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Three new *Simonsenia* species (Bacillariophyta) from Brazil

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Abstract: The genus *Simonsenia* is characterized by the raphe system that opens into a longitudinal channel over a marginal keel, and small circular areolae, occluded by hymens. So far, the occurrence of *Simonsenia* species in Brazil is known only by two records of *S. delognei*, documented in light microscopy. Here, are described three new species of *Simonsenia*, one from karst freshwater environments and two from an estuarine stream. Also, we report *S. delicatula* for the first time to Brazil, in a lotic freshwater body. The new species are distinguished from each other and from similar *Simonsenia* taxa mainly due to size, valve contour, apices shape, morphology of transapical ribs, and number of areolae rows of the striae. This study is an important contribution to the taxonomy, diversity and distribution of the genus, still underestimated, especially in estuaries and karst of tropical regions.

Keywords: Bacillariales, estuarine, freshwater, karstic, simonsenioid, South America

Introduction

Simonsenia Lange–Bertalot (1979) was separated from *Nitzschia* Hassall considering an intermediate morphology between Bacillariaceae and Surirellaceae. This genus presents nitzschioid raphe system, alar canals connecting the raphe system with the valve interior, and the marginal raphe canal supported by fenestral bars interspersed with open fenestrae, typical of Surirellaceae (Lange–Bertalot 1979). Phylogeny based on molecular data supported the position of this genus in Bacillariaceae (Witkowski et al. 2015, 2021; Kim et al. 2019).

The genus was initially proposed to accommodate a single species, *Simonsenia delognei* (Grunow) Lange–Bertalot, occurring in continental to slightly saline waters, tolerating a wide range of conductivity (Lange–Bertalot 1979). Currently, nine species are accepted, the marine ones being found in high abundance (Kim et al. 2019; Witkowski et al. 2021). *Simonsenia* has been recorded in several parts of the world, such as: Europe (Lange–Bertalot & Krammer 1993; Werum & Lange–Bertalot 2004; Wojtal 2009; Witkowski et al. 2014, 2015; Vidaković et al. 2018), Turkey (Sivaci et al. 2008; Witkowski et al. 2014), Asia (Mikhailov & Makarova 1983; Genkal et al. 2006, Kulikovskiy 2008; You et al. 2016; Al–Saedy & Al–Shaheen 2021), Australia (Sonneman et al. 2001), North America (Hay et al. 1997, 2000; Mize & Deacon 2001; Potapova & Charles 2003), Central America (Podzorski 1985) and South America (Morales et al. 2007; Tremarin et al. 2009; Heinrich et al. 2014, 2019). In Brazil, there are two records of *Simonsenia delognei*, in the Guaraguaçu River, a coastal watershed in State of Paraná (Tremarin et al. 2009), and in the Andreas Basin, State of Rio Grande do Sul (Heinrich et al. 2014). However, these records were based only in light microscopy and require confirmation by electron microscopy, since the species are mainly distinguished by ultrastructural features of frustule.

New *Simonsenia* species have been described in the marine (Witkowski et al. 2015, 2021; Kim et al. 2019) and freshwater environments (Mikhailov & Makarova 1983; Lange–Bertalot & Krammer 1993; You et al. 2016). Recently, *S. delognei* and the new species, *S. maolaniana* You et Kociolek, were found in karst habitats from southwest China (You et al. 2016), endorsing that

these environments may still reveal unknown species diversity. The goals of the present paper are to propose three new species, one found in karst environments from Central–western Brazil and two for an estuarine stream from Northern Brazil, documenting the morphology and distribution of *Simonsenia* taxa to the country.

