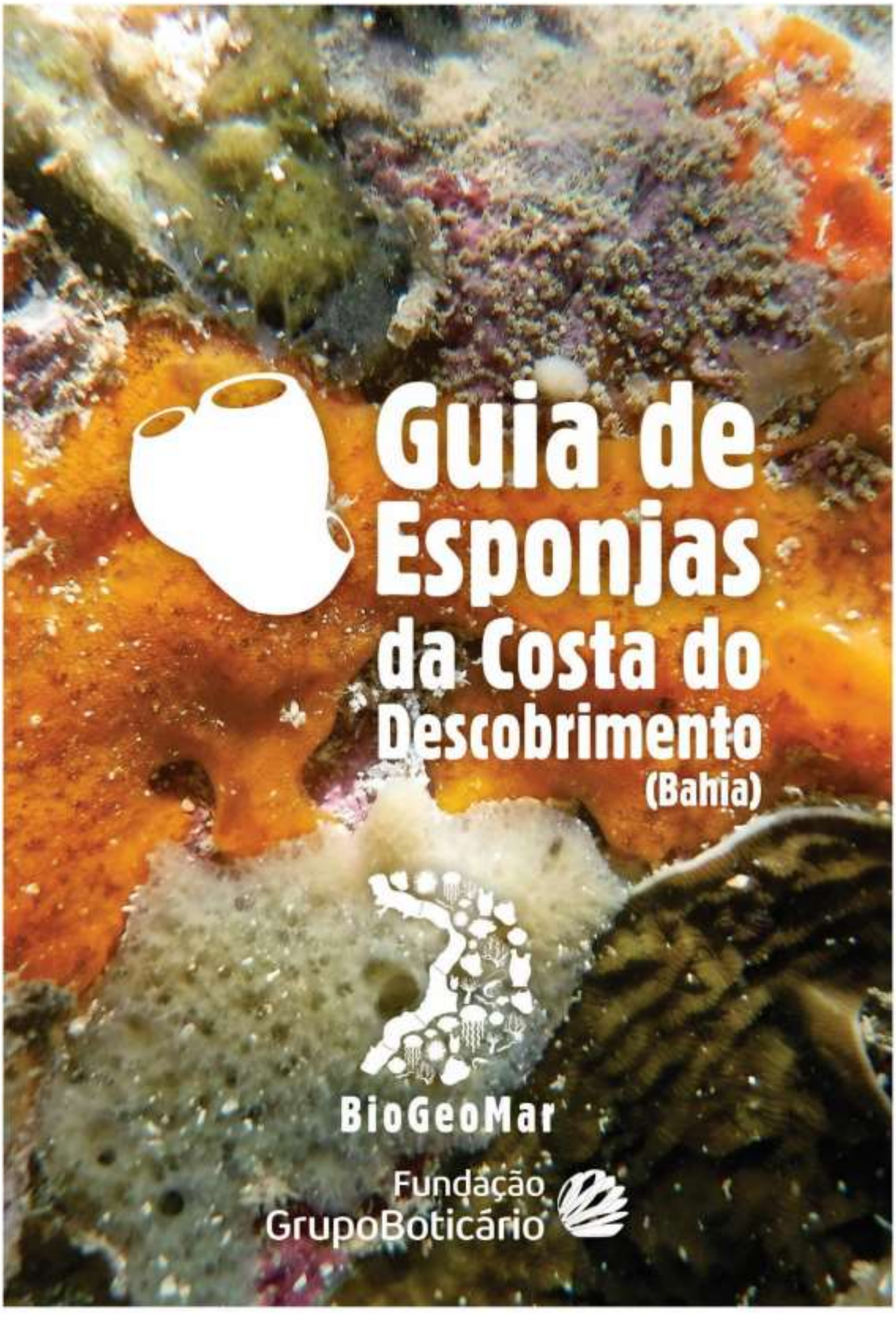

Guia de Esponjas da Costa do Descobrimento (Bahia)

BioGeoMar

Fundação GrupoBoticário

5 CONSIDERAÇÕES FINAIS

Foram analisados 101 morfotipos diferentes de esponjas, dos quais 60 foram identificados em nível de espécie. Neste trabalho identificamos 41 morfotipos em nível de gênero, sendo necessário ainda o aprofundamento taxonômico para trabalhos futuros mostrando que essa região ainda há muito o que ser estudado e possivelmente promissora em diversidade de espécies de esponjas.

Neste trabalho constatamos a presença de novos registros para o Brasil (*Prosuberites laughlini, Cliona amplicavata, Cliona* cf. *mucronata*, *Haliclona* (*Halichoclona*) *albifragilis, Haliclona* (*Reniera*) *tubífera* e *Halisarca caerulea*); além do registro de *Acanthotetilla walteri* que era conhecida apenas a descrição original para Camaçari (Peixinho et al. 2007). São oferecidas ainda a caracterização de *Placospongia cristata*, sendo mais nova e detalhada, adicionando uma espícula não comentada em sua descrição original; e um segundo registro para *Samus anonymus* desde sua descrição original, com uma caracterização atualizada.

Além disso, 57 novos registros para a Costa do Descobrimento e 23 novos para Bahia, aumentando respectivamente para 79 e 195 seus números de espécies conhecidas. Ainda constatamos a ocorrência de uma espécie criptogênica, com seu primeiro registro no Brasil, [*Haliclona* (*Reniera*) *laubenfelsi*] fornecendo sua caracterização morfológica e molecular, comparando com material coletado no Havai. A partir desses dados, verificamos que a taxonomia é fundamental para o conhecimento da diversidade de determinada região, além de poder subsidiar dados para compreensão da ocorrência e dispersão das espécies.

Foi também elaborado um Guia de Campo para a Costa do Descobrimento com as fotos das esponjas. Esperamos que este guia contribua para difusão do conhecimento por parte da população que acessa este ambiente, como moradores, turistas e pesquisadores de modo que incentive a conservação deste ecossistema e de toda sua biota. O Guia vai ficar disponível gratuitamente para ser baixado.

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