

# *Racekiela cavernicola* (Porifera: Demospongiae) new species and the first record of cave freshwater sponge from Brazil

## A nova espécie *Racekiela cavernicola* (Porifera: Demospongiae) e o primeiro registro de esponja cavernícola de água doce do Brasil

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### Abstract

*Racekiela cavernicola* n. sp., first species of Neotropical freshwater sponge found in cave habitat was discovered in the Lapa dos Brejões, a large cave system (coordinates 11°00'42,7"S; 41°25'59,6"W) on karstic terrains at the northern part of the Chapada Diamantina, State of Bahia, northeast Brazil. The description of the new species is provided altogether with "in situ" photographs of specimens and gemmules, SEM photographs of the spicules and the gemmular structure. Two distinct classes of gemmoscleres differing in size and shape are present. This is the second species of genus *Racekiela* Bass and Volkmer-Ribeiro, 1998 registered for the Neotropical Region. The first one, *R. sheilae* (Volkmer-Ribeiro, De Rosa-Barbosa and Tavares, 1988) is known up to now only from coastal wetland areas in Brazil. Extensive surveys in the open tracts of river Jacaré are required before the new species may be considered a troglobitic species. However, this species has high potential to be included in this category, once the epigean reach of the Jacaré River is not perennial.

**Key words:** continental sponges, caves, Neotropical Region, preserved area.

### Resumo

*Racekiela cavernicola* n. sp., primeiro registro de esponja de água doce em cavernas na Região Neotropical, foi descoberta na Lapa dos Brejões, um extenso sistema de cavernas (coordenadas 11°00'42,7"S; 41°25'59,6"W) situado em terrenos cársticos na parte setentrional da Chapada Diamantina, Estado da Bahia, região Nordeste do Brasil. A descrição da nova espécie é apresentada juntamente com fotos "in situ" de exemplares e gêmulas, fotografias ao MEV das espículas e estrutura das gêmulas. Duas classes distintas, em forma e tamanho, de gemoscleras estão presentes. Esta vem a ser a segunda espécie do gênero *Racekiela* Bass and Volkmer-Ribeiro, 1998, com registro para a Região Neotropical. A primeira, *R. sheilae* (Volkmer-Ribeiro, De Rosa-Barbosa e Tavares, 1988) é, até agora, conhecida somente de ambientes lênticos de pequenas dimensões em áreas úmidas costeiras do Brasil. Levantamentos mais abrangentes nos trechos epígeos do rio Jacaré são recomendados antes que a nova espécie possa ser considerada troglóbia (restrita ao ambiente subterrâneo); entretanto, cabe ressaltar que esse rio não é perene em sua porção epígea além de ser possível que a espécie pertença a esse status ecológico-evolutivo.

**Palavras-chave:** esponjas continentais, cavernas, região neotropical, área preservada.

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## Introduction

Records of freshwater sponges occupying underground water in caves are rare and include two types of events: sponges from the surface that enter in the system by accident and which cannot be considered true cave-dwellers and sponges whose habitat is restricted to caves, with modifications associated to such isolation (troglóbites). In the first case, there is the example of *Ephydatia fluviatilis* cited by Van Soest and Velikonja (1986) in a study that compiles the existing knowledge of the cave-dwelling fauna from around the world. *Eunapius subterraneus* Sket and Velikonja, 1984, found in subterranean caves in the municipality of Ogulin, Croatia, constitutes the only record of a troglóbite freshwater sponge (Bilandžija *et al.*, 2007). These authors studied the morphological variability and the distribution patterns of this species, listed among the threatened species of fauna in Yugoslavia.

To date, there have been no records of cave sponges for the Neotropical Region. *Spongilla cenota* Penney and Racek, 1968 was described for the cenotes in the Yucatan (Mexico) lake and running water environments, developed in karstic terrains, with underground communication. However, there is no register of this species in the underground part of this system. The occurrence of a sponge in the waters of the River Jacaré within the Lapa dos Brejões in Chapada Diamantina, State of Bahia, northeast of Brazil comes to be this first register as well as represent a new species for science. The description was occasioned by the fact that the samples possessed abundant gemmules. The register provides a basis for the creation of a more effective local conservation unit, since the Lapa dos Brejões already lies within an APA (Environmental Protection Area), and also extend the number of cave-dwelling species to the State of Bahia and the Neotropical Region.

