

NEW GENUS OF FRESHWATER SPONGES WITH A NEW SPECIES FROM AMAZONIAN WATERS (PORIFERA, DEMOSPONGIAE)

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ABSTRACT

Pottsiela n. gen. of continental sponges is defined to contain *P. pesae*, n. sp, besides *P. spoliata* n. comb., *P. aspinosa*, n. comb., *P. inarmata* n. comb., the last three transferred from genus *Spongilla* Lamarck 1816. The new genus has as distinctive characteristics gemmules allways deprived of pneumatic coat and gemmoscleres, but surrounded by an irregular arrangement of megascleres which may form a conspicuos cage. The distinction among the species is stablished upon the differing arrangements of the megascleres around or on the gemmules, the shape of the gemmules, as well as on the shape and size of megascleres and microscleres. The new genus has a distribution which encompasses the Palearctic, Neartic, and Neotropical Regions.

Key words: continental sponges, missing gemoscleres, *Pottsiela pesae* n. gen. n. sp.

RESUMO

Novo gênero de esponjas de água doce com uma nova espécie de águas amazônicas (Porifera, Demospongiae). *Pottsiela* n. gen. de esponjas continentais é definido, contendo *P. pesae*, n. sp, além de *P. spoliata* n. comb., *P. aspinosa*, n. comb., *P. inarmata* n. comb., essas três transferidas do gênero *Spongilla* Lamarck 1816. *Pottsiela* n. gen. distingui-se por gêmulas sempre desprovidas de camada pneumática e gemoscleras, mas circundadas por um arranjo irregular de megascleras, que podem formar um conspícuo ninho em torno da gêmula, operando-se a distinção entre as espécies pelos diferentes arranjos das megascleras em torno ou sobre a gêmula, pela forma das gêmulas e pela forma e tamanho das megascleras e microscleras. O novo gênero tem distribuição nas Regiões Paleártica, Neártica e Neotropical.

Palavras-chave: esponjas continentais, gemoscleras ausentes, *Pottsiela pesae* n. gen. n. sp.

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INTRODUCTION

Upon restricting the genus *Spongilla* Lamarck, 1816, Penney and Racek, 1968, coined a new definition that was intended to contain the species that remained after they had excluded several others that were transferred to the genus *Eunapius* Gray, 1867, redefined, genus *Stratospongilla* Annandale 1909, also redefined and *Radiospongilla* n. gen. They acknowledged, however, that the redefined genus *Spongilla* contained two distinct groups of species that the authors distinguished mainly by the microscleres present in both groups “as well as in some other morphological features” (Penney and Racek, 1968, pg. 8). However, these two groups possess features as distinctive as those used in the process of exclusion they had performed: one has gemmules provided with a pneumatic layer and incrustation of peculiar gemmoscleres, where they aligned *S. lacustris*, the species type of the genus, besides *S. alba* Carter, 1849, *S. arctica* Annandale, 1915, *S. helvetica* Annandale 1909, *S. cenota* n. sp. and *S. wagneri* Potts, 1889; the other has gemmules lacking pneumatic layer and gemmoscleres, while containing microscleres, on occasion, *S. aspinosa* Potts, 1880 and *S. inarmata* Annandale 1918. Manconi and Pronzato, 2002, adopted the redefinition and list of species of *Spongilla* proposed by Penney and Racek, 1968, while adding *S. shikaribensis* Sasaki, 1934, an species with microscleres and gemmules with pneumatic coat and gemmoscleres and yet *S. stankovic* Arndt, 1938, where gemmoscleres and microscleres seem to be absent. Manconi and Pronzato (op.cit.) were unaware of the synonymization made by Poirrier, 1976, of *S. wagneri* in *S. alba* and the description of *S. spoliata* Volkmer-Ribeiro and Maciel, 1983, a species also deprived of gemmoscleres. *S. spoliata*, described from several fragments of a specimen encrusted on in submersed riparian vegetation in the river Cuieras, near Manaus, Amazonas State, Brazil, had several features in common with *S. aspinosa* occurring in the United States and Canada and *S. inarmata* recorded for Japan (Volkmer-Ribeiro and Maciel, op.cit.) The subsequent receipt of several specimens from the Venezuelan and Brazilian Amazon in which the gemmules also lacked gemmoscleres, had microscleres somewhat similar to *S. spoliata*, but with megascleres varying from spiny oxea on their median parts to oxea with one or two spines, led to the re-description of *S. spoliata* by Tavares and Volkmer-Ribeiro (1997), with the assumption of variations of an ecomorphic nature. However, the proposal of the genus *Duosclera* by Ricciardi and Reischwig, 1993, containing only *Spongilla mackay* Carter, 1885, in which both gemmoscleres and microscleres are absent, returned the focus precisely to the species that have microscleres but gemmules in which gemmoscleres and pneumatic coat are absent, until now retained in the

genus *Spongilla*, i. e. *S. aspinosa*, *S. inarmata* and *S. spoliata*. The purpose of granting a new taxonomic status to these species, was reinforced when plenty of new materials of sponges with microscleres but missing pneumatic coat and gemmoscleres were collected from the Amazonian Region thus providing an extensive study of such materials, including the ones dealt with by Tavares and Volkmer-Ribeiro (1997). This effort resulted in the recognition of two south-american species with sufficiently distinct and recurrent anatomical and ecological characteristics, to the definition of the new genus *Pottsiela*, encompassing the other known species sharing the same characteristics, the redescription of *Pottsiela spoliata* n. comb., type species of the new genus and the description of *Pottsiela pesae* n. sp.

MATERIAL AND METHODS

The specimens object of the present study, are catalogued in the Porifera collection of the Museum of Natural Sciences of the Zoobotanical Foundation of Rio Grande do Sul (MCN-POR). Preparations of spicular dissociation of the sponges were performed according to Volkmer-Ribeiro (1985) and Volkmer-Ribeiro and Turcq (1996), for studies with, respectively, light optical and Scanning Electron Microscopy. The SEM photographs were obtained at the Electron Microscopy Laboratory of ULBRA, in Canoas, Rio Grande do Sul and later treated and mounted with the use of computer graphics. Fifty (50) measurements were made of each spicular component, considering all the specimens of each one of the species. Digital photographs of representative specimens of each of the four species were also produced.