MATERIAL AND METHODS

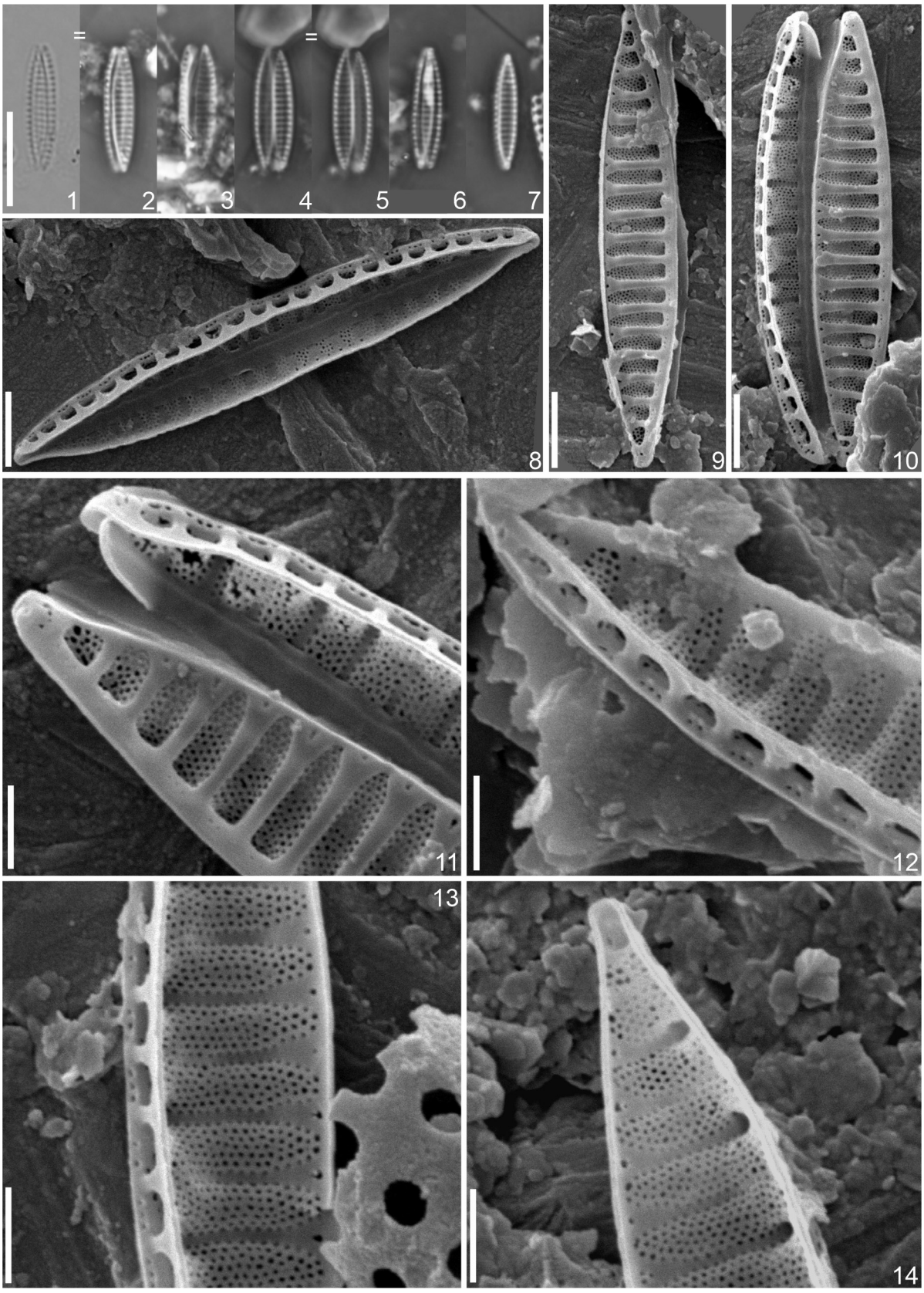
Studied area. The sampling was carried out in three states of Brazil: Mato Grosso do Sul, Ceará and Pará. The first is located in a central west region of Brazil in Serra da Bodoquena karst (21°05'42"S, 56°42'17"W) at the southwest edge of the Pantanal Complex, covering the cities of Bonito, Jardim and Bodoquena. Crystal clear and carbonated water characterize local water bodies, and sinkholes are frequent, despite the predominance of surface drainage (LINO et al. 1984; SALLUN FILHO et al. 2004). Active limestone tufas are formed by the continuous accumulation of calcium carbonate in association with biological activity (moss and algae) along the drainage system (SALLUN FILHO et al. 2009; BOGGIANI et al. 2011). The second location, in Ceará, northeastern Brazil, is at the foot of the Serra da Ibiapaba in the city of Ipu. Bica do Ipu (4°19'01.4"S 40°43'39"W), the highest waterfall in the Serra da Ibiapaba (Ipuçaba River), 130 meters height, is located in an altitude area with semi–arid climate, characterized by low thermal amplitude (temperatures above 25 °C throughout the year), annual precipitation lower than 800 mm, rainfall concentrated in only three months of the year and high evapotranspiration. The third sampling place is located in the Amazonian estuarine region, north of Brazil, on a fluvial island in the Guamá river, Belém city. The Murutucu island (1°29'09"S, 48°25'52"W) has wet soil and several streams that are irrigated by periodic tides. In this place, the dense alluvial ombrophilous vegetation has been altered by the extractivism of açaí (*Euterpe oleracea* Mart.) and anthropic expansion.

Sampling. Five periphytic samples were collected in karstic environments (waterfall, streams and springs) from Serra da Bodoquena. Water temperature (°C), pH and electrical conductivity (µS.cm–[1]) data were measured by the Horiba probe. Periphytic diatoms were obtained by scraping different substrates in Serra da Bodoquena freshwaters, such as epiphytic diatoms associated with mosses and epilithic samples attached to stones. One epilithic sample was collected in the Bica do Ipu. Finally, submerged stones and leaves were obtained in Murutucu Island. In all samples, the periphyton was manually collected and preserved with formalin solution (4% v/v).