## Material and methods

### Study area

Lapa dos Brejões is located in the North part of the Chapada Diamantina region, Drought Polygon (Polígono das Secas), to the centre-north of the State of Bahia (coordinates 11°00'42,7"S, 41°25'59,6"W; Figure 1), having been formed in Neoproterozoic limestone terrain of the Grupo Una (Salitre Formation). This area accompanies the course of the Jacaré River, also known locally as Vereda do Romão Gramacho; a right bank tributary of the São Francisco River, on the northeast edge of the Irecê Sediment Basin. According to Berbert-Born and Karmann (2000) (Figure 2),

"The cave developed in grey laminated calcissiltites with fine intercalations of algal laminites belonging to the Lower New America Subunit, probably related to the start of the first depositional cycle of the four cycles that constitute the Salitre Formation, according to Pedreira (1993). Brejões I nominates the upstream stretch of the river and the depression canyon. The River Jacaré disappears in a sink around 300 metres before the main entrance, reappearing inside the cave about 750 metres from the entrance. From there it runs the full length of the most western gallery of the cave in a south-north direction, until it meets a syphon close to the "2<sup>nd</sup> skylight", while maintaining a calm perennial flow with several pools".

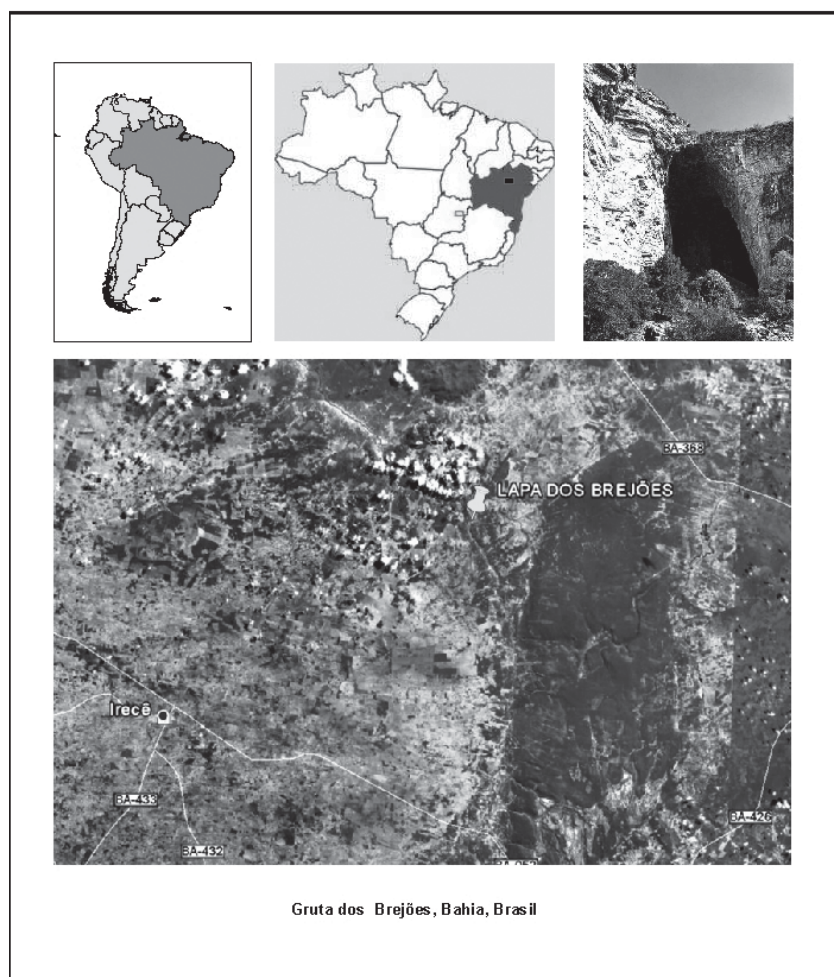
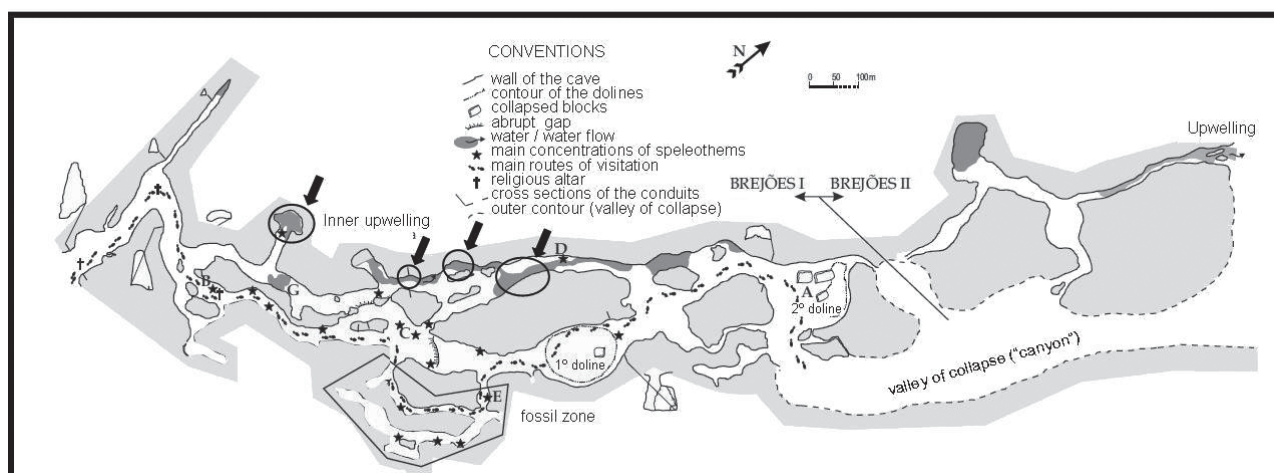