RESULTS

Taxonomy

Family Spongillidae Gray, 1867

Genus *Pottsiela* n. gen.

Spongilla Manconi and Pronzato 2002: 925-929 (partim); 2007: 61-77 (partim)

Type species – *Spongilla spoliata* Volkmer-Ribeiro and Maciel, 1983

Definition

Sponges with one class of smooth to spined megascleres, spined microscleres, dermal membrane spicular, gemmules missing pneumatic layer and gemmoscleres, the megascleres forming cages to contain the gemmules or else they irregularly adhere

to the gemmular wall, sponges forming arborescent brown growths around leaves, twigs and branches of the seasonally flooded vegetation or sponges forming flat whitish crusts on rocky bottoms.

Composition and Distribution

The new genus encompasses the species *P. aspinosa* (Potts, 1880) (USA and Canada), *P. inarmata* (Annandale 1918) (Japan), *P. spoliata* (Volkmer-Ribeiro and Maciel, 1983) and *P. pesae* n. sp. (both at the Brazilian and Venezuelan Amazonia Region), with a **distribution in the Palearctic, Neartic and Neotropical Regions.**

Etymology

The genus name is dedicated to the memory of Edward Potts, the first to describe a freshwater sponge deprived of gemmoscleres and the taxonomist who dedicated the best of his life to bring to light the North American and part of the Canadian Fauna of continental sponges, altogether with precise and delightful descriptions of their habitats.

Pottsiela spoliata (Volkmer-Ribeiro and Maciel, 1983) n. comb.

Figs. 1, 2, 3 A-B

Spongilla spoliata Volkmer-Ribeiro and Maciel, 1983:255-264. figs. 1,2. Volkmer-Ribeiro and Tavares, 1993:187-188 (partim). Manconi and Pronzato 2007: 61-77. Non *Spongilla spoliata* Volkmer-Ribeiro and Pauls, 2000: 1-28; *Spongilla spoliata* Volkmer-Ribeiro and Batista, 2007; Batista, Volkmer-Ribeiro and Melão:2007; Roque, Trivinho-Strixino, Couceiro, Hamada and Volkmer-Ribeiro, 2010:131-139; Volkmer-Ribeiro, Parolin, Fürstenau-Oliveira and Menezes, 2010:340-347.

Holotype

Brazil, Amazonas, River Cuieras – UTM: -2.50, -2.6090, -60.0, -60.20910, MNRJ, 0087, E. J. Fittkau leg. Esquizoholotype, MCN-POR 37.

Material Examined

VENEZUELA, **Amazonas**: (Caño Caripo, 3°06'40"N 65°51'06"W) 29.I.1979, S. M. Pauls col. (MCN-POR 623); BRASIL, **Amazonas**: Manaus, River Cuieras (Esquizoholotype), 2°41'55,8"S 60°19'49,02"W), 1961, E.J. Fittkau col. (MCN-POR 37), 20.III.1993, N. L. Chao col. (MCN-POR 7675); **Rondônia**: Porto Velho

(River Verde, 8°31'S 63°31'W), 24.XI.1988, M. C. M. Tavares col. (MCN-POR 1701, 1620, 2423, 2526, 2676); **Mato Grosso:** (River Xingu, River 7 de Setembro, 12° 56'59,59"S 52° 48'36,00"W), VIII.65, E. J. Fittkau col. (MCN-POR 69, 70).

Diagnosis

Continental sponges with gemmules missing gemmoscleres and pneumatic coat, singly loosely contained inside an open circular arrangement of megascleres, the thick sponginous coat provided with one short porus tube. Megascleres long, stout, smooth oxea, rarely exhibiting a few sparse spines. Microscleres scanty, long, stout, straight to slightly curved, microspined, abruptly pointed oxea bearing except at their extremities several digitiform also microspined projections.

Redescription

Sponges forming hispid grayish crusts on submersed woody materials and displaying a tendency to progress in growth from flat crusts at the sponge border towards irregularly branching upright pinnacles and crests at the middle part of the crust, these projections sometimes topped by conspicuous oscular apertures. (Fig. 3, A-B).

Skeleton an open isodictial reticulation which may condense into upright branching fibers and as the growth progresses these fibers may next fuse forming crests and conular projections which extend beyond the conspicuous pinacoderm so as to produce a hispid coralliform surface (Fig. 3-B). Consistency of dry sponge friable, dry color from yellow at the base to whitish gray at the top. Pinacoderm conspicuous, charged with microscleres. Megascleres: quite long, slender to robust, completely smooth, rarely bearing a few sparse spines, slightly curved anfxoexa with abruptly, almost lanceolated extremities. Microscleres from minute to quite robust microspined oxea, slightly crescentic in outline, with abruptly pointed extremities and bearing except at their extremities several digitiform also microspined projections (Fig. 2 ,B-E). Spicules measures in table 1. Gemmoscleres: absent. Gemmules: small, scarce, inconspicuous, singly held inside circular loose tangential arrangements of megascleres, generally situated close to surface of the sponge, with a maximum diameter of 623 micrometers; ovoid to spherical, pneumatic layer and gemmoscleres absent, foramen bearing a short, conical collar. (Fig. 1 A-D)