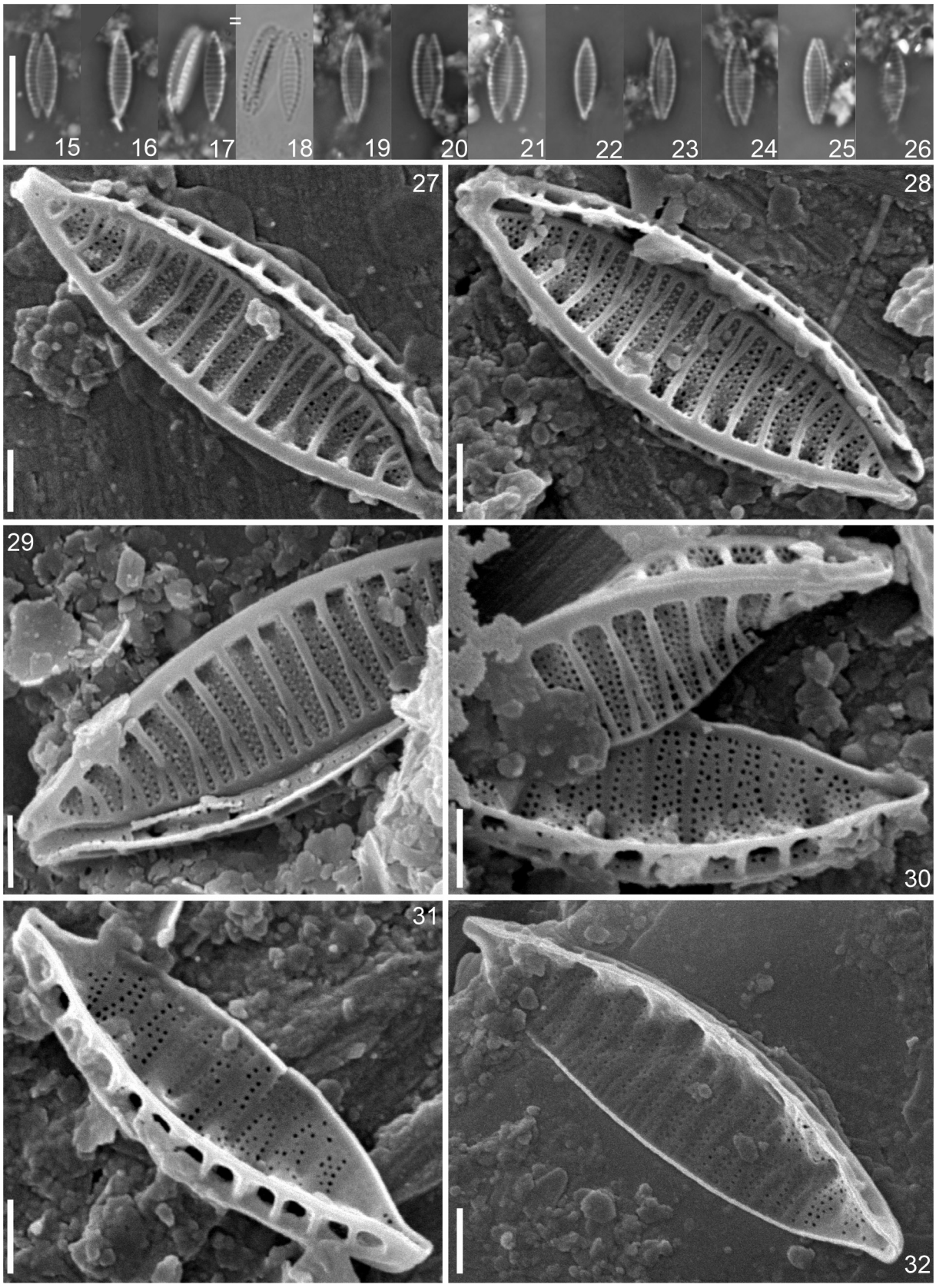
Diatom analysis. Samples were cleaned according to SIMONSEN (1974) and MOREIRA–FILHO & VALENTE–MOREIRA (1981). Slides were prepared with Naphrax® (R.I.= 1.74), and analyzed using an Olympus BX40 microscope at 1000× magnification (N.A. 1.30, planachromat), equipped with Phase Contrast optics and the Olympus DP71 Imaging System. Cleaned samples were placed on aluminum stubs, dried and covered with gold in Balzers Sputtering SCD 030 for ultrastructural analyses of the frustules in the scanning electron microscopy (SEM). The SEM images were performed in a JEOL JSM 6360LV and TESCAN VEGA3 LMU microscopies, operated at 10–15 kV and 5–8 mm work distance. Besides that, part of the cleaned material was air dried on the formvar–coated copper grids (300

Table 1. Sampling data and access number in the Herbarium of the Federal University of Rio Grande do Sul (ICN), Federal University of Paraná (UPCB) and State University of Vale do Acaraú (HUVA).