Figure 1. Map of the Lapa dos Brejões, Bahia, Brazil.





**Figure 2.** Map of the Lapa dos Brejões cave system, indicating the sites where *Racekiela cavernicola* n. sp. was found (modified from Berbet-Born and Karmann, 2000).

With the aim of preserving its scientific, environmental, archeological and anthropological context, the APA (Environmental Protection area) Gruta de Brejões/Vereda Romão Gramacho was created, while taking into account that its chemical deposits and fossil-bearing sediments can contribute towards the paleoenvironmental interpretations of the Quaternary.

### Laboratory procedures

Preparations of spicular dissociation of the sponge were performed according to Volkmer-Ribeiro (1985), and Volkmer-Ribeiro and Turcq (1996), at the Spongology Laboratory of Natural Sciences Museum of Fundação Zoobotânica do Rio Grande do Sul (FZB-RS), at Porto Alegre, RS, Brazil, for studies with, respectively, light optical and Scanning Electron Microscopy. The SEM photographs were obtained at the Electron Microscopy Laboratory of ULBRA – Universidade Luterana do Brasil, in Canoas, RS, Brazil, and later treated and mounted with the use of computer graphics. Fifty measurements were made of each spicular component. Holotype deposited at the Porifera Collection of Museum of Natural Sciences (MCN-POR) of FZB-RS.

### Taxonomy

Genus *Racekiela* Bass and Volkmer-Ribeiro, 1998

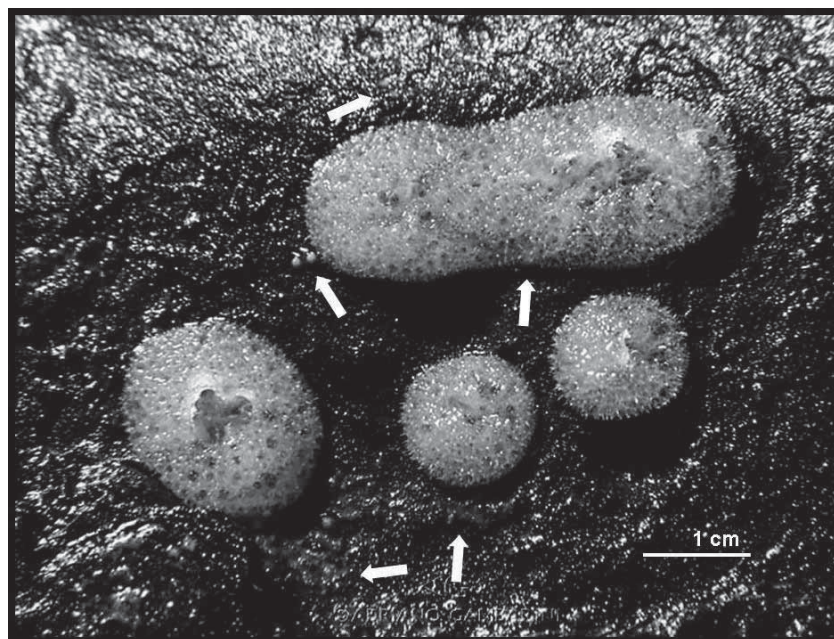
*Racekiela cavernicola* sp. nov.