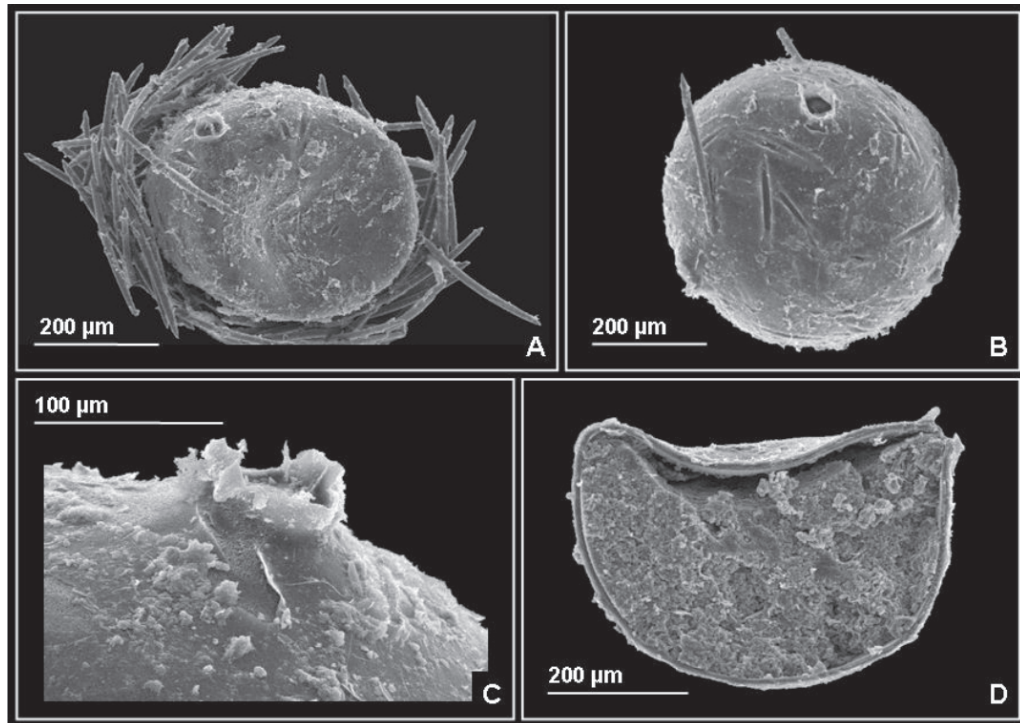


Figure 1. *Pottsiela spoliata* n. comb. SEM illustrations of the gemmule. A: megascleres condensation around the gemmule. B: gemmule with foraminal tube and impression of the surrounding megascleres upon the gemmular wall. C: detail of the foraminal tube. D: cross section of the gemmular wall evidencing the absence of pneumatic coat and gemmoscleres.

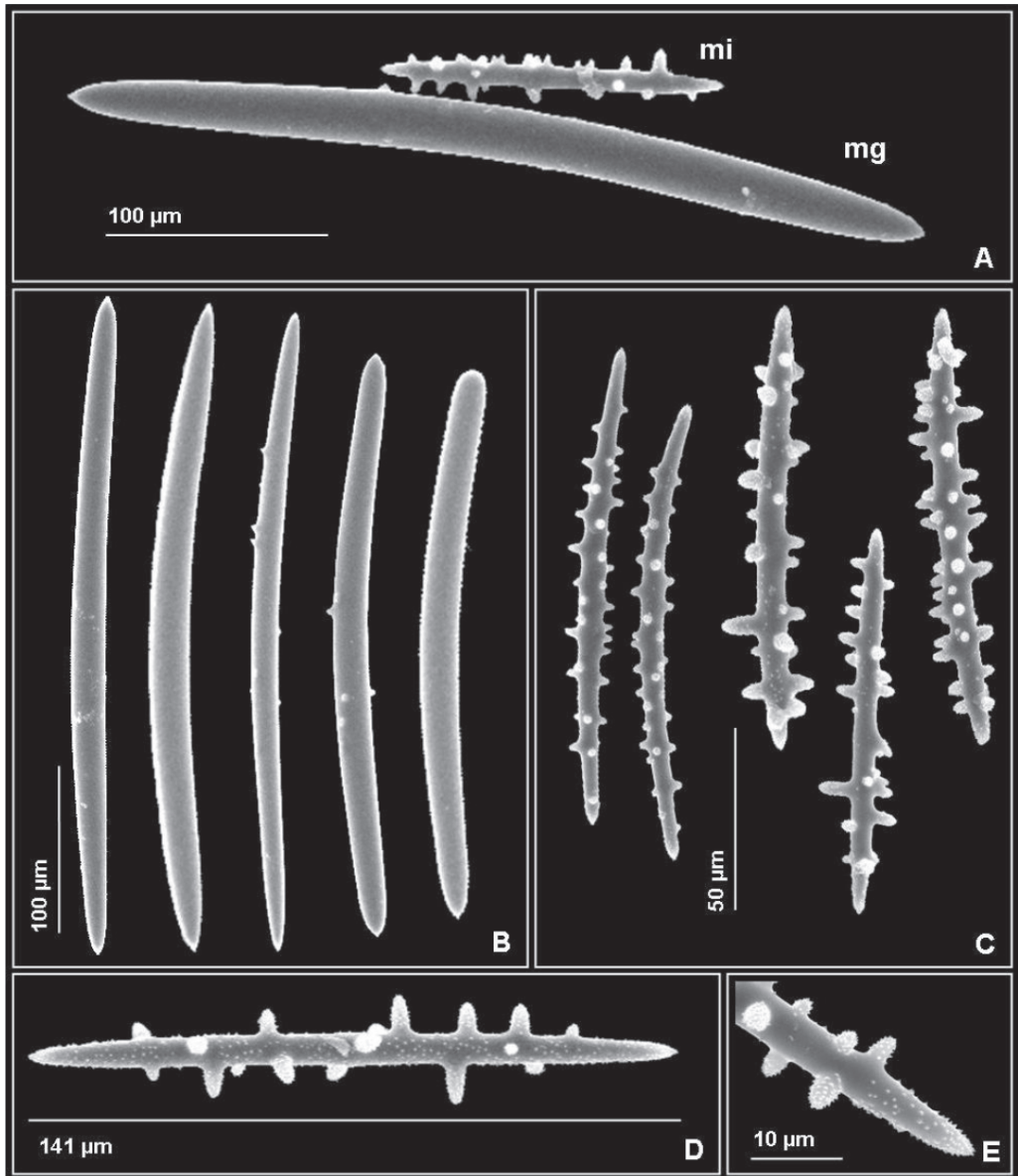


Figure 2. *Pottsiela spoliata* n. comb. SEM illustrations of the spicules. A: megasclere (mg) and microsclere (mi). B: variation of the megascleres. C: variations of the microscleres. D and E: details of the shape and smount and disposition of the spines on the microsclere and their microspine covering.

Type Locality

Brazil, Amazonas, River Cuieras, (2°41'55,8"S 60°19'49,02"W)

Habitat

The species is found encrusting parts of the usually most deeply seasonally submersed vegetation but it may also encrust fallen logs and branches at 15 m deep and thus be permanently covered by water.