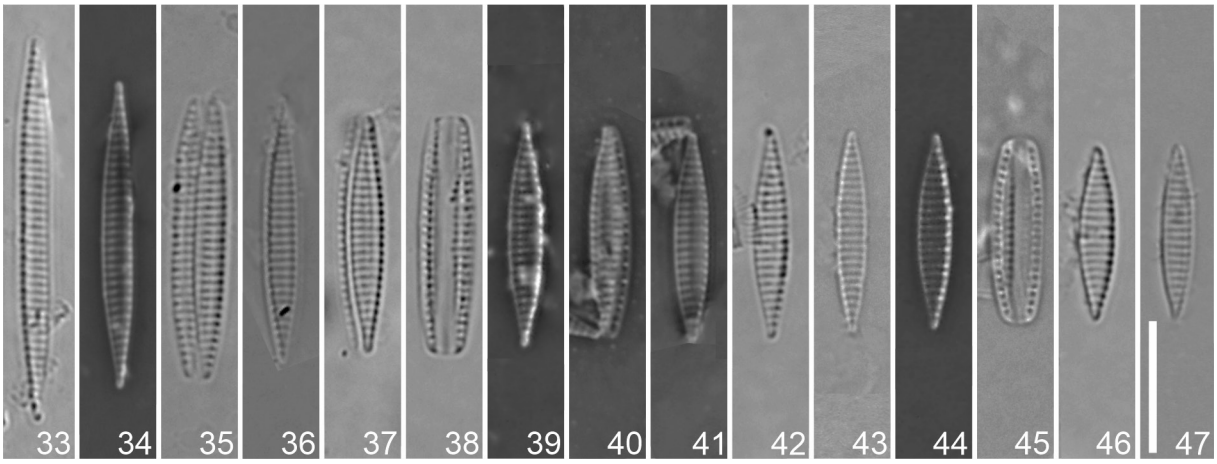
Date	Access UPCB	Access ICN	Access HUVA	Locality	City	Geographical coordinates	Sample or substrate	pH	Conductivity (µS.cm–1)	Altitude (m)	Water Temperature (°C)
11/11/2015	78246			Chapeninha Spring	Bonito	20°50'28.7"S, 56°35'39.8"W	Epiphyton/Mosses	7.5	476	308	24
11/11/2015	78248			Chapena waterfall	Bonito	20°49'58.8"S, 56°33'17.3"W	Epiphyton/Mosses	7.6	382	308	28
11/15/2015	78240			Boca da Onça waterfall	Bodoquena	20°44'23.5"S, 56°44'04.6"W	Epiphyton/Mosses	7.3	407	270	27
11/26/2019	78422	203533		Boca da Onça waterfall	Bodoquena	20°44'23.5"S, 56°44'04.6"W	Epiphyton/Mosses	8.6	395	270	26
11/27/2019	78434	203545		Cachoeira Park	Bonito	21°00'20.4"S, 56°30'04.7"W	Epilithon	7.7	476	274	25
07/16/2003	58045			Murutucu Island	Belém	1°29'09"S, 48°25'52"W	Epilithon and Epiphyton	–	–	6	–
12/13/2018	78396		24520	Bica do Ipu	Ipu	04°19'01.4"S, 40°43'39.1"W	Epilithon	6.6	257	–	26



Figs 1–14. *Simonsenia amazonica* sp. nov.: (1–7) valve views, LM (phase contrast in 2–7); (4–5) specimen from holotype; (8–14) SEM; (8) internal view of valve. Note the fenestral bars. (9) overview of valve; (10) internal and external valve views; (11) details of apices showing the cingulum band and transapical ribs bifurcate near the distal margin of the valve; (12) detail of apex in internal view showing the striation pattern and the fenestral bars; (13–14) internal view of median region of valve and apex, respectively. Note the marginal fibula and portulae. Scale bars 10 µm (1–7), 2 µm (8–10), 1 µm (11–14).



Figs 15–32. *Simonsenia bifurcata* sp. nov.: (15–26) valve views, LM (phase contrast in 15–17, 19–26), (17–18) specimen from holotype; (27–32) SEM, (27–29) external view of valve showing the transapical ribs, fenestral bars and striation pattern, (30) external and internal valve views. Note the striation pattern, marginal raphe and fenestral bars. (31–32) internal view of the valve showing the fenestral bars and fibula, respectively. Scale bars 10 μm (15–26), 1 μm (27–32).