Figures 3-6

**Studied material.** Holotype, MCN-POR 8309, Jacaré River, APA Gruta dos Brejões/Vereda Romão Gramacho, Morro do Chapéu, Bahia. Maria Elina Bichuette leg. 15/V/2009 (one dry specimen, 2 permanent slides

and 2 SEM stubbs with gemmules and dissociated spicules).

**Diagnosis.** Sponge forming thin crusts or rounded small specimens on the rocky bottom of the river in low, slow flowing waters, spongin scanty, skeleton composing an isodictyal reticulation with scanty spongin, megascleres acanthoxeas, microscleres absent, abundant gemmules, inside the skeleton or singly sticking to the substrate, gemmoscleres in two categories differing in shape and size,

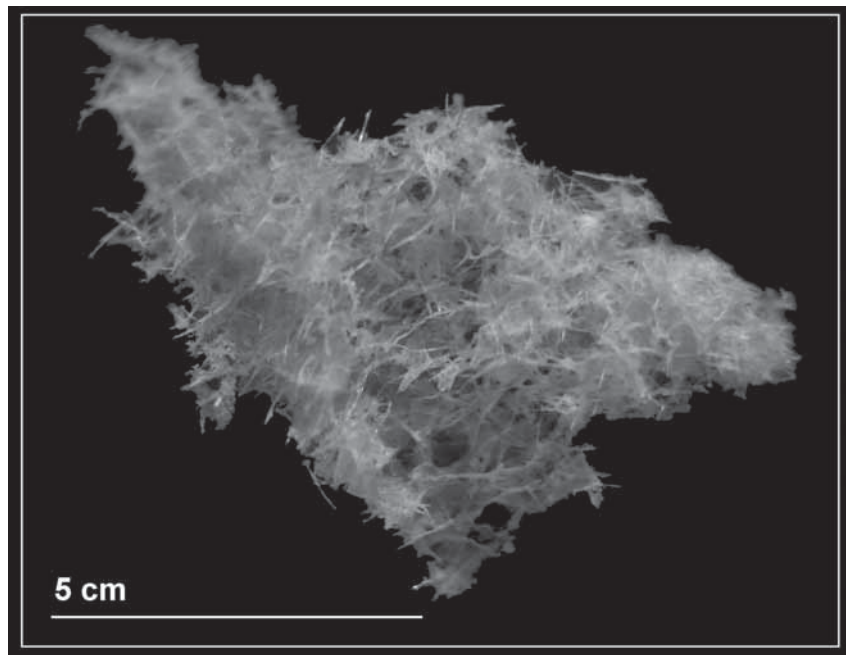


**Figure 3.** Photograph of several specimens and gemmules (arrows) of *Racekiela cavernicola* n. sp. "in situ" at Lapa dos Brejões. Photo by Adriano Gambarini.

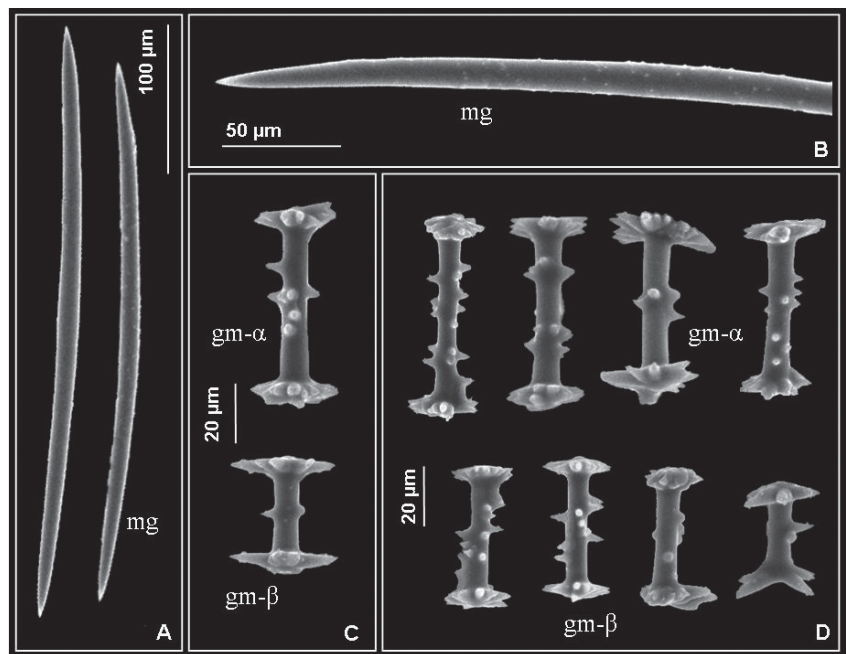
the longer ones with small, flat to slightly umbonate rotules, the shorter ones with flat expanded deeply incised rotules, shafts in both categories profusely to poorly spined.