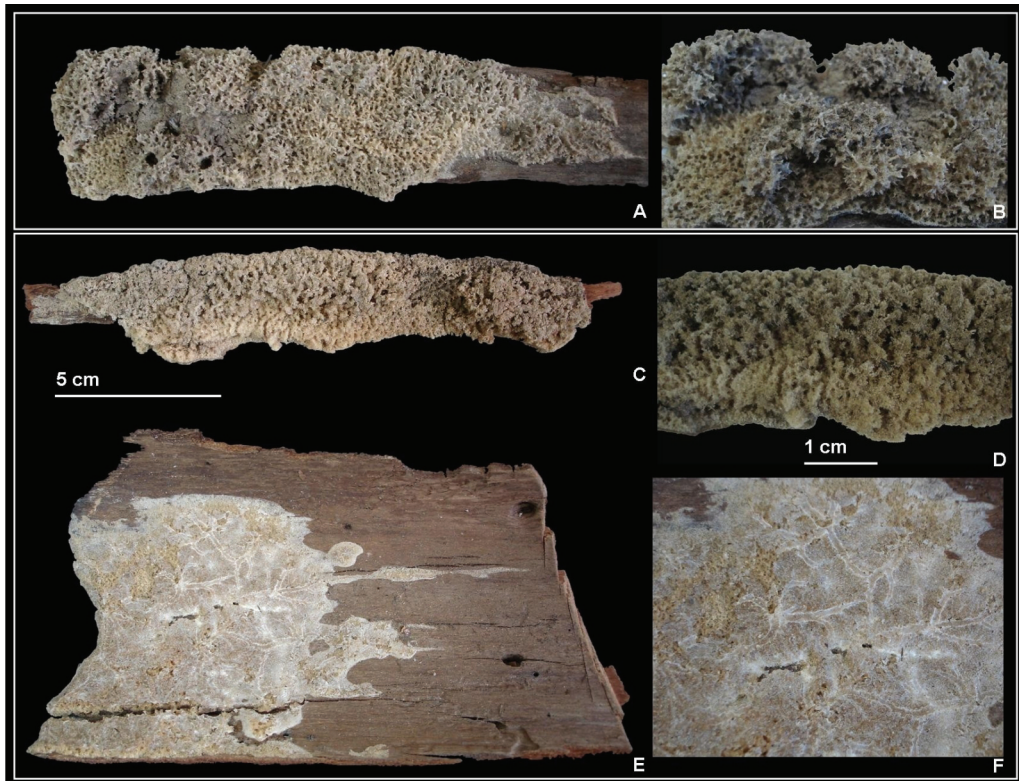


Figure 3. A and B: *Pottsiela spoliata* n. comb. C, D, E, F: *Pottsiela pesae* n. sp. Digital photographs of the specimens evidencing the macroscopic differences in the sponge surface sculpture. E and F: flat specimen of *Pottsiela pesae* n. sp showing the withish conspicuous pinacoderm and its astrorhizae. Photograph by Vanessa de S. Machado.

Pottsiela pesae n. sp.

Figs. 3 C-F, 4, 5, 6

S. spoliata Volkmer-Ribeiro and Tavares, 1993:187-188; Tavares and Volkmer-Ribeiro, 1997:97-111. fig. 3-4 (partim); Volkmer-Ribeiro and Pauls, 2000: 1-28; Volkmer-Ribeiro and Batista, 2007; Batista, Volkmer-Ribeiro and Melão: 2007; Roque, Trivinho-Strixino, Couceiro, Hamada and Volkmer-Ribeiro, 2010:131-139; Volkmer-Ribeiro, Parolin, Fürstenau-Oliveira and Menezes, 2010:340-347.

Holotype

BRASIL, Pará, River Tapajós (between the villages of Alter do Chão and Santarem), 29.X.1994. R. Reis col. (MCN-POR 2923).

Paratypes

VENEZUELA, Amazonas, River Casiquiare (3°08'16,78"N 65°52'49,37"W), 29.I.1979, S. M. Pauls col. (MCN-POR 676); BRAZIL, Roraima, Bom Fim, Igarapé da Arraia (03°21.038'N 59°54.255'W), 22.III.2002, A. M. Pes col. (MCN-POR 5907); Caracará, Cachoeira do Bem Querer (01°55.743'N 61°00.143'W), 21.II.2002 A. M. Pes col. (MCN-POR 5916); Pará, River Tapajós, Praia Arariá (2°24'50,10"S 54°48'34, 90"W), 13.X.91, J. A. Andrade col. (MCN-POR 2399); Amazonas, Curuá-Una Hydroelectric Reservoir (2°49'02,22"S 54°18'05,09"W), 10.X.1991, C. Volkmer-Ribeiro col. (MCN-POR 2344)

Material Examined

VENEZUELA, **Bolivar**: Guayana, Puerto Ordaz (Parque Cachamay, 8°18'18,57"N 62°41'54,26"W), 21.II.1993, G. Pereira col. (MCN-POR 2897); **Amazonas**: River Ventuari (3°58'58,39"N 67°03'04,33"W), 03.IV.2005, N. K. Lujan col. (MCN-POR 6923, 6925); La Esmeralda, River Orinoco (3°10'22,80"N 65°32'40,66"W), 03.II.1979, S. M. Pauls col. (MCN-POR 2440, 2441); River Casiquiare (3°08'16,78"N 65°52'49,37"W), 29.I.1979, S. M. Pauls col. (MCN-POR 676, 677, 2106, 2431); BRAZIL, **Roraima**: Bom Fim, Igarapé da Arraia (03°21.038'N 59°54.255'W), 22.III.2002, A. M. Pes col. (MCN-POR 5907); Boa Vista, River Cauamé (02°52'05,2"N 60°44'25,5"W), 28.VI.2003, N. Hamada col. (MCN-POR 6350); Alto Alegre, River Cauamé (02°52'05,2"N 60°44'25,5"W), 25.X.2004, R. L. M. Ferreira and N. Hamada col. (MCN-POR 7696); Caracará, Cachoeira do Bem Querer (01°55.743'N 61°00.143'W), 21.II.2002 A. M. Pes col. (MCN-POR 5916); Caroebe, Jatapu Hydroelectric Reservoir (0°50'59,6"N 59°18'13,7"W), II.2007, L.