Figs 33–47. *Simonsenia bodoquenensis* sp. nov., LM (phase contrast in 33–34, 39–41, 44): (33–37, 39–44, 46–47) valve views; (38, 45) girdle views; (43) specimen from holotype. Scale bar 10 μm.

mesh) and analyzed under transmission electron microscopy (TEM) using a JEM 1200 EXII, operated at 80 kV. Samples and permanent slides were deposited in the Herbarium of the Federal University of Paraná (UPCB), Federal University of Rio Grande do Sul (ICN), and State University of Vale do Acaraú (HUVA), Brazil, (Table 1). The terminology used in the description of taxa was based on Barber & Haworth (1981), Lange–Bertalot (1979), Round et al. (1990) and Witkowski et al. (2015). Length and width of the valves were measured on the LM and SEM images, with the means and standard deviations given in brackets in the description. The transapical ribs were measured on the LM images and the fenestral bars and fibulae density were measured on the SEM images.

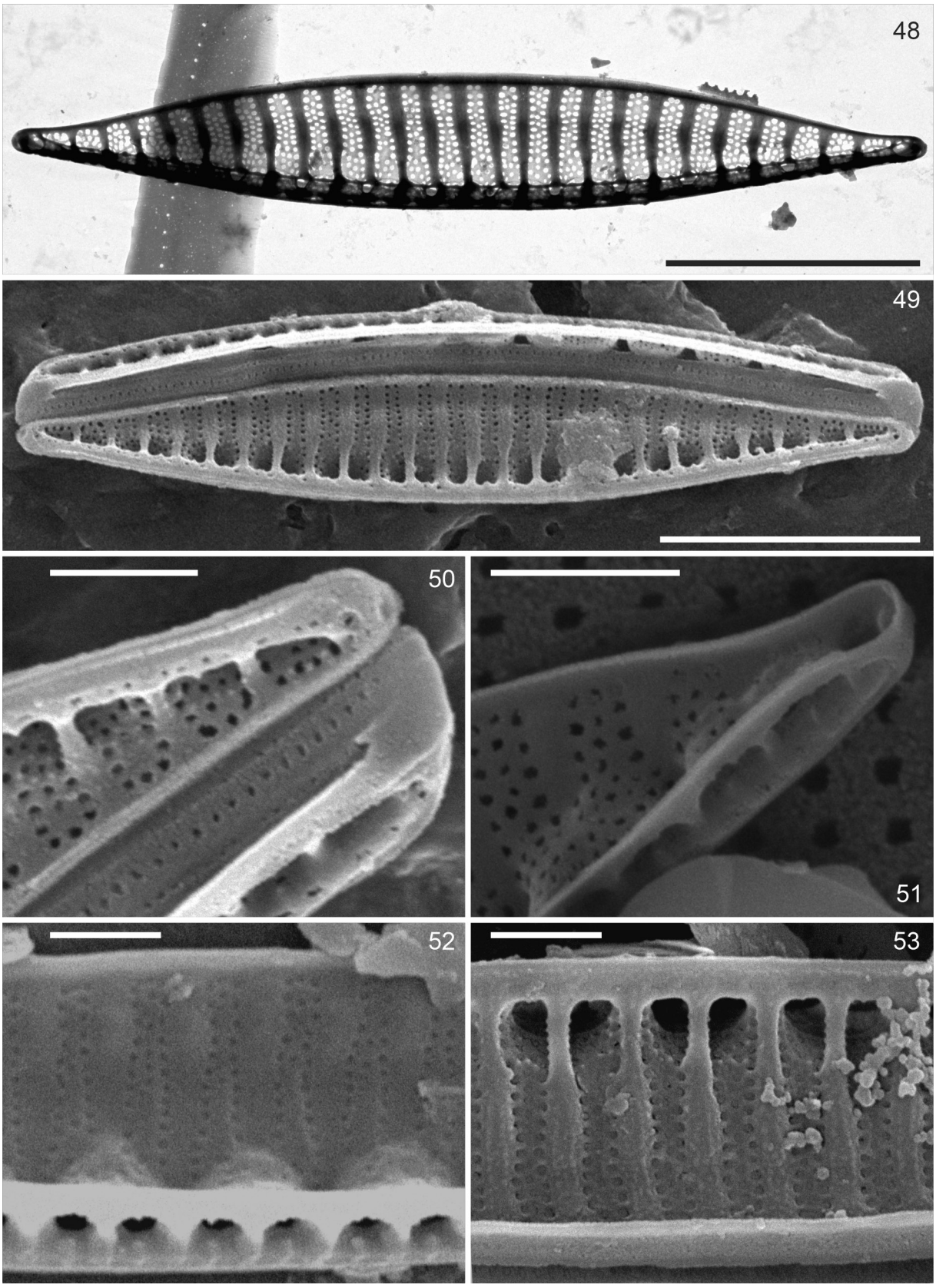
Results and Discussion

***Simonsenia amazonica* Tremarin sp. nov. (Figs 1–14)**
Description
LM (Figs 1–7): Frustules small with symmetry typically nitzschioid; valves linear–lanceolate with acute ends; transapical ribs parallel; other valve ornamentation details are not resolvable in LM. Length: 11.0–15.3 μm (12.5 ± 1.0; n=28), width: 1.8–2.4 μm (2.2 ± 0.2; n=28), 16–18 transapical ribs in 10 μm.