**Description.** Young sponges forming small whitish rounded specimens with a conspicuous central oscular area (Figure 3) or sponges forming thin, very fragile yellowish crusts (Figure 4) on the river rocky bottom. Skeleton composing an isodictyal reticulation with scanty spongin (Figure 4). Megascleres slender, gradually very sharply pointed, slightly curved, sparsely spined anfixoxea, spines minute (Figures 5A-B). Microscleres absent. Gemmules abundant in the skeleton meshwork or singly sticking to the substrate (Figure 3). Gemmule spherical (Figures 6A-B), foraminal tube short and expanded in an irregularly cut collar in its upper portion (Figures 6B-C). Pneumatic coat thick, with irregularly sized air cameras (Figure 6D). Gemmoscleres side by side radially set in the pneumatic coat. Outer coat concealing the upper rotules of the longer gemmoscleres (Figure 6A). Gemmoscleres in two categories, differing in size as well as shape (Figure 5C). The longer ones birotulates with small slightly umbonated rotules cut in a number a short, blunt rays, shafts robust with a few spines grouped in the middle of the shaft or shafts whole spined (Figure 5C). The shorter birotulates with large expanded, flat rotules deeply cut in a number of long rays, shafts slender, smooth or bearing a few long spines in its middle portion (Figure 5C). Gemmoscleres displaying an extraordinary array of malformations which may conceal the differences between the two classes (Figure 5D). These malformations include rotules of quite differing sizes or one rotule reduced to a knob with a few projected rays, or both rotules reduced to an irregular arrangement of rays of quite differing sizes (Figure 5D). Spicule measurements in Table 1.

**Habitat.** The sponge occupies several low flowing water compartments of



**Figure 4.** Photograph of the dry preserved holotype of *Racekiela cavernicola* n. sp. Photo by Vanessa de S. Machado.



**Figure 5.** *Racekiela cavernicola* n. sp. SEM photographs of the spicular set. A, megascleres (mg); B, enlarging of the megasclere (mg) surface evidencing the spines; C, figure of one gemmosclere (gm-α) of the longer class (up) and one of the shorter class (bottom) (gm-β); D, illustration of the malformations exhibited by the two classes of gemmoscleres (gm-α and gm-β).

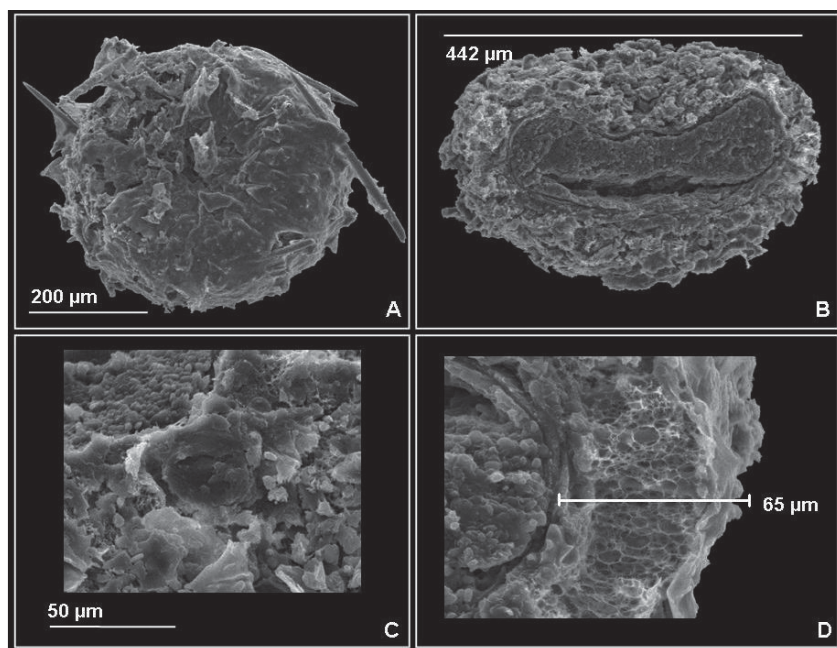
Jacaré River inside the Brejões I cave system (Figure 2).