M. Fusari, C. A. Azevedo, J. Falcão & J. Silva col. (MCN-POR 7659); **Amazonas:** Manaus (concrete columns of the Manaus Harbor, 3°8'8.14"S 60° 1'48.02"W), 17.X.2009, V. F. V. Junior and I. B. Barros col. (MCN-POR 8355); Presidente Figueiredo, Balbina Hydroelectric Reservoir (1°55'05,55"S 59°28'27,66"W) X.1987, Alvarenga and Costa col. (MCN-POR 2024, 2025); River Uatumã (downstream of the Balbina Hydroelectric Reservoir, 1°57'12,82"S 59°28'30,41"W), 27.X.1988, Emilio Masuda col. (MCN-POR 2685, 2686, 2687); River Uatumã, 15.XII.74, R. P. Leal col. (MCN-POR 993); Manaus, River Negro (Lake of Prato at Anavilhanas, 2°45'S 60°44'13,43"W), 17.VII.1990, M. Garcia col. (MCN-POR 8304); **Pará:** Santarém, River Tapajós (downstream Ponta das Pedras, 02°26'17,4"S 54°53'58,6"W), 02.X.2007 (MCN-POR 8281), 01.X.2007 (MCN-POR 8288), D. M. Pimpão and D. C. Fettuccia col.; River Tapajós, Praia Arariá (2°24'50,10"S 54°48'34, 90"W), 13.X.91, J. A. Andrade col. (MCN-POR 2399, 2578, 2581); River Tapajós (between Santarém and Alter do Chão, 2°24'50,04"S 54°49'25,65"W), 29.X.1994, R. E. Reis col. (MCN-POR 2923); Curuá-Una Hydroelectric Reservoir (2°49'02,22"S 54°18'05,09"W), 15.X.1991 (MCN-POR 2335), 10.X.1991 (MCN-POR 2342, 2344, 2345, 2347), C. Volkmer-Ribeiro col.; Altamira, River Iriri (Cachoeira Grande, 03°50'34,1"S 52°44'08,5"W), 24.X.2007, L. M. Fusari and N. Hamada col. (MCN-POR 7981); **Rondônia:** Porto Velho, River Jamari (downstream the Samuel Hydroelectric Reservoir, 8°44'36,71"S 63°27'56,33"W), 19-21.XI.88, M. C. M. Tavares col. (MCN-POR 1621,1622, 1636, 1637, 1649, 1661, 1688, 1694, 1703, 2323); **Mato Grosso:** Cocalinho, River Cristalino (14°22'10,60"S 50°59'12,42"W), 09.X.2002, T. C. A. Batista and C. Volkmer-Ribeiro col. (MCN-POR 5945); **Goiás:** São Miguel do Araguaia, River Crixás Açu (APA Meandros do Rio Araguaia, 13°19'02,44"S 50°36'35,90"W), 12.X.2002, T. C. A. Batista and C. Volkmer-Ribeiro col. (MCN-POR 6081, 6085), 22.IX.2005, T. C. A. Batista col. (MCN-POR 7119, 7121, 7122, 7128).

Diagnosis

Continental sponges with gemmules missing gemmoscleres and pneumatic coat but surrounded by a tangential arrangement of the megascleres which closely adhere to the gemmular coat, one foraminal orifice present. Megascleres short, stout, spiny oxea, the short, conical spines never covering the spicule extremities. Microscleres abundant, more often short, stout, straight, microspined, abruptly pointed oxea bearing along its length abundant, conical also microspined spines.

Description

Sponges forming from quite thin and smooth withish crusts to voluminous, massive, spongy, hemispherical, yellowish, sculptured crusts on rocky bottoms as well as on woody permanently submersed substrates. Withish flat crusts exhibiting a thick, conspicuous pinacoderm studded with microscleres and with conspicuous astrorhiza. Thick elastic crusts with hispid surface sculptured into shallow furrows and crests with also conspicuous oscula. Skeleton an isodictial closed reticule which may condense into fibers composing a meandering structure were no main or secondary fibers may be detected. Consistency of dry sponge rigid but brittle. Megascleres: Short, stout, spiny oxea, the short, conical spines never covering the sclere extremities. Microscleres abundant, varying from quite long, slightly curved sparsely spined gradually pointed oxea to, more often, short, stout, straight, microspined, abruptly pointed oxea bearing along its length abundant, conical also microspined spines. Gemmoscleres: absent.

Gemmules: scarce, spherical, close to the sponge surface, gemmoscleres and pneumatic layer absent, a tangential arrangement of the megascleres closely adhering to the gemmular coat, the thick sponginous coat provided with one single foramen; maximum diameter of 750 micrometers.

Table 1. Spicule micrometries of *Pottsiela spoliata* and *P. pesae* n. sp. (Min, minimum; Max, maximum; Ave, average; SD, standard deviation). All measures in μm .

	<i>Pottsiela spoliata</i>				<i>Pottsiela pesae</i> n. sp			
	Megascleres		Microscleres		Megascleres		Microscleres	
	Length	Width	Length	Width	Length	Width	Length	Width
Min	268,2	13,3	124,7	6,3	211,6	11,1	98	7,2
Max	899,6	34,4	254,6	14,1	345,9	28,1	193,5	15,4
Ave	415,7	22,0	171,0	9,7	264,6	20,1	131,3	10,1
SD	135,6	5,3	26,3	1,6	26,3	3,3	22,7	1,7