SEM (Figs 8–14): Valve face with slight longitudinal undulation. Externally, the transapical ribs are robust and bifurcated towards the valve margin opposite the keel (Figs 9–11). Bifurcations are short, not reaching 1/5 of the transapical ribs length, and each bifurcation delimit one marginal areola (Figs 11, 13, 14). The striae are multiseriate (composed of 5–6 rows of circular areolae) and depressed below the transapical ribs (Figs 9–10). The canal raphe is strongly eccentric and supported by fenestral bars, 16–18 in 10 μm (Figs 10, 13, 14). Two to four pores are present on both sides of the canal raphe, between each transapical rib and fenestral bar. Internally, the fibulae are perforated, 10 in 10 μm, and the portulae are separated by one or, usually two fenestral bars. Girdle composed of unperforated open bands.

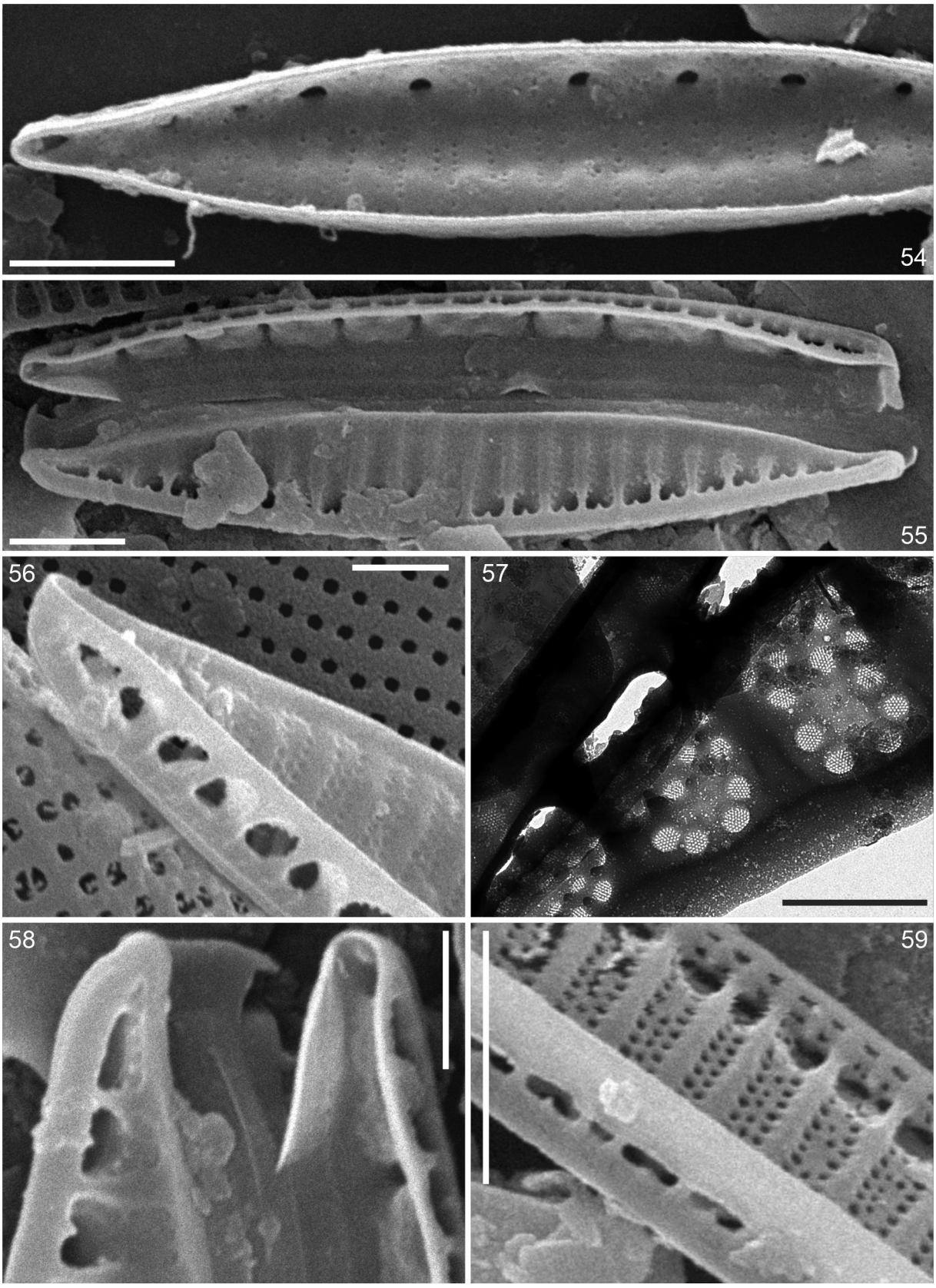
Holotype: UPCB collection No. 58045 (here depicted in Figs 4–5), deposited in Federal University of Paraná, Botany Department, Brazil.
Type locality: Brazil. Pará: Belém, Murutucu island 1°29'09"S, 48°25'52"W, July 2003, F. Ferrari and P.I. Tremarin s.n.
Habitat: periphytic (epilithon and epiphyton).
Etymology: The species name refers to its occurrence in the Amazon region.
Ecology: *Simonsenia amazonica* was rare in the samples. The population was observed in periphytic habitat (epilithon and epiphyton) occurring together with estuarine and freshwater diatom species, such as *Polymyxus coronalis* L.W. Bailey, *Thalassiocyclus lucens* (Hustedt) Håkansson et Mahood, *Cymatosira belgica* Grunow, *Tryblionella debilis* Arnott ex O'Meara, *Desikaneis simplex* (Frenguelli) Tremarin, Procopiak, Ludwig et Serieyssol, *Stephanocyclus gamma* (Sovereign) Kulikovskiy, Genkal et Kociolek, as well as *Frustulia* spp. and *Eunotia* spp.

