UNIVERSIDADE ESTADUAL DE CAMPINAS
INSTITUTO DE BIOLOGIA

PAULO VINICIUS FERRAZ CORRÊA

PROCHAETODERMATIDAE (APLACOPHORA , MOLLUSCA) DO SUDESTE DO BRASIL

PROCHAETODERMATIDAE (APLACOPHORA , MOLLUSCA) FROM SOUTHEASTERN BRAZIL

CAMPINAS
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Dissertação apresentada ao Instituto de Biologia da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do título de Mestre em Biologia Animal, na Área de Biodiversidade Animal

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Resumo

Prochaetodermatidae Salvini-Plawen, 1972 constitui uma família de Caudofoveata cujas espécies são caracterizadas pelo estreitamento da região posterior do corpo (como uma cauda), a presença de um escudo oral bipartido e um par de mandíbulas conectado a uma rádula dística com uma placa central entre cada par de dentes. Até o momento, essa família possui 39 espécies agrupadas em seis gêneros. Recentemente, foram coletados espécimes de Caudofoveata no Sudeste do Brasil, incluindo de Prochaetodermatidae, na costa dos estados do Rio de Janeiro e Espírito Santo, pelos Projetos HABITATS e AMBES. Utilizando técnicas de microscopia de luz e eletrônica de varredura, os exemplares foram analisados quanto à morfologia externa e quanto aos detalhes da estrutura das espículas; também foram comparados com material-tipo de algumas espécies depositadas no National Museum of Natural History, em Washington, EUA. Dentre 88 amostras com 102 exemplares analisados, foram identificadas cinco espécies de dois gêneros: *Clavidema* Scheltema & Ivanov, 2000 e *Spathoderma* Scheltema, 1985. *Claviderma* apresenta espículas do tronco alongadas, o eixo longitudinal reto ou pouco curvado, a divisão entre base e lâmina é pouco evidente, e por serem levemente curvadas em direção ao corpo. Já em *Spathoderma*, as espículas do tronco possuem a base larga e uma lâmina bastante afunilada, a lâmina apresenta uma leve quilha central e o plano da lâmina é curvado para fora e rotacionado em relação ao plano da base. *Clavidema crassum* Ivanov & Scheltema 2008, *C. amplum* Ivanov & Scheltema, 2008 e *Spathoderma quadratum* Ivanov & Scheltema, 2008 foram descritas para o Atlântico Norte e agora têm sua distribuição ampliada para o Brasil, no Atlântico Sul. *Spathoderma bulbosum* Ivanov & Scheltema, 2008, já registrada para o Nordeste do Brasil, igualmente, tem sua distribuição estendida mais ao sul. Suas distribuições batimétricas também serão ampliadas e as descrições originais complementadas, com a caracterização de variações na morfologia e espículas. Além disso, é descrita uma nova espécie de *Claviderma*, caracterizada pelo tronco alongado e uma cauda curta e por possuir variações nas espículas da cauda nunca ilustradas para o gênero até agora.

Abstract

Prochaetodermatidae Salvini-Plawen 1972 is a family of Caudofoveata whose species are characterized by a narrow in the posterior region of the body (like a tail), the presence of a bipartite oral shield and a pair of jaws connected to a distichous radula with a central plate between each pair of teeth. This family has 39 species grouped into six genera up to date. Recently, specimens of Caudofoveata, including Prochaetodermatidae, were collected in southeastern Brazil, off Rio de Janeiro and Espírito Santo states, by the HABITAT and AMBES Projects. Using techniques of light microscopy and scanning electron microscopy, specimens were analyzed for external morphology and for details of the structure of sclerites; they were also compared with the type material of some species deposited in the National Museum of Natural History in Washington, USA. A total of 88 samples with 102 specimens were analyzed and five species from two genera were identified: *Claviderma* Scheltema & Ivanov, 2000 and *Spathoderma* Scheltema, 1985. *Claviderma* have trunk sclerites elongated, with the longitudinal axis straight or slightly curved, the division between base and blade is not evident, and they are slightly curved towards the body. In *Spathoderma*, the trunk sclerites have a broad base, a tapered blade, the blade has a slight central keel and the blade plane is bended outwards and rotated in relation to the base plane. *Claviderma crassum* Ivanov & Scheltema 2008, *C. amplum* Ivanov & Scheltema, 2008 and *Spathoderma quadratum* Ivanov & Scheltema, 2008 were described for the North Atlantic Ocean and now they have their geographic distribution expanded to Brazil, in the South Atlantic. *Spathoderma bulbosum* Ivanov & Scheltema, 2008 were already recorded for the Northeast Brazil and, likewise, its distribution is extended further south. Their bathymetric distributions are also increased and original descriptions are complemented with the characterization of variations in morphology and sclerites. Additionally, a new species of *Claviderma* is described, characterized by an elongated trunk and a short tail and it has shank sclerites with variations that were never illustrated for the genus so far.

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Introdução Geral

O filo Mollusca é o segundo maior filo animal, com aproximadamente 80.000 espécies recentes descritas (ROSENBERG, 2014) e cerca de 60.000 fósseis (TAYLOR & LEWIS, 2005). Possui representantes adaptados a uma vasta gama de modos de vida, refletindo o seu sucesso evolutivo, que possibilitou estes animais a se diversificarem em ambientes bem distintos, como no mar, água doce e na terra. Atualmente existe uma concordância entre os pesquisadores de que esse grupo é monofilético (STÖGER et al., 2013), mas ainda existem debates acerca de com quais grupos de invertebrados eles são mais relacionados (VINTHER, 2014), além de discussões sobre as relações filogenéticas entre as suas classes (SIGWART & LINDBERG, 2015).

Atualmente, oito classes de Mollusca são bem reconhecidas – Caudofoveata, Solenogastres, Polyplacophora, Monoplacophora, Gastropoda, Cephalopoda, Bivalvia e Scaphopoda (GIRIBET, 2014). Caudofoveata e Solenogastres têm sido ultimamente agrupados em um clado maior, Aplacophora (veja abaixo). Os aplacóforos compõem um grupo de animais com o corpo de aspecto vermiforme, ou seja, alongado e cilíndrico, que é caracteristicamente coberto por espículas (SALVINI-PLAWEN, 1975; TODT et al., 2008), o que os distingue dentro do filo, onde a maioria dos seus integrantes possuem uma concha. Em comum com os demais moluscos, os aplacóforos apresentam uma rádula, cuja estrutura é bastante variável, e uma cavidade palial, abrigando a saída dos dutos dos aparelhos digestório e reprodutor.

Existem cerca de 280 espécies descritas de Solenogastres (TODT, 2013), que podem ser desde menores que um milímetro e ter até 30 centímetros de comprimento. Esses são epifaunais, com um pé ventral que se apresenta como um sulco pedioso em animais fixados, estendendo-se desde a região anterior até a posterior. Seu sistema digestório possui um único compartimento e a cavidade do manto não possui brânquias, e sim papilas respiratórias.

Já para Caudofoveata existem em torno de 130 espécies descritas até o momento (IVANOV et al., 2009; SALVINI-PLAWEN & GARCÍA-ÁLVAREZ, 2014). O tamanho pode variar de poucos milímetros até 15 centímetros. Diferentemente dos Solenogastres, eles não possuem o sulco pedioso e a abertura da boca é envolta por um epitélio sem espículas, chamado de disco oral, o qual possui função sensorial e reflete o modo de vida infaunal desse grupo. Apresentam um par de brânquias

bipectinadas na cavidade do manto e seu sistema digestório é compartimentalizado em estômago e divertículo digestivo.

As relações de parentesco entre os aplacóforos e as outras classes de Mollusca são ainda incertas, existindo várias hipóteses sobre esse assunto (TODT et al., 2008; KOCOT, 2013). As principais são mostradas na Figura 1, que podem ser resumidas em basicamente quatro. Na “Hipótese Testaria” (Fig. 1A) Solenogastres e Caudofoveata formam o grupo monofilético Aplacophora, que por sua vez seria um grupo irmão de Testaria, formado por Polyplacophora e Conchifera (WALLER, 1998). A “Hipótese Aculifera” (Fig. 1B) também suporta a monofilia de Aplacophora, mas o agrupa com Polyplacophora, formando o clado Aculifera (BLUMRICH, 1891; SCHELTEMA, 1993, 1996). As outras duas hipóteses consideram Aplacophora como parafilético e suportam o grupo Testaria, porém, a “Hipótese Hepagastralia” (Fig. 1C) coloca Caudofoveata como grupo irmão de Testaria (HASZPRUNAR, 2000), e a “Hipótese Adenopoda” (Fig. 1D) considera Solenogastres como grupo irmão de Testaria (SALVINI-PLAWEN, 1985). Este tema ainda está em debate entre os filogeneticistas, mas nas discussões mais recentes, a hipótese “Aculifera” tem se

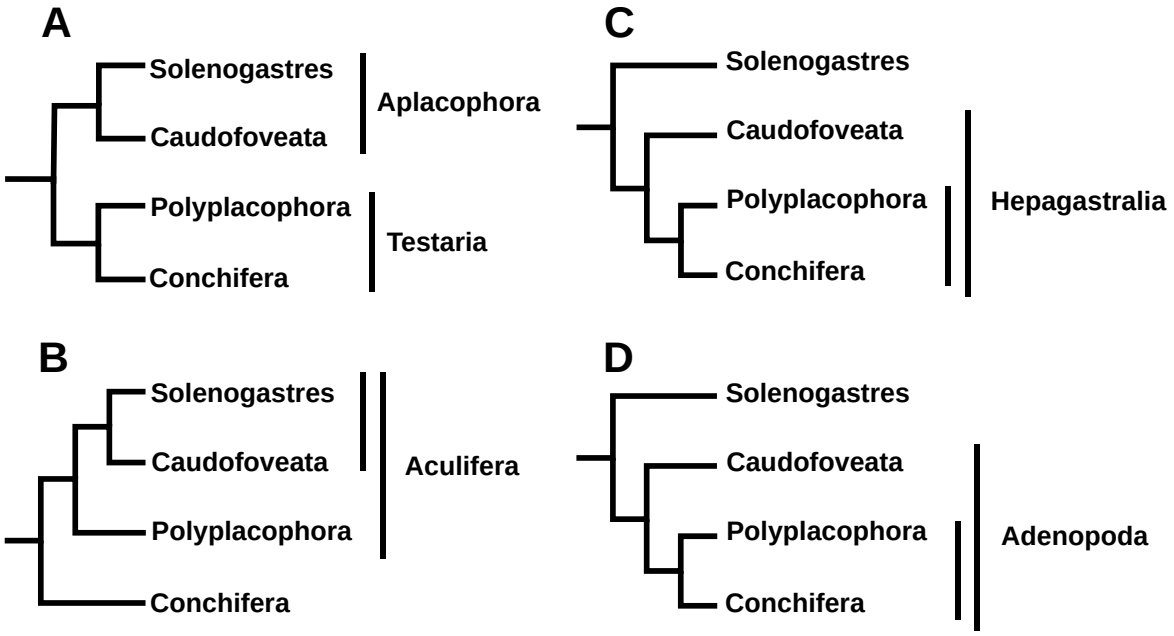

Figura 1. Hipóteses de filogenia dos Mollusca. **A.** “Hipótese Testaria” (WALLER, 1998), onde Aplacophora (Solenogastres + Caudofoveata) é um grupo irmão de Testaria (Polyplacophora + Conchifera). **B.** “Hipótese Aculifera” (SCHELTEMA, 1993; VINTHER 2015), onde Aplacophora é um grupo monofilético e irmão de Polyplacophora, formando o grupo Aculifera. Esse por sua vez é grupo irmão dos demais moluscos. **C.** “Hipótese Hepagastralia” (HASZPRUNAR 2000), onde Testaria é um grupo irmão de Caudofoveata, formando o clado Hepagastralia. Este seria um grupo irmão de Solenogastres. **D.** “Hipótese Adenopoda” (SALVINI-PLAWEN 1985), onde Testaria é um grupo irmão de Solenogastres, formando o clado Adenopoda. Este seria um grupo irmão de Caudofoveata.

mostrado a mais plausível e aceita pelos pesquisadores, apoiada fortemente em dados moleculares (KOCOT et al., 2011; SMITH et al., 2011; VINTHER et al., 2012). Em todo caso, os aplacóforos são tradicionalmente posicionados na base da filogenia dos Mollusca, com duas características relacionadas à sua ancestralidade: a ausência de uma concha sólida e a cavidade palial posicionada na região posterior. Entretanto, recentes descobertas de novos fósseis indicam que o ancestral comum de Mollusca teria mais características em comum com Polyplacophora do que Aplacophora (SUTTON et al., 2012; VINTHER, 2015), incluindo placas sólidas no dorso do corpo e uma rádula típica dos quítons. Nessa nova visão, a ausência de placas sólidas e a cavidade do manto posterior seriam sinapormorfias de Aplacophora, e não uma plesiomorfia de Mollusca como era proposto antigamente.

Caudofoveata é dividido em 3 famílias, distinguidas pelas características da rádula, do disco oral e pela morfologia do corpo (SALVINI-PLAWEN, 1975). São elas:

- Limifossoridae Salvini-Plawen, 1968: possuem corpo homogêneo, sem divisões visíveis externamente. A rádula é bipartida, composta de várias fileiras transversais de dentes. O disco oral circunda toda a boca, ou possui uma forma de U, ou então é pareado lateralmente à abertura bucal;

- Chaetodermatidae Théel, 1875: o corpo pode ser homogêneo ou possui uma região posterior mais afilada (chamada de cauda), distinta da anterior (chamada de tronco). A rádula é representada por 1 ou 2 pares de dentes, com suportes laterais. O disco oral pode ser em forma de U ou circular à abertura oral. A extremidade anterior se destaca do tronco por uma constrição, formando uma espécie de colarinho;

- Prochaetodermatidae Salvini-Plawen, 1972: o corpo é dividido em tronco e cauda (Fig. 2A). A rádula é bipartida, com várias fileiras transversais de dentes e há uma placa central entre cada par de dentes. A rádula também é conectada a um par de mandíbulas. O disco oral é pareado lateralmente (Fig. 2B). São diferenciados externamente dos Chaetodermatidae com cauda por não possuírem o colarinho; e, geralmente, suas espículas são orientadas diagonalmente em relação ao eixo ântero-posterior, e não paralelamente a ele.

Ao longo dos últimos 40 anos, as relações filogenéticas dentro de Caudofoveata têm sido intensamente debatidas, onde os gêneros *Scutopus* Salvini-Plawen, 1968 e *Psilodens* Salvini-Plawen, 1977 (Limifossoridae) são tradicionalmente apontados como os que possuem morfologia da rádula e do trato digestório com

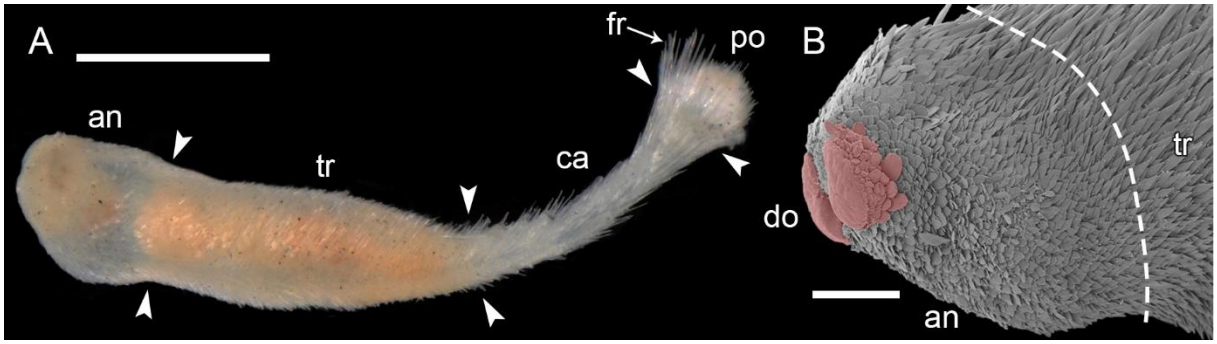

Figura 2. Um exemplo de um Prochaetodermatidae. **A.** Vista lateral esquerda, sob estereomicroscópio, mostrando as principais divisões do corpo (indicado por setas). **B.** Detalhe da região anterior, sob microscopia eletrônica de varredura, mostrando o disco oral e suas espículas em volta (destacado em vermelho) e a divisão entre o anterium e o tronco (linha tracejada). an - anterium, ca - cauda (shank), do - disco oral (oral shield), fr - franja (fringe), po – ponta (knob) e tr - tronco (trunk). Posterium equivale a região da cauda + ponta. Escalas em A: 500 µm e B: 200 µm.

características mais plesiomórficas (SALVINI-PLAWEN, 1975; SCHELTEMA, 1981), enquanto Chaetodermatidae tem sido considerado como a família com caracteres mais derivados. Entretanto, essas relações ainda não foram bem resolvidas (TODT et al., 2008) e foram desenvolvidas com base em comparações de estruturas anatômicas. Dentre essas estruturas, se destacam a forma e as células do saco radular e o epitélio do estômago (SALVINI-PLAWEN, 1981; SCHELTEMA, 1981), a organização dos gânglios nervosos (SHIGENO et al., 2007; FALLER et al., 2012) e aspectos morfológicos do pericárdio e da cavidade do manto (HEATH, 1918; SCHELTEMA, 1973). Contudo, existem poucos trabalhos sobre a anatomia de Caudofoveata, onde poucas espécies tiveram suas estruturas bem descritas. Para Prochaetodermatidae, o conhecimento é ainda mais escasso, onde apenas dois estudos mais completos foram feitos para espécies do gênero *Prochaetoderma*, descrevendo principalmente o trato digestório (SCHELTEMA, 1978, 1981).

Além disso, não existe até o momento trabalhos em filogenia molecular que discutem as relações entre as famílias de Caudofoveata. Apenas durante o último WCM (World Congress of Malacology), MIKKELSEN et al. (2013) apresentaram resultados preliminares indicando que dentre as famílias, Prochaetodermatidae seria a que possui características mais plesiomórificas quando comparada à Limifossoridae e Chaetodermatidae. Por isso, novos estudos de anatomia são necessários utilizando técnicas de microscopia mais recentes e para uma maior quantidade de espécies, principalmente para Prochaetodermatidae. Uma reinterpretação desses dados anatômicos em conjunto com trabalhos moleculares que incluam as relações entre famílias é necessária sobre a nova percepção da filogenia de Caudofoveata, a qual

pode trazer novas evidências que podem sustentar a hipótese Aculifera, ou refutá-la, propondo outras alternativas.

Embora tenha importância filogenética e taxonômica, pode-se dizer que um número pequeno de pesquisadores se dedicam à descoberta e descrição detalhada da diversidade taxonômica e biológica dos aplacóforos. Recentemente, pesquisadores importantes para esse grupo faleceram nos últimos anos, em especial Schander, Scheltema e Salvini-Plawen, estagnando grande parte dos estudos com esses animais. Atualmente existe apenas um grupo de estudo na Espanha que trabalha ativamente com esses animais, além de outros pesquisadores espalhados pelo mundo que já realizaram ou realizam trabalhos, mas não como um grupo de pesquisa consolidado. Aplacóforos são animais exclusivamente marinhos, cujas espécies são, em geral, muito pequenas e encontradas em grandes profundidades. Por esses fatores, são de difícil coleta e poucos pesquisadores dispõem de material abundante e em bom estado de preservação para suas pesquisas.

No Brasil, o conhecimento ainda é muito escasso. Até o momento foram citadas apenas quatro espécies de Caudofoveata: *Chevroderma turnerae* Scheltema, 1985 e *Sphatoderma bulbosum* Ivanov & Scheltema, 2008 para o litoral de Pernambuco (SCHELTEMA, 1985; IVANOV & SCHELTEMA, 2008) e *Falcidens targatus* Salvini-Plawen, 1992 e *Falcidens acutargatus* Salvini-Plawen, 1992 para a Bacia de Campos (CORRÊA et al., 2014). SCHELTEMA (1990) também cita duas espécies do gênero *Falcidens* Salvini-Plawen, 1968, mas sem uma identificação até o nível de espécie. RIOS (2009) cita quatro espécies na costa brasileira (uma de Solenogastres e três de Caudofoveata), mas sem citar referências bibliográficas ou mencionar material testemunho. Na sua Tese de Doutorado, MARTINS (2008) descreve quatro espécies, todas consideradas como novas, mas esses dados não foram publicados até o presente. Esses poucos registros demonstram uma grande deficiência no conhecimento sobre essa classe, particularmente para o Brasil, que ocupa uma vasta área do Atlântico Sudoeste, onde ainda são poucos os estudos em maiores profundidades.

Somente mais recentemente, com o interesse em explorar comercialmente recursos vivos e minerais, é que se tem feito prospecções do fundo marinho, incluindo a coleta de organismos bentônicos. Nesse contexto, a PETROBRAS vem acessando o litoral dos Estados de Rio de Janeiro e Espírito Santo em grandes profundidades, através do Projeto HABITATS, “Avaliação da Heterogeneidade Ambiental da Bacia de

Campos", e AMBES "Caracterização Ambiental da Bacia do Espírito Santo e norte da Bacia de Campos", com o objetivo geral, de caracterizar as comunidades bentônicas da plataforma continental e do talude, fornecendo subsídios para o planejamento e gestão ambiental.

Interessantemente, IVANOV & SCHELTEMA (2008) também levantaram uma hipótese sobre a quebra da diversidade da fauna de Prochaetodermatidade entre as latitudes 8ºS e 36ºS na costa leste da América do Sul (entre o Rio Grande do Norte e o Uruguai), da mesma forma que ocorre no Atlântico Norte, na latitude de 35ºN (CUTLER, 1975). Entretanto, esses mesmos autores deixaram essa questão em aberto, devido à falta de conhecimento sobre a fauna de aplacóforos do Atlântico Sudoeste, principalmente na costa brasileira. Um inventário mais detalhado dessa fauna pode refutar ou não essa hipótese, e inclusive trazer novas informações e hipóteses sobre a distribuição de aplacóporos ao longo do Atlântico.

Objetivos

O presente trabalho possui como objetivo identificar parte do material proveniente das coletas feitas pelos projetos HABITATS e AMBES, registrando novas ocorrências para o Brasil e, mais especificamente, para os Estados do Rio de Janeiro e Espírito Santo, e também descrever eventuais espécies novas. Assim, será feito um inventário sobre a diversidade da família Prochaetodermatidae na região, fornecendo mais dados sobre a sua distribuição geográfica e batimétrica.

Material e Métodos

O material analisado foi proveniente dos Projetos HABITATS e AMBES (Fig. 3). Pelo HABITATS as coletas ocorreram na Bacia de Campos, no litoral do Rio de Janeiro e sul do Espírito Santo. Foram feitos 8 transectos em 12 isobatas, nos anos de 2008 e 2009. Já pelo AMBES, as coletas ocorreram no litoral do Espírito Santo; nessa área, foram feitos 6 transcectos em 10 isobatas, entre 2012 e 2013. As profundidades variaram de 25 a até 3000 metros, incluindo as zonas de plataforma continental, talude superior e cânions submarinos. Em ambos os projetos foram utilizados pegadores de fundo do tipo Van-veen e Box-corer, conforme o tipo de substrato, e as coletas para cada ponto foram feitas três réplicas. A maior parte das amostras também foram subdivididas em estratos de 0–2, 2–5, e 5–10 cm. No total

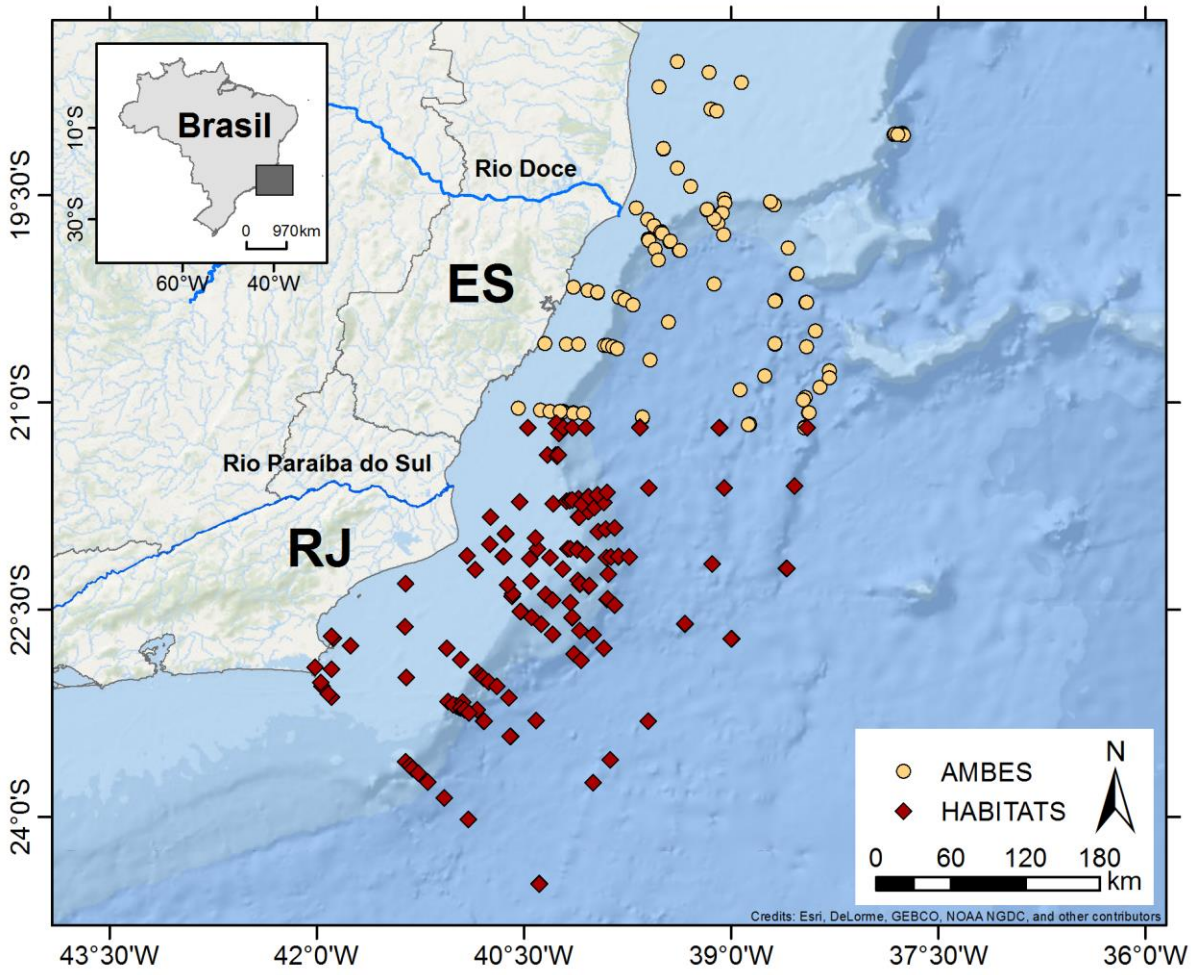

Figura 3. Litoral sudeste do Brasil, mostrando os pontos que foram amostrados nos Projetos HABITATS e AMBES.

foram coletados 3275 caudofoveados, os quais foram fixados em formol e preservados em álcool 70%.

Inicialmente, os exemplares de aplacóforos foram separados em morfoespécies identificadas até o nível de família. As amostras foram analisadas sob estereomicroscópio, verificando as características externas de cada exemplar, com atenção especial à distinção das regiões do corpo, aos detalhes das espículas e do disco oral, todos eles fundamentais na identificação de gêneros e espécies de aplacóforos (SALVINI-PLAWEN, 1975; SCHELTEMA & IVANOV, 2000; IVANOV & SCHELTEMA, 2008). Os exemplares obtidos foram também comparados com o material tipo de espécies de Prochaetodermatidae depositados no Smithsonian National Museum of Natural History, Washington (EUA), onde se encontram várias espécies da família descritas para o Atlântico Oeste.

Para extração das espículas, cada região do corpo de espécimes selecionados foi isolada e banhada com solução de NaClO 2% durante 5 minutos para

dissolução das partes moles. Nesses indivíduos, nenhuma parte mole foi mantida, para isolar o maior número possível de espículas. Então, a cutícula junto com as espículas foi colocada sobre um fragmento de lamínula, onde as espículas foram retiradas com auxílio de uma pinça de ponta bem fina e pincel. Posteriormente, as lamínulas foram fixadas sobre *stubs* e metalizadas com ouro, utilizando o "Sputter Balzers SCD-050". Espículas de algumas espécies possuem características apenas visíveis em microscopia de luz transmitida, as quais foram colocas em uma lâmina e montadas com Entellan ("Merck"). Para extração da rádula, indivíduos tiveram sua massa bucal isolada, a qual também eram banhadas com solução de NaClO 2%. Com o passar do tempo, as partes moles são dissolvidas, expondo cuidadosamente a rádula, que foi então colocada sobre uma lâmina ou *stub* para ser observada em microscópios de luz e varredura, respectivamente.

Espécimes mais bem preservados foram selecionados para varredura de corpo inteiro e do disco oral. Estes foram secados através do ponto crítico de CO_2 utilizando o equipamento "Balzers CPD-030" e colocados em stubs com uma fita de carbono dupla-face para, em seguida, serem metalizados. Posteriormente, esses indivíduos foram retirados dos stubs e tiveram as espículas e rádulas isoladas para a confirmação da sua identificação.

Fotos de todos os exemplares foram tiradas através de câmera acoplada a um estereomicroscópio "Zeiss SteREO Discovery.V8". Utilizando o software AxioVision 4.8.2, foram feitas medidas de quatro regiões do corpo que apresentam importância taxonômica (Figs. 2A e B): comprimento do tronco, comprimento do posterium (cauda + ponta), diâmetro do tronco e diâmetro da cauda. Essas medidas foram obtidas através das fotos dos animais. Fotos de espículas e rádula em microscopia de luz foram feitas através do microscópio "Zeiss AXIO Imager.A2", também com uma câmera acoplada. O microscópio de varredura utilizado foi um "Joel JSM 5800LV". Desenhos em 3D foram criados utilizando o software Blender 2.76b.

Todo o material examinado será depositado em coleções zoológicas, como a do Museu de Zoologia "Prof. Adão José Cardoso", da UNICAMP, Campinas (ZUEC). Essas amostras serão compostas de espécimes íntegros em etanol 70%, ou preparações de lâminas e stubs das espículas e rádulas, ou ainda da rádula e mandíbulas isoladas, também em etanol.