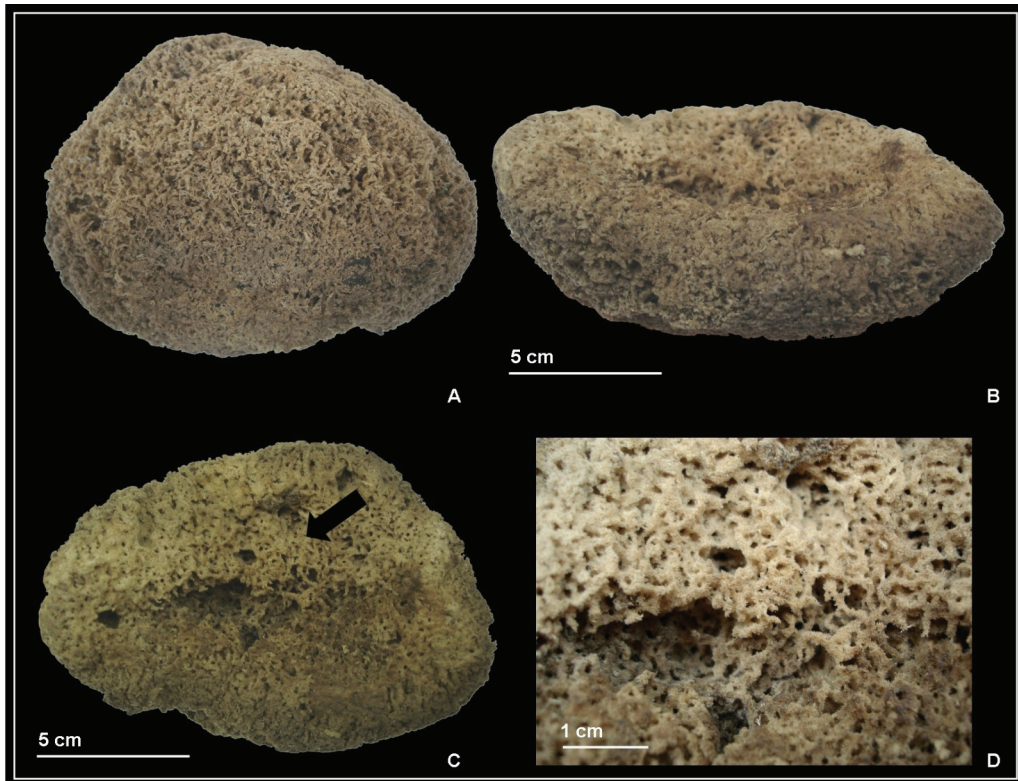


Figure 4. Digital photographs of the holotype of *Pottsia pesae* n. sp. A: upper view. B: lateral view to show the specimen curvature. C: bottom surface showing the sponge hollow inner part and the wall thickness. D: magnification of the bottom surface (arrow in C) to show the reticulum anastomosing structure. Photograph by Vanessa de S. Machado.

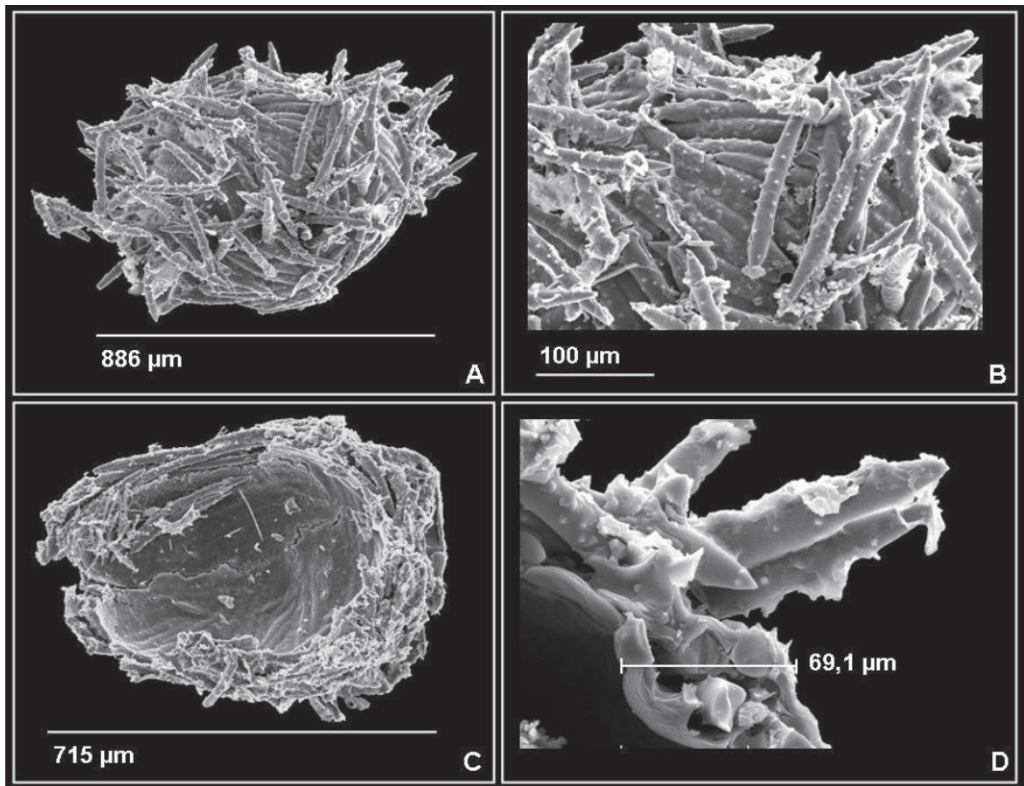


Figure 5. *Pottsiela pesae* n. sp. SEM illustrations of the gemmule. A and B: tangential arrangement of the megascleres composing the gemmular capsule. C and D: cross section of the gemmular wall evidencing the absence of pneumatic coat and gemmoscleres as well as the capsule of megascleres sticking to the gemmular wall.