Comments: *Simonsenia amazonica* resembles *S. delicatula* Mikhailov et Makarova (≈*Simonsenia delognei* ssp. *rossii* Lange–Bertalot et Krammer) in the valve outline and valve dimensions (Table S1). In addition, both species present forked transapical ribs close to the valve margin opposite the keel, which are only observed in electron microscope images. However, *S. amazonica* differs by the shorter bifurcations and the greater number of rows of areolae in each striae, when compared to *S. delicatula* (Mikhailov & Makarova 1983).

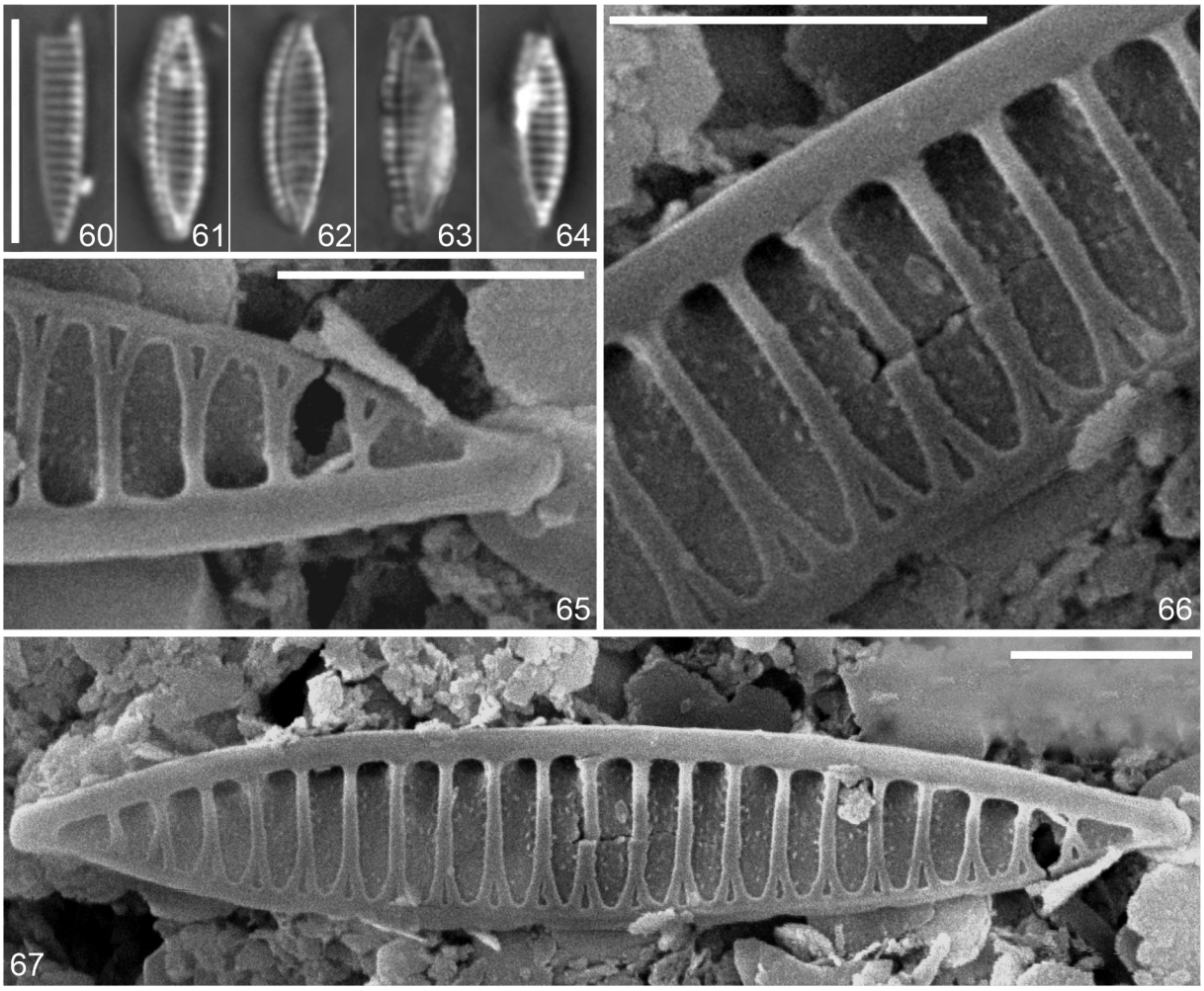
***Simonsenia bifurcata* Tremarin sp. nov. (Figs 15–32)**
Description
LM (Figs 15–26): Frustules small with symmetry typically nitzschioid; valves lanceolate with acute ends, slightly protracted apices; transapical ribs parallel; other valve ornamentation details are not resolvable in LM. Length: 6.9–9.6 μm (8.4 ± 0.8; n=42), width: 1.9–2.5 μm (2.2 ± 0.2; n=42), 18–22 transapical ribs in 10 μm.
SEM (Figs 27–32): Valve face with slight longitudinal