**Etymology.** The species name refers to its presently known habitat.

## Discussion

The two categories of gemoscleres allied to their particular shape exclude





**Figure 6.** *Racekiela cavernicola* n. sp. SEM photographs of the gemmules. A, entire gemmule with outer gemmular coat; B, cross section of the gemmule; C, detail of the foraminal tubule; D, detail of the inner, the pneumatic and the outer coats of the gemmular wall.

any chance to place this species in other genus of freshwater sponges but *Racekiela* Bass and Volkmer-Ribeiro (1998). This is the second species of this genus registered for the

Neotropical Region. The first one, *R. sheilae* (Volkmer-Ribeiro, De Rosa-Barbosa and Tavares, 1988) is known up to now only from coastal wetland areas in Brazil (Volkmer-Ribeiro

and Machado, 2007). Three species are now seen to compose this genus i.e. *R. ridery* (Potts, 1882) from the Neartic Region and *R. sheilae* and *R. cavernicola* n. sp. from the Neotropical Region. The differences among the three species show up as a set of clearly discernible characteristics, i. e. the size of the spicules set, which enlarges from the first to the third one; the size differences between the two gemosclere categories, which diminishes from the first to the second and the third species (Table 2); the robustness and spines of shafts of the longer gemosclere, where *R. sheilae* attains a middle position; the umbonate curvature of the rotules of the longer gemosclere, where *R. ridery* shows the most umbonate rotules provided with curved spines and *R. cavernicola* n. sp. the less umbonate ones; and yet the deep cutting of the rotules of the shorter gemosclere, which attains its maximum in *R. cavernicola* n. sp.

The gemmoscleres of the new species show an array of evident malformations, which may be attributed to the fact that the waters of Jacaré River, may be draining regional mineral reserves

**Table 1.** Spicule micrometries (shaft and the diameter of the rotules) of *Racekiela cavernicola* nov. sp. Abbreviations: Min, minimum; Max, maximum; Ave, average; SD, standard deviation. All measures in µm.

	Megascleres		Longer Gemoscleres			Shorter Gemoscleres		
	Shaft		Shaft		Rotules	Shaft		Rotules
	Length	Width	Length	Width	diameter	Length	Width	diameter
Min	359,2	10,3	60,6	6,5	19,70	37,2	5,6	21,66
Max	512,1	20,3	84,9	11,8	50,57	58,5	11,2	57,53
Ave	439,7	15,3	69,2	9,0	30,94	52,6	8,9	35,48
SD	37,5	2,2	5,9	0,9	5,11	4,9	1,2	7,79

**Table 2.** Spicule micrometries for *Racekiela ryderi*, *R. sheilae* and *R. cavernicola* nov. sp. All measures in µm.

		<i>R. ryderi</i>	<i>R. sheilae</i>	<i>R. cavernicola</i> sp.n.
Megascleres	Length	296-431	259-462	359-512,1
	Width	12-26	4-17	10,3-20,3
Longer gemoscleres	Length	47-92	41-70	60,6-84,9
	Width	5-10	2-10	6,5-11,8
Shorter gemoscleres	Length	33-49	35-54	37,2-58,5
	Width	5-8	4-8	5,6-11,2
	Rotules	25-29	26-33	21,66-57,53
Gemules	Diameter	320-350	370-543	431-483

rich in plumb, zinc, fluorite and barium (Misi and Silva, 1994).