Chapter 1: Taxonomy of Prochaetodermatidae - a review of the literature

Prochaetodermatidae is a family of Caudofoveata with a great ecological importance in the deep-sea benthos (GRASSLE & MACIOLEK, 1992). In studies made in the Northwest Atlantic, in the Northeast Pacific and in the Aleutian Trench, species of prochaetodermatids were among the five to ten top dominants species in most samples (SCHELTEMA, 1997). Members of this family are small, usually 1 to 10mm in length, and mainly occur in the continental slope or in the continental rise. They are mainly registered from the Northwest and throughout the East Atlantic and in the North and West Indian Ocean, and in fewer locations at the Pacific and in the Southwest Atlantic Ocean (Fig. 4). They are distinguished by a short or long tail-like posterium, a paired oral shield, and their trunk have no body divisions. Usually, their sclerites are obliquely positioned, pointing dorsoposteriorly. They are known as being opportunists (SCHELTEMA, 1987), feeding mainly on organic detritus and small organisms. Species of Prochaetodermatidae are easily differentiated from those of other families, as they have a distichous radula with up to 11 pairs of teeth, with a serrate membrane on each tooth and a central plate between each pair of teeth. Furthermore, they have a pair of spatulate jaws located in the left and right sides of the mouth that are unique for Aplacophora. Formerly, their function were inferred to be assisting in the opening of the mouth (SCHELTEMA, 1981), but recently, studies show evidence that they serve to hold the food inside the mount while the radula is rasping it (SCHELTEMA & IVANOV, 2000).

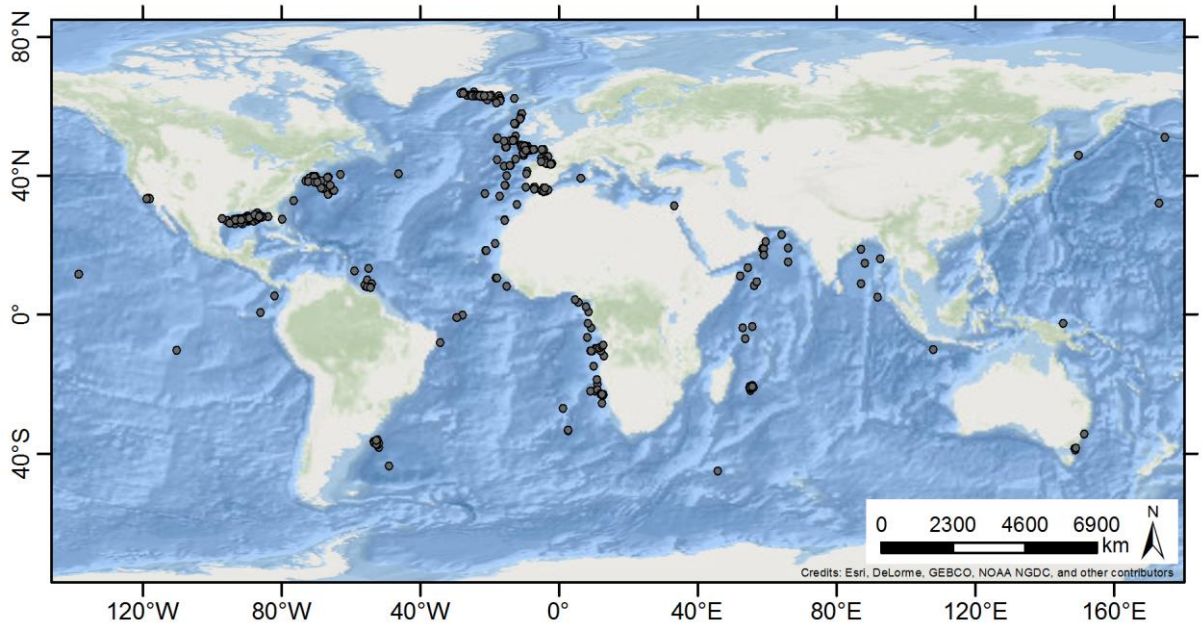

Figure 4. Map showing the location (grey points) of all collected samples of all species of Prochaetodermatidae gathered from the literature. See Appendix A for a complete list of all samples.

It is the most recent family of Caudofoveata, with six genera and 39 species accepted so far, as listed below:

Family Prochaetodermatidae Salvini-Plawen 1972
- Genus *Chevroderma* Scheltema, 1985
  - *Chevroderma cuspidatum* Ivanov & Scheltema, 2008
  - *Chevroderma gauson* Scheltema, 1985
  - *Chevroderma hadalis* Ivanov, 1996
  - *Chevroderma javanicum* Ivanov & Scheltema, 2002
  - *Chevroderma lusae* Ivanov & Scheltema, 2002
  - *Chevroderma paradoxum* Ivanov & Scheltema 2001
  - *Chevroderma scalpellum* Scheltema, 1985
  - *Chevroderma turnerae* Scheltema, 1985
  - *Chevroderma vityazi* Ivanov & Scheltema, 2002
  - *Chevroderma whitlachi* Scheltema, 1985
- Genus *Claviderma* Scheltema & Ivanov, 2000 [= *Rhabdoderma* Scheltema, 1989]
  - *Claviderma amplum* Ivanov & Scheltema, 2008
  - *Claviderma australe* (Scheltema, 1989)
  - *Claviderma brevicaudatum* Scheltema & Ivanov, 2000
  - *Claviderma compactum* Ivanov & Scheltema, 2008
  - *Claviderma crassum* Ivanov & Scheltema, 2008
  - *Claviderma gagei* Ivanov & Scheltema, 2001
  - *Claviderma gladiatum* (Salvini-Plawen, 1992)
  - *Claviderma iberogallicum* (Salvini-Plawen, 1999) [=*Prochaetoderma breve* Salvini-Plawen, 1999, *Claviderma tricosum* Scheltema & Ivanov, 2000]
  - *Claviderma laticarinatum* Ivanov & Scheltema, 2001
  - *Claviderma mexicanum* Ivanov & Scheltema, 2008
- Genus *Dacryomica* Ivanov & Scheltema, 2004
  - *Dacryomica plana* Ivanov & Scheltema, 2004
- Genus *Niteomica* Ivanov, 1996 [= *Scleroderma* Ivanov, 1995]
  - *Niteomica captainkiddae* Ivanov & Scheltema, 2008
  - *Niteomica hystrix* Scheltema & Ivanov, 2000
  - *Niteomica latispiculata* (Ivanov, 1995)
  - *Niteomica liliae* Ivanov & Scheltema, 2001
- Genus *Prochaetoderma* Thiele, 1902
  - *Prochaetoderma arabicum* Ivanov & Scheltema, 2002
  - *Prochaetoderma atlanticum* Scheltema & Ivanov, 2000
  - *Prochaetoderma boucheti* Scheltema & Ivanov, 2000
  - *Prochaetoderma gilrowei* Ivanov & Scheltema, 2008
  - *Prochaetoderma raduliferum* (Kowalevsky, 1901)
  - *Prochaetoderma yongei* Scheltema, 1985
- Genus *Spathoderma* Scheltema, 1985
  - *Spathoderma alleni* Scheltema & Ivanov, 2000
  - *Spathoderma bulbosum* Ivanov & Scheltema, 2008

Spathoderma californicum (Schwabl, 1963)
Spathoderma clenchi Scheltema, 1985
Spathoderma grossum Scheltema & Ivanov, 2000
Spathoderma longisquamosum (Salvini-Plawen, 1992)
Spathoderma quadratum Ivanov & Scheltema, 2008
Spathoderma subulatum Ivanov & Scheltema, 2001

Although most genera and species were described recently, in the last 25 years, there have been some unsolved taxonomic problems in this family, starting with its authority. A search in the literature shows that the year of its original publication has been interpreted in many different ways: “Salvini-Plawen, 1968” (SALVINI-PLAWEN, 1975; SALVINI-PLAWEN & GARCÍA-ÁLVAREZ, 2014), “Salvini-Plawen, 1969” (SCHELTEMA, 1985, 1989), “Salvini-Plawen, 1972” (IVANOV & SCHELTEMA, 2001a, 2004, 2008) and “Salvini-Plawen, 1975” (SCHELTEMA & IVANOV, 2000; IVANOV & SCHELTEMA, 2001b; BOUCHET & GOFAS, 2010). The first reference of the family Prochaetodermatidae was as following:

> The new class Caudofoveata includes three families with 49 species in six genera [at the moment]: *Limifossor* Heath, *Scutopus* Salvini-Plawen and *Metachaetoderma* Thiele as Limifossoridae – the only *Prochaetoderma* Thiele as Prochaetodermatidae – and *Chaetoderma* Lovén (= *Crystallophrisson* Möbius) and *Falcidens* Salvini-Plawen as Chaetodermatidae. (SALVINI-PLAWEN, 1968, p. 252, translated from the german)

It is the only passage where the author mentions this family, and a formal description or diagnosis was not provided, neither the reasons to create this family were stated. A diagnosis was first given by the same author four years later (SALVINI-PLAWEN, 1972, p. 37). Therefore, here we are considering “Salvini-Plawen, 1972” as the correct authority, according to the Article 13.1 of the Code and in agreement to other authors (IVANOV & SCHELTEMA, 2001b, 2008). “Salvini-Plawen, 1968” and “1969” should be considered invalid because they do not satisfy all requirements the Code. The same applies for “Salvini-Plawen, 1975”, because of the Principle of Priority.

Furthermore, there are other problems regarding the taxonomy of Prochaetodermatidae. The three families of Caudofoveata are mainly distinguished by the radula: in both Limifossoridae and Prochaetodermatidae the radula is seriated, but in Prochaetodermatidae it is associated with a pair of jaws; in Chaetodermatidae, the radula is reduced to only one pair of teeth and large supports. Genera of Chaetodermatidae and Limifossoridae are also mainly distinguished by the radula, in particularly with the morphology of teeth and denticles. Additionally, in these families

there are some clusters of species with similar sclerites, and some of those clusters were grouped in subgenera (e.g., *Chiastofalcidens* in CORRÊA et al., 2014).

However, Prochaetodermatidae has a different taxonomic organization from other two families. Its radula is uniform among all species described so far and its six genera are distinguished by sclerites, mainly the morphology of trunk sclerites and the number of rows in oral shield sclerites. This created two schools of classification, where Scheltema and Ivanov always supported this classification with six genera (e.g. SCHELTEMA & IVANOV, 2000; IVANOV & SCHELTEMA, 2008), as presented above. On the other hand, Salvini-Plawen disagrees with this classification, and considers that genera *Chevroderma*, *Claviderma*, *Dacryomica*, *Niteomica* and *Spathoderma* are synonyms of *Prochaetoderma* (SALVINI-PLAWEN, 1992; SALVINI-PLAWEN & GARCÍA-ÁLVAREZ, 2014). He states that characteristics of sclerites used to distinguish these genera are highly variable with many intermediate conditions and may be convergent, and thus cannot be used to delimit a natural taxon. In addition, any anatomical character is known to correlate with this classification, like the morphological differences of the radula in the families Chaetodermatidae and Limifossoridae. Salvini-Plawen only agrees that *Chevroderma* has a more homogeneity in its sclerites morphology and therefore, can be considered as a subgenus of *Prochaetoderma* (SALVINI-PLAWEN, 1992).

In fact, the sclerites are highly variable and even careful observations may lead to incorrect identifications (e.g. SCHELTEMA & IVANOV, 2001). Despite a few exceptions in some species, there are patterns in the morphology of body and in details of the sclerites that may be used to characterize these genera. Here, the classification of Scheltema and Ivanov is considered as valid, recognizing that additional studies must be done before any decisions can be made; unnecessary synonymization can bring serious taxonomic problems in the future. The anatomy of Prochaetodermatidae is poorly know, with exception of the radula. There are only two older works, one with *Prochaetoderma* (KOWALEVSKY, 1901) and another with *Spathoderma* (SCHWABL, 1963); and two more recent works that describe the digestive system in more details, both about species of *Prochaetoderma* (SCHELTEMA, 1978, 1981). More comprehensive works in anatomy can point out different structures between genera, supporting the classification of Ivanov and Scheltema, or can just indicate more similarities, thus supporting the classification of Salvini-Plawen. Furthermore, studies in molecular phylogeny can indicate if species in the same genus have a common

ancestor and what is the phylogenetic distance between these genera, corroborating or not with one classification or another, also showing if a genus is valid as a natural group.

Moreover, SALVINI-PLAWEN (1992, p. 324) described the subgenus *Lonchoderma* Salvini-Plawen, 1992, with a single species, *Prochaetoderma longisquamosum* Salvini-Plawen, 1992. The main diagnosis of this subgenus is the presence of two lateral projections of the radular membrane alongside each radula tooth. However, IVANOV & SCHELTEMA (2001b, p. 31) latter analyzed the radula preparation of Salvini-Plawen and were unable to detect the two lateral projections. Based on the morphology of the sclerites, they transferred this species to *Spathoderma* and, consequently, *Lonchoderma* should be considered an invalid name. However, the WoRMS database incorrectly lists *Lonchoderma* as a valid genus (BOUCHET & GOFAS, 2010).

Features used to distinguish genera are gathered from the literature and organized in the Table 1. Also, the typical morphology and main ornamentations of sclerites described in the table are illustrated in Figure 5. The table and figure are intended to assist future taxonomic studies in Prochaetodermatidae and avoid more confusion on how to differentiate these genera. A table that gathers the data of samples of all species of Prochaetodermatidae should assist as well when comparing geographic and bathymetric distribution of different species. The list in Appendix A provides the main data of this table.

Sometimes, the description of some species and genera were incomplete or were based on one single or a few specimens, and as a result, the variations of the morphology of the body and of the sclerites were not investigated in detail. A good example is the genus *Dacryomica*. It is monotypic and its species was described using a single specimen, hence several diagnostic characters were not observed, including oral shield sclerites, radula, jaws and variability in body and sclerite morphology (IVANOV & SCHELTEMA, 2004). Therefore, we repeat and extend a note made by SCHELTEMA & IVANOV (2001), where extreme careful examination must be taken when studying and identifying species of prochaetodermatids, since there is convergence in some of the characteristics used to describe new species.

Table 1. Main characteristics of each genus of Prochaetodermatidae. Note that sclerites have a certain degree of variability in morphology, and characteristics given here represent the most common sclerites found on that particularly region. Morphology of oral shield sclerites and fringe are usually similar along genera. Sclerites of shank often are often alike with trunk sclerites, but they can be even more variable.

Features	*Chevroderma*	*Claviderma*	*Dacryomica*	*Niteomica*	*Prochaetoderma*	*Spathoderma*
Sclerites arrangement at trunk	from anteroventral to dorsoposterior; adpressed against the body	from anteroventral to dorsoposterior; adpressed against the body	from anteroventral to dorsoposterior; adpressed against the body	from anteroventral to dorsoposterior; spiny, bent outwards from the body	parallel to the longitudinal body axis, except in *Prochaetoderma atlanticum*; adpressed against the body	most from anteroventral to dorsoposterior, except in northern specimens of *Spathoderma quadratum;* usually bent outwards from the body
Oral shield sclerites	2 rows	3 or more rows	not described	One or 2 rows	2 rows	3 rows
Shape of trunk sclerites	base elongated; blade narrower than base at waist (Figs. 5A, B)	base long, larger or equal than blade, same width as blade; base and blade not well distinguished (Figs. 5D, E)	base wider than base, tear-drop shape (less defined waist), an intermediate state between *Spathoderma* and *Claviderma* (Figs. 5G, H)	base wider than blade; blade long, sharp, needle-shaped (Figs. 5K, L)	sclerite short, base wider than blade and blade usually evenly tapered; base and blade not well distinguished (Figs 5O, P)	base wider than base, spatula-like shape (more defined waist) (Figs. 5R, S, U)

(continued)

Features	*Chevroderma*	*Claviderma*	*Dacryomica*	*Niteomica*	*Prochaetoderma*	*Spathoderma*
Base and blade planes of trunk sclerites	plane of blade bent outwards from plane of base (Fig. 5C)	curved longitudinally towards body (Fig. 5F)	planes usually rotated relative to each other (Fig. 5I); plane of sclerite curved transversely towards body (Fig. 5J)	plane of blade bent outwards from plane of base (slight or great angle) (Fig. 5M); plane of base curved transversely towards body (Fig. 5N)	planes of base and blade usually flat (Fig. 5Q), or slight curved longitudinally to body	plane of blade bent outwards from plane of base; planes usually rotated relative to each other (Fig. 5T)*
Proximal end of trunk sclerites	chevron-shaped or rounded	most rounded	most rounded	most quadrate	most rounded	most rounded
Ornamentations	growth lines chevron-shaped (Fig. 5A); medial groove distinct, but sometimes faint (Figs. 5A, B)	longitudinal striations	longitudinal striations	longitudinal striations; keel present at blade (Fig. 5L)	longitudinal striations; short or long medial keel at blade (Figs. 5O, P)	longitudinal striations; may have a faint keel at blade (Figs. 5R, S)
Isochromes	asymmetrical on each side of groove	usually symmetrical	asymmetrical	nearly symmetrical	usually symmetrical	symmetrical

* both characteristics may give a false impression that the longitudinal axis, usually straight, is curved and that the sclerite is asymmetrical (Fig. 5U). This depends on which position sclerites land over the slide.

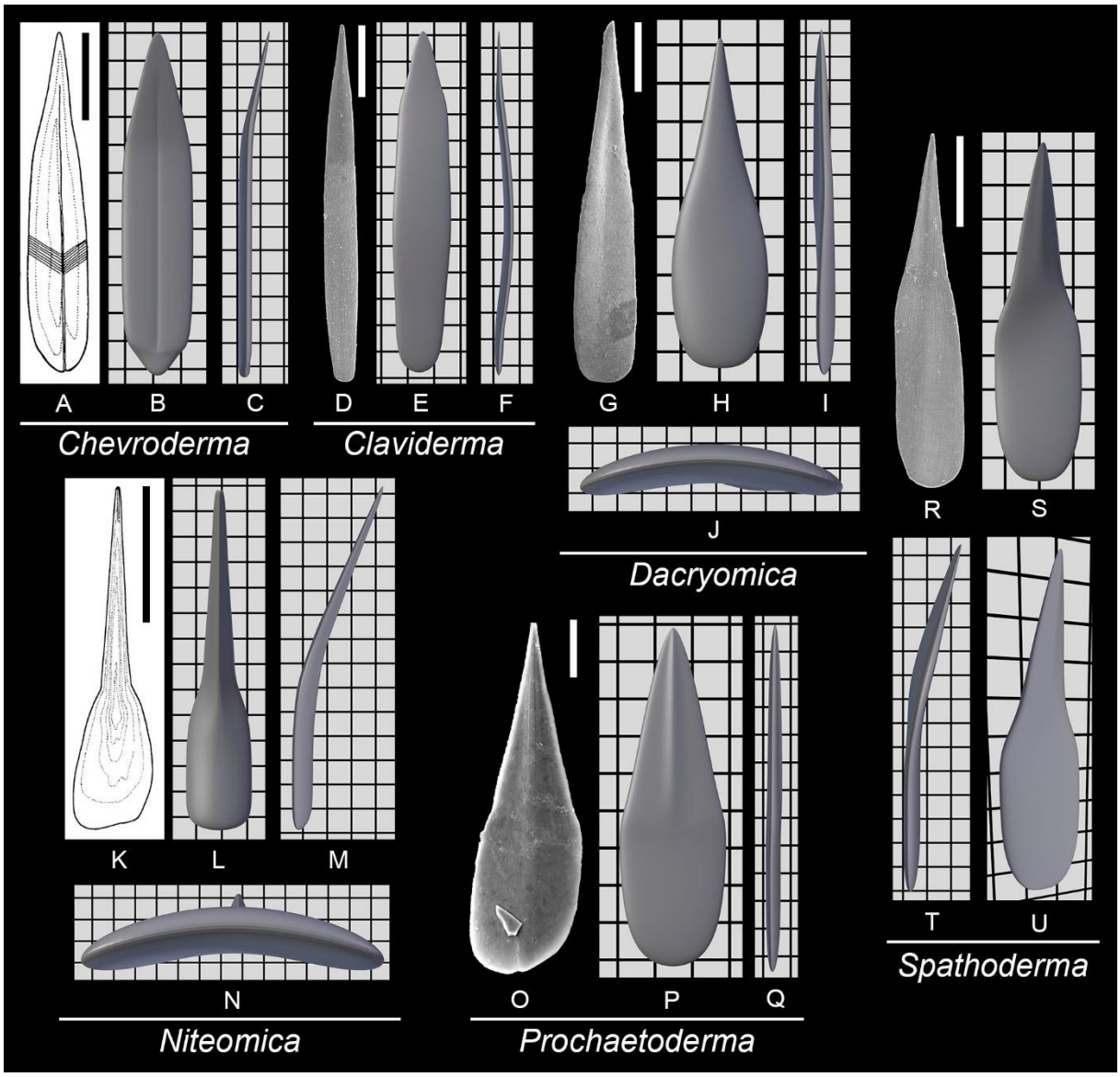

Figure 5. General morphology of trunk sclerites of all genera of Prochaetodermatidae. **A** and **K** are drawings based on birefringence; **D**, **G**, **O** and **R** are SEM photos and all the others are 3D drawings emphasizing trunk sclerites main features on Table 1. They do not have striations on surface to facilitate visualization. **A**–**C.** *Chevroderma*. **D**–**F.** *Claviderma*. **G**–**J.** *Dacryomica*. **K**–**N.** *Niteomica*. **O**–**Q.** *Prochaetoderma.* **R**–**U.** *Spathoderma*. **B**, **D**, **E**, **H**, **L**, **O**, **P**, **R** and **S.** frontal view. **G.** abfrontal view. **C**, **F**, **I**, **M**, **Q** and **T.** lateral view, where the right side is the frontal face. **J** and **N.** view from the base. **U**. diagonal view, showing distal, frontal and lateral views at the same time. **A** - modified from SCHELTEMA & IVANOV (2000, fig. 13J), **G** - modified from IVANOV & SCHELTEMA (2004, fig. 3A), **K** - modified from SCHELTEMA & IVANOV (2000, fig. 22J) and **O** - modified from IVANOV & SCHELTEMA (2008, fig. 18D). Scales for D, K and R: 100 µm, A and G: 50 µm and **O**: 20 µm.

Chapter 2: Genus *Claviderma* Scheltema & Ivanov, 2000

Introduction

Claviderma Scheltema & Ivanov, 2000 (= *Rhabdoderma* Scheltema, 1989) is composed of 10 species so far and are one of the six genera of Prochaetodermatidae. Species are mainly distinguished by their trunk sclerites morphology (SCHELTEMA & IVANOV, 2000; IVANOV & SCHELTEMA, 2008), which are elongated and slim, with no clear difference between the base and blade (Figs. 5D and E). Its lateral edges have almost the same width throughout the longitudinal axis, being straight or slight convex, and the sclerites are slightly curved (Fig. 5F). They lack evident ornamentation, like ridges or grooves. There are faint longitudinal striations and transverse growth lines that are observed by only transmitted light microscope. In addition, this genus has three or more rows of oral shield sclerites. Characteristics used to describe and differentiate species of this genus are as follows: the number of rows of oral shield sclerites and if those sclerites are numerous or a few; the shape of the trunk and shank, whether they are more elongated or shorter, wider or slender and if one is well distinguished from another; and the shape of the knob, which can be rounded, cone-shaped or truncated; for isolated sclerites of the trunk, the distal end can be tapered more evenly, sharply or triangular-like and a waist may be visible or not; and finally, the morphology of shank sclerites and how they differ from trunk ones. Also, other features are used for some specific cases.

Despite some records for the Indian Ocean and Southeastern Australia, most works done so far described species of *Claviderma* mainly from the North Atlantic Ocean and West coast of Africa. For the Southwest Atlantic Ocean, only one species is known, *Claviderma compactum* Ivanov & Scheltema, 2008, off Uruguay Coast. Due to the lack of specialists on aplacohorans, the fauna of *Claviderma*, and more generally of Prochaetodermatidae, is poorly known for this region.

Results

Family **Prochaetodermatidae** Salvini-Plawen, 1972

Diagnosis: body length <5 mm in most species, bearing a long or short posterium narrower than trunk (tail-like posterium). Oral shield divided in right and left sides, usually surrounded by sclerites that are different from those of the anterium. A pair of large, spatulate cuticular jaws present. Radula distichous, with 9-12 rows of curved, mirror-image teeth, with a small, central plate between the base of each pair;

teeth with serrated membrane; jaws and radula morphology are uniform among genera and species.

Genus ***Claviderma*** Scheltema & Ivanov, 2000

Diagnosis (modified from IVANOV & SCHELTEMA, 2008)**:** With characters of the family. Sclerites closely adpressed against the body; plane of sclerite base and/or blade curved toward body; without keel or groove and usually with weak longitudinal striations in frontal surface; longitudinal axis usually straight; waist distinct or indistinct; trunk sclerites elongated, usually with convex edges, blade nearly as broad as base and blade tapered about in its half-length or, more commonly, tapered only near tip; isochromes usually symmetrical; oral shield sclerites in 3 or more rows, innermost rows of sclerites smaller than outer rows.

Type species: *Rhabdoderma australe* Scheltema, 1989, by original designation. Transferred to *Claviderma* for the first time by Scheltema & Ivanov, 2000.

Distribution: Western Atlantic Ocean between 35ºN and 35°S, including the Gulf of Mexico, Guiana Basin, Southeastern Brazil and Uruguay Basin; eastern Atlantic Ocean between 50°N and 25°S, including Bay of Biscay and Cape Basin; westernmost Mediterranean Sea, south of Spain; Indian Ocean, including east of Madagascar, Arabian Sea and Bay of Bengal; and southeastern Australia. Coordinates are given in Appendix A.

Composition: *C. amplum* Ivanov & Scheltema, 2008, *C. australe* (Scheltema, 1989), *C. brevicaudatum* Scheltema & Ivanov, 2000, *C. compactum* Ivanov & Scheltema, 2008, *C. crassum* Ivanov & Scheltema, 2008, *C. gagei* Ivanov & Scheltema, 2001, *C. gladiatum* (Salvini-Plawen, 1992), *C. iberogallicum* (Salvini-Plawen, 1999), *C. laticarinatum* Ivanov & Scheltema, 2001, *C. mexicanum* Ivanov & Scheltema, 2008 and the new species described below.

Claviderma amplum Ivanov & Scheltema 2008

(Figures 6, 7, 8 and 10A; Tables 2 and 3)

Type material examined: Holotype USNM 1112615; Paratypes USNM 1137102–1137110, 1137112–1137126 and 1138676–1138690, 91 spm. Paratype 1137111 not found.

Additional material examined: 24 specimens in 20 samples. HAB4-CANG07-R1(2-5), 21°56'13.4"S 39°57'46.56"W, 705.2 m, 28/may/2008, 1 spm; HAB3-A08-R1(0-2), 23°41'11.65"S 41°16'9.21"W, 986 m, 3/may/2008, 1 spm; HAB3-A08-R2(5-10), 23°41'13.41"S 41°16'8.11"W, 984.5 m, 4/may/2008, 1 spm; HAB4-CANG08-R1(2-5), 21°55'8.58"S 39°54'32.76"W, 999.9 m, 28/may/2008, 3 slides; HAB6-CANAC08-R1(2-5), 21°45'56.4"S 39°59'28.73"W, 1023.3 m, 8/jul/2008, 1 stub and 2 slides; HAB6-CANAC08-R2(0-2), 21°45'55.96"S 39°59'26.98"W, 1031.7 m, 9/jul/2008, 2 spms; HAB6-CANAC08-R2(2-5), 21°45'55.96"S 39°59'26.98"W, 1031.7 m, 9/jul/2008, 1 spm; HAB6-CANAC08-R3(0-2), 21°45'55.74"S 39°59'27.63"W, 1035 m, 10/jul/2008, 1 spm; HAB6-CANAC08-R3(2-5), 21°45'55.74"S 39°59'27.63"W, 1035 m, 10/jul/2008, 1 spm; HAB8-A07-R3(0-2), 23°39'23.32"S 41°18'34.67"W, 692.7 m, 28/jan/2009, 1 stub; HAB8-C07-R2(2-5), 22°59'55.55"S 40°47'46.3"W, 692 m, 29/jan/2009, 1 spm; HAB9-CANAC07-R1(2-5), 21°47'28.25"S 40°1'56.61"W, 780 m, 6/feb/2009, 1 spm; HAB9-CANAC07-R3(0-2), 21°47'28.25"S 40°1'57.05"W, 775 m, 6/feb/2009, 1 isolated radula with jaws; HAB9-CANAC08-R1(0-2), 21°45'56.4"S 39°59'28.73"W, 1030 m, 6/feb/2009, 1 spm; HAB9-CANG07-R2(0-2), 21°56'13.4"S 39°57'46.78"W, 720 m, 7/feb/2009, 3 spms; HAB9-CANG07-R2(2-5), 21°56'13.4"S 39°57'46.78"W, 720 m, 7/feb/2009, 2 spms; HAB9-H07-R1(2-5), 21°41'13.83"S 40°1'57.71"W, 701 m, 5/feb/2009, 3 slides and 1 isolated radula with jaws; HAB9-I07-R1(0-2), 21°11'13.81"S 40°12'53.35"W, 682 m, 4/feb/2009, 1 spm; HAB9-I08-R1(2-5), 21°11'5.9"S 40°9'0.01"W, 993 m, 3/feb/2009, 4 slides; AMB6-D04-R2(2-5), 19°45'54.62"S 39°30'26.28"W, 149 m, 15/jan/2012, 1 spm.

Geographical and bathymetrical distribution: *C. amplum* was originally described from off Southeast Florida, Gulf of Mexico and Guiana Basin, in depths from 293 to 1023 m of the upper continental slope. This new record from Brazil extends its distribution to the Southwestern Atlantic Ocean, in Rio de Janeiro and Espírito Santo Coasts. In this region the distribution ranges from 19°45'59.78"S to 23°41'11.89"S, and

from 39°30'33.41"W to 41°18'33.05"W (Fig. 6). The bathymetric distribution is also slightly increased, from 121 to 1035 m (Fig. 7).