Figs 48–53. *Simonsenia bodoquenensis* sp. nov.: (48) TEM; (49–53) SEM, (49) external valve view, (50–51) external and internal valve apex, respectively, (52) internal view of median region of valve, (53) external view of median region, transapical ribs supporting the canal raphe. Scale bars 5 μm (48–49), 2 μm (50–53).



Figs 54–59. *Simonsenia bodoquenensis* sp. nov.: (54–56, 58–59) SEM, (54) internal valve view, (55) valve overview showing the striation pattern; (57) TEM, detail of areolae occlusion, note the hymens; (58) external and internal valve apex, respectively, (59) internal view of median region. Scale bars 2 μm (54–55, 59), 1 μm (56, 58), 0.5 nm (57).



Figs 60–67. *Simonsenia delicatula*: (60–64) valve views, LM (phase contrast); (65–67) external valve view, SEM, (65–66) detail of the transapical ribs bifurcate near the distal margin of the valve, (65) external view of valve apex, (66) external view of median region showing the transapical ribs, (67) note fibulae and fenestral bars. Scale bars 10 μm (60–64), 2 μm (65–67).

undulation. Externally, the transapical ribs are bifurcated near the median region of the valve, opposite the keel (Figs 27–30). Each bifurcation delimits one to six transapical areolae (Figs 27–30). The striae are bi– to multiseriate (composed by 2–4 irregular rows of circular areolae) and slightly depressed below the transapical ribs (Figs 27–29). The canal raphe is strongly eccentric and supported by fenestral bars, 18–22 in 10 μm (Figs 27, 28, 31). Internally, the fibulae are perforated, 9–10 in 10 μm, and the portulae are separated by two fenestral bars. Girdle composed of perforated open bands (Fig. 29).

Holotype: UPCB collection No. 58045 (here depicted in Figs 17–18), deposited in Federal University of Paraná, Botany Department, Brazil.
Type locality: Brazil. Pará: Belém, Murutucu island 1°29'09"S 48°25'52"W, July 2003, F. Ferrari and P.I. Tremarin s.n.
Habitat: periphytic (epilithon and epiphyton).
Etymology: The species name refers to the typical bifurcation of transversal ribs of the valve.
Ecology: *Simonsenia bifurcata* occurred together with *S. amazonica* in a periphytic sample of soft estuarine stream of Murutucu Island.

Comments: *Simonsenia amazonica* and *S. bifurcata* occurred in the same location (Murutucu Island), however the former was less frequent in the sample. Despite the coexistence, *S. bifurcata* can be differentiated to *S. amazonica* by having smaller valves with lanceolate outline, and by the greater number of fenestral bars and transapical ribs (Table S1). *Simonsenia bifurcata* also has bifurcated