An extensive survey for freshwater sponges along Jacaré River and neighbour basins should be performed before *R. cavernicola* n. sp. may be considered restricted to this cave system and thus a true troglobic species, but there is a high potential for this consideration. The fact is that the State of Bahia, which has not been subject of freshwater sponge surveys, holds up to now only two registers of these sponges: that of *Corvomeyenia thumi* (Traxler, 1895) for seasonal small water ponds at the Abaeté protected dune area, at the municipality of Salvador (Volkmer-Ribeiro, 1992), and that of *Drulia browni* (Bowerbank, 1863), *Trochospongilla paulula* (Bowerbank, 1863) and *Trochospongilla delicata* Bonetto and Ezcurra de Drago, 1967 for the Grande and Paramirim rivers (Volkmer-Ribeiro and Peixinho, 1989), contributors to the São Francisco River at the municipalities of Barra and Paramirim, BA.

The finding of *R. cavernicola* n.sp. inside the Lapa dos Brejões cave system, now the only one in Brazil to shelter a freshwater sponge, comes to be a fresh new argument which adds to the archeological and geological ones in favor of the monitoring and continued conservation of this area.

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## References

- BASS, D.; VOLKMER-RIBEIRO, C. 1998. *Radiospongilla crateriformis* (Porifera, Spongillidae) in the West Indies and Taxonomic Notes. *Iheringia, Série Zoologia*, **85**:123-128.
- BERBET-BORN, M.; KARMANN, I. 2000. Lapa dos Brejões – Vereda Romão Gramacho, Chapada Diamantina, Bahia. In: C. SCHOBENHAUS; D. A. CAMPOS; E. T. QUEIROZ; M. WINGE; M. BERBET-BORN (eds.). *Sítios Geológicos e Paleontológicos do Brasil*. Available online at: <http://www.unb.br/ig/sigekp/sitio016.sitio016.htm>; accessed on VII.2009.
- BILANDŽIJA, H.; BEDEK, J.; JALŽIĆ, B.; GOTTSTEIN, S. 2007. The morphological variability, distribution patterns and endangerment in the Ogulin cave sponge *Eunapius subterraneus* Sket & Velikonja, 1984 (Demospongiae, Spongillidae). *Natura Croatica*, **16**(1):1-17.
- MISI, A.; SILVA, M.G. 1994. *Chapada Diamantina Oriental – Bahia: geologia e depósitos*. Secretaria da Industria, comércio e mineração / Superintendência de Geologia e Recursos Minerais, Salvador, 194 p.
- SOEST, R. W. M. VAN; VELIKONJA, M. 1986. Porifera. In: L. BOTOSANEANU (ed.), *Stygofauna Mundi: a faunistic, distributional and ecological synthesis of the world fauna inhabiting subterranean waters (including the marine interstitial)*. Leiden, E.J.Brill/Dr. W. Backhuys, p. 30-32.
- SKET, B.; VELIKONJA, M. 1984. Prethodni izvještaj o nalazima slatkovodnih spužvi (Porifera Spongillidae) u špiljama Jugoslavije. Zbornik predavanja, *Deveti Jugoslavenski Speleološki kongres, Zagreb*, p. 553-557.
- VOLKMER-RIBEIRO, C. 1985. *Manual de técnicas para a preparação de coleções zoológicas 3*. São Paulo, Sociedade Brasileira de Zoologia, CNPq, 6 p.
- VOLKMER-RIBEIRO, C. 1992. The freshwater sponges in some peat-bog ponds in Brazil. *Amazoniana*, **12**(2):317-335.
- VOLKMER-RIBEIRO, C.; DE ROSA-BARBOSA, R.; MARQUES-TAVARES, M. C. 1988. *Anheteromeyenia sheilae* sp. n. e outras esponjas dulciaquícolas da região costeira do Rio Grande do Sul. *Iheringia, Série Zoologia*, **68**:83-98.
- VOLKMER-RIBEIRO, C.; PEIXINHO, S. 1989. *Drulia browni* (Bowerbank, 1863) (= *Spongilla franciscana* Lutz & Machado, 1915, Syn. N.) na Bacia do Rio São Francisco, Bahia, Brasil (Porifera, Metaniidae). *Iheringia, Série Zoologia*, **69**:147-148.
- VOLKMER-RIBEIRO, C.; MACHADO, V. S. 2007. Freshwater sponges (Porifera, Demospongiae) indicators of some coastal habitats in South America: redescrptions and key to identification. *Iheringia, Série Zoologia*, **97**(2):157-167.
- VOLKMER-RIBEIRO, C.; TURCQ, B. 1996. SEM analysis of silicious spicules of a freshwater sponge indicate paleoenvironmental changes. *Acta Microscopica*, **5**(B):186-187.

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