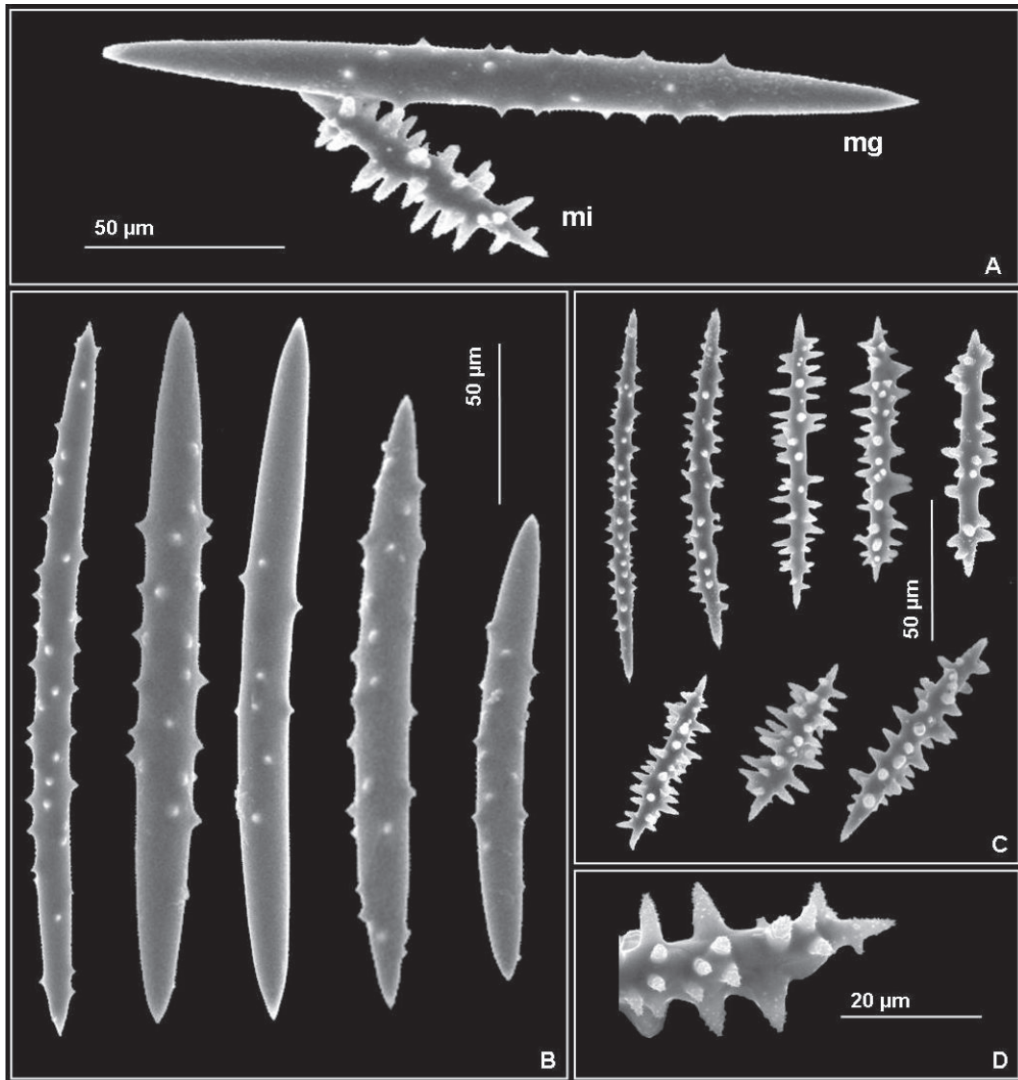


Figure 6. *Pottsia pesae* n. sp. SEM illustrations of the spicules. A: megasclere and microsclere. B: variation of the megascleres. C: variations of the microscleres. D: details of the shape and disposition of the spines on the microsclere and their microspine covering.

Habitat

The species is bound to encrust rocky substrates at fast running waters, where it may form from quite thin to the massive crusts but it may also take substrates permanently submerged at amazonian man-made lakes, as at the Curuá-Una one.

Type Locality

BRAZIL, Pará, River Tapajós (2°24'50,04"S 54°49'25,65"W), between the villages of Alter do Chão and Santarem.

Etymology

The species is dedicated to Dr. Ana Maria Oliveira Pes, INPA, for her contribution with freshwater sponge materials gathered in her search for the associated Trichopteran species in particularly amazonian water.

Remarks

Only two species were described in the genus *Spongilla* "sensu" Penney and Racek (1968), with gemmules which lack gemmoscleres and pneumatic coat and are contained inside cages built up of the megascleres, i. e. *S. aspinosa* Potts (1880) and *S. inarmata* Annandale (1918). The first one is known only from the United States and the second is apparently restricted to Japan. The description of *S. stankovici* Arndt, 1938, with gemmules devoid of pneumatic coat and which seems to have passed undetected to Penney and Racek, op. cit., leads to the hypothesis that this may also be a *Pottsiela* species. New collections of *S. stankovici* are however required, aiming a comparison and reevaluation with the few materials described in what respects the dubious evidences of the presence of gemmoscleres offered in the original description.

The size, shape and presence or not of spine covering of megascleres and microscleres are distinctive enough to set apart the four species presently recognized in *Pottsiela* n. gen. *P. pesae* n. sp. is however the sole one to have its megascleres composing a capsule which closely adheres to the gemmular coat.

The presently known distribution of the new genus in South America points to a larger concentration in the amazonian region (Fig. 7), however that may be taken with precaution since this distribution may result of more intensive surveys being carried by zoologists, limnologists and freshwater biologists at that area in the last decades.

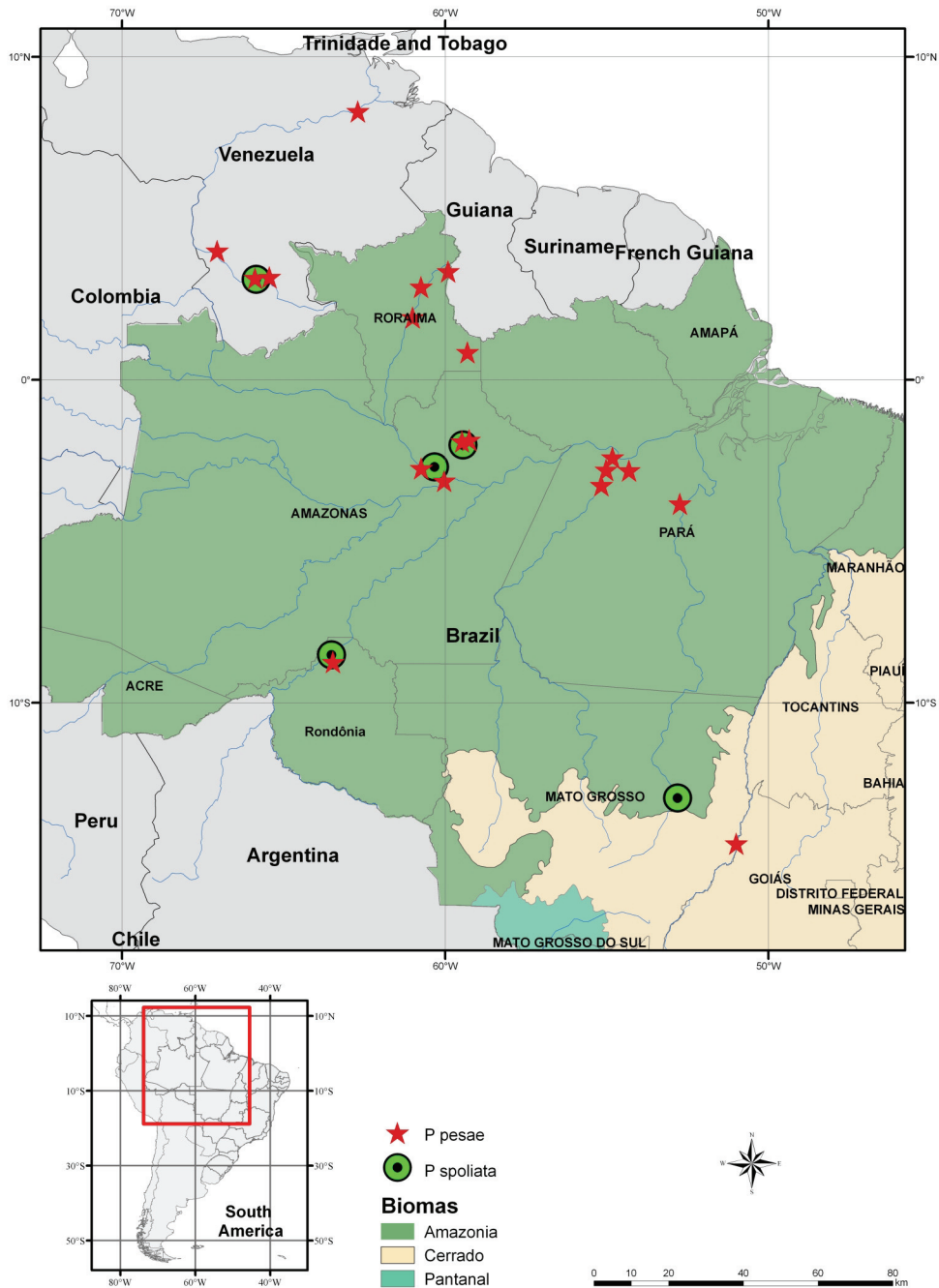


Figure 7. Map showing the presently known distribution of genus *Pottsia* n. gen in the South American continent.

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REFERENCES

- ANNANDALE, N. 1918. Zoological results of a tour in the far east. II. Freshwater sponges from Japan, China and the Malay Peninsula. **Mem. Asiatic Soc. Bengal**, **6**:199-216.
- ARNDT, W. 1938. Spongiologische Untersuchungen am Ochridasee. **Arch. f Hydrobiologie**, **34**:48-80.
- BATISTA, T. C. A.; VOLKMER-RIBEIRO, C.; MELÃO, M. G. G. 2007. Espongofauna da Área de Proteção Ambiental Meandros do Rio Araguaia (GO, MT, TO), Brasil, com descrição de *Heteromeyenia cristalina* sp. nov. (Porifera: Demospongiae). **Rev. Bras. Zool**, **24**:608-630.
- MANCONI, R.; PRONZATO, R. 2002. Suborder Spongillina subord nov.: Freshwater Sponges In: J. N. A. Hooper; R. W. M. Soest. (Org.). **Systema Porifera: a guide to the classification of sponges**. New York: Kluwer Academic/ Plenum Publishers, p. 921-1019.
- PENNEY, J. T.; RACEK, A. A. 1968. Comprehensive revision of a worldwide collection of freshwater sponges (Porifera: Spongillidae). **U.S. Nat. Mus. Bull**, **272**:1-184.
- POTTS, E. 1880. On freshwater sponges. **Proc. Acad. Nat. Sci. Philadelphia**, **1881**:356-357.
- ROQUE, F. O. et al. 2010. Chironomidae (Diptera) living in freshwater sponges (Porifera) in Brazil. In: L. C. Ferrington Jr. (Org). **Proceedings of the XV International Symposium on Chironomidae**. Saint Paul: University of Minnesota, p. 131-139.
- TAVARES, M. C. M.; VOLKMER-RIBEIRO, C. 1997. Redescrição das esponjas de água doce *Oncosclera navicella* (Carter, 1881) (Potamolepidae) e *Spongilla spoliata* Volkmer-Ribeiro & Maciel, 1983 (Spongillidae). **Biociências**, **5**(1):97-111.
- VOLKMER-RIBEIRO, C. 1985. Manual de técnicas para a preparação de coleções zoológicas. **SBZ**, **3**:1-6.

- VOLKMER-RIBEIRO, C.; BATISTA, T. C. A. 2007. Levantamento de cauxi (Porifera, Demospongiae), provável agente etiológico de doença ocular em humanos, Araguatins, rio Araguaia, Estado do Tocantins, Brasil. **Revista Brasileira de Zoologia**, **24**:133-143.
- VOLKMER-RIBEIRO, C.; MACIEL, S. B. 1983. New freshwater sponges from Amazonian waters. **Amazoniana**, **8**(2):255-264.
- VOLKMER-RIBEIRO, C. et al. 2010. Colonization of hydroelectric reservoirs in Brazil by freshwater sponges, with special attention on itaipu. **Interciência**, **35**(5):340-47.
- VOLKMER-RIBEIRO, C.; PAULS, S. M. 2000. Esponjas de Água Dulce (Porifera, Demospongiae) de Venezuela. **Acta Biol. Venez.**, **20**(1):1-28.
- VOLKMER-RIBEIRO, C.; TAVARES, M. C. M. 1993. Sponges from the flooded sandy beaches of two amazonian clear water rivers (Porifera). **Iheringia Sér. Zool.**, **75**:81-101.
- VOLKMER-RIBEIRO, C.; TURCQ, B. 1996. SEM analysis of silicious spicules of a freshwater sponge indicate paleoenvironmental changes. **Acta Microscópica**, **5**:186-187.