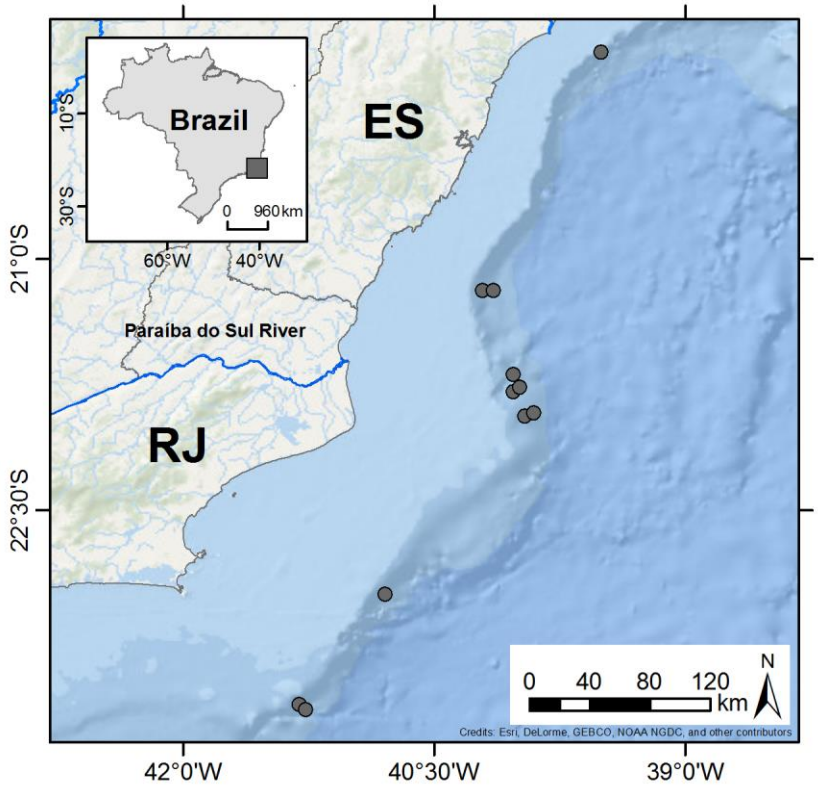

Figure 6. Locations (grey points) where *Claviderma amplum* were collected in the Southeastern Brazil.

Remarks: A complete description and diagnosis can be viewed in IVANOV & SCHELTEMA (2008, p. 11–14), with some notes added below. For a comparison of *C. amplum* with *C. crassum*, see remarks of *C. crassum*.

When compared to the type-specimens deposited in the USNM, the southeastern Brazilian animals are very similar in external appearance (Fig. 8A). However, we identified some individuals (Figs. 8B and C) that are morphologically slightly different from the adults, where the posterium is relatively less elongated than the trunk. Sometimes the anterior end (anterium plus the most anterior region of the trunk) is very prominent, followed by a narrowing in the trunk (Fig. 8B). Furthermore, sometimes the middle of the trunk can be rather larger (Fig. 8C). Mean of measurements of each region are show on Table 2, but some specimens can reach up to 4 mm in body length. The oral shield is paired (Fig. 8D), 130 µm in height, with oral shield sclerites similar to the ones originally described (but they are often broken off). One radula and a pair of jaws were examined (HAB9-I08-R1(2-5)), which are the same in morphology, although they are smaller: radula with 11 pair of teeth, 350 µm

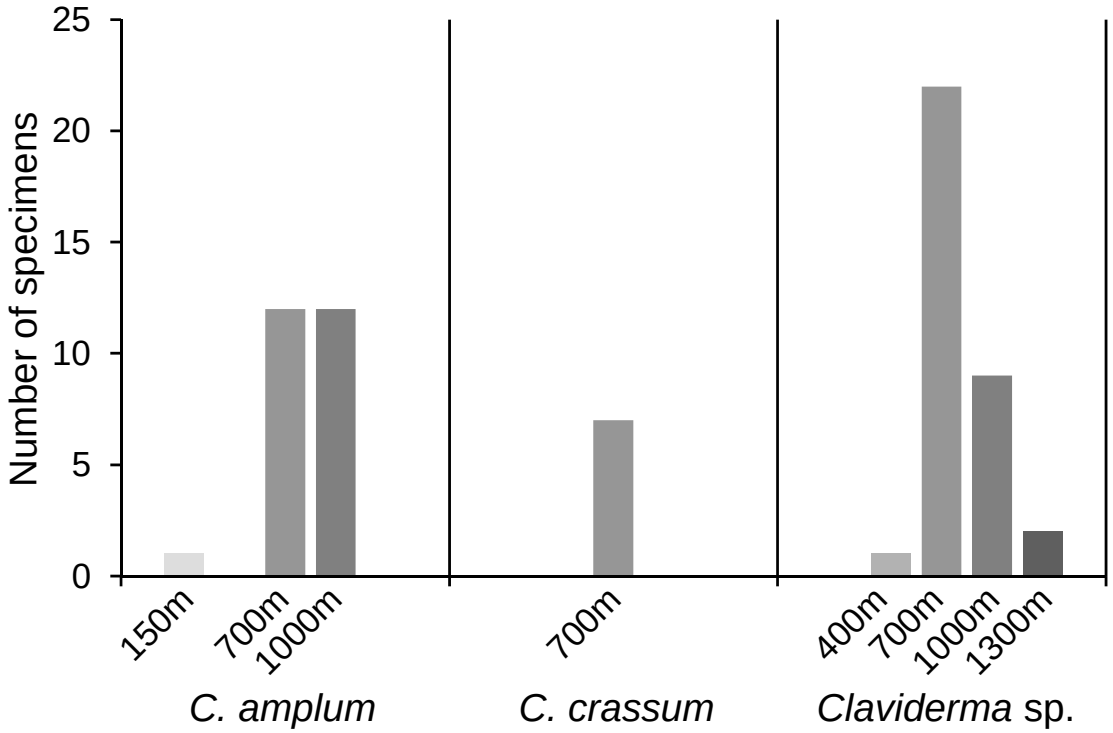

Figure 7. Bathymetric distribution of *Claviderma* species collected in Southeastern Brazil. Each bar represents the number of specimens collected in each isobath sampled.

long and each teeth are 130 µm long; jaws with 500 µm in length and 170 µm in width at the anterior end. Sclerites have the same features described for the type material, with some differences. In the Brazilian material, sclerites (Fig. 8E1–7) are smaller (Table 3) and the waist is almost always indistinct, except in the anterium, where sometimes the waist is well visible (Fig. 8E1). While sclerites of most regions were well described, we are complimenting some variations found in the knob. Between the shank and the knob, sclerites are wider at the base and triangular (Fig. 8E8), about 90 µm in length and 40 µm in width. Some are smaller, 75 x 25 µm, with the same shape. At the knob, sclerites are conglomerate and needle-shaped (Fig. 8A–C). A few are unequal, where about 1/5 to 1/4 of the proximal end tapers abruptly and it is pulled away from the longitudinal axis (Fig. 8E9). Some are small, with the base wider than the blade (Fig. 8E10, IVANOV & SCHELTEMA, 2008, fig. 6H). Others are larger and very thin, with no variation in the width of the base and the blade (Fig. 8E11). A few are large, with the base also wider than the blade, but the former is more ovoid and the latter is very thin along all its length (Fig. 8E12). The largest sclerites are those of the fringe (around the knob), which are also needle-shaped, straight and the blade is evenly tapered along its longitudinal axis (Fig. 8E13; IVANOV & SCHELTEMA, 2008, fig. 6I).

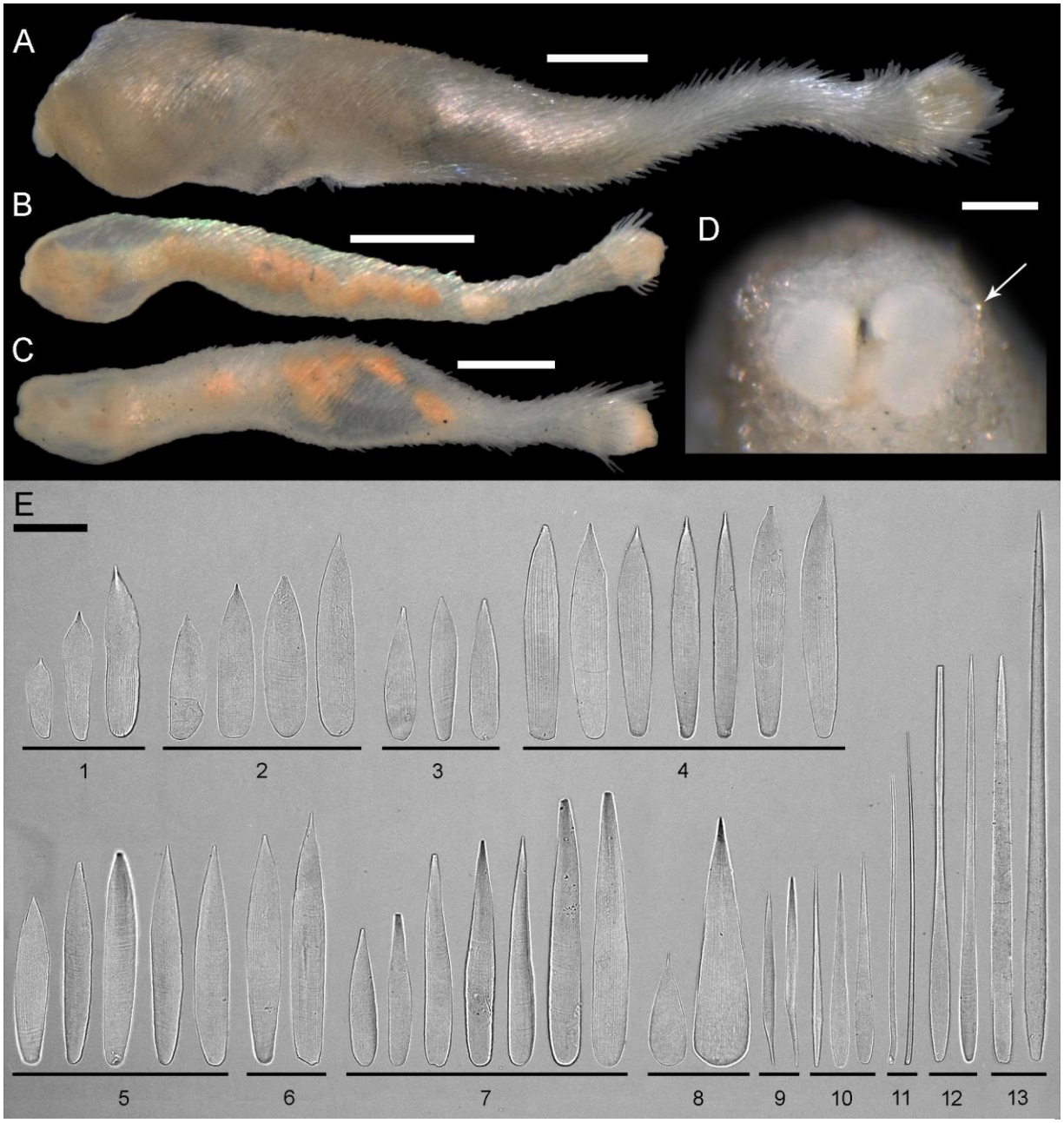

Figure 8. Photos under estereomicroscope (A–D) and light microscope (E and F) of *Claviderma amplum* from Brazil. **A.** Left view of a typical adult, sample HAB3-A08-R1(0-2). **B** and **C.** Left view of specimens showing variations in the morphology, samples HAB4-CANG08-R1(2-5) and HAB9-H07-R1(2-5), respectively. **D.** oral shield, same specimen in A. Arrow indicates remaining oral shield sclerites. **E.** Sclerites of different body regions, sample HAB9-I08-R1(2-5). 1 and 2 - anterium, 3 - ventral anterior trunk, 4 - ventral posterior trunk, 5 - dorsal anterior trunk, 6 - dorsal posterior trunk, 7 - shank and 8–13 - knob. Scales for A–C: 500 µm and D–E: 50 µm.

Table 2. Mean of the body regions measurements of *Claviderma* species, in mm, and 95% confidence interval.

Species	N	trunk length	trunk width	posterium length	posterium width	posterium /trunk
C. amplum	24	1.29 ± 0.22	0.3 ± 0.06	0.9 ± 0.17	0.14 ± 0.02	0.706 ± 0.09
C. crassum	7	2.42 ± 0.79	1.2 ± 0.35	1.03 ± 0.35	0.46 ± 0.12	0.426 ± 0.054
Claviderma n. sp	37	1.93 ± 0.3	0.59 ± 0.08	0.99 ± 0.16	0.27 ± 0.04	0.54 ± 0.058

Table 3. Sclerites measurements of *Claviderma* species, in µm.

Body region	*C. amplum*		*C. crassum*		*Claviderma* sp	
	Length	Width	Length	Width	Length	Width
Anterium	50 to 135	20 to 30	65 to 120	~21	65 to 100	13 to 25
Ventral midline trunk	90 to 100	~20	90 to 100	18 to 22	165 to 200	~30
Ventro-lateral trunk	140 to 160	20 to 25	185 to 220	20 to 25	~300	~32
Dorso-lateral trunk	110 to 150	20 to 25	130 to 180	20 to 35	200 to 300	25 to 42
Dorsal midline trunk	155 to 170	~23	185 to 230	25 to 35	395 to 490	35 to 48
Shank	90 to 190	15 to 20	150 to 250	20 to 30	250 to 430	25 to 48
Fringe	280 to 375	13 to 15	240 to 300	7 to 15	~615	~20

Claviderma crassum Ivanov & Scheltema 2008

(Figures 7, 9, 10B and 11; Tables 2 and 3)

Type material examined: Holotype USNM 1112621; Paratypes USNM 1138692, 7 spm, and 1138693, 20 spm. Paratype 1138691 (slide with sclerites) not found.

Additional material examined: off Rio de Janeiro State, 7 specimens in 7 samples. HAB6-A07-R2(0-2), 23°39'21.57"S, 41°18'31.81"W, 692.2 m, 24/jun/2008, 1 spm; HAB6-B07-R2(0-2), 23°13'3.71"S, 40°57'38.25"W, 724.2 m, 27/jun/2008, 1 spm;

HAB6-C07-R2(0-2), 22°59'54.23"S, 40°47'46.3"W, 689.4 m, 30/jun/2008, 1 spm; HAB6-C07-R3(0-2), 22°59'53.79"S, 40°47'46.74"W, 686.1 m, 1/jul/2008, 1 spm; HAB8-C07-R2(2-5), 22°59'55.55"S, 40°47'46.3"W, 692 m, 29/jan/2009, 1 spm; HAB9-H07-R1(0-2), 21°41'13.83"S, 40°1'57.71"W, 701 m, 5/feb/2009, 1 spm; HAB9-I07-R3(2-5), 21°11'13.81"S, 40°12'52.92"W, 683 m, 4/feb/2009, 3 slides and 1 isolated radula with jaws.

Geographical and bathymetrical distribution: *C. crassum* was originally described from Guiana Basin and now its distribution is extended to the Southwestern Atlantic Ocean, in the coast of Rio de Janeiro. In this region, the distribution ranges from 21°11'12.23"S–23°39'19.83"S to 40°1'56.35"W–41°18'30.23"W (Fig. 9). Ivanov & Scheltema (2008) examined 3 samples from depths of 508, 1000 and 1456 m. In Brazil, specimens were collected in a very shorter range, from 683 to 724 m, in the upper continental slope (Fig. 7).

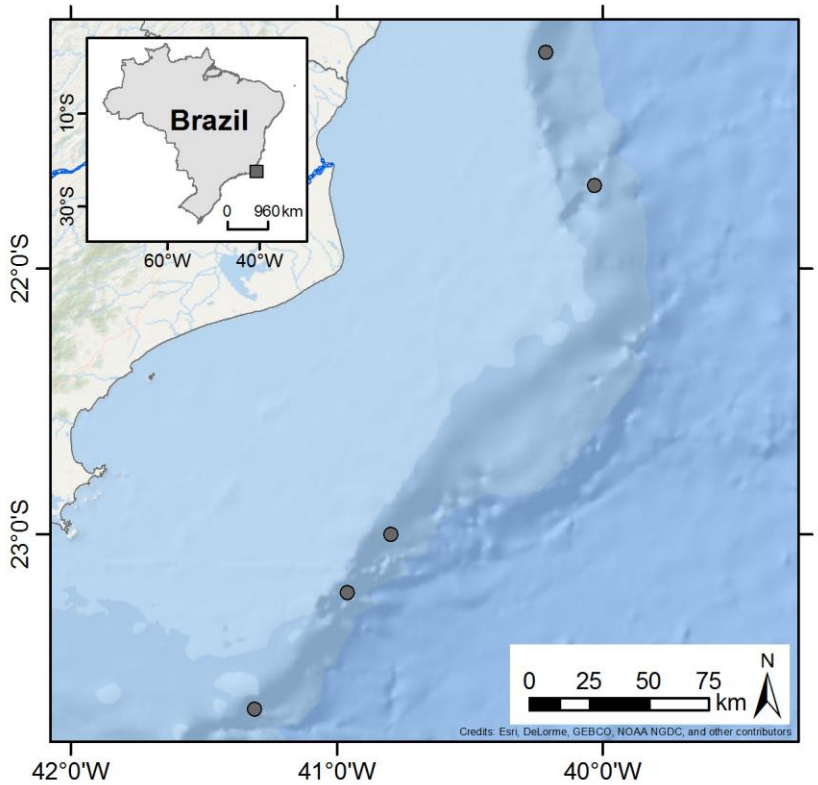

Figure 9. Locations (grey points) where *Claviderma crassum* were collected in the Southeastern Brazil.

Remarks: As stated by IVANOV & SCHELTEMA (2008, p. 16–19), the sclerites are very similar to those of *C. amplum*. However, they can be distinguished by growth lines transversal to the longitudinal axis: in *C. amplum* (Figs 8E and 10A) there are a few lines, almost not visible, whereas in *C. crassum* (Figs 10B and 11C)

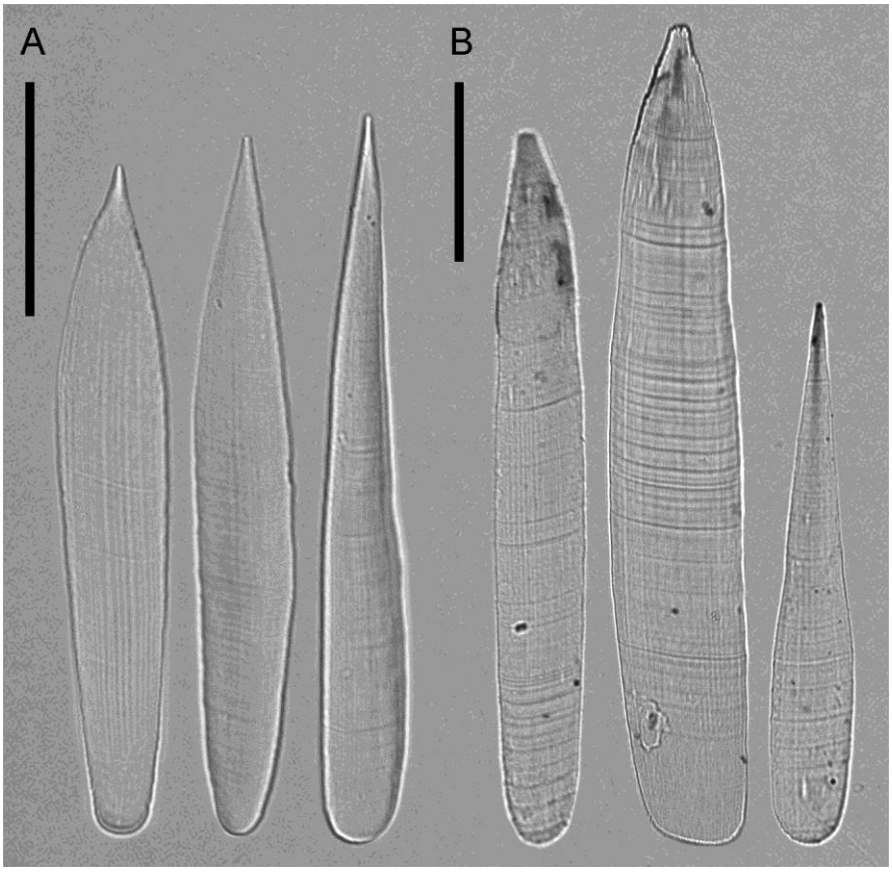

Figure 10. Photos under light microscope. **A.** *C. amplum*. Sclerites with fewer and less evident transversal growth lines, sample HAB9-I08-R1(2-5). Left - ventral trunk, middle - dorsal trunk and right - shank. **B.** *C. crassum*. Sclerites with many and more evident growth lines, sample HAB9-I07-R3(2-5). Left - ventral trunk, middle - dorsal trunk, right - shank. Scales in 50 µm.

there are usually more lines, more evident. These growth lines can only be seen under transmitted light microscopy. Besides, *C. crassum* is distinct from most Prochaetodermatidae by a very wide, robust trunk and a short posterium. See also remarks of *Claviderma* sp.

The Brazilian specimens have the same singular external appearance (Fig. 11A) exhibited by those deposited in USMN. Mean measurements of body regions are in Table 2, although some individuals have up to 5.7mm in length. It is the only species that the trunk width is usually higher than posterium length. The oral shield is paired, 120 µm in height. Oral shield sclerites were originally described as in 5 rows, not obvious (IVANOV & SCHELTEMA, 2008, fig. 9C). In one specimen of Rio de Janeiro analyzed under SEM (Fig. 11B), these sclerites are arranged in only 3 rows, where the outer row is formed by 2 or 3 larger sclerites in each side (indicated by arrows). Unfortunately, most of them are tumbled or dropped. One radula and a pair of jaws were analysed (HAB9-I07-R3(2-5)) and show the same morphology, although they are also smaller: radula with 10 pair of teeth, 140 µm long and each teeth are 85 µm long.

Jaws with 270 µm in length and 100 µm in width at the anterior end. A full description of the sclerites were not given for the type material in the original description, where it is only stated that they are very similar to those of *C. amplum*. This was confirmed for the Brazilian specimens (Fig. 11C$_{1–6}$), although they are slightly larger (Table 3). Only

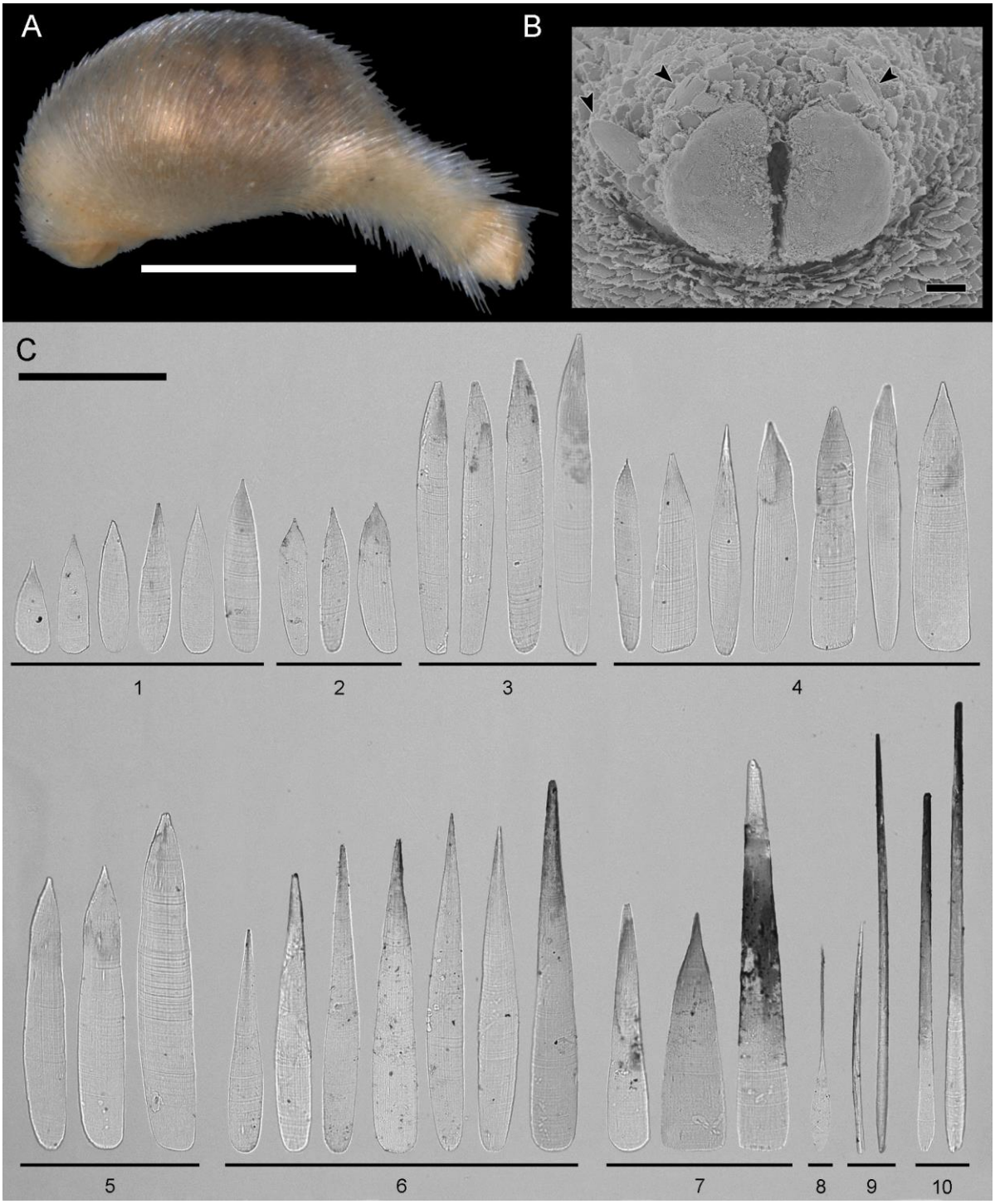

Figure 11. Photos under estereomicroscope (A), SEM (B) and light microscope (C) of *Claviderma crassum* from Rio de Janeiro. **A.** Left view of a typical adult, sample HAB6-C07-R2(0-2). **B.** oral shield, sample HAB9-l07-R3(2-5). **C.** Sclerites of different body regions, same sample as B. 1 - anterium, 2 - ventral anterior trunk, 3 - ventral posterior trunk, 4 - dorsal anterior trunk, 5 - dorsal posterior trunk, 6 - shank and 7-10 - knob. Scales for A: 1000 µm, B: 30 µm and C: 100 µm.

exceptions are found in the anterium, where most sclerites do not have a distinct waist, and in the knob: between the shank and the knob, sclerites may be longer or wider (up to 260 µm and 43 µm, respectively), and also have a triangular shape, but the proximal end is usually straight (Fig. 11C7, IVANOV & SCHELTEMA, 2008, fig. 10H). There are also those that have an ovoid base (Fig. 11C8, IVANOV & SCHELTEMA, 2008, fig. 10L), with 140 x 14 µm, and those that are needle-shaped (Fig. 11C9, IVANOV & SCHELTEMA, 2008, fig. 10I,M), with 155 to 280 µm in length and about 7 µm in width. The fringe sclerites (Fig. 11C10, IVANOV & SCHELTEMA, 2008, fig. 10N) are relatively smaller when compared to those of *C. amplum*.

***Claviderma* sp.**

(Figures 7, 12, 13, 14, and 15; Tables 2 and 3)

Material examined: off Rio de Janeiro and Espírito Santo States. 33 specimens in 26 samples. HAB3-B08-R3(0-2), 23°13'47.87"S, 40°55'57.4"W, 986.4 m, 15/may/2008, 1 spm; HAB3-B08-R1(0-2), 23°13'50.51"S, 40°55'56.74"W, 986.4 m, 13/may/2008, 1 spm, 7 stubs and 1 isolated radula with jaws; HAB3-B08-R3(2-5), 23°13'47.87"S, 40°55'57.4"W, 986.4 m, 15/may/2008, 1 spm; HAB3-C09-R2(2-5), 23°3'38.35"S, 40°42'55.82"W, 1291.6 m, 26/may/2008, 1 spm; HAB4-CANG07-R2(2-5), 21°56'11.64"S, 39°57'44.59"W, 709.7 m, 28/may/2008, 6 stubs; HAB4-CANG07-R3(0-2), 21°56'12.74"S, 39°57'45.02"W, 712.6 m, 28/may/2008, 1 spm; HAB4-CANG07-R3(2-5), 21°56'12.74"S, 39°57'45.02"W, 712.6 m, 28/may/2008, 1 stub and 2 slides; HAB6-A07-R3(0-2), 23°39'21.79"S, 41°18'31.81"W, 732.9 m, 25/jun/2008, 5 stubs and 1 isolated radula with jaws; HAB6-C07-R2(2-5), 22°59'54.23"S, 40°47'46.3"W, 689.4 m, 30/jun/2008, 7 stubs, 3 slides and 2 isolated radulas with jaws; HAB6-CANAC07-R2(2-5), 21°47'28.25"S, 40°2'15.07"W, 752.5 m, 6/jul/2008, 2 spms; HAB7-H07-R2(0-2), 21°41'13.39"S, 40°2'21.88"W, 699.4 m, 7/jul/2008, 1 spm; HAB7-H07-R2(2-5), 21°41'13.39"S, 40°2'21.88"W, 699.4 m, 7/jul/2008, 1 spm; HAB8-A07-R1(2-5), 23°39'21.13"S, 41°18'29.61"W, 699 m, 28/jan/2009, 7 stubs; HAB8-A07-R3(2-5), 23°39'23.32"S, 41°18'34.67"W, 692.7 m, 28/jan/2009, 6 stubs and 1 isolated radula with jaws; HAB8-A08-R3(2-5), 23°41'10.55"S, 41°16'8.55"W, 1001.5 m, 13/jan/2009, 3 slides; HAB8-C07-R1(0-2), 22°59'53.79"S, 40°47'44.54"W, 708 m, 29/jan/2009, 2 spms, 6 stubs and 1 slide; HAB9-CANG07-R3(0-2), 21°56'13.84"S, 39°57'46.56"W,

720 m, 7/feb/2009, 1 stub, 3 slides and 1 pair of isolated jaws; HAB9-CANAC07-R3(2-5), 21°47'28.25"S, 40°1'57.05"W, 775 m, 6/feb/2009, 2 spms, 3 slides and 1 isolated radula with jaws; HAB9-CANAC08-R1(0-2), 21°45'56.4"S, 39°59'28.73"W, 1030 m, 6/feb/2009, 1 spm; HAB9-CANG08-R1(2-5), 21°55'8.58"S, 39°54'32.76"W, 998 m, 7/feb/2009, 1 spm; HAB9-G08-R3(2-5), 22°7'20.04"S, 39°52'22.18"W, 1003 m, 08/feb/2009, 1 spm; HAB9-H07-R3(2-5), 21°41'14.27"S, 40°1'57.71"W, 702 m, 6/feb/2009, 1 spm; HAB9-I07-R1(2-5), 21°11'13.81"S, 40°12'53.35"W, 682 m, 4/feb/2009, 1 spm; HAB9-I07-R3(2-5), 21°11'13.81"S, 40°12'52.92"W, 683 m, 4/feb/2009, 1 spm; AMB5-C07-R2(0-10), 20°17'39.43"S, 39°42'33.8"W, 1358 m, 9/jan/2012, 1 spm; AMB12-E05-R3(5-10), 19°36'26.2"S, 39°10'18.88"W, 360 m, 26/jun/2013, 1 spm.

Diagnosis: Trunk long, sclerites adpressed to the body. Posterium short, narrow, 1/3 trunk length or greater, sclerites often bent outwards from the body. Fringe sclerites in single row, sometimes not well distinct, about the same size as the cone-shaped knob. Oral shield sclerites in 4 rows. Trunk sclerites with characteristics of the genus, plus long, waist indistinct, with numerous evident, transversal growth lines, proximal end round, tapered only near the tip. Shank sclerites unlike those of the trunk: some with distinct waist, blade thinner than base; others tapered more evenly, without waist; and others with short base, curved to one side, and a needle-shaped blade.

Description: *External appearance:* Body brownish to opaque, about 2.9mm in length, trunk long relatively to the short shank; mean measurements are shown in Table 2. Trunk sclerites are addressed against body at about 45º to the longitudinal axis and shank sclerites often bent greatly outwards from it. Shank is about twice narrower than trunk, with an evident division between trunk and shank (Fig. 12A). Fringing sclerites are in a single row extending to end of or beyond the cone-shaped knob. Some specimens have a trunk curved dorsally, due to fixation (Fig. 12B). Others, mainly smaller specimens (Fig. 12C), may likewise have a more elongated shank, with sclerites more addressed against the body, or may have a swollen anterium (Fig. 12D).

Oral shield is paired (Fig. 12E), with 0.10–0.22 mm in height, and with 4 rows of oral shield sclerites, where 2 innermost rows have very small sclerites, 15–30 µm.

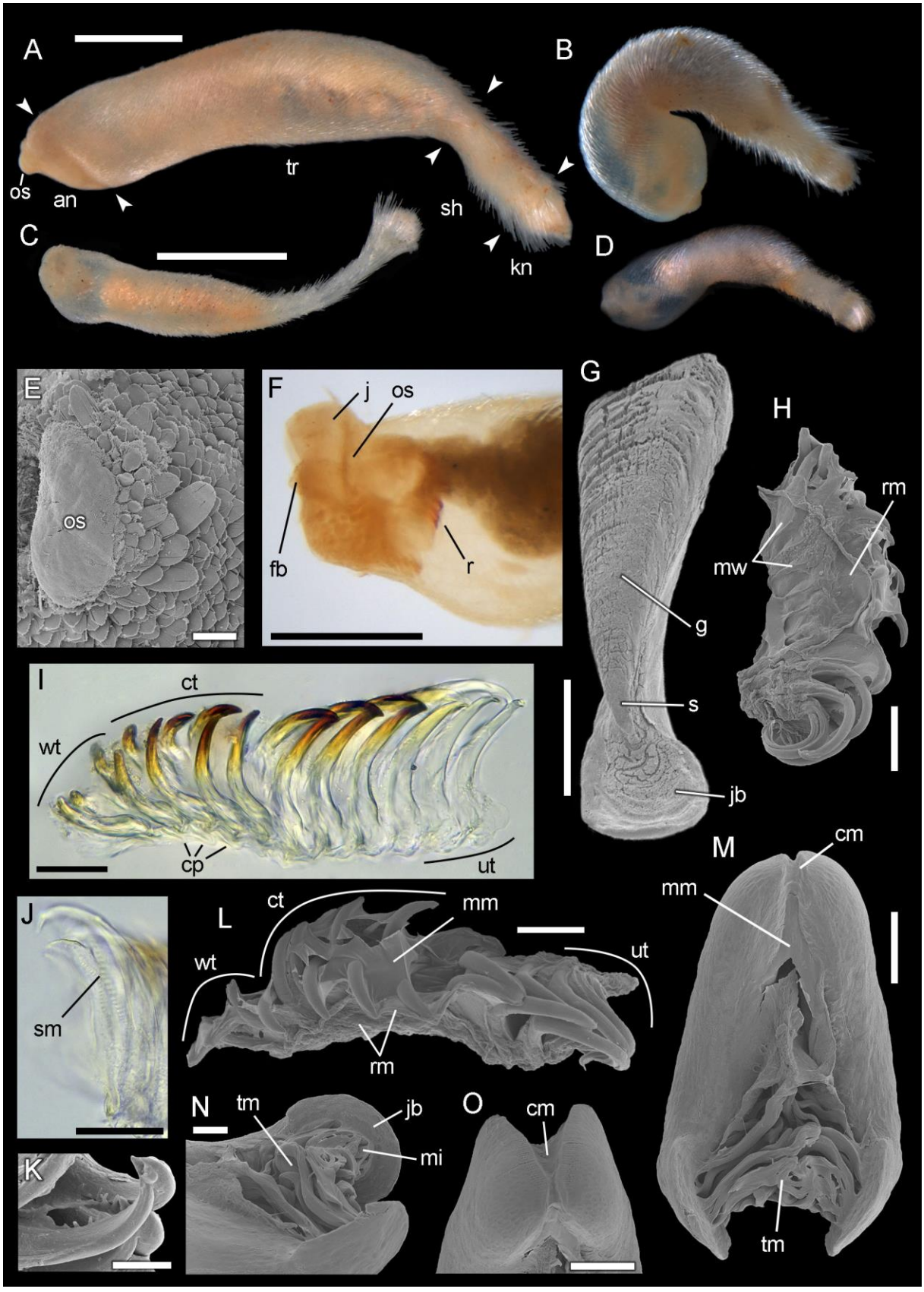

Figure 12. Photos under estereomicroscope (A–D, F), SEM (E,G–H,K–O) and light microscope (I, J) of Claviderma sp. **A.** Left view of a typical adult. Arrows indicate body divisions. **B–D.** Left view of specimens showing variations in the morphology, samples HAB6-C07-R2(2-5), HAB9-CANG08-R1(2-5) and HAB8-C07-R1(0-2), respectively. **E.** Left side of the oral shield, with sclerites, sample HAB8-A08-R3(2-5). **F.** Left view, showing internal parts by transparency, sample HAB8-C07-R1(0-2). **G.** Abfrontal view of the right jaw, from same specimen of D. **H.** Left view of the radula, sample HAB4-CANG07-R3(2-5). **I.** Left vew of the radula, sample HAB8-A07-R3(2-5). **J.** Detail of one tooth, sample HAB8-A07-R1(2-5). **K.** Detail of one pair of tooth. **L.** Posterior view of the radula, same radula as H. **M.** Posterior view of a pair of jaws, with intact muscles, from same specimen of D. **N.** Detail of the insercion of the muscle in the jaw base, same jaws as M. **O.** Dorso-posterior view of the pair of jaws, same jaws as M. an - anterium, cm - cuticular membrane, cp - central plate, ct - crossed teeth, fb - food bolus, g - grasper, j - jaw, jb - jaw base, kn - knob, mi - muscle insertion, mm - mucous membrane, mw - membranous wing, os - oral shield, r - radula, rm - radular membrane, s - stem, sh - shank, sm - serrated membrane, tm - tensor muscle, tr - trunk, ut - unsclerotized teeth and wt - worn teeth. Scales for A: 1000 µm, B and D same as A, C and F: 500 µm, E, H–J, L and N: 50 µm, G, M and O: 100 µm and K: 10 µm.

Radula and Jaws: In all specimens, a pair of jaws and a radula are positioned vertically (Fig. 12F). Figures 12G and H show the jaw and radula as positioned in specimens viewed from the left side. Jaws are divided in three parts (Fig. 12G): dorsally there is a larger grasper; ventrally there is an ovate base and a stem that connects the base with the grasper, which is the thinnest region of the jaw. Jaws of five paratypes are about 400 µm long, 130 µm in width at dorsal end and 110 µm at base. In the radula, older teeth are more dorsally and younger ones are more ventrally (Fig. 12H). The radula is divided in two parts (Figs. 12I and L): dorsally, each tooth crosses with its pair. Ventrally, each pair is juxtaposed near the tip. At dorsal end, two or three pairs are always worn (Figs. 12I and L). At ventral end, two or three pairs are not sclerotized (Fig. 12I), and are writhed when they dry out for SEM preparations (Figs. 12H and K). Teeth are covered by a membrane, transparent in light microscope, that frontally forms a wing (Fig. 12H), and abfrontally is serrated (Fig. 12J). Radula of three paratypes is about 300 µm long, teeth up to 120 µm long, serrated membrane about 85 µm long, situated almost medially. Ventrally, the two bases are connected by a muscle, which can stretch and articulates the two jaws (Fig. 12N). Dorsally, the two jaws are connected by a dense cuticle that work as a hinge (Fig. 12O). In a few specimens, fixated while feeding (Fig. 12F), the inner wall of the buccal cavity is also partially protruded to outside of the body and each side of the oral shield are not juxtaposed. In addition, the jaws are protruded, which graspers are partially outside the buccal cavity and it is possible to see a food bolus hold between the graspers. In the Figures 12L and M, a thin membrane is present between the jaws and the dorsal teeth of the radula that is probability a vestige of the food mucus produced in the buccal cavity.

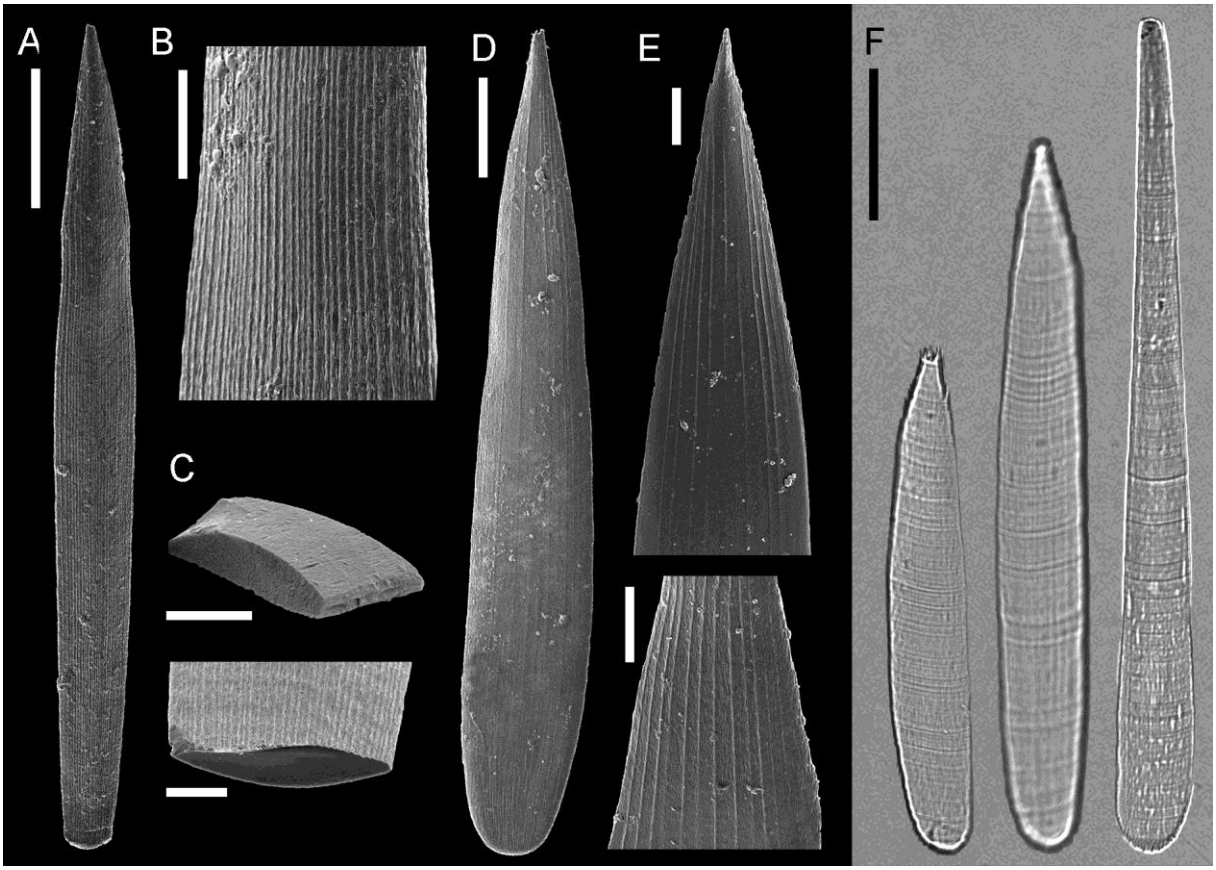

Figure 13. Photos under SEM (A–E) and light microscope (F) of sclerites of *Claviderma* sp. **A.** Frontal view of whole sclerite from the trunk, sample HAB8-C07-R1(0-2). **B.** Detail of the frontal surface (same sample as A). **C.** Broken sclerites, showing the transverse profile, sample HAB8-A07-R3(2-5). **D.** Abfrontal view of whole sclerite from the trunk, sample HAB3-B08-R1(0-2). **E.** Detail of the abfrontal surface near the distal end, sample HAB8-A07-R1(2-5). **F.** Sclerites with many and more evident growth lines, sample HAB9-CANAC07-R3(2-5). Left - ventral trunk, middle - dorsal trunk, right - shank. Scales in A and D: 30 µm, B–C and E: 10 µm and F: 50 µm.

Sclerites: Elongated, with no evident ornamentation, except numerous longitudinal striations on the frontal surface (Figs. 13A and B); and usually fewer, spaced ones, on the abfrontal surface of the blade (Figs. 13D and E). Sclerites profile are symmetrical (Fig. 13C - above) or slight asymmetrical (below), ranging 5–7 µm thick in the middle. Sclerites throughout the body have very distinct numerous growth lines (Fig. 13F) and they are curved longitudinally towards the body (Fig. 14D$_{13}$). Sclerites were isolated from seven regions (Fig. 14A). Measurements are in Table 3. Anterium (Fig. 14D$_1$): small, with distinct waist, blade equal to or wider than base. Trunk (Fig. 14D$_{2–5}$): base long, about once to twice length of the blade, waist usually indistinct, proximal end round shaped, distal end tapered more abruptly, often triangular shaped, longitunal axis usually slight curved, lateral edges straight to slight convex; sclerites vary in size from anteroventral (smaller) to posterodorsal (longer; Fig. 14C): ventral anterior sclerites (Fig. 14D$_2$) are the smallest ones, followed by the dorsal anterior ones (Fig. 14D$_4$) and those of the ventral posterior (Fig. 14D$_3$). The longest

are at dorsal posterior (Fig. 14D5). Shank: there is a wide variation in these sclerites, which can be summarized in 3 types. First type (Fig. 14D6) is smaller, base half of the sclerite length, slightly ovoid and wider than blade, which is thin and pointed; second type (Fig. 14D7) resembles trunk sclerites, with the slightly wider and shorter base, 1/3

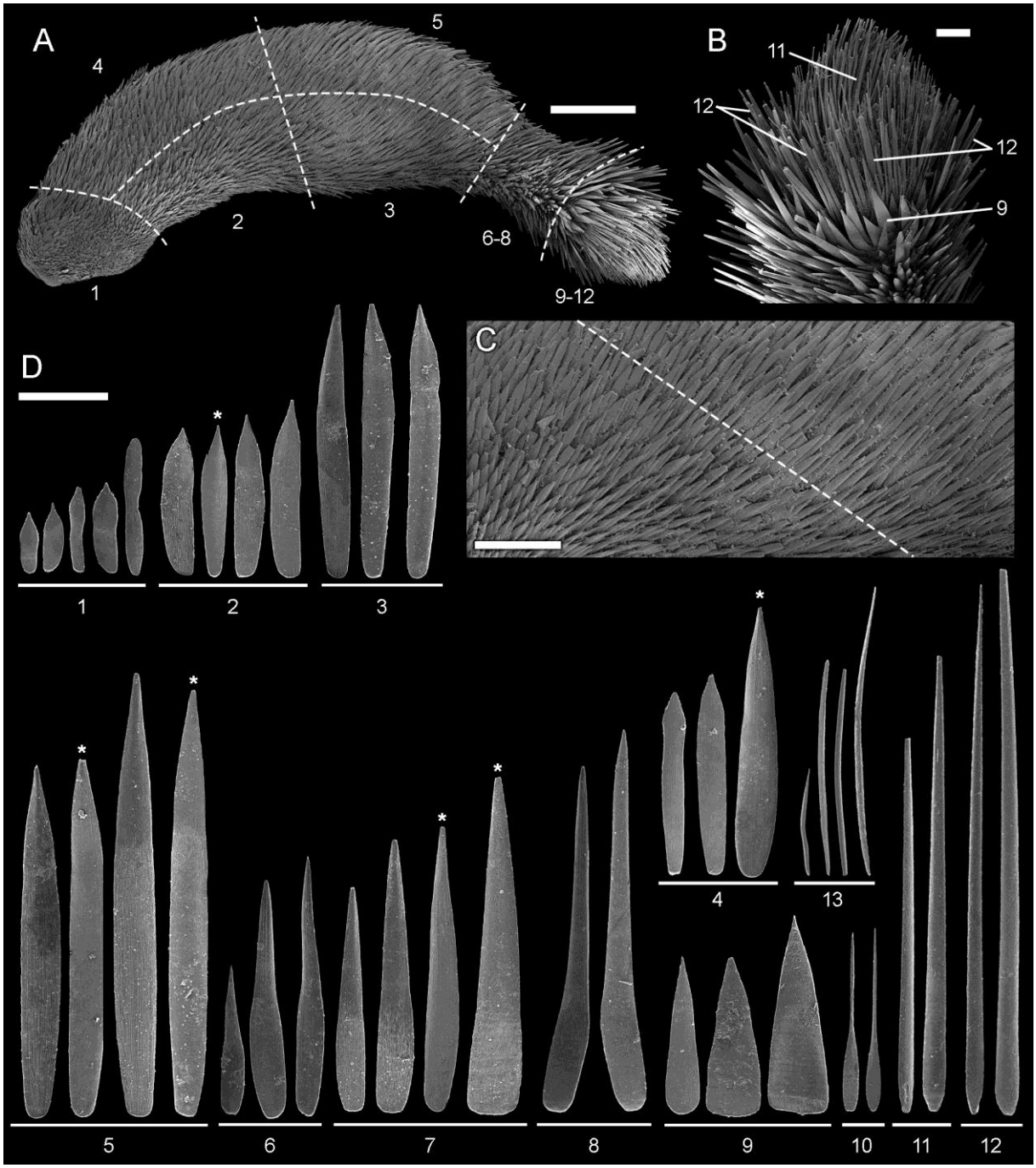

Figure 14. Photos under SEM of *Claviderma* sp. **A.** Left view, with body divisions, sample HAB8-A08-R3(2-5). Numbers correspond with D. **B.** Detail of the knob, same specimen as A. **C.** Detail of the trunk, same specimen as A. Line separates smaller, anterior sclerites (left side) from larger, posterior ones (right side). **D.** Isolated sclerites of different body regions, samples HAB3-B08-R1(0-2), HAB6-C07-R2(2-5) and HAB8-A07-R3(2-5). 1 - anterium, 2 - ventral anterior trunk, 3 - ventral posterior trunk, 4 - dorsal anterior trunk, 5 - dorsal posterior trunk, 6–8 - shank, 9 - between the shank and knob, 10 and 11 - knob, 12 - fringe and 13 - lateral view of a sclerite from, left to right, anterium, trunk, shank and knob. * indicates abfrontal view of sclerites. Scales for A: 500 µm, B and D: 100 µm and C: 250 µm.

to half of sclerite length, proximal end sometimes are straighter, blade is evenly tapered and distal end is never triangular; third type (Fig. 14D8) are longest, with a blade needle-shaped and a base wider, bent to one site, about 1/4 sclerite length. Usually smaller specimens tends to have more of the first type and some of the second type of sclerites, while larger ones tends to have more of the second type and some of the third type, and sometimes may lack the first type. Knob (Fig. 14B): in the division of the shank and knob, sclerites are wider at the base and triangular (Fig. 14D9), proximal end usually straight, about 220 µm in length and 60 µm in width. At the knob, some are small, with a short ovoid base and a very thin blade (Fig. 14D10), up to 200 x 17 µm, but most are longer, straight and needle-shaped (Fig. 14D11), up to 510 x 23 µm. Fringe sclerites (Fig. 14D12) are also needle-shaped, but longer, and arranged around the knob.

Geographical and bathymetrical distribution: Up to now, only known from off Rio de Janeiro and Espírito Santo States, Brazil, exclusively on the continental slope, depths from 349 to 1,309m (Fig. 7). Distribution ranges from 19°36'27.21"S–23°41'9.14"S to 39°10'14.62"W–41°18'33.05"W (Fig. 15).

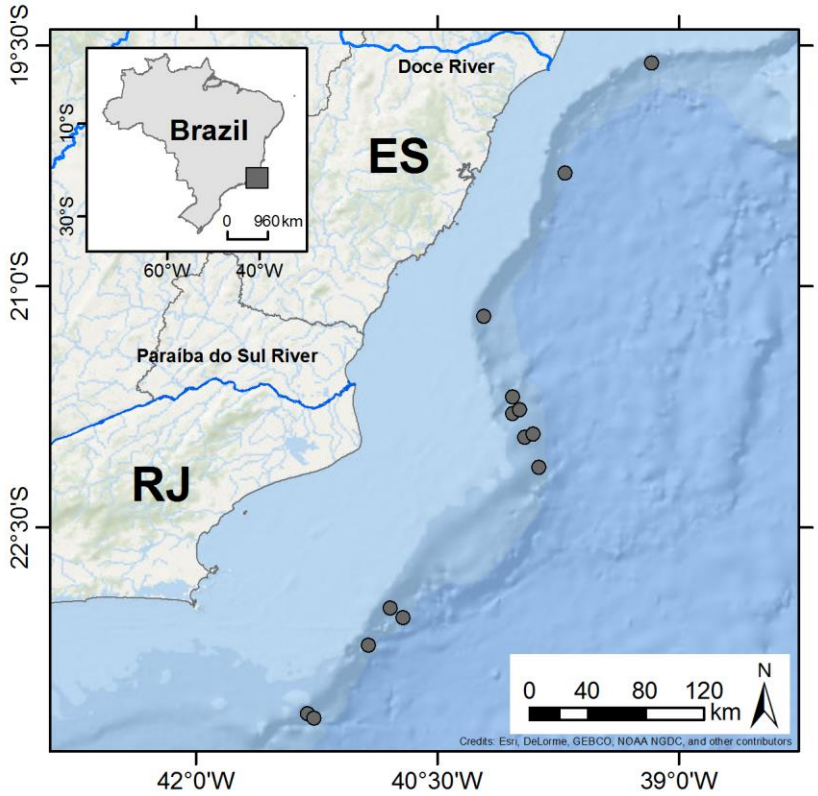

Figure 15. Locations (grey points) where *Claviderma* sp. were collected in the Southeastern Brazil.

Remarks: *Claviderma* sp. has sclerites very similar to those of *C. amplum* and *C. crassum*. They are mainly differentiated by morphological features: the trunk is usually elongated, resembling the trunk of *C. amplum*, but the shank is usually short and sclerites bent outwards the body, resembling the shank of *C. crassum*. Figures 12A and 14A shows the typical shape of *Claviderma* sp., with these features well evident. However, some specimens with morphological variations may be mistaken with *C. amplum*. In those cases, individuals can be differentiated by the sclerites: in *C. amplum* (Fig. 10A), they have fewer, less evident growth lines, while in *Claviderma* sp. they have more growth lines, more distinct (Fig. 13F), similar to those of *C. crassum* (Fig. 10B). Nevertheless, *Claviderma* sp. can be easily discerned from *C. crassum* by the body morphology. Moreover, the typical body of *Claviderma* sp. resembles those of *C. australe* (Scheltema, 1989), *C. gagei* Ivanov & Scheltema, 2001 and *C. gladiatum* (Salvini-Plawen, 1992). However, they can be easily discerned by the shape of shank sclerites: the first and third type of sclerites found in *Claviderma* sp. were not described in these three species. In fact, sclerites similar to the third type were not illustrated for any species of *Claviderma* up to now. Moreover, these species have a distinct geographic distribution of *Claviderma* sp.: *C. australe* was registered in Pacific Ocean, *C. gagei* in Indian Ocean and *C. gladiatum* in East Atlantic Ocean.

Furthermore, in all specimens the radula and jaws are always in the same position as described above: both are vertically positioned, where the grasper and older teeth are dorsally and the jaw base and newer teeth are ventrally. This is the same pattern as illustrated by some authors (e.g. SCHELTEMA & IVANOV, 2000, fig. 5E), but different from what is described by SCHELTEMA (1978, 1981) for *Prochaetoderma yongei* Scheltema, 1985, where the radula and jaws are both more horizontally: the grasper and older teeth are anteriorly, and the jaw base and newer teeth are posteriorly. When the jaws are in the vertical position, the mouth is located at the anterior end, but when they are in the horizontal position, the mouth is more ventrally. These two conditions apparently do not represent different states of contraction, because the vertical condition is found in specimens of *Claviderma* sp. with the anterium region either contracted or dilated. It is possible that these two conditions can be used as a taxonomic character in the family Prochaetodermatidae for the description of species; however, a more detailed analysis of other species is needed to confirm if this is an intra or interspecific variation. Since the position of the

radula and jaws are not illustrated nor described for most species, a conclusion cannot be made using the literature only.

Discussion

In the present study, two species of this genus are recorded for the first time in Brazil and have their geographic distribution extended. Also, we are describing sclerites in some regions of the body in more details . Additionally, one new species of *Claviderma* is described in detail. Therefore, the study of the recently collected prochaetodermatids from Southeastern Brazil is filling a gap on their knowledge in the Southwest Atlantic Ocean.

These records suggest a continuity in the distribution of species of Prochaetodermatidae on the continental slope between the north and south of the West Atlantic. IVANOV & SCHELTEMA (2008) suggested a faunal break between 5°S and 35°S in the West Atlantic, alike the well-known break at 35°N off Cape Hatteras, where few species cross this break. However, based in the new geographic distribution of *C. amplum* and *C. crassum*, and additionally of *Falcidens targatus* Salvini-Plawen, 1992 and *F. acutargatus* Salvini-Plawen, 1992 (CORRÊA et al., 2014), the fauna of Caudofoveata appears to be continuous between 35°N and 35°S. Nonetheless, a break may still occurs in 35°S, at mouth of the Río de la Plata, although collections of north and south of this place must be further analyzed.

Studies of this genus may be challenging, since identification of its species are based on features, which are often not easily observed. For example, oral shield and fringe sclerites are sometimes broken off, thus being hard to determine the number of rows of oral shield sclerites and whether fringe sclerites extend or not beyond the knob. The shank may be more or less contracted and the anterium may be more inflated or not, due to fixation. In addition, some details are not well visible in all sclerites, hence many sclerites must be isolated from all body regions, mainly the trunk and shank. Therefore, species of *Claviderma* should be thoroughly examined as much as possible to avoid taxonomic problems (SCHELTEMA & IVANOV, 2001). To clarify future identification, we gathered from the literature diagnostic characteristics for each species of *Claviderma* in Table 4, as well as some key articles that should be consulted for each species, its geographic distribution and type material. Additionally, this table includes a new species of *Claviderma* and complementary data of *C. amplum* and *C. crassum*. The table should assist future studies of *Claviderma* and avoid incorrect identifications and taxonomic problems for the group.

Table 4. Main diagnostic characteristics of all species of *Claviderma*. The table also includes key articles that were consulted, along with a list of the type material and its geographic distribution.

Species	Key article	Type material	Distribution	Oral shield sclerites
C. amplum	Ivanov & Scheltema, 2008[1]	Holotype: USNM 1112615 (1 spm + 1 slide); Paratypes: USNM 1137102–1137126 and 1138676–1138690 (93 spms [not 102] + 5 slides), TAMU (7 spms in 3 samples) and ZMUM Le1 167–169 (19 spms)	Western Atlantic: off Florida, Gulf of Mexico, Guiana Basin and Southeastern Brazil	5 rows, numerous
C. australe	Scheltema, 1989[1,2]	Holotype: AM C156230 (1 spm + 1 slide) and MV F54196 (1 slide); Paratypes: AM C156231 (1 spm) and MV F54195 (1 spm + 2 slides)	off Wollongong and Point Hicks, Southeast of Australia	not obvious
C. brevicaudatum	Scheltema & Ivanov, 2000[1]	Holotype: USNM 880675 (1 spm + 1 slide); Paratypes: USNM 880676–880678 (570 spms [not checked] + 1 slide) and ZMUM Le1 56	Eastern Atlantic: from Cape Verde to Cape Basins, South Africa	3 or more rows, numerous
C. compactum	Ivanov & Scheltema, 2008[1]	Holotype: USNM 1112622 (1 spm + 1 slide); Paratypes: USNM 1138694–1138700 (629 spms [not 660] + 1 slide), TAMU, ZMUM Le1 172–176	Off Uruguay	3 rows
C. crassum	Ivanov & Scheltema, 2008[1]	Holotype: USNM 1112621 (1 spm); Paratypes: USNM 1138691 (1 slide), 1138693 (7 spms + 1 slide), 1138693 (20 spms [not 25]), TAMU, ZMUM Le1 179 (5 spms)	Guiana Basin and Southeastern Brazil	not obvious, 3 or more rows
C. gagei	Ivanov & Scheltema, 2001b[1]	Holotype: BMNH 19991520 (1 spm + 1 slide); Paratypes: BMNH 19991521–19991525 (31 spms + 3 slides) and ZMUM Le1 66, 70–72 (14 spms)	West and Southwest of Arabian Sea	3 rows, numerous

(continued)

Species	Key article	Type material	Distribution	Oral shield sclerites
C. gladiatum	Salvini-Plawen, 1992[1,3]; Scheltema & Ivanov, 2000[4]	Holotype: CMNML 48320 (1 spm); Paratype: CMNML 92953 (1 spm)	Eastern Atlantic: from Bay of Biscay to Cape Basins, South Africa	5 rows, numerous
C. iberogallicum [= *Prochaetoderma breve* Salvini-Plawen, 1999, *C. tricosum* Scheltema & Ivanov, 2000]	Salvini-Plawen, 1999[1,3]; Scheltema & Ivanov, 2001 (synomys)	Holotype: MNCN 15.01/2-A (1 spm); Paratype: MNCN 15.01/2-B (1 spm); P. breve holotype: MNCN 15.01/1-A and C. tricosum holotype: MNHN IM 2000 6249	Bay of Biscay and Alboran Sea	3 rows
C. laticarinatum	Ivanov & Scheltema, 2001b[1]; Ivanov & Scheltema, 2002 (diagnosis)	Holotype: MNHN IM 2000 6267 (1 spm + 1 slide); Paratypes: MNHN-IM-2000-6266 (16 spms + >2 slides), ZMUM Le1 64 and 65 (5 spms)	Bay of Bengal and Northeast of La Réunion	3 rows
C. mexicanum	Ivanov & Scheltema, 2008[1]	Holotype: USNM 1112617 (1 spm + 1 slide); Paratypes: USNM 1137127–1137146, 1138701 (49 spms [not 48] + 2 slides), TAMU (6 spms in 3 samples), ZMUM Le1170 (3 spms)	Gulf of Mexico and Guiana Basin	3 rows
Claviderma sp.			Southeastern Brazil	4 rows

(continued)

Key article: 1 - original description, 2 - described as *Rhabtoderma*, 3 - described as *Prochaetoderma*, 4 - the morphology and sclerites are illustrated and the geographic distribution is expanded.
Museums: AM - Australian Museum, BMNH - Natural History Museum of London, CMNML - Canadian Museum of Nature, MNCN - Museo Nacional de Ciencias Naturales (Madrid), MNHN - Muséum national d'Histoire aturelle (Paris), MV - Museum Victoria, TAMU - Texas A&M University University at Galveston, Department of Marine Biology, USNM - National Museum of Natural History (Washington, DC), ZMUM - Zoological Museum of Moscow State University.

Species	Body	Knob	Trunk sclerites distal end	Trunk sclerites waist	Shank sclerites	Others
C. amplum	body elongated; CC/CT equal or higher than 0.7; shank distinguished from the trunk	rounded to cone-shaped	triangular shaped and lifted	waist evident or not	base broadest and straight or rouded proximally, tapering evenly, waist indistinct	a few inconspicuous growth lines
C. australe	shank distinguished from the trunk	rounded	triangular shaped	waist evident or not	similar to trunk sclerites, but longer and narrower	
C. brevicaudatum	shank short, not well distinguished from the trunk	truncated	thin and sharp or short, triangular shaped	waist often indented	one type with blade longer than base, base somewhat quadrate shaped; a second type broadly triangular	great variation of sclerites; proximal end rounded or sometimes concave; trunk sclerites base may be much wider than blade
C. compactum	shank fuzzy, distinguished from the trunk	rounded	thinner above waist, triangular shaped	waist distinct	one type similar to trunk sclerites, with longer blade; second type shorter with a wide quadrate base	
C. crassum	trunk large and shank short; shank distinguished from the trunk	rounded to cone-shaped	triangular shaped and lifted	waist distinct or not	base broadest and straight or rouded proximally, tapering evenly, waist indistinct	numerous conspicuous growth lines
C. gagei	shank distinguished from the trunk	rounded to cone-shaped	triangular shaped	waist distinct	similar to trunk sclerites, but tapering evenly, waist indistinct	

(continued)

Species	Body	Knob	Trunk sclerites distal end	Trunk sclerites waist	Shank sclerites	Others
C. gladiatum	shank distinguished from the trunk	rounded to truncated	triangular shaped	waist distinct	similar to dorsal trunk sclerites but longer; or tapered evenly, without waist	
C. iberogallicum	shank short, with sclerites adpressed against the body; shank distinguished from the trunk	rounded to cone-shaped	tapered with edges curved very convenxly	waist distinct	similar to trunk sclerites, with a evenly tapered blade	sclerites resembles the ones of *Prochaetoderma*
C. laticarinatum	body slender; shank distinguished from the trunk by sclerites arrangement	rounded to cone-shaped	tapered evenly	waist distinct or not	similar to trunk sclerites	chevron-shaped growth lines
C. mexicanum	body slender; shank well distinguished from the trunk	rounded; two lateral clusters of long, hair-like sclerites, but often missing	triangular shaped and lifted	waist not distinct	similar to those from dorsal trunk	
Claviderma sp.	trunk long and shank short, well distinguished from the trunk	rounded to cone-shaped	triangular shaped	waist not distinct	3 types: first with base wider, about half of sclerite length; second similar to trunk sclerites, evenly tapered; third elongated, with base bended to one site	numerous conspicuous growth lines

Chapter 3: Genus *Spathoderma* Scheltema, 1985

Introduction

Spathoderma Scheltema, 1985 is composed of 8 species so far and are one of the six genera of Prochaetodermatidae. They are distinguished mainly by the trunk sclerites morphology (SCHELTEMA & IVANOV, 2000; IVANOV & SCHELTEMA, 2008): these have a wide base, usually longer than blade, which gives a spatula-like shape (Figs. 5R and S). The blade is thinner and tapered. Base and blade are very distinguished from each other, often by a concave waist. Plane of blade bent outwards from plane of base (Fig. 5T) and both planes are more or less rotated relative to each other. Consequentially, the longitudinal axis, usually straight, may appear curved at waist or proximal end of base may appear slanted. This gives a false impression that sclerites are very asymmetrical (Fig. 5U). They lack evident ornamentation, with exception of longitudinal striations, usually more evident distally, and sometimes they bear a faint central keel in the blade. In addition, this genus has usually three rows of oral shield sclerites. Characteristics used to describe and differentiate species of this genus are as follows: if oral shield sclerites are numerous, well visible, or small, not obvious; the shape of the trunk and shank, whether they are more elongated or shorter, wider or slender and if one is well distinguished from another; the shape of the knob, which can be rounded, cone-shaped or truncated; and the morphology of isolated sclerites of the anterior and posterior trunk and the shank.

Spathoderma is known mainly for the North Atlantic Ocean, with a few records in the Southwest Indian Ocean, South Atlantic and off California. In South Atlantic, two species were recorded so far: *Spathoderma grossum*, which is an abyssal and amphi-Atlantic species, and *Spathoderma bulbosum*. The later was collected off Pernambuco, Brazil, being one of four species of caudofoveates registered so far for Brazil.

Results

Genus ***Spathoderma*** Scheltema, 1985

Diagnosis (modified from IVANOV & SCHELTEMA, 2008): With characters of the family. Sclerites usually adpressed against the body in the trunk and may bent outwards from it in the shank; plane of blade bent outwards from plane of base, planes

rotated relative to each other; with or without a central, longitudinal keel and usually with weak longitudinal ridges; proximal end of base asymmetrical, usually convex; waist distinct, blade narrower than base at waist, giving the sclerites a spiny, spatula-like shape; edges straight or slightly convex at the base and tapered or concave at the blade; isochromes symmetrical. Oral shield sclerites in 3 rows.

Type species: *Spathoderma clenchi* Scheltema, 1985, by original designation

Distribution: North Pacific Ocean, near the California Coast; Western Atlantic Ocean between 40ºN and 35°S, including east of New Jersey, the Gulf of Mexico, Guiana Basin, east of Pernambuco, Southeastern Brazil and the Argentine Basin; Eastern Atlantic Ocean between 60°N and 35°S, including south of Iceland, Bay of Biscay and Cape Basin; Western Mediterranean Sea; and Western Indian Ocean, including east and south of Madagascar. Coordinates are given in Appendix A.

Composition: *S. alleni* Scheltema & Ivanov, 2000; *S. bulbosum* Ivanov & Scheltema, 2008; *S. californicum* (Schwabl, 1963); *S. clenchi* Scheltema, 1985; *S. grossum* Scheltema & Ivanov, 2000; *S. longisquamosum* (Salvini-Plawen, 1992); *S. quadratum* Ivanov & Scheltema, 2008; *S. subulatum* Ivanov & Scheltema, 2001

Spathoderma bulbosum Ivanov & Scheltema 2008
(Figures 16, 17 and 18, Tables 5 and 6)

Material examined: Off Rio de Janeiro and Espírito Santo States, 15 specimens in 15 samples. HAB9-CANAC09-R3(0-2), 21°43'46.11"S, 39°55'18.91"W, 1300 m, 13/feb/2009, 1 spm; HAB3-A08-R3(0-2), 23°41'14.95"S, 41°16'10.31"W, 984.4 m, 5/may/2008, 1 spm; HAB3-B09-R3(2-5), 23°15'12.91"S, 40°53'48.86"W, 1302.3 m, 18/may/2008, 3 slides and 1 isolated radula with jaws; HAB3-C08-R2(0-2), 23°1'33.55"S, 40°45'21.28"W, 975 m, 23/may/2008, 1 spm; HAB3-C09-R3(0-2), 23°3'39.89"S, 40°42'58.46"W, 1291.6 m, 27/may/2008, 1 spm; HAB3-E08-R1(0-2), 22°33'40.33"S, 40°9'3.99"W, 975.2 m, 6/jun/2008, 1 spm; HAB6-CANAC09-R3(2-5), 21°43'46.11"S, 39°55'18.47"W, 1395.5 m, 13/jul/2008, 1 spm; HAB8-D08-R2(2-5),

22°40'58.02"S, 40°17'38.81"W, 1010 m, 22/jan/2009, 1 spm; HAB8-F09-R1(0-2), 22°25'36.06"S, 39°53'43.55"W, 1335 m, 25/jan/2009, 8 stubs; AMB5-A06-R3(5-10), 21°4'44.67"S, 40°8'29.02"W, 1024 m, 30/dec/2011, 1 spm; AMB5-B06-R1(0-10), 20°36'2.02"S, 39°51'35.2"W, 1000 m, 8/jan/2012, 1 spm; AMB11-A06-R2(0-10), 21°4'43.58"S, 40°8'31.88"W, 1015 m, 8/jun/2013, 1 spm; AMB11-B06-R1(0-10), 20°36'1.58"S, 39°51'38.94"W, 1003 m, 18/jun/2013, 1 spm; AMB11-B06-R2(0-10), 20°35'56.96"S, 39°51'37.84"W, 1003 m, 18/jun/2013, 1 spm; AMB12-D06-R1(0-10), 19°50'5.55"S, 39°26'34.47"W, 1050 m, 27/jun/2013, 1 spm.

Geographical and bathymetrical distribution: *S. bulbosum* was originally described from off North Carolina, Gulf of Mexico, Guiana Basin and off Pernambuco. The additional material extend its distribution further south in the Brazilian coast. The distribution of the new records ranges from 19°36'27.21"S to 23°41'9.14"S and from 39°10'14.62"W to 41°18'33.05"W (Fig. 16). They were collected in depths from 349 to 1309 m (Fig. 17), which extends the original bathymetric distribution (622 to 3000 m) to shallower waters.

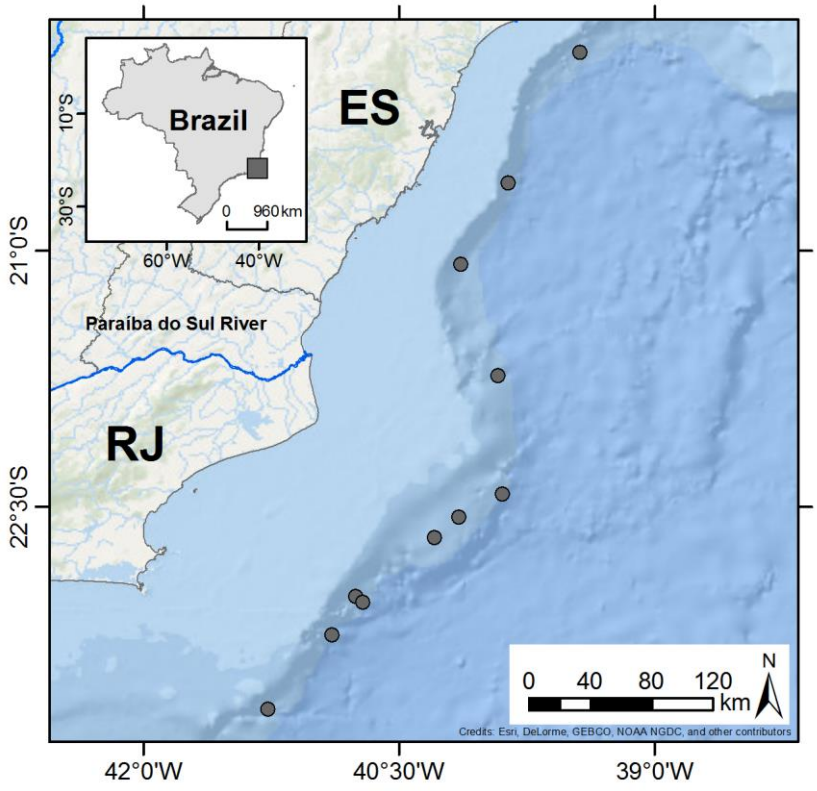

Figure 16. Locations (grey points) where *Spathoderma bulbosum* were collected in the Southeastern Brazil.

Remarks: A complete description and diagnosis can be viewed in IVANOV & SCHELTEMA (2008, p. 30–33), with some notes added below. For a comparison between *S. bulbosum* and *S. quadratum*, see remarks of *S. quadratum*.

The specimens examined are similar in external appearance (Fig. 18A), with an anterior trunk wider than rest of the body (like a bulbous). They have about the same size (Table 5) from those described by IVANOV & SCHELTEMA (2008), but some can be larger, up to 3.37 mm. The oral shield is paired, about 125 µm in height. All specimens have the oral shield and anterium contracted in a way that it is not possible to see the oral shield sclerites clearly for comparison. The radula and jaws (HAB8-F09-R1(0-2)) have the same morphology and size of those of the paratype: radula 270 µm long and each tooth is 120 µm long. Jaws with 570 µm in length and 225 µm in width at the anterior end. Sclerites have the same features described for the paratype, with some variations added here. In both materials, they are about the same size (Table 6). At the anterium (Fig. 18B), sclerites are smaller and can vary from more rounded to a more elongated shape, with the waist usually visible. Between the anterium and trunk (Fig. 18C) and on the anterior trunk (Fig. 18D), they are wider at the base when compared from those typical of the other regions of the anterium. At the mid-trunk, (Fig. 18E), sclerites are about the same length, but have a more elongated aspect. They have the same characteristics for the genus *Spathoderma*, including

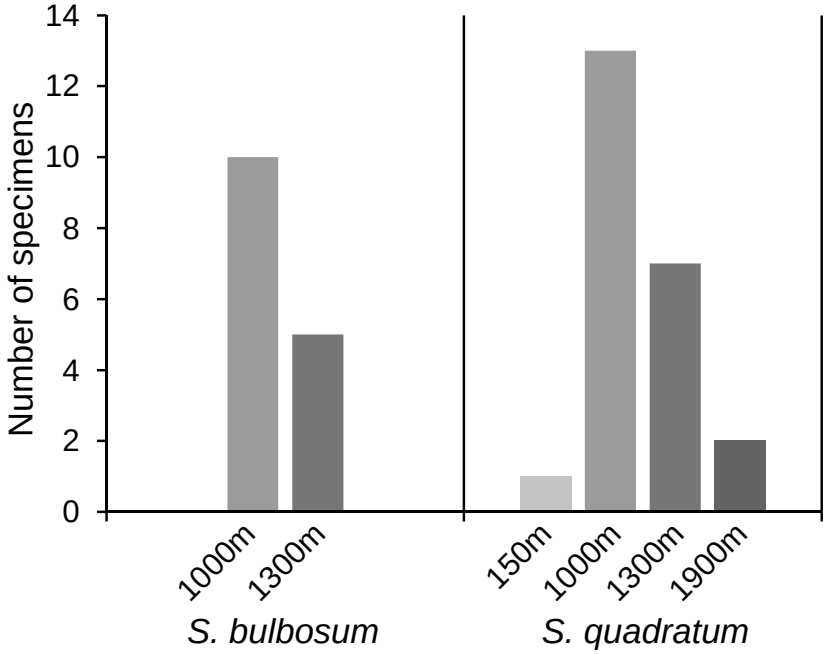

Figure 17. Bathymetric distribution of both *Spathoderma* species collected in Southeastern Brazil. Each bar represents the number of specimens collected in each isobath sampled.

planes of the base and blade rotated relative to each other (Fig. 18F). In the trunk and shank there are some smaller ones, with an oval shaped base and a thin blade, usually with a evident central keel (Figs. 18E and G, indicated with a). In the shank, sclerites

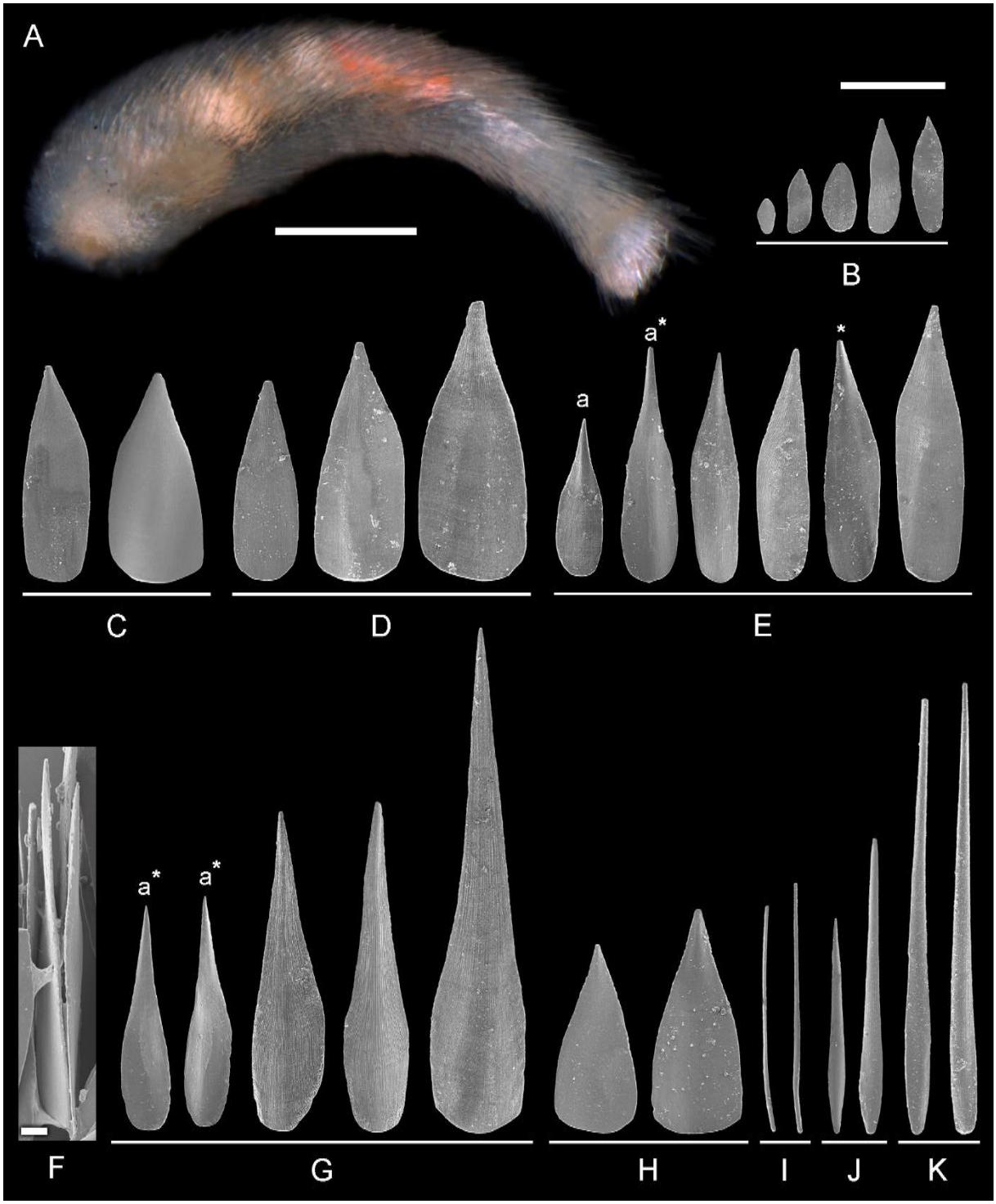

Figure 18. Photos under estereomicroscope (A) and SEM (B–K) of *Spathoderma bulbosum* from Southeastern Brazil. **A.** Left view of a typical adult, sample HAB8-F09-R1(0-2). **B–K.** Sclerites of different body regions, same sample as A. **B.** Anterium. **C.** Between anterium and trunk. **D.** Anterior trunk. **E.** Mid-trunk. **F.** Lateral view of the sclerites of the trunk. **G.** Shank. **H.** Between the shank and knob. **I–J.** Knob. **K.** Fringe. "a" indicates sclerites with ovate shape. * indicates sclerites showing the abfrontal surface. Scales for A: 500 µm, B: 100 µm and F: 10 µm. Scales in C–E and G–K same as B.

have a base shorter than the blade, about 1/3 of their length. Sometimes they bent outwards from the body, but usually are adpressed against it. In SEM images, shank sclerites have more distinguished, well-defined striations than those of the trunk (Fig. 18G). In the division of the shank and knob (Fig. 18H), sclerites have a triangular shape, up to 215 µm in length and 85 µm in width. The knob is usually truncated and the cluster of sclerites reported in the original description were not found in the material examined here. Sclerites in the middle are needle shaped, where some are very thin, up to 240 µm in length and 7 µm in width (Fig. 18I) and others are wider, up to 285 x 23 µm (Fig. 18J). The fringe sclerites (Fig. 18K) are similar to these of the knob, but longer.

Table 5. Mean of body regions measurements of *Spathoderma* species, in mm, and 95% confidence interval.

Species	N	trunk length	trunk width	posterium length	posterium width	posterium/ trunk
S. bulbosum	15	1.57 ± 0.25	0.62 ± 0.09	0.69 ± 0.14	0.31 ± 0.05	0.443 ± 0.066
S. quadratum	21	1.77 ± 0.35	0.51 ± 0.11	0.73 ± 0.14	0.27 ± 0.05	0.441 ± 0.055

Table 6. Sclerites measurements of *Spathoderma* species, in µm.

	S. bulbosum			*S. quadratum*	
	Length	Width		Length	Width
Anterium	35 to 110	18 to 30	Anterium	35 to 100	17 to 30
Anterior trunk	190 to 265	60 to 100	Dorsal trunk	200 to 360	75 to 150
Mid-trunk	150 to 265	45 to 65	Lateral and ventral trunk	230 to 370	45 to 70
Shank	215 to 480	45 to 90	Shank	280 to 716	55 to 85
Fringe	415 to 430	~25	Fringe	~540	~30

Spathoderma quadratum Ivanov & Scheltema 2008

(Figures 17, 19 and 20, Tables 5 and 6)

Material examined: off Rio de Janeiro and Espírito Santo States, 23 specimens in 20 samples. HAB8-F08-R1(2-5), 22°14'48.74"S, 39°53'30.15"W, 1021 m, 24/jan/2009, 1 spm; HAB3-A08-R1(2-5), 23°41'11.65"S, 41°16'9.21"W, 986 m,

3/may/2008, 1 spm; HAB3-B08-R2(5-10), 23°13'48.97"S, 40°55'57.84"W, 986.4 m, 14/may/2008, 2 slides; HAB3-C09-R2(0-2), 23°3'38.35"S, 40°42'55.82"W, 1291.6 m, 26/may/2008, 2 spms; HAB3-C10-R1(0-2), 23°8'24.66"S, 40°36'43.61"W, 1891.2 m, 28/may/2008, 1 spm; HAB3-E10-R2(0-2), 22°41'7.7"S, 39°59'58.63"W, 1871.5 m, 10/jun/2008, 9 stubs and 1 isolated radula with jaws; HAB3-H09-R1(0-2), 21°39'21.56"S, 39°53'58.27"W, 1293.2 m, 24/jun/2008, 1 spm; HAB6-CANAC08-R1(0-2), 21°45'56.4"S, 39°59'28.73"W, 1023.3 m, 8/jul/2008, 1 spm; HAB8-A08-R3(0-2), 23°41'10.55"S, 41°16'8.55"W, 1001.5 m, 13/jan/2009, 2 spms; HAB8-C09-R1(0-2), 23°3'35.94"S, 40°41'56.49"W, 1285.8 m, 16/jan/2009, 1 spm; HAB8-D08-R3(0-2), 22°40'59.34"S, 40°17'37.71"W, 1013 m, 22/jan/2009, 7 stubs; HAB9-CANAC09-R2(0-2), 21°43'46.11"S, 39°55'18.91"W, 1310 m, 12/feb/2009, 2 spms; HAB9-G08-R2(0-2), 22°7'21.59"S, 39°52'23.57"W, 1003 m, 8/feb/2009, 1 spm; HAB9-G08-R3(0-2), 22°7'21.59"S, 39°52'23.57"W, 1003 m, 8/feb/2009, 1 spm; HAB9-H09-R1(0-2), 21°39'21.56"S, 39°53'58.27"W, 1302 m, 13/feb/2009, 1 spm; AMB5-A06-R1(0-10), 21°4'43.58"S, 40°8'31.66"W, 1024 m, 30/dec/2011, 1 spm; AMB5-C06-R2(0-2), 20°15'33.74"S, 39°46'15.72"W, 1040 m, 9/jan/2012, 1 spm; AMB5-D06-R2(0-10), 19°50'4.45"S, 39°26'33.37"W, 1055 m, 11/jan/2012, 1 spm; AMB6-CANWN04-R2(0-10), 19°49'6.44"S, 39°36'9.06"W, 158 m, 14/jan/2012, 1 spm; AMB12-D06-R2(0-10), 19°50'6.87"S, 39°26'34.03"W, 1050 m, 27/jun/2013, 1 spm.

Geographical and bathymetrical distribution: *S. quadratum* was originally described from the Gulf of Mexico and now its distribution is extended to the Southwestern Atlantic Ocean. The distribution of the new records ranges from 19°49'4.67"S to 23°41'10.27"S and from 39°26'28.68"W to 41°16'7.97"W (Fig. 19). The original bathymetric distribution, which is 357 to 1826 m, is now slight extended, from 124 to 1891 m (Fig. 17).

Remarks: A complete description and diagnosis can be viewed in IVANOV & SCHELTEMA (2008, p. 33–36), with some notes added below. Sometimes it may be difficult to clear separate *S. quadratum* with *S. bulbosum*: both have about the same length and do not have a well-defined division between the trunk and the shank. Usually in *S. bulbosum* the anterior region of the body is like a bulbous, with the anterium and anterior trunk wider and a slowly tapering towards the shank. *S. quadratum* have a body more slender and elongated. However, sometimes this

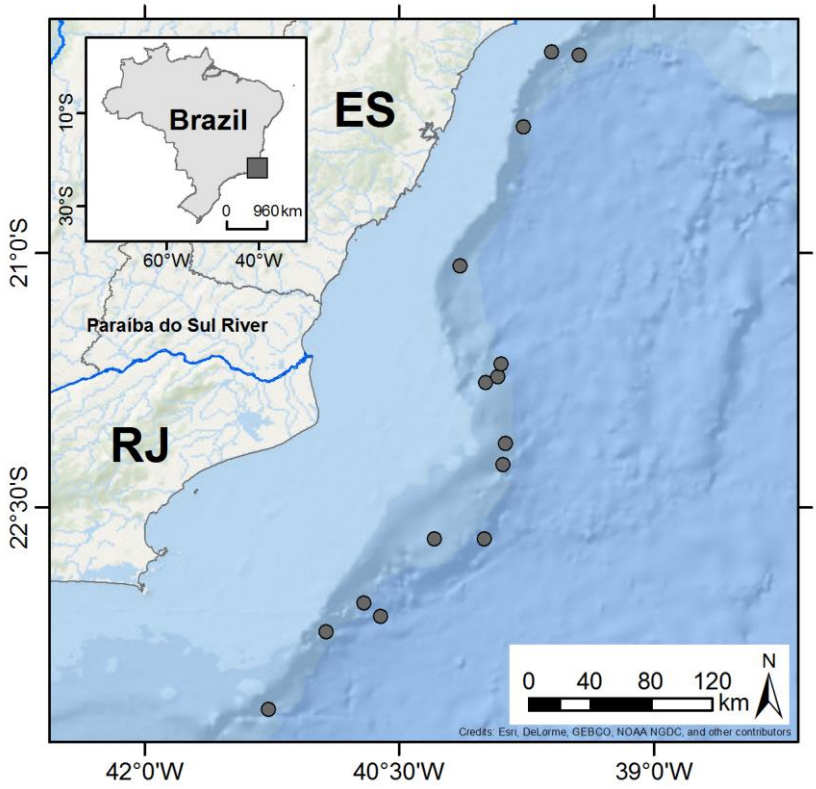

Figure 19. Locations (grey points) where *Spathoderma quadratum* were collected in the Southeastern Brazil.

characteristic is not sufficient to differentiate these species. As stated by IVANOV & SCHELTEMA (2008), they can also be distinguished by the knob, where in *S. bulbosum*, fringe sclerites are not distinct from the shank sclerites and there are groups of long sclerites in the middle of the knob. In *S. quadratum*, fringe sclerites are well distinct in a single row around the knob and they are longer than the knob. Still, in the material examined this is not conspicuous: in *S. bulbosum*, there are not clusters of long sclerites and sometimes the fringe sclerites are clearly distinct, in which case they are about the same length as the knob (Fig. 18A). In *S. quadratum*, fringe sclerites are usually broken off or sometimes they do not extend beyond the knob (Figs. 20A–C). However, both species are easily separated by the dorsal trunk sclerites: in *S. quadratum* (Fig. 20D2) they have a wider base, a more defined waist, a longer and thinner blade, and the proximal edge of the base is more symmetrical and straighten than in *S. bulbosum* (Figs. 18C and D). In addition, the shank sclerites are a bit different: in *S. quadratum* (Fig. 20D6) they have a blade much longer than the base when compared to *S. bulbosum* (Fig. 18G) and the central keel is slightly more visible.

In external appearance, the material examined is similar to the type material, with an anterium contracted in a rectangular shape (Fig. 20A, IVANOV &

SCHELTEMA, 2008, fig. 1l) or the body may be more elongated (Fig. 20B). In general, they have about the same size (Table 5) from the type material, but some can be

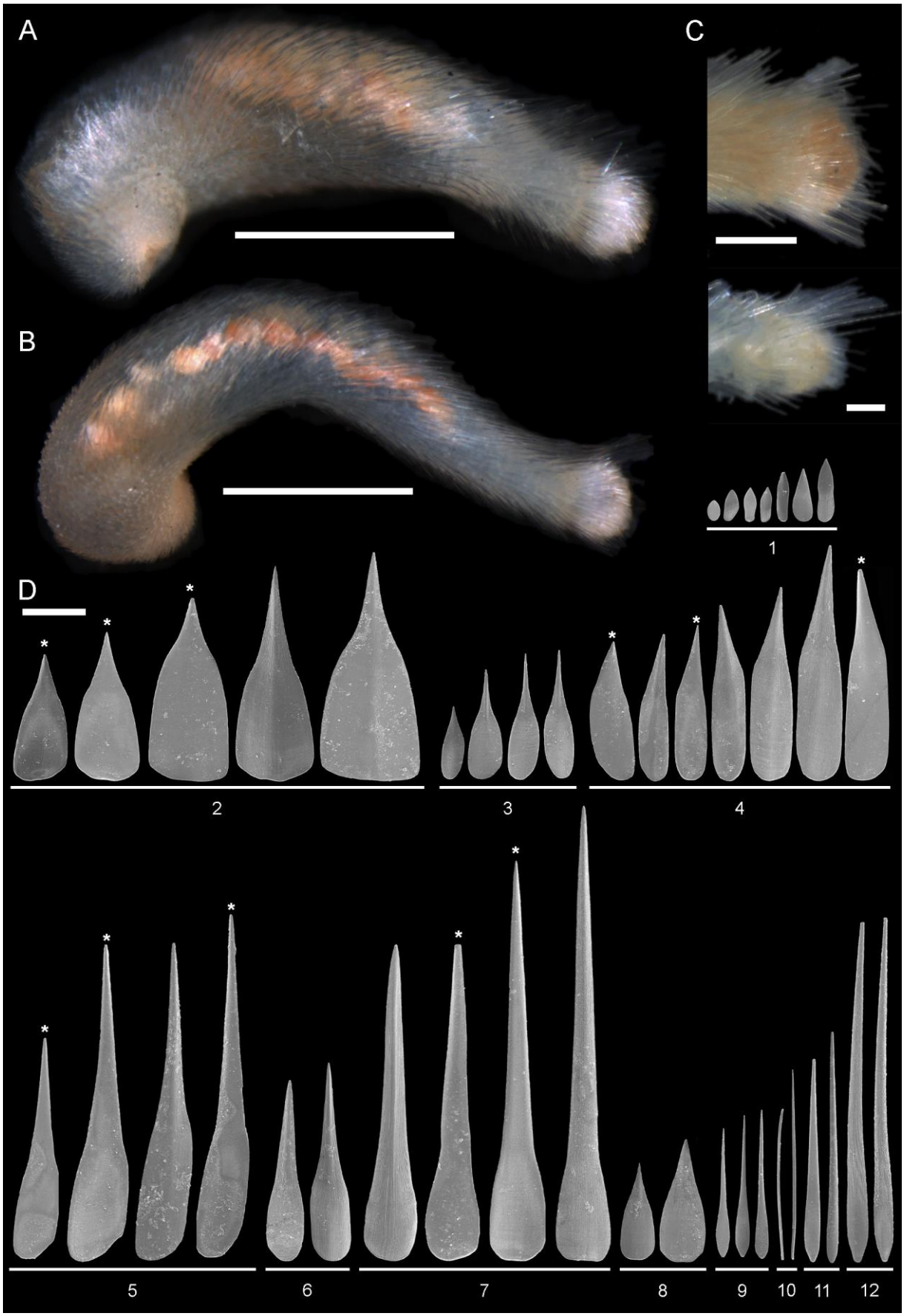

Figure 20. Photos under estereomicroscope (A–C) and SEM (D) of *Spathoderma quadratum* from Southeastern Brazil. **A** and **B.** Left view of typical adults, samples HAB8-D08-R3(0-2) and HAB3-E10-R2(0-2), respectively. **C.** Left view, showing variations on the fringe sclerites, samples AMB5-D06-R2(0-10) (above) and AMB5-A06-R1(0-10) (below). **D.** Sclerites of different body regions, same specimens as A and B. 1 - anterium, 2 - dorsal trunk, 3–4 - lateral and ventral trunk, 5 - between trunk and shank, 6–7 - shank 8 - between shank and knob, 9–11 - knob and 12 - fringe. * indicates sclerites showing the inner surface. Scales for A and B: 1000 µm, C: 250 µm and D: 100 µm.

longer, up to 4.91 mm. The oral shield is paired, 120 µm in height. For this species, it was also not possible to see the oral shield sclerites clearly for comparison. The radula and jaws (HAB3-E10-R2(0-2)) have the same morphology and size: radula with 10 pair of teeth, 270 µm long and each teeth are 130 µm long. Jaws with 720 µm in length and 300 µm in width at the anterior end. Sclerites (Fig. 20D) bear the same appearance from the ones described for the paratype, with some variations. Sizes given by IVANOV & SCHELTEMA (2008) are within the ranges of sclerites measurements made on the Brazilian specimens, given on Table 6. At dorsal trunk, there are the same quadrate shape sclerites (Fig. 20D2), that are a diagnostic characteristic of this species. In the trunk and shank, also there are some smaller, with an oval shaped base (Figs. 20D3 and D6), that resembles those of *S. bulbosum* (Figs. 18E and G, indicated with "a"). Typical sclerites of the trunk (Fig. 20D4) are almost indistinguishable from the ones of *S. bulbosum.* In the posterior trunk, there are intermediate sclerites between trunk and shank sclerites (Fig. 20D5), that are not illustrated for the type material. They have an elongated blade like those of the shank, but the base is not as short. The planes may be rotated to each other, like in the trunk sclerites. The proximal end is more or less chamfered in one side. In the shank (Fig. 20D7), sclerites are elongated, with a blade about four to five times longer than the base. Its base is slightly wider than the blade and the proximal end is sometimes more straight. Some differences were found in the knob. There are triangular sclerites between the shank and the knob (Fig. 20D8), up to 190 µm in length and 70 µm in width. The knob bears sclerites with a wider, ovulate base and a blade long and thin (Fig. 20D9), up to 235 x 20 µm and others very thin (Fig. 20D10), up to 300 x 5 µm. However, the most common are wider and needle shaped (Fig. 20D11), up to 360 x 24 µm. IVANOV & SCHELTEMA (2008) described a sclerite with a bent proximal end, like those in Figure 8F9, which was not founded in the material examined here. The fringe sclerites (Fig. 20E12) are fairly different: in the Brazilian specimens, they are more needle-shaped, contrasting with the ones described for the paratype, with a short base, wider than the blade, similar to those of the shank (IVANOV & SCHELTEMA, 2008, fig. 22J).

Discussion

In the present study, one species of this genus is recorded for the first time in Brazil and another one has its geographic distribution extended further to the southeastern Atlantic. A detailed description of sclerites of both species and external morphological variations are also furnished here. Some features are often not easy to observe, like the division between the trunk and shank that is usually indistinct in some species, and some sclerites that sometimes are broken off, mainly those of the oral shield and knob. Also, some details are not well visible in all sclerites, hence many sclerites were isolated from all body regions, mainly the trunk and shank, to avoid incorrect identifications and taxonomic problems. To assist future studies, we gathered from the literature diagnostic characteristics for each species of *Spathoderma* in Table 7, as well as some key articles that should be consulted for each species, its geographic distribution and type material. Additionally, this table includes complementary data of *S. bulbosum* and *S. quadratum*.

Table 7. Main diagnostic characteristics of all species of *Spathoderma*. The table also includes key articles that were consulted, along with a list of the type material and its geographic distribution.

Species	Key article	Type material	Distribution	Oral shield sclerites
S. alleni	Scheltema & Ivanov, 2000[1]	Holotype: BMNH 19991526 (1 spm + 1 slide); Paratypes: BMNH 19991527 (176 spms + 4 slides) and 19991528 (65 spms), MNHN-IM-2000-6260 and ZMUM Le1 58	West European Basin and Mediterranean Sea	not obvious
S. bulbosum	Ivanov & Scheltema, 2008[1]	Holotype: USNM 1112620 (1 spm + slide); Paratypes: USNM 1137222–1138707 (89 spms + 4 slides), TAMU (7 spms in 3 samples) and ZMUM Le1 171 (3 spms)	Off North Carolina, Gulf of Mexico, Guiana Basin, off Pernambuco, Brazil and Southeastern Brazil	3 rows, 3rd row with 2-3 large dorsal sclerites, but sometimes missing
S. californicum	Schwabl, 1963[1,2]; Scheltema, 1998a[3,4]; Barwick & Cadien 2005[3]	Lectotype: LACM 2091 (1 spm); Paralectotypes: LACM 2092 (3 spms + 1 slide)	off California, USA	not described
S. clenchi	Scheltema, 1985[1]; Scheltema & Ivanov 2000[3]; Ivanov & Scheltema, 2001a[3]	Holotype: USNM 850209 (1 spm + slide); Paratypes: USMN 850210 (1 spm + slide) and 850211 (1 spm + slide), MNHN IM 2000 6255 and 6298	Northeast American Basin, West European Basin and Southwest Africa Basin (amphi-Atlantic)	not obvious, ventral sclerites often missing
S. grossum	Scheltema & Ivanov, 2000[1]; Ivanov & Scheltema 2008[4]	Holotype: MNHN IM 2000 28236; Paratypes: MNHN IM 2000 28237–28241, USNM 880687–880689 (1,2,1 spms) and ZMUM Le1 59	Guiana Basin, Uruguai Basin, West European Basin and Southwest Africa Basin (amphi-Atlantic)	small, not obvious
S. longisquamosum	Salvini-Plawen, 1992[1,2]; Ivanov & Scheltema, 2001b[3]	Holotype: AMNH 265328 (1 spm) and 265329 (1 slide); There is no paratype	Southwest Indian Ocean between Prince Edward and Crozet islands	3 rows, numerous
S. quadratum	Ivanov & Scheltema, 2008[1]	Holotype: USNM 1112618 (1 spm + 1 slide); Paratypes: USNM 1137268–1137276 (24 spms + 2 slides), TAMU (6 spms in 3 samples), ZMUM Le1 162 (3 spms) and 163 (8 spms)	Gulf of Mexico and Southeastern Brazil	3 rows

(continued)

Species	Key article	Type material	Distribution	Oral shield sclerites
S. subulatum	Ivanov & Scheltema, 2001b[1]	Holotype: MNHN IM 2000 6254 (1 spm + 1 slide); Paratypes: MNHN IM 2000 6253 (37 spms + >2 slides) and ZMUM Le1 69 (5 spms)	off La Réunion	not obvious

(continued)

Species	Body	Knob	Anterior trunk sclerites	Mid and posterior trunk sclerites	Shank sclerites	Others
S. alleni	shank short, with sclerites arranged from anteroventral to posterodorsal even on shank; shank distinguished from the trunk	cone-shaped	triangular shaped	base equal or longer than blade; blade broad	base very short; blade needle shaped, sometimes broad	has ovate type of sclerites* on shank
S. bulbosum	widest anteriorly (bulbous-shaped), shank indistinct from trunk	truncated, with clusters of long sclerites, but often missing	triangular shaped or elongated	base longer than blade; blade broad	base shorter than blade; blade broad, sometimes long	has ovate type of sclerites* on trunk and shank
S. californicum	shank distinguished from the trunk	rounded to cone-shaped	elongated	base longer than blade; blade broad	similar to trunk sclerites, slight narrow	
S. clenchi	body slender; shank distinguished from the trunk by sclerites arrangement	rounded, fringing sclerites extend beyond knob	elongated	base equal or shorter than blade; blade narrow	base short; blade needle shaped	

(continued)

Species	Body	Knob	Anterior trunk sclerites	Mid and posterior trunk sclerites	Shank sclerites	Others
S. grossum	shank indistinct from trunk, sclerites visibly long	rounded to truncated	similar to mid-trunk sclerites	base equal or shorter than blade; blade narrow	base very short; blade needle shaped	most sclerites with a shallow, medial groove not obvious, best seen under SEM
S. longisquamosum	shank indistinct from trunk, sclerites visibly long	rounded to truncated	narrow, elongated	base equal or shorter than blade; blade broad	base very short; blade needle shaped	has ovate type of sclerites* on shank
S. quadratum	body slender, shank indistinct from trunk, scleriters may be arranged nearly parallel to antero-dorsal axis at trunk	rounded to cone-shaped, fringing sclerites extend beyond knob, but often missing	similar to mid-trunk sclerites	base longer than blade; blade broad (exept in at dorsal trunk)	base very short; blade needle shaped	At dorsal trunk, sclerites with very wide base, quadrate shaped and a narrow blade; between trunk and shank, sclerites have a proximal end more or less chamfered in one side; has ovate type of sclerites on trunk and shank
S. subulatum	body slender, shank distinguished from the trunk	rounded to cone-shaped, fringing sclerites extend beyond knob	triangular shaped	base longer than blade; blade narrow	base equal or shorter than blade; blade needle shaped	With chevronshaped growth lines at blade

*same type of sclerites illustrated in Figure 18E and G, indicated with "a", and Figure 20D3 and D6.

Key article: 1 - original description, 2 - described as *Prochaetoderma*, 3 - morphology and sclerites are illustrated and 4 - geographic distribution is expanded.

Museums: AMNH - American Museum of Natural History, BMNH - Natural History Museum of London, LACM - Natural History Museum of Los Angeles County, MNHN - Muséum national d'Histoire aturelle (Paris), TAMU - Texas A&M University University at Galveston, Department of Marine Biology, USNM - National Museum of Natural History (Washington, DC), ZMUM - Zoological Museum of Moscow State University.

Considerações finais

Aplacophora, incluindo a família Prochaetodermatidae, é um grupo pouco estudado devido a diversos fatores. Primeiramente são animais pequenos, dificultando sua triagem e manejo, que devem ser feitos com muito cuidado para não danificar o material ou para que não sejam perdidos. Também são animais de difícil acesso por serem exclusivamente bentônicos e, geralmente, viverem em grandes profundidades. Sua coleta requer embarcações de grande porte, e por isso os custos para obtenção de amostras são extremamente altos e as coletas realizadas em grandes intervalos de tempo. Além da coleta, seus estudos exigem o uso de equipamento óptico de boa qualidade e resolução, e técnicas avançadas de microscopia, como a varredura. Dessas dificuldades resulta um número muito reduzido de especialistas nesse grupo e, portanto, o material coletado em grandes projetos de pesquisa acaba, na maioria das vezes, não sendo identificado pela falta de taxonomistas; quando muito, é depositado em coleções com identificação até o nível de família, ou até mesmo de classe.

O presente trabalho registra quatro espécies de dois gêneros de Prochaetodermatidae para o litoral sudeste do Brasil, sendo que três delas estão sendo conhecidas pela primeira vez para o Brasil. Assim, essas espécies terão suas respectivas distribuições geográficas ampliadas. Suas descrições originais também serão complementadas, com a caracterização de variações na morfologia de vários espécimes da mesma espécie e descrição de espículas encontradas em algumas regiões do corpo, mas que não foram ilustradas originalmente. Além disso, uma nova espécie é descrita, até o momento endêmica para o sudeste do Brasil. Essa espécie possui espículas da cauda com morfologia singular, não encontrada em outras espécies do gênero. Nesse trabalho, as principais características de cada gênero foram reunidas numa tabela e ilustradas de uma maneira conveniente através de desenhos em 3D. Adicionalmente, as diagnoses para cada espécie dos dois gêneros estudados aqui, *Claviderma* e *Spathoderma*, foram também reunidas em tabelas. Isso irá facilitar em muito a identificação de indivíduos para esses grupos no futuro.

Portanto, a fauna de Prochaetodermatidae, e em mais geral de Aplacophora, que esteve por muitos anos praticamente desconhecida para o Brasil, começa a ser revelada em mais detalhes para a ciência. Também, esse trabalho representa um passo adiante a um objetivo maior, que é a implantação de um novo grupo de estudo de Aplacophora no mundo, pioneiro no Brasil.

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Glossário

Português	Inglês	Significado
anterium	anterium	Extremidade anterior do corpo, onde está localizada a rádula, mandíbulas e espíclas de menor tamanho que as do tronco.
base	base	Região distal da espícula, que está fora da cutícula.
cauda	tail	O mesmo que pedúnculo. Esse termo não é mais usado em inglês para Prochaetodermatidae, mas é o utilizado para o Português.
cintura	waist	Um estreitamento que ocorre no meio da espícula. Em alguns grupos, pode indicar a divisão em lâmina e base.
disco oral	oral shield	Região do epitélio em volta da boca sem espículas. Possui função sensorial.
escleritos	sclerites	São estruturas formadas por carbonato de cálcio, secretado pelo manto e que recobrem todo o corpo.
estriações	striations	Linhas longitudinais na superfície das espículas. Podem ser vistas em microscópio de luz transmitida ou MEV.
lâmina	blade	Região proximal da espícula, que está embebida pela cutícula.
linhas de crescimento	growth lines	Linhas transversais vistas em espículas. Podem ser vistas apenas em microscópio de luz transmitida.
mandíbulas	jaws	Estrutura grande, sempre em par e em forma de espátula. Se localiza dentro da cavidade bucal, associada com a rádula.
pedúnculo	shank	Porção posterior do corpo, com o diâmetro menor que o tronco.
placas centrais	central plates	Placas localizadas entre as bases de cada par de dentes da rádula.
ponta	knob	Extremidade posterior do corpo, onde está localizado a cavidade do manto.
posterium	posterium	Compreende a região da cauda mais a da ponta
espículas	spicules	O mesmo que escleritos. Esse termo não é mais usado em inglês para Caudofoveata, mas é o utilizado em Português.
tronco	trunk	Porção anterior do corpo, onde se localiza o estômago e divertículo digestico.

Apêndice A

Lista das amostras reunidas da literatura de todas as espécies da família Prochaetodermatidae. Dados foram retirados de 16 artigos no total (GROVES, 2012; HARTMAN, 1955; IVANOV, 1995, 1996, IVANOV; SCHELTEMA, 2001a, 2001b, 2002, 2004, 2008, SALVINI-PLAWEN, 1992, 1999; SALVINI-PLAWEN et al., 1998; SCHELTEMA, 1985, 1989; SCHELTEMA; IVANOV, 2000; SCHWABL, 1963). A lista está categorizada em espécie e artigo onde foram extraídos. Cada linha representa uma amostra coletada, com o número de espécimes, data de coleta, profundidade, latitude e longitude, respectivamente. Observe que a lista está em inglês e com a data no formato DD/MM/AAAA.

Chevroderma cuspidatum

Ivanov and Scheltema 2008
1 spm; 14/11/1984; 1032m; 27°44'28"N; 89°59'4"W
24 spms; 11/06/2000; 667m; 29°19'59.4"N; 87°2'54"W
2 spms; 26/11/1983; 615m; 27°54'18"N; 90°5'54"W
34 spms; 11/06/2000; 658m; 29°20'3"N; 87°3'22.8"W
126 spms; 16/06/2000; 990m; 28°13'8.4"N; 89°29'30.6"W
103 spms; 16/06/2000; 987m; 28°13'9"N; 89°29'47.4"W
139 spms; 16/06/2000; 983m; 28°13'13.2"N; 89°29'46.2"W
42 spms; 17/06/2000; 677m; 28°27'4.2"N; 89°40'13.2"W
57 spms; 17/06/2000; 676m; 28°27'3.6"N; 89°40'21.6"W
13 spms; 11/06/2000; 668m; 29°19'55.8"N; 87°3'1.2"W
6 spms; 14/11/1984; 1032m; 27°44'28"N; 89°59'4"W
7 spms; 14/11/1984; 1029m; 27°44'8"N; 89°59'4"W
3 spms; 13/11/1984; 625m; 27°54'44"N; 90°6'32"W
1 spm; 16/04/1984; 357m; 28°27'36"N; 86°1'48"W
1 spm; 12/04/1984; 605m; 27°54'18"N; 90°5'54"W
1 spm; 04/04/1984; 366m; 27°34'60"N; 93°33'6"W
2 spms; 27/11/1983; 610m; 27°54'18"N; 90°6'6"W
1 spm; 26/11/1983; 615m; 27°54'18"N; 90°5'54"W
1 spm; 16/05/1985; 631m; 28°7'34.8"N; 85°52'18"W

Chevroderma gauson

Scheltema 1985
2 spms; 01/08/1976; 4829m; 48°19'12"N; 15°23'18"W
1 spm; 02/08/1976; 4829m; 48°19'12"N; 15°15'54"W
8 spms; 24/08/1972; 4632m; 50°43'30"N; 17°51'42"W
8 spms; 23/08/1972; 4426m; 50°4'42"N; 15°44'48"W

Chevroderma hadalis

Ivanov 1996
5 spms; 20/06/1969; 7250m; 51°9'42"N; 174°35'30"E
9 spms; 31/08/1966; 8390m; 45°55'0"N; 149°46'60"E

Chevroderma javanicum

Ivanov and Scheltema 2002
22 spms; 01/11/1959; 6935m; 10°16'60"S; 110°16'60"W
15 spms; 04/11/1959; 6820m; 10°7'60"S; 107°55'0"E

Chevroderma lusae

Ivanov and Scheltema 2002
1 spm; 25/11/1960; 3840m; 15°7'0"N; 65°57'0"E
1 spm; 04/02/1961; 3620m; 8°54'0"N; 87°1'60"E
1 spm; 26/11/1960; 3160m; 19°12'60"N; 65°56'0"E

Chevroderma paradoxum

Ivanov and Scheltema 2001b
1 spm; 22/03/1960; 4144m; 3°47'60"S; 53°0'0"E
1 spm; 01/11/1960; 4458m; 8°20'60"N; 56°16'60"E
3 spms; 24/08/1982; 3630m; 21°49'60"S; 55°13'0"E
1 spm; 05/09/1982; 3500m; 20°26'0"S; 55°39'60"E
4 spms; 05/09/1982; 3240m; 20°51'0"S; 56°2'60"E
1 spm; 01/11/1960; 3470m; 9°33'0"N; 57°1'60"E

Ivanov and Scheltema 2002
1 spm; 30/10/1962; 3850m; 5°4'60"N; 91°45'0"E

Chevroderma scalpellum

Scheltema 1985
11 spms; 05/02/1967; 1624m; 10°30'0"N; 17°51'30"W
22 spms; 22/05/1968; 1964m; 9°28'60"S; 11°33'60"E
1 spm; 22/05/1968; 2644m; 9°40'60"S; 10°54'60"E
9 spms; 06/02/1967; 2185m; 10°35'60"N; 17°48'60"W
59 spms; 23/05/1968; 1427m; 9°4'60"S; 12°16'60"E

Chevroderma turnerae

Ivanov and Scheltema 2002
1 spm; 01/03/1961; 2520m; 16°8'60"N; 92°36'60"E
1 spm; 28/11/1960; 3530m; 23°11'60"N; 64°12'0"E
1 spm; 25/03/1960; 3272m; 3°30'0"S; 55°45'60"E
1 spm; 05/03/1960; 3888m; 6°53'0"S; 53°36'0"E
1 spm; 25/11/1960; 3840m; 15°7'0"N; 65°57'0"E

Ivanov and Scheltema 2008
4 spms; 17/03/1971; 5208m; 43°32'60"S; 48°58'6"W
13 spms; 27/03/1971; 2440m; 36°5'12"S; 52°17'54"W
13 spms; 26/03/1971; 3305m; 37°13'18"S; 52°45'0"W
5 spms; 13/03/1971; 4382m; 38°16'54"S; 51°56'6"W

2 spms; 15/03/1971; 3343m; 37°15'6"S; 52°45'0"W
74 spms; 14/03/1971; 2707m; 36°55'42"S; 52°1'24"W
1 spm; 14/03/1971; 3815m; 37°36'48"S; 52°23'36"W

Scheltema and Ivanov 2000

1 spm; 02/06/1992; 3095m; 18°30'6"N; 21°5'24"W
1 spm; 26/01/1991; 3138m; 18°32'42"N; 20°57'24"W
1 spm; 30/05/1981; 4270m; 34°6'0"N; 17°3'60"W
1 spm; 08/06/1981; 5320m; 39°59'30"N; 15°2'36"W
1 spm; 02/06/1992; 3097m; 18°30'0"N; 21°4'60"W
1 spm; 11/06/1981; 4360m; 42°51'12"N; 15°55'18"W

Scheltema 1985

6 spms; 04/10/1981; 4135m; 47°35'18"N; 9°8'30.6"W
1 spm; 04/10/1981; 4130m; 47°35'12"N; 9°39'30"W
2 spms; 04/10/1981; 4210m; 47°34'54"N; 9°9'48.6"W
1 spm; 18/05/1980; 2730m; 47°32'12"N; 9°4'30"W
1 spm; 30/10/1974; 4475m; 44°22'54"N; 4°4'48.6"W
2 spms; 29/10/1974; 4459m; 44°23'12"N; 4°1'24"W
4 spms; 22/07/1971; 4079m; 6°37'30"S; 8°8'12"E
3 spms; 28/10/1974; 4434m; 44°24'54"N; 4°1'18"W
8 spms; 30/10/1974; 4475m; 44°22'54"N; 4°4'48.6"W
1 spm; 08/10/1981; 4170m; 47°34'48"N; 9°0'18.6"W
5 spms; 17/06/1974; 4150m; 47°30'60"N; 9°50'60"W
2 spms; 26/10/1974; 4706m; 46°30'48"N; 10°18'60"W
3 spms; 22/06/1971; 3777m; 21°58'36"S; 10°16'0''E
6 spms; 09/06/1971; 4184m; 21°57'30"S; 9°2'42"E
4 spms; 22/05/1968; 3764m; 9°46'60"S; 10°28'60"E
5 spms; 19/05/1968; 3797m; 14°48'60"S; 10°0'60"E
1 spm; 21/05/1968; 4559m; 10°28'60"S; 9°41'0"E
4 spms; 19/03/1968; 2670m; 27°23'36"N; 15°39'36"W
4 spms; 04/10/1981; 4130m; 47°35'0"N; 9°0'0"W
1 spm; 07/10/1981; 4200m; 47°35'0"N; 9°8'30.6"W
3 spms; 07/10/1981; 4110m; 47°34'48"N; 9°9'54.6"W
2 spms; 07/10/1981; 4150m; 47°34'42"N; 9°9'0.6"W
1 spm; 07/10/1981; 4130m; 47°34'54"N; 9°9'18.6"W
4 spms; 07/10/1981; 4170m; 47°34'42"N; 9°9'6.6"W
2 spms; 07/10/1981; 4135m; 47°35'24"N; 9°9'12.6"W
3 spms; 06/10/1981; 4190m; 47°34'24"N; 9°8'54.6"W
1 spm; 19/03/1968; 2988m; 27°14'54"N; 15°36'18"W
11 spms; 24/08/1972; 4632m; 50°43'30"N; 17°51'42"W
5 spms; 25/10/1974; 4706m; 46°31'12"N; 10°23'48"W
14 spms; 30/08/1972; 4400m; 40°42'36"N; 46°13'36"W
2 spms; 13/02/1967; 3730m; 0°3'0"S; 27°48'0"W
11 spms; 14/02/1967; 3459m; 0°46'0"S; 29°27'60"W
6 spms; 21/08/1972; 3356m; 50°8'18"N; 13°53'42"W
1 spm; 01/04/1980; 4617m; 40°21'30"N; 63°6'12"W
13 spms; 23/08/1972; 4426m; 50°4'42"N; 15°44'48"W
1 spm; 24/11/1973; 3264m; 38°14'24"N; 70°20'18"W
1 spm; 20/07/1976; 2897m; 55°7'42"N; 12°52'36"W
1 spm; 27/07/1976; 2719m; 50°12'42"N; 13°16'36"W
1 spm; 27/07/1976; 2659m; 50°15'24"N; 13°15'48"W
1 spm; 30/07/1976; 2634m; 50°14'24"N; 13°10'54"W
4 spms; 31/07/1976; 4823m; 48°25'30"N; 15°10'42"W
3 spms; 01/08/1976; 4823m; 48°20'24"N; 15°14'36"W
11 spms; 22/08/1972; 3859m; 50°4'54"N; 14°23'48"W
6 spms; 21/08/1966; 4800m; 35°50'0"N; 65°11'0"W
1 spm; 24/05/1961; 3752m; 38°5'0"N; 69°35'60"W
6 spms; 23/08/1964; 4680m; 36°22'60"N; 67°58'0"W
15 spms; 04/08/1965; 4749m; 36°24'24"N; 67°56'0"W
6 spms; 05/07/1965; 3834m; 37°59'12"N; 69°26'12"W
3 spms; 13/12/1965; 4694m; 36°20'0"N; 67°56'0"W
2 spms; NA; 3644m; 38°18'24"N; 69°35'36"W
2 spms; 20/08/1966; 5018m; 34°43'0"N; 66°32'48"W
5 spms; 05/08/1976; 4796m; 46°3'54"N; 10°12'48"W
12 spms; 21/08/1966; 4833m; 35°50'0"N; 64°57'30"W
4 spms; 23/08/1966; 4825m; 37°23'60"N; 65°54'0"W
4 spms; 24/08/1966; 3806m; 39°37'0"N; 66°46'60"W
1 spm; 18/12/1966; 2178m; 39°38'30"N; 70°36'30"W
13 spms; 29/11/1967; 4667m; 36°36'0"N; 68°29'0"W
2 spms; 11/07/1976; 3600m; 38°16'30"N; 69°38'30"W
4 spms; 17/12/1965; 3753m; 38°32'60"N; 68°31'60"W
1 spm; 24/10/1974; 4240m; 47°31'48"N; 9°4'36"W
1 spm; 22/02/1974; 4125m; 47°34'54"N; 9°0'54.6"W
2 spms; 23/02/1974; 4050m; 47°32'42"N; 9°8'12.6"W
2 spms; 24/02/1974; 3742m; 47°26'48"N; 9°7'12"W
1 spm; 24/02/1974; 2963m; 47°30'24"N; 9°6'54.6"W
1 spm; 25/02/1974; 4140m; 47°25'60"N; 9°8'42.6"W
1 spm; 04/08/1976; 4796m; 46°0'30"N; 10°18'18"W
2 spms; 02/08/1976; 4829m; 48°19'12"N; 15°15'54"W
1 spm; 31/08/1973; 4230m; 44°26'48"N; 4°0'42"W
6 spms; 26/10/1974; 4715m; 46°30'24"N; 10°27'6"W
4 spms; 27/10/1974; 4720m; 46°29'30"N; 10°29'30"W
1 spm; 29/10/1974; 4462m; 44°25'24"N; 4°2'48.6"W
6 spms; 30/10/1974; 4462m; 44°23'12"N; 4°0'48.6''W
10 spms; 23/10/1974; 4237m; 47°31'60"N; 9°5'54.6"W
4 spms; 25/10/1974; 4715m; 46°32'12"N; 10°28'30"W
6 spms; 16/06/1974; 3480m; 47°28'12"N; 9°33'0"W
5 spms; 10/08/1976; 4277m; 47°28'48"N; 9°4'0.6"W
1 spm; 25/10/1974; 4825m; 46°27'18"N; 10°25'48"W
1 spm; 05/08/1976; 4804m; 46°2'60"N; 10°15'42"W
3 spms; 06/08/1976; 4822m; 46°1'54"N; 10°17'54"W
4 spms; 07/08/1976; 4281m; 47°30'36"N; 9°7'6.6"W
1 spm; 09/08/1976; 4287m; 47°30'30"N; 9°3'42"W
5 spms; 09/08/1976; 4316m; 47°27'18"N; 9°6'12"W
1 spm; 01/09/1973; 2124m; 44°8'54"N; 4°5'54.6"W
26 spms; 10/08/1976; 4249m; 47°31'48"N; 9°4'18.6"W
4 spms; 31/08/1973; 4203m; 44°29'0"N; 4°3'60"W
2 spms; 11/08/1976; 4354m; 47°27'18"N; 9°9'54.6"W
4 spms; 11/08/1976; 4327m; 47°29'48"N; 9°9'12.6"W
1 spm; NA; 4512m; 45°35'12"N; 3°1'36.6"W
51 spms; NA; 4760m; 45°7'60"N; 5°11'0"W
1 spm; 27/08/1973; 4260m; 47°33'54"N; 9°8'24.6"W
5 spms; 04/08/1976; 4798m; 46°2'30"N; 10°19'30"W
2 spms; 09/08/1976; 4268m; 47°29'48"N; 9°3'24.6''W
6 spms; 01/08/1976; 4823m; 48°17'60"N; 15°11'30"W

Chevroderma vityazi

Ivanov and Scheltema 2002

1 spm; 29/10/1964; 2875m; 14°51'42"N; 88°9'54"E

Chevroderma whitlatchi

Scheltema 1985
1 spm; NA; 4985m; 11°43'54"N; 138°22'12"W
2 spms; NA; 5117m; 8°16'0"N; 15°11'0"W
1 spm; 18/02/1979; 2730m; 0°35'0"N; 86°5'42"W
31 spms; 09/09/1981; 3912m; 5°20'42"N; 81°56'12"W
1 spm; 21/03/1970; 3950m; 31°47'0"N; 12°13'60"W
1 spm; 09/02/1965; 2800m; 44°50'54"N; 12°33'60"W
31 spms; 20/07/1970; 7298m; 50°58'0"N; 17°37'0"W

Claviderma amplum

Ivanov and Scheltema 2008
11 spms; 11/06/2000; 668m; 29°19'55.8"N; 87°3'1.2"W
1 spm; 25/06/1982; 318m; 27°30'31.2"N; 79°48'57"W
1 spm; 26/11/1983; 603m; 27°54'24"N; 90°5'60"W
17 spms; 11/06/2000; 658m; 29°20'3"N; 87°3'22.8"W
9 spms; 08/02/1972; 508m; 7°45'18"N; 54°23'60"W
5 spms; 28/02/1972; 1000m; 8°4'12"N; 54°21'18"W
1 spm; 25/06/1982; 311m; 27°29'24"N; 79°48'24"W
2 spms; 25/06/1982; 318m; 27°30'12"N; 79°49'9.6"W
4 spms; 25/06/1982; 318m; 27°30'12"N; 79°49'3.6"W
1 spm; 26/11/1983; 615m; 27°54'18"N; 90°5'54"W
3 spms; 24/08/1981; 342m; 27°30'22.2"N; 79°49'54.6"W
6 spms; 04/05/1981; 298m; 27°30'23.4"N; 79°49'0.6"W
1 spm; 27/11/1983; 610m; 27°54'18"N; 90°6'6"W
2 spms; 04/05/1981; 298m; 27°30'22.8"N; 79°48'48.6"W
1 spm; 02/04/1982; 311m; 27°30'37.8"N; 79°48'58.2"W
2 spms; 09/06/2000; 767m; 28°15'9.6"N; 86°25'4.2"W
2 spms; 14/05/2000; 625m; 27°24'48"N; 93°20'15.6"W
2 spms; 04/05/2000; 400m; 27°46'16.8"N; 91°45'43.8"W
1 spm; 02/04/1981; 329m; 27°27'18"N; 79°47'32.4"W
5 spms; 02/04/1981; 329m; 27°27'18"N; 79°47'32.4"W
2 spms; 02/04/1981; 329m; 27°27'18"N; 79°47'32.4"W
1 spm; 04/05/1981; 293m; 27°30'32.4"N; 79°49'1.2"W
1 spm; 19/05/1985; 622m; 28°16'46.2"N; 86°14'45.6"W
1 spm; 16/06/2000; 987m; 28°13'9"N; 89°29'47.4"W
1 spm; 17/06/2000; 676m; 28°27'3.6"N; 89°40'21.6"W
1 spm; 11/06/1985; 761m; 27°41'31.8"N; 91°17'51"W
1 spm; 11/06/1985; 753m; 27°41'37.2"N; 91°17'53.4"W
1 spm; 09/06/1985; 549m; 27°43'31.2"N; 92°7'57"W
1 spm; 08/06/1985; 750m; 27°35'33.6"N; 92°21'42"W
1 spm; 16/06/2000; 990m; 28°13'8.4"N; 89°29'30.6"W
1 spm; 18/05/1985; 624m; 28°16'48"N; 86°14'52.8"W
1 spm; 13/05/1985; 624m; 28°35'26.4"N; 86°44'27"W
1 spm; 16/05/1985; 631m; 28°7'34.8"N; 85°52'18"W
1 spm; 16/05/1985; 633m; 28°7'20.4"N; 85°52'20.4"W
1 spm; 15/05/1985; 624m; 28°2'44.4"N; 85°40'6.6"W
1 spm; 13/05/1985; 865m; 28°28'27.6"N; 87°0'2.4"W
1 spm; 07/04/1984; 605m; 27°24'54"N; 93°20'24"W
4 spms; 24/08/1981; 326m; 27°30'22.2"N; 79°49'54.6"W
1 spm; 09/06/1985; 550m; 27°43'47.4"N; 92°30'19.2"W
18 spms; 11/06/2000; 667m; 29°19'59.4"N; 87°2'54"W
1 spm; 08/04/1984; 860m; 27°10'36"N; 93°19'24"W
1 spm; 11/04/1984; 595m; 27°54'24"N; 90°6'12"W
1 spm; 12/04/1984; 840m; 27°49'24"N; 90°7'0"W
2 spms; 14/11/1984; 1032m; 27°44'28"N; 89°59'4"W
5 spms; 13/05/1985; 622m; 28°35'21.6"N; 86°46'25.8"W

Claviderma australe

Scheltema 1989
1 spm; 15/11/1981; 1120m; 38°35'6"S; 148°36'48"E
1 spm; 16/11/1981; 2510m; 38°42'18"S; 148°48'0"E
6 spms; 16/11/1981; 1730m; 38°55'36"S; 148°46'24"E
9 spms; 13/12/1976; 1200m; 34°26'30"S; 151°26'60"E
5 spms; 22/07/1986; 1850m; 38°25'54"S; 148°58'36"E
47 spms; 22/07/1986; 1500m; 38°25'60"S; 149°0'0"E

Claviderma brevicaudatum

Scheltema and Ivanov 2000
250 spms; 16/05/1968; 1007m; 23°0'0"S; 12°45'0"E
13 spms; 06/02/1991; 1590m; 20°32'12"N; 18°30'0"W
5 spms; 11/08/1971; 1267m; 4°21'12"N; 4°35'12"E
11 spms; 20/06/1971; 1227m; 19°56'60"S; 11°1'60"E
104 spms; 27/06/1971; 1432m; 18°40'0"S; 10°56'30"E
1 spm; 24/07/1971; 2243m; 3°47'60"S; 9°17'42"E
5 spms; 17/05/1968; 974m; 23°4'60"S; 12°45'0"E
315 spms; 17/05/1968; 1546m; 23°4'60"S; 12°31'30"E
2 spms; 09/07/1971; 1537m; 11°57'36"S; 12°54'18"E

Claviderma compactum

Ivanov and Scheltema 2008
91 spms; 12/03/1971; 2195m; 36°53'24"S; 53°10'12"W
1 spm; 15/03/1971; 3343m; 37°15'6"S; 52°45'0"W
186 spms; 28/03/1971; 2041m; 36°12'42"S; 52°42'42"W
55 spms; 11/03/1971; 993m; 36°32'36"S; 53°22'60"W
29 spms; 27/03/1971; 2440m; 36°5'12"S; 52°17'54"W
325 spms; 11/03/1971; 1661m; 36°49'0"S; 53°15'24"W

Claviderma crassum

Ivanov and Scheltema 2008
1 spm; 27/02/1972; 1456m; 8°58'0"N; 54°4'18"W
25 spms; 08/02/1972; 508m; 7°45'18"N; 54°23'60"W
7 spms; 28/02/1972; 1000m; 8°4'12"N; 54°21'18"W

Claviderma gagei

Ivanov and Scheltema 2001b
7 spms; 08/11/1994; 3400m; 18°58'54.6"N; 59°0'18.6"E
7 spms; 11/10/1994; 3392m; 19°0'12"N; 59°0'10.2"E
121 spms; 31/10/1994; 3150m; 19°7'60"N; 58°38'60"E
1 spm; 19/10/1994; 3382m; 18°59'50.4"N; 59°0'57.6"E
1 spm; 20/10/1994; 3380m; 18°59'46.2"N; 59°0'29.4"E
1 spm; 15/04/1960; 3070m; 13°35'60"N; 54°28'0"E
2 spms; 29/10/1960; 2833m; 11°7'0"N; 52°13'0"E
4 spms; 04/11/1960; 3717m; 17°18'0"N; 58°58'0"E
3 spms; 18/10/1994; 3384m; 18°59'30.6"N; 59°0'45.6"E

Claviderma gladiatum

Scheltema and Ivanov 2000

1 spm; 07/02/1967; 3814m; 10°37'0"N; 18°14'0"W
30 spms; 11/06/1971; 2992m; 21°45'30"S; 11°7'48"E
1 spm; 13/07/1967; 1784m; 43°40'48"N; 3°36'0"W
9 spms; 16/07/1967; 1739m; 43°40'48"N; 3°35'12"W
10 spms; 18/07/1967; 2379m; 43°46'42"N; 3°38'0"W
75 spms; 05/02/1967; 1624m; 10°30'0"N; 17°51'30"W
9 spms; 06/02/1967; 2185m; 10°35'60"N; 17°48'60"W
2 spms; 10/08/1971; 1376m; 3°30'42"N; 5°31'48"E
23 spms; 11/08/1971; 1267m; 4°21'12"N; 4°35'12"E
10 spms; 09/07/1971; 1537m; 11°57'36"S; 12°54'18"E
2 spms; 14/07/1971; 1787m; 10°31'0"S; 11°57'48"E
3 spms; 24/07/1971; 2243m; 3°47'60"S; 9°17'42"E
7 spms; 22/05/1968; 2644m; 9°41'0"S; 10°54'60"E
1 spm; 23/05/1968; 1427m; 9°5'0"S; 12°16'60"E
1 spm; 17/06/1971; 2745m; 22°50'12"S; 11°57'54"E
17 spms; 17/05/1968; 2864m; 22°53'60"S; 11°54'60"E
5 spms; 03/04/1957; 2972m; 25°33'0"S; 12°26'60"E
1 spm; 02/08/1971; 2273m; 0°50'6"N; 8°26'0"E
3 spms; 23/05/1968; 1946m; 9°28'60"S; 11°33'60"E

Claviderma iberogallicum

Salvini-Plawen 1999
7 spms; 11/06/1991; 139m; 43°29'41.6"N; 2°0'45"W
10 spms; 11/06/1991; 97m; 43°22'40.8"N; 2°15'6.3"W
6 spms; 11/06/1991; 130m; 43°27'31.1"N; 2°24'10.6"W

Salvini-Plawen et al. 1998
6 spms; 10/07/1997; 204m; 36°35'24.6"N; 4°18'59.1"W
1 spm; 10/07/1997; 79m; 35°38'35.1"N; 4°20'16.8"W
1 spm; 10/07/1997; 300m; 36°37'60"N; 4°2'60"W

Scheltema and Ivanov 2000
2 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
1 spm; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W

Claviderma laticarinatum

Ivanov and Scheltema 2001b
24 spms; 05/09/1982; 3240m; 20°51'0"S; 56°2'60"E

Ivanov and Scheltema 2002
3 spms; 31/01/1961; 2029m; 18°56'60"N; 87°0'0"E

Claviderma mexicanum

Ivanov and Scheltema 2008
3 spms; 15/06/2000; 1401m; 27°49'37.2"N; 89°9'57"W
9 spms; 16/06/2000; 1401m; 27°49'40.8"N; 89°10'4.2"W
14 spms; 27/02/1972; 1456m; 8°58'0"N; 54°4'18"W
3 spms; 12/06/2000; 1825m; 28°55'9.6"N; 87°40'13.2"W
1 spm; 14/05/2000; 860m; 27°10'22.2"N; 93°19'18"W
1 spm; 12/06/1985; 748m; 27°45'17.4"N; 90°47'37.8"W
3 spms; 14/05/2000; 875m; 27°10'27"N; 93°19'24"W
1 spm; 20/05/1985; 1536m; 28°15'48"N; 86°36'57.6"W
3 spms; 14/05/2000; 860m; 27°10'22.8"N; 93°19'19.8"W
1 spm; 11/06/1985; 770m; 27°41'17.4"N; 91°17'45.6"W
1 spm; 11/06/1985; 753m; 27°41'36.6"N; 91°17'57"W
1 spm; 13/06/1985; 547m; 27°50'29.4"N; 90°44'6"W
1 spm; 18/05/1985; 860m; 28°7'5.4"N; 86°19'15"W
1 spm; 13/05/1985; 865m; 28°28'27.6"N; 87°0'2.4"W
1 spm; 15/05/1985; 624m; 28°2'44.4"N; 85°40'6.6"W
11 spms; 16/05/1985; 618m; 28°14'49.8"N; 86°9'47.4"W
1 spm; 13/05/1985; 624m; 28°35'26.4"N; 86°44'27"W
1 spm; 14/05/1985; 353m; 28°27'27.6"N; 86°1'30.6"W
2 spms; 13/11/1984; 885m; 27°49'37"N; 90°7'5"W
1 spm; 13/11/1984; 885m; 27°49'37"N; 90°7'5"W
2 spms; 13/11/1984; 6362m; 27°54'42"N; 90°4'24"W
1 spm; 13/04/1984; 1390m; 27°28'24"N; 89°46'48"W
1 spm; 12/06/1985; 755m; 27°45'9"N; 90°47'34.2"W
1 spm; 19/05/1985; 625m; 28°18'2.4"N; 86°18'39"W
1 spm; 12/06/1985; 748m; 27°45'14.4"N; 90°47'48.6"W

Dacryomica plana

Ivanov and Scheltema 2004
1 spm; 21/05/1970; 1300m; 32°8'60"N; 172°55'60"E

Niteomica captainkiddae

Ivanov and Scheltema 2008
2 spms; 11/06/1985; 554m; 27°42'36.6"N; 91°33'3.6"W
2 spms; 09/06/1985; 550m; 27°43'54.6"N; 92°30'14.4"W
3 spms; 09/06/1985; 550m; 27°43'54.6"N; 92°30'1.2"W
1 spm; 08/06/1985; 750m; 27°35'34.8"N; 92°21'42"W
1 spm; 09/06/1985; 545m; 27°43'27.6"N; 92°8'7.8"W
2 spms; 09/06/1985; 549m; 27°43'31.2"N; 92°7'57"W
1 spm; 09/06/1985; 549m; 27°43'31.2"N; 92°7'57"W
2 spms; 09/06/1985; 547m; 27°43'31.8"N; 92°7'57"W
2 spms; 31/05/2000; 1455m; 27°27'33.6"N; 89°47'8.4"W
3 spms; 10/06/1985; 556m; 27°42'45.6"N; 91°32'57.6"W
1 spm; 15/05/1985; 624m; 28°2'44.4"N; 85°40'6.6"W
2 spms; 13/06/1985; 545m; 27°50'30"N; 90°44'7.2"W
1 spm; 13/06/1985; 545m; 27°50'30"N; 90°44'7.2"W
2 spms; 13/06/1985; 550m; 27°50'22.8"N; 90°44'1.2"W
1 spm; 13/06/1985; 547m; 27°50'29.4"N; 90°44'6"W
1 spm; 11/06/1985; 753m; 27°41'37.2"N; 91°17'53.4"W
1 spm; 11/06/1985; 753m; 27°41'36.6"N; 91°17'57"W
1 spm; 11/06/1985; 770m; 27°41'17.4"N; 91°17'45.6"W
1 spm; 13/06/1985; 1236m; 27°19'40.8"N; 91°33'1.8"W
2 spms; 10/06/1985; 580m; 27°42'43.2"N; 91°33'2.4"W
1 spm; 13/05/1985; 624m; 28°35'26.4"N; 86°44'27"W
2 spms; 12/06/2000; 1825m; 28°55'9.6"N; 87°40'13.2"W
1 spm; 30/11/1983; 1325m; 27°29'30"N; 89°43'36"W
1 spm; 08/04/1984; 860m; 27°10'36"N; 93°19'24"W
1 spm; 13/04/1984; 1394m; 27°28'18"N; 89°46'60"W
1 spm; 17/04/1984; 845m; 28°9'36"N; 86°25'0"W
1 spm; 16/11/1984; 1482m; 27°27'46"N; 89°47'6"W
2 spms; 14/11/1984; 1198m; 27°30'25"N; 89°49'23"W
1 spm; 15/11/1984; 1392m; 27°29'35"N; 89°47'53"W
2 spms; 09/06/1985; 550m; 27°43'47.4"N; 92°30'19.2"W
1 spm; 20/05/1985; 852m; 28°15'45"N; 86°37'7.8"W
1 spm; 18/05/1985; 860m; 28°7'5.4"N; 86°19'15"W
1 spm; 19/05/1985; 627m; 28°18'38.4"N; 86°18'9"W
1 spm; 19/05/1985; 627m; 28°18'42"N; 86°18'10.2"W
1 spm; 19/05/1985; 622m; 28°16'46.2"N; 86°14'45.6"W

1 spm; 19/05/1985; 618m; 28°16'50.4"N; 86°14'40.2"W
1 spm; 16/05/1985; 618m; 28°14'49.8"N; 86°9'47.4"W
1 spm; 17/05/1985; 620m; 28°14'47.4"N; 86°9'36"W
1 spm; 16/05/1985; 627m; 28°7'47.4"N; 85°52'21"W
1 spm; 16/05/1985; 627m; 28°7'49.8"N; 85°52'18"W
2 spms; 11/06/1985; 554m; 27°42'36.6"N; 91°33'3.6"W
2 spms; 21/05/1985; 849m; 28°21'55.8"N; 86°47'56.4"W
1 spm; 02/04/1981; 329m; 27°27'18"N; 79°47'32.4"W
2 spms; 10/06/1985; 580m; 27°42'43.2"N; 91°33'2.4"W
5 spms; 12/06/2000; 1832m; 28°55'0.6"N; 87°40'3.6"W
2 spms; 12/06/2000; 1826m; 28°55'9.6"N; 87°40'13.2"W
4 spms; 09/06/2000; 767m; 28°15'9.6"N; 86°25'4.2"W
1 spm; 10/06/2000; 768m; 28°15'6.6"N; 86°25'1.2"W
1 spm; 10/06/2000; 763m; 28°15'13.8"N; 86°24'48"W
1 spm; 14/05/2000; 625m; 27°24'48"N; 93°20'15.6"W
3 spms; 14/05/2000; 625m; 27°24'51"N; 93°20'24"W
1 spm; 05/05/2000; 1175m; 27°19'25.8"N; 91°33'9.6"W
3 spms; 31/05/2000; 1452m; 27°27'36.6"N; 89°46'46.2"W
1 spm; 29/10/1995; 850m; 32°52'0"N; 76°27'0"W
1 spm; 04/05/1981; 298m; 27°30'22.8"N; 79°48'48.6"W
1 spm; 25/06/1982; 318m; 27°30'31.2"N; 79°48'57"W
12 spms; 21/05/2000; 1620m; 26°30'16.8"N; 95°0'11.4"W
2 spms; 30/05/2000; 1070m; 27°43'58.2"N; 89°58'37.2"W
1 spm; 15/06/2000; 1401m; 27°49'37.2"N; 89°9'57"W
1 spm; 16/06/2000; 1401m; 27°49'40.8"N; 89°10'4.2"W
1 spm; 08/05/2000; 1875m; 26°33'23.4"N; 91°49'28.2"W
1 spm; 08/02/1972; 508m; 7°45'18"N; 54°23'60"W
22 spms; 27/02/1972; 1456m; 8°58'0"N; 54°4'18"W

Niteomica hystrix

Scheltema and Ivanov 2000
1 spm; 24/07/1971; 2243m; 3°47'60"S; 9°17'42"E
1 spm; 17/05/1968; 2094m; 22°56'0"S; 12°18'0"E
5 spms; 17/05/1968; 2117m; 23°2'0"S; 12°18'60"E
9 spms; 23/05/1968; 1427m; 9°5'0"S; 12°16'60"E
50 spms; 23/05/1968; 1946m; 9°28'60"S; 11°33'60"E
8 spms; 06/02/1967; 2185m; 10°35'60"N; 17°48'60"W
4 spms; 03/08/1971; 2470m; 2°19'48"N; 7°49'6"E
168 spms; 05/02/1967; 1624m; 10°30'0"N; 17°51'30"W
7 spms; 26/07/1971; 2514m; 2°31'60"S; 8°18'6"E
12 spms; 22/05/1968; 2644m; 9°41'0"S; 10°54'60"E

Niteomica latispiculata

Ivanov 1995
1 spm; 01/01/1958; 1062m; 2°31'0"S; 145°22'0"E

Niteomica liliae

Ivanov and Scheltema 2001b
1 spm; 24/08/1982; 3630m; 21°49'60"S; 55°13'0"E
1 spm; 30/08/1982; 1875m; 20°48'60"S; 55°0'60"E
1 spm; 30/08/1982; 1050m; 20°52'0"S; 55°6'0"E
10 spms; 05/09/1982; 3500m; 20°26'0"S; 55°39'60"E
7 spms; 05/09/1982; 3240m; 20°51'0"S; 56°2'60"E

Prochaetoderma arabicum

Ivanov and Scheltema 2002
2 spms; 05/11/1960; 1730m; 21°8'60"N; 59°38'60"E

Prochaetoderma atlanticum

Scheltema and Ivanov 2000
75 spms; 23/05/1968; 527m; 8°46'0"S; 12°46'60"E

Prochaetoderma boucheti

Scheltema and Ivanov 2000
1 spm; 31/05/1984; 370m; 36°46'18"N; 7°7'18"W
21 spms; NA; 90m; NA; NA
2 spms; NA; 60m; NA; NA
16 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
2 spms; 17/06/1984; 489m; 35°50'6"N; 4°57'36"W
1 spm; 01/06/1984; 250m; 36°47'12"N; 7°4'24"W
6 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
154 spms; 13/06/1984; 425m; 35°51'12"N; 5°10'24"W
11 spms; 15/07/1967; 860m; 43°35'36"N; 3°24'48"W
8 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
9 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
5 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
13 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
1 spm; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
14 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
17 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
1 spm; 12/07/1967; 119m; 47°39'60"N; 5°0'0"W
4 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
10 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
14 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
12 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
2 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
18 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
24 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W
14 spms; 24/07/1978; 101m; 47°40'54"N; 4°20'18"W

Prochaetoderma gilrowei

Ivanov and Scheltema 2008
1 spm; 10/06/1985; 580m; 27°42'43.2"N; 91°33'2.4"W
3 spms; 16/06/2000; 983m; 28°13'13.2"N; 89°29'46.2"W
2 spms; 17/06/2000; 676m; 28°27'3.6"N; 89°40'21.6"W
1 spm; 30/05/2000; 336m; 28°3'34.8"N; 90°14'57"W
2 spms; 30/05/2000; 334m; 28°3'36"N; 90°14'55.8"W
1 spm; 12/06/1985; 748m; 27°45'14.4"N; 90°47'48.6"W
1 spm; 11/06/1985; 770m; 27°41'17.4"N; 91°17'45.6"W
1 spm; 11/06/1985; 761m; 27°41'31.8"N; 91°17'51"W
2 spms; 04/05/2000; 348m; 27°46'33"N; 91°45'56.4"W
1 spm; 11/06/1985; 761m; 27°41'31.8"N; 91°17'51"W
1 spm; 11/06/1985; 753m; 27°41'36.6"N; 91°17'57"W
2 spms; 16/06/2000; 987m; 28°13'9"N; 89°29'47.4"W
1 spm; 12/06/1985; 739m; 27°45'22.8"N; 90°47'47.4"W
1 spm; 16/06/2000; 990m; 28°13'8.4"N; 89°29'30.6"W
10 spms; 11/06/2000; 658m; 29°20'3"N; 87°3'22.8"W
7 spms; 11/06/2000; 667m; 29°19'59.4"N; 87°2'54"W
6 spms; 11/06/2000; 668m; 29°19'55.8"N; 87°3'1.2"W
5 spms; 09/06/2000; 767m; 28°15'9.6"N; 86°25'4.2"W

2 spms; 10/06/2000; 768m; 28°15'6.6"N; 86°25'1.2"W
10 spms; 28/02/1972; 1000m; 8°4'12"N; 55°21'18"W
1 spm; 10/06/2000; 763m; 28°15'13.8"N; 86°24'48"W
4 spms; 13/05/2000; 389m; 27°34'52.8"N; 93°33'1.8"W
50 spms; 08/02/1972; 508m; 7°45'18"N; 54°23'60"W
1 spm; 11/04/1984; 358m; 28°3'18"N; 90°15'12"W
1 spm; 09/06/1985; 547m; 27°43'31.8"N; 92°7'57"W
6 spms; 10/06/2000; 366m; 28°30'6.6"N; 86°4'60"W
1 spm; 20/05/1985; 852m; 28°15'45"N; 86°37'7.8"W
1 spm; 30/11/1983; 853m; 27°49'18"N; 90°7'0"W
1 spm; 30/11/1983; 853m; 27°49'18"N; 97°7'0"W
1 spm; 26/11/1983; 420m; 28°3'12"N; 90°15'12"W
2 spms; 14/11/1984; 1007m; 27°44'38"N; 89°59'13"W
2 spms; 16/05/1985; 627m; 28°7'49.8"N; 85°52'18"W
2 spms; 17/05/1985; 620m; 28°14'47.4"N; 86°9'36"W
1 spm; 16/05/1985; 618m; 28°14'49.8"N; 86°9'47.4"W
4 spms; 19/05/1985; 618m; 28°16'50.4"N; 86°14'40.2"W
2 spms; 19/05/1985; 625m; 28°18'48"N; 86°18'9"W
1 spm; 19/05/1985; 625m; 28°18'2.4"N; 86°18'39"W
2 spms; 18/05/1985; 819m; 28°9'21"N; 86°24'54"W
1 spm; 30/11/1983; 853m; 27°49'36"N; 90°6'48"W
1 spm; 11/04/1984; 348m; 28°3'18"N; 90°15'36"W
2 spms; 13/05/1985; 624m; 28°35'26.4"N; 86°44'27"W
1 spm; 20/05/1985; 852m; 28°15'29.4"N; 86°36'41.4"W
1 spm; 21/05/1985; 847m; 28°21'58.2"N; 86°47'55.8"W
1 spm; 15/05/1985; 351m; 28°12'4.2"N; 85°31'30"W
1 spm; 15/05/1985; 353m; 28°11'60"N; 85°31'31.2"W
3 spms; 15/05/1985; 350m; 28°12'14.4"N; 85°31'28.2"W
3 spms; 14/05/1985; 344m; 28°20'4.8"N; 83°46'51"W
2 spms; 14/05/1985; 353m; 28°53'21"N; 86°23'30"W
6 spms; 14/05/1985; 353m; 28°27'30.6"N; 86°1'27"W
7 spms; 14/05/1985; 353m; 28°27'30.6"N; 86°1'27"W
3 spms; 14/05/1985; 353m; 28°27'27.6"N; 86°1'30.6"W
1 spm; 14/05/1985; 353m; 28°27'28.8"N; 86°1'33.6"W
1 spm; 14/05/1985; 353m; 28°27'28.8"N; 86°1'33.6"W
3 spms; 13/05/1985; 625m; 28°35'16.2"N; 86°46'24"W
1 spm; 12/11/1984; 358m; 28°4'6"N; 90°15'53"W
2 spms; 12/04/1984; 841m; 27°49'36"N; 90°7'6"W
2 spms; 16/04/1984; 357m; 28°27'36"N; 86°1'48"W
1 spm; 16/04/1984; 625m; 28°16'42"N; 86°15'6"W
1 spm; 13/11/1984; 625m; 27°54'44"N; 90°6'32"W
1 spm; 13/11/1984; 884m; 27°49'34"N; 90°7'7"W
1 spm; 13/11/1984; 885m; 27°49'37"N; 90°7'5"W
1 spm; 12/04/1984; 841m; 27°49'36"N; 90°7'6"W
1 spm; 12/11/1984; 361m; 28°4'6"N; 90°15'22"W
2 spms; 13/05/1985; 852m; 28°28'46.8"N; 87°0'1.2"W
2 spms; 14/11/1984; 1021m; 27°44'39"N; 89°58'58"W
3 spms; 14/11/1984; 1029m; 27°44'8"N; 89°59'4"W
1 spm; 15/05/1985; 618m; 28°2'54"N; 85°39'58.2"W
3 spms; 13/05/1985; 852m; 28°28'46.8"N; 87°0'1.2"W
1 spm; 13/05/1985; 865m; 28°28'27.6"N; 87°0'2.4"W
1 spm; 13/05/1985; 622m; 28°35'21.6"N; 86°46'25.8"W
4 spms; 13/11/1984; 885m; 27°49'37"N; 90°7'5"W
2 spms; 15/05/1985; 624m; 28°2'44.4"N; 85°40'6.6"W
1 spm; 12/04/1984; 834m; 27°49'12"N; 90°7'6"W
1 spm; 30/11/1983; 853m; 27°49'36"N; 90°6'48"W
1 spm; 30/11/1983; 853m; 27°49'36"N; 90°6'48"W
1 spm; 04/04/1984; 366m; 27°34'60"N; 93°33'6"W
1 spm; 11/04/1984; 348m; 28°3'18"N; 90°15'12"W
2 spms; 08/04/1984; 860m; 27°10'36"N; 93°19'24"W
1 spm; 12/04/1984; 834m; 27°49'12"N; 90°7'6"W
1 spm; 12/04/1984; 605m; 27°54'18"N; 90°5'54"W

Prochaetoderma raduliferum

Scheltema and Ivanov 2000
2 spms; NA; 50m; NA; NA
1 spm; NA; 71m; NA; NA
1 spm; NA; 115m; NA; NA
1 spm; NA; 155m; NA; NA
1 spm; NA; 51m; NA; NA
1 spm; NA; 62m; NA; NA
2 spms; 13/10/1966; 110m; 31°29'0"N; 33°16'60"E

Prochaetoderma yongei

Ivanov and Scheltema 2001a
10 spms; 05/09/1992; 1209m; 63°14'36.6"N; 26°29'8.4"W
1 spm; 02/07/1993; 1170m; 62°44'51.61"N; 21°33'10.2"W
73 spms; 02/07/1993; 819m; 63°0'10.8"N; 21°0'32.4"W
5 spms; 02/07/1993; 1074m; 62°51'36"N; 21°44'6"W
1 spm; 02/07/1993; 1060m; 62°52'22.19"N; 21°43'25.2"W
8 spms; 01/07/1993; 917m; 62°58'36.01"N; 21°49'18"W
2 spms; 02/07/1993; 784m; 63°0'18"N; 21°0'45.6"W
18 spms; 01/07/1993; 934m; 62°59'12.01"N; 21°46'60"W
3 spms; 01/07/1993; 802m; 63°2'17.99"N; 21°50'48"W
64 spms; 01/07/1993; 838m; 63°2'53.99"N; 21°49'36"W
23 spms; 10/09/1992; 775m; 63°0'6.01"N; 22°39'36.6"W
6 spms; 02/07/1993; 256m; 63°9'55.8"N; 21°12'4.8"W
8 spms; 02/09/1994; 1121m; 64°5'30.01"N; 27°49'42"W
1 spm; 05/09/1992; 1025m; 63°15'29.41"N; 26°3'30"W
31 spms; 05/05/1993; 1099m; 62°27'0"N; 12°55'0"W
4 spms; 31/08/1995; 1681m; 62°4'12.61"N; 20°35'33"W
10 spms; 29/08/1995; 2074m; 62°20'30.01"N; 16°59'18"W
2 spms; 27/08/1995; 1085m; 63°5'24"N; 17°21'6"W
2 spms; 23/08/1995; 1695m; 62°39'50.4"N; 19°45'21.6"W
6 spms; 03/09/1994; 1407m; 63°55'18.01"N; 28°16'48"W
88 spms; 05/07/1993; 842m; 63°4'12"N; 21°34'54"W
3 spms; 02/09/1994; 1042m; 64°10'12"N; 27°43'6"W
29 spms; 03/07/1993; 778m; 63°9'54"N; 20°3'41.4"W
1 spm; 05/07/1993; 791m; 63°4'4.19"N; 21°35'16.8"W
12 spms; 05/07/1993; 666m; 63°6'42.01"N; 21°37'36"W
2 spms; 05/07/1993; 647m; 63°6'50.4"N; 21°36'25.8"W
2 spms; 03/07/1993; 965m; 63°13'48"N; 19°31'42"W
14 spms; 03/07/1993; 1207m; 63°4'4.8"N; 19°51'19.8"W
36 spms; 03/07/1993; 1016m; 63°7'54.01"N; 19°57'12"W
34 spms; 02/09/1994; 1295m; 63°50'30.01"N; 27°42'48"W

Scheltema 1985
9 spms; 26/06/1972; 1470m; 39°24'0"N; 72°7'60"W
2 spms; 15/07/1976; 2091m; 57°59'42"N; 10°39'48"W

7 spms; 04/05/1966; 2022m; 39°43'36"N; 70°37'24"W
1 spm; 05/05/1966; 530m; 39°56'36"N; 71°2'60"W
175 spms; 16/08/1966; 2030m; 39°39'12"N; 70°24'30"W
45 spms; 16/12/1966; 1254m; 39°46'30"N; 70°45'12"W
21 spms; 18/12/1966; 2178m; 39°38'30"N; 70°36'30"W
3 spms; 01/07/1967; 1839m; 39°44'48"N; 70°31'60"W
166 spms; 21/02/1969; 805m; 39°51'18"N; 70°54'18"W
435 spms; 22/02/1969; 1501m; 39°47'36"N; 70°49'54"W
78 spms; 22/02/1969; 2024m; 39°43'0"N; 70°45'60"W
48 spms; 19/07/1976; 1764m; 39°45'30"N; 70°37'12"W
20 spms; 19/07/1976; 1815m; 39°44'54"N; 70°34'60"W
3 spms; 03/12/1973; 457m; 39°54'6"N; 70°10'42"W
986 spms; 06/07/1965; 1102m; 39°48'42"N; 70°40'48"W
19 spms; 17/08/1972; 1500m; 51°32'12"N; 12°35'54"W
1 spm; 29/10/1973; 1180m; 48°37'18"N; 9°3'0"W
1 spm; 16/07/1976; 2081m; 57°58'48"N; 10°48'30"W
1 spm; 22/10/1973; 1175m; 47°33'24"N; 7°9'0"W
1 spm; 27/10/1973; 1200m; 48°52'12"N; 11°7'0"W
5 spms; 18/02/1974; 2006m; 44°6'18"N; 4°2'24.6"W
41 spms; 12/06/1972; 1760m; 39°45'60"N; 70°40'0"W
6 spms; 01/11/1974; 1913m; 44°5'12"N; 4°19'24"W
1 spm; 01/11/1974; 1894m; 44°5'12"N; 4°5'42"W
1 spm; 01/11/1974; 1894m; 44°5'0"N; 4°16'60"W
1 spm; 25/07/1967; 1922m; 46°15'0"N; 4°0'60"W
19 spms; 05/02/1967; 1624m; 10°30'0"N; 17°51'30"W
3 spms; 23/05/1968; 1427m; 9°4'60"S; 12°16'60"E
66 spms; 17/05/1968; 1546m; 23°4'60"S; 12°31'30"E
14 spms; 26/07/1975; 2142m; 38°51'0"N; 72°13'0"W
1 spm; 02/07/1965; 5042m; 39°40'60"N; 66°28'0"W
911 spms; 25/08/1964; 1470m; 39°46'30"N; 70°43'18"W
5 spms; 20/08/1964; 2000m; 39°43'18"N; 70°37'48"W
3 spms; 07/09/1963; 2000m; 38°34'18"N; 72°55'0"W
3 spms; 24/05/1963; 2000m; 39°42'0"N; 70°39'0"W
7 spms; 24/05/1961; 1500m; 39°46'60"N; 70°45'0"W
5 spms; 25/05/1961; 823m; 39°50'30"N; 70°34'60"W
8 spms; 31/10/1974; 1950m; 44°4'48"N; 4°8'42.6"W

Spathoderma alleni

Ivanov and Scheltema 2001a
8 spms; 10/09/1992; 600m; 63°3'52.81"N; 22°41'13.2"W
1 spm; 10/09/1992; 266m; 63°14'55.79"N; 22°47'26.4"W
28 spms; 10/09/1992; 263m; 63°15'1.19"N; 22°47'22.2"W
1 spm; 30/06/1993; 288m; 63°15'0"N; 22°11'60"W
3 spms; 30/06/1993; 291m; 63°15'2.99"N; 22°12'7.2"W
1 spm; 30/06/1993; 346m; 63°9'54"N; 21°53'12"W
5 spms; 01/07/1993; 511m; 63°7'30"N; 21°56'19.2"W
115 spms; 01/07/1993; 520m; 63°7'23.99"N; 22°53'54"W
2 spms; 10/09/1992; 601m; 63°3'25.81"N; 22°39'55.2"W
11 spms; 03/07/1993; 600m; 63°10'23.99"N; 20°8'60"W
12 spms; 08/09/1992; 390m; 63°8'15.61"N; 23°55'36.6"W
288 spms; 03/07/1993; 495m; 63°10'16.21"N; 20°9'32.4"W
1 spm; 02/07/1993; 259m; 63°9'54"N; 21°11'48"W
8 spms; 03/07/1993; 770m; 63°8'30.01"N; 20°3'42"W
1 spm; 03/09/1992; 213m; 64°15'40.79"N; 24°26'3"W
1 spm; 04/09/1992; 293m; 63°27'1.19"N; 24°40'47.4"W
4 spms; 04/09/1992; 296m; 63°27'6.01"N; 24°40'45"W
1 spm; 04/09/1992; 305m; 63°21'4.21"N; 25°21'46.8"W
4 spms; 09/09/1992; 351m; 63°20'27.6"N; 23°24'57"W
12 spms; 08/09/1992; 313m; 63°8'22.81"N; 24°58'60"W
1 spm; 09/09/1992; 347m; 63°20'28.21"N; 23°25'15"W
4 spms; 03/07/1993; 800m; 63°10'18.01"N; 20°3'48"W
58 spms; 03/07/1993; 778m; 63°9'54"N; 20°3'41.4"W
24 spms; 05/07/1993; 448m; 63°10'0.01"N; 21°30'54"W
27 spms; 05/07/1993; 450m; 63°9'54"N; 21°31'36"W
29 spms; 05/07/1993; 666m; 63°6'42.01"N; 21°37'36"W
1 spm; 08/09/1992; 390m; 63°8'24.61"N; 23°55'35.4"W
1 spm; 08/09/1992; 316m; 63°8'15.61"N; 24°59'16.2"W

Scheltema and Ivanov 2000
1 spm; 08/09/1972; 820m; 41°20'36"N; 9°10'48"W
1 spm; 26/10/1973; 610m; 48°35'0"N; 10°23'42"W
5 spms; 22/10/1973; 1175m; 47°33'24"N; 7°18'60"W
3 spms; 25/10/1973; 860m; 48°28'12"N; 9°39'6"W
3 spms; 25/10/1973; 850m; 48°27'12"N; 10°49'42"W
1 spm; 26/10/1973; 720m; 48°40'42"N; 9°54'6"W
3 spms; NA; 300m; NA; NA
1 spm; 30/05/1984; 1283m; 36°45'48"N; 9°29'24"W
1 spm; 01/06/1984; 864m; 36°17'48"N; 7°15'24"W
3 spms; NA; 2632m; 39°16'30"N; 6°18'24"E
1 spm; 14/06/1984; 720m; 35°35'24"N; 3°48'30"W
1 spm; 15/06/1984; 1005m; 35°33'12"N; 4°23'0"W
128 spms; 13/06/1984; 425m; 35°51'12"N; 5°10'24"W
8 spms; 13/06/1984; 570m; 35°55'36"N; 5°2'6"W
1 spm; NA; 170m; NA; NA
1 spm; 14/06/1984; 905m; 35°51'24"N; 3°57'18"W
7 spms; 14/06/1984; 480m; 35°35'18"N; 3°45'6"W
1 spm; 16/06/1984; 252m; 35°56'54"N; 3°6'48"W
24 spms; 17/06/1984; 489m; 35°50'6"N; 4°57'36"W
38 spms; 04/10/1970; 1000m; 43°37'0"N; 2°19'12"W
1 spm; NA; 60m; NA; NA
3 spms; 27/10/1973; 730m; 48°41'18"N; 10°33'48"W
1 spm; NA; 550m; NA; NA
2 spms; NA; 50m; NA; NA
3 spms; 08/09/1972; 740m; 40°33'30"N; 9°24'0"W
9 spms; 08/09/1972; 1040m; 40°36'48"N; 9°21'30"W
2 spms; 08/09/1972; 900m; 41°17'24"N; 9°15'42"W
2 spms; 08/09/1972; 810m; 41°19'24"N; 9°14'24"W
2 spms; 08/09/1972; 550m; 41°19'42"N; 9°11'36"W
1 spm; 12/10/1971; 1000m; 44°7'60"N; 5°3'60"W
64 spms; 19/07/1967; 641m; 43°43'0"N; 3°47'48"W
176 spms; 15/07/1967; 860m; 43°35'36"N; 3°24'48"W
2 spms; 29/10/1973; 800m; 48°38'12"N; 9°52'36"W
3 spms; NA; 540m; NA; NA

Spathoderma bulbosum

Ivanov and Scheltema 2008
7 spms; 29/02/1972; 2487m; 8°12'24"N; 55°50'12"W
2 spms; 15/11/1984; 1147m; 27°30'36"N; 89°49'2"W
1 spm; 13/06/1985; 1251m; 27°19'57.6"N; 91°32'46.2"W

1 spm; 08/06/1985; 1229m; 27°23'40.2"N; 92°44'25.8"W
1 spm; 08/06/1985; 1225m; 27°23'33.6"N; 92°44'21.6"W
1 spm; 08/06/1985; 1238m; 27°23'37.8"N; 92°44'19.2"W
1 spm; 13/05/1985; 865m; 28°28'27.6"N; 87°0'2.4"W
1 spm; 18/05/1985; 622m; 28°16'46.8"N; 86°14'46.2"W
1 spm; 20/05/1985; 852m; 28°15'45"N; 86°37'7.8"W
2 spms; 01/03/1972; 2842m; 8°28'48"N; 56°4'30"W
3 spms; 15/11/1984; 1392m; 27°29'35"N; 89°47'53"W
6 spms; 20/02/1967; 943m; 7°58'0"S; 34°16'60"W
1 spm; 13/06/1985; 1236m; 27°19'40.8"N; 91°33'1.8"W
2 spms; 15/11/1984; 1147m; 27°30'36"N; 89°49'2"W
1 spm; 20/05/1985; 852m; 28°21'45"N; 86°48'5.4"W
1 spm; 09/11/1984; 2540m; 26°57'30"N; 89°41'12"W
1 spm; 09/11/1984; 2533m; 26°57'12"N; 89°33'54"W
2 spms; 15/11/1984; 1506m; 27°27'41"N; 89°47'19"W
1 spm; 29/11/1983; 1440m; 27°28'18"N; 89°47'6"W
1 spm; 29/11/1983; 1440m; 27°28'18"N; 89°47'6"W
1 spm; 30/11/1983; 1378m; 27°29'6"N; 89°46'24"W
1 spm; 30/11/1983; 1325m; 27°29'30"N; 89°43'36"W
1 spm; 08/04/1984; 841m; 27°10'18"N; 93°19'18"W
1 spm; 13/04/1984; 1394m; 27°28'18"N; 89°46'60"W
1 spm; 13/04/1984; 1386m; 27°28'24"N; 89°46'54"W
1 spm; 18/04/1984; 2800m; 28°0'30"N; 86°38'54"W
1 spm; 15/11/1984; 1507m; 27°29'47"N; 89°47'26"W
1 spm; 28/10/1995; 850m; 32°52'0"N; 76°27'0"W
2 spms; 06/06/2000; 3000m; 27°29'57"N; 87°0'4.8"W
3 spms; 14/06/2000; 2627m; 28°16'46.8"N; 87°20'6"W
1 spm; 15/11/1984; 1507m; 27°29'47"N; 89°47'26"W
1 spm; 15/05/2000; 1420m; 26°43'54"N; 93°19'10.2"W
1 spm; 13/06/1985; 1229m; 27°19'54.6"N; 91°32'52.8"W
1 spm; 08/06/2000; 2974m; 28°0'51"N; 86°34'33.6"W
2 spms; 05/05/2000; 1168m; 27°19'23.4"N; 91°33'21"W
1 spm; 13/04/1984; 2377m; 26°56'54"N; 89°36'12"W
1 spm; 13/06/2000; 2382m; 28°33'25.8"N; 87°45'38.4"W
2 spms; 21/05/2000; 1580m; 26°44'57"N; 95°14'40.8"W
4 spms; 21/05/2000; 1570m; 26°44'53.4"N; 95°14'46.2"W
1 spm; 22/05/2000; 1320m; 27°0'18"N; 95°30'11.4"W
4 spms; 31/05/2000; 1463m; 27°27'9"N; 89°46'33.6"W
1 spm; 16/05/2000; 2750m; 26°16'8.4"N; 93°21'47.4"W
3 spms; 06/05/2000; 2253m; 27°12'10.2"N; 91°24'21.6"W
3 spms; 09/05/2000; 2060m; 26°15'5.4"N; 91°12'45"W
2 spms; 01/06/2000; 2487m; 26°55'46.2"N; 89°34'16.8"W
3 spms; 31/05/2000; 1452m; 27°27'36.6"N; 89°46'46.2"W
4 spms; 30/05/2000; 1080m; 27°43'42"N; 89°58'46.8"W
1 spm; 19/05/2000; 2480m; 26°23'32.4"N; 94°33'24"W
7 spms; 30/05/2000; 1070m; 27°43'58.2"N; 89°58'37.2"W
2 spms; 30/05/2000; 1066m; 27°43'53.4"N; 89°59'0.6"W
2 spms; 15/06/2000; 1401m; 27°49'37.2"N; 89°9'57"W
4 spms; 16/06/2000; 1401m; 27°49'40.8"N; 89°10'4.2"W
1 spm; 05/06/2000; 2750m; 27°0'5.4"N; 87°59'17.4"W
3 spms; 31/05/2000; 1455m; 27°27'33.6"N; 89°47'8.4"W

Spathoderma californicum

Groves 2012

3 spms; 24/06/1953; 704m; 33°40'12"N; 118°22'6"W

Schw abl 1963 plus Hartman 1955

1 spm; 08/05/1955; 658m; 33°31'17"N; 118°58'0"W
34 spms; 24/06/1953; 704m; 33°40'12"N; 118°22'6"W
1 spm; 28/02/1953; 536m; 33°24'8"N; 118°13'55"W
3 spms; 28/02/1953; 549m; 33°31'57"N; 118°14'3"W
2 spms; 08/07/1953; 785m; 33°41'55"N; 118°30'6"W
4 spms; 17/09/1953; 732m; 33°29'59"N; 118°14'57"W
5 spms; 23/05/1954; 706m; 33°36'0"N; 118°36'3"W
1 spm; 23/05/1954; 768m; 33°27'57"N; 118°14'0"W
2 spms; 17/06/1954; 830m; 33°26'2"N; 118°17'58"W
3 spms; 28/07/1954; 486m; 33°30'0"N; 118°2'2"W
6 spms; 17/06/1954; 816m; 33°25'60"N; 118°15'58"W

Spathoderma clenchi

Ivanov and Scheltema 2001a

91 spms; 29/08/1995; 2074m; 62°20'30.01"N; 16°59'18"W
3 spms; 02/09/1994; 1295m; 63°50'30.01"N; 27°42'48"W
55 spms; 29/08/1995; 2270m; 61°50'13.2"N; 16°52'51.6"W
35 spms; 30/08/1995; 2295m; 61°43'25.79"N;
1 spm; 30/08/1995; 2400m; 61°10'10.81"N; 18°2'34.2"W
1 spm; 31/08/1995; 1681m; 62°4'12.61"N; 20°35'33"W

Scheltema 1985

4 spms; 18/02/1974; 2430m; 44°11'18"N; 4°5'24.6"W
215 spms; 18/07/1976; 2494m; 56°26'36"N; 11°10'30"W
1 spm; 20/08/1972; 2890m; 50°12'18"N; 13°35'48"W
3 spms; 25/02/1974; 2250m; 47°34'42"N; 8°8'48"W
7 spms; 30/07/1976; 2498m; 50°19'18"N; 12°55'48"W
2 spms; 27/07/1976; 2719m; 50°12'42"N; 13°16'36"W
5 spms; 20/07/1976; 2895m; 55°3'24"N; 12°46'12"W
2 spms; 30/07/1976; 2634m; 50°14'24"N; 13°10'54"W
6 spms; 19/07/1976; 2888m; 55°2'18"N; 12°40'18"W
1 spm; 26/02/1974; 2126m; 47°32'48"N; 8°50'60"W
3 spms; 19/07/1976; 2884m; 55°0'42"N; 12°31'0"W
2 spms; 26/02/1974; 2156m; 47°29'12"N; 8°0'42"W
172 spms; 18/07/1976; 2503m; 56°28'6"N; 11°11'42"W
2 spms; 17/07/1976; 2483m; 56°33'12"N; 11°11'18"W
1 spm; 17/07/1976; 2466m; 56°37'60"N; 11°6'24"W
2 spms; 16/07/1976; 2091m; 57°58'24"N; 10°42'48"W
13 spms; 16/07/1976; 2040m; 57°57'42"N; 10°54'60"W
23 spms; 16/07/1976; 2081m; 57°58'48"N; 10°48'30"W
141 spms; 15/07/1976; 2091m; 57°59'42"N; 10°39'48"W
10 spms; 21/08/1972; 3356m; 50°8'18"N; 13°53'42"W
55 spms; 19/07/1976; 2891m; 55°1'60"N; 12°34'36"W
1 spm; 18/05/1980; 2770m; 47°32'6"N; 9°5'12.6"W
5 spms; 17/05/1968; 2864m; 22°53'60"S; 11°54'60"E
4 spms; 22/05/1968; 2644m; 9°40'60"S; 10°54'60"E
1 spm; NA; 2120m; 47°33'24"N; 8°3'42.6"W
1 spm; 19/05/1980; 2828m; 47°31'60"N; 9°6'18.6"W
1 spm; 18/05/1980; 2748m; 47°31'30"N; 9°5'6.6"W
1 spm; 19/05/1980; 2828m; 47°31'60"N; 9°6'18.6"W
1 spm; 18/05/1980; 2748m; 47°31'30"N; 9°5'6.6"W
1 spm; 26/02/1974; 2175m; 47°32'48"N; 8°1'0"W
1 spm; 18/05/1980; 2730m; 47°32'12"N; 9°4'30"W

22 spms; 19/07/1976; 2884m; 55°0'24"N; 12°29'24"W
1 spm; 17/05/1980; 2885m; 47°32'30"N; 9°5'30"W
1 spm; 16/05/1980; 2740m; 47°31'36"N; 9°4'12.6"W
1 spm; NA; 2227m; 47°34'18"N; 8°9'48.6"W
2 spms; 08/06/1979; 2170m; 47°32'54"N; 8°9'6.6"W
1 spm; NA; 2225m; 47°34'12"N; 8°0'18.6"W
1 spm; 18/05/1979; 2182m; 47°33'24"N; 8°9'42"W
2 spms; 01/06/1974; 1913m; 44°5'12"N; 4°19'24"W
2 spms; 21/06/1974; 2150m; 44°8'48"N; 4°17'24"W
2 spms; 18/05/1980; 2811m; 47°31'30"N; 9°6'24.6"W
1 spm; 07/09/1963; 2000m; 38°34'18"N; 72°55'0"W
211 spms; 16/08/1966; 2030m; 39°39'12"N; 70°24'30"W
71 spms; 18/12/1966; 2178m; 39°38'30"N; 70°36'30"W
5 spms; 01/12/1967; 1839m; 39°44'48"N; 70°31'60"W
6 spms; 22/02/1969; 1501m; 39°47'36"N; 70°49'54"W
274 spms; 22/02/1969; 2024m; 39°43'0"N; 70°45'60"W
11 spms; 19/07/1976; 1764m; 39°45'30"N; 70°37'12"W
3 spms; 19/07/1976; 1815m; 39°44'54"N; 70°34'60"W
1 spm; 24/11/1973; 3264m; 38°14'24"N; 70°20'18"W
6 spms; 12/06/1972; 1760m; 39°45'60"N; 70°40'0"W
18 spms; 04/05/1966; 2022m; 39°43'36"N; 70°37'24"W
19 spms; 25/08/1964; 1470m; 39°46'30"N; 70°43'18"W
1 spm; 04/05/1966; 2050m; 39°41'18"N; 70°35'54"W
2 spms; 20/08/1964; 2000m; 39°43'18"N; 70°37'48"W
1 spm; 24/05/1963; 2000m; 39°42'0"N; 70°39'0"W
1 spm; 03/08/1976; 2749m; 38°30'0"N; 72°11'0"W
74 spms; 20/07/1976; 2897m; 55°7'42"N; 12°52'36"W
4 spms; 07/09/1975; 2673m; 39°19'0"N; 70°12'0"W
33 spms; 26/07/1975; 2142m; 38°51'0"N; 72°13'0"W
8 spms; 26/06/1972; 1470m; 39°24'0"N; 72°7'60"W
1 spm; 15/08/1975; 3264m; 38°45'60"N; 71°10'0"W
5 spms; 21/08/1964; 2496m; 39°25'60"N; 70°32'60"W

Spathoderma grossum

Ivanov and Scheltema 2008
41 spms; 27/03/1971; 2440m; 36°5'12"S; 52°17'54"W
15 spms; 24/03/1971; 3906m; 37°40'54"S; 52°19'18"W
4 spms; 15/03/1971; 3343m; 37°15'6"S; 52°45'0"W
5 spms; 14/03/1971; 3815m; 37°36'48"S; 52°23'36"W
1 spm; 03/03/1972; 3862m; 12°34'24"N; 58°59'18"W
1 spm; 26/02/1972; 3859m; 10°6'6"N; 55°13'60"W
1 spm; 26/03/1971; 3305m; 37°13'18"S; 52°45'0"W
3 spms; 24/02/1972; 4980m; 13°16'0"N; 54°52'12"W

Scheltema and Ivanov 2000
2 spms; 21/05/1968; 4559m; 10°24'0"S; 9°9'0"E
1 spm; 12/06/1981; 5280m; 43°0'6"N; 14°2'54"W
1 spm; 18/07/1981; 4220m; 37°20'0"N; 15°37'0"W
2 spms; 30/05/1981; 4270m; 34°6'0"N; 17°3'60"W
1 spm; 08/06/1981; 5320m; 39°59'30"N; 15°2'36"W
1 spm; 12/06/1981; 5260m; 42°59'42"N; 14°5'24"W
3 spms; 30/05/1981; 4270m; 34°6'6"N; 17°6'18"W
1 spm; 21/05/1968; 4597m; 10°28'60"S; 9°3'60"E
6 spms; 17/05/1981; 4450m; 37°17'60"N; 15°33'0"W
1 spm; 06/01/1979; 5220m; 26°59'54"S; 1°6'42"E
2 spms; 09/06/1971; 4184m; 21°59'6"S; 9°1'30"E
2 spms; 30/12/1978; 4560m; 33°20'30"S; 2°34'54"E
1 spm; 31/12/1978; 4585m; 33°24'30"S; 2°32'54"E
1 spm; 29/12/1978; 4610m; 33°20'54"S; 2°37'54"E
3 spms; 20/07/1983; 4990m; 44°41'12"N; 17°48'60"W
1 spm; 11/08/1976; 4327m; 47°29'48"N; 9°39'12"W
2 spms; 09/08/1976; 4268m; 47°29'48"N; 9°33'24"W
1 spm; 23/08/1972; 4426m; 50°4'42"N; 15°44'48"W
2 spms; 21/05/1981; 5160m; 34°53'60"N; 21°26'6"W
1 spm; 10/08/1976; 4277m; 47°28'48"N; 9°33'60"W

Spathoderma longisquamosum

Ivanov and Scheltema 2001b
1 spm; 08/01/1960; 1622m; 45°0'0"S; 45°45'60"E

Spathoderma quadratum

Ivanov and Scheltema 2008
1 spm; 08/06/1985; 1222m; 27°23'30"N; 92°44'15"W
8 spms; 12/06/2000; 1832m; 28°55'0.6"N; 87°40'3.6"W
5 spms; 12/06/2000; 1825m; 28°55'9.6"N; 87°40'13.2"W
4 spms; 22/05/2000; 950m; 27°15'14.4"N; 95°44'37.2"W
1 spm; 13/06/1985; 547m; 27°50'29.4"N; 90°44'6"W
1 spm; 18/05/1985; 860m; 28°7'3.6"N; 86°19'7.8"W
7 spms; 15/04/1984; 347m; 28°27'42"N; 86°1'0"W
1 spm; 11/04/1984; 595m; 27°54'30"N; 90°6'12"W
1 spm; 11/04/1984; 348m; 28°3'18"N; 90°15'12"W
2 spms; 11/04/1984; 357m; 28°3'18"N; 90°15'12"W
4 spms; 12/06/2000; 1826m; 28°55'9.6"N; 87°40'13.2"W
3 spms; 22/05/2000; 950m; 27°14'58.8"N; 95°44'49.8"W

Spathoderma subulatum

Ivanov and Scheltema 2001b
4 spms; 23/08/1982; 1390m; 21°11'60"S; 55°0'60"E
3 spms; 24/08/1982; 1175m; 21°12'60"S; 55°4'0"E
12 spms; 30/08/1982; 1875m; 20°48'60"S; 55°0'60"E
17 spms; 30/08/1982; 1710m; 20°47'0"S; 55°5'0"E
6 spms; 30/08/1982; 1050m; 20°52'0"S; 55°6'0"E
13 spms; 03/09/1982; 1575m; 20°45'60"S; 55°37'60"E

Anexos

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Em observância ao **§5º do Artigo 1º da Informação CCPG-UNICAMP/001/15**, referente a Bioética e Biossegurança, declaro que o conteúdo de minha Dissertação de Mestrado, intitulada "***Prochaetodermatidae (Aplacophora , Mollusca) do Sudeste do Brasil***", desenvolvida no Programa de Pós-Graduação em Biologia Animal do Instituto de Biologia da Unicamp, não versa sobre pesquisa envolvendo seres humanos, animais ou temas afetos a Biossegurança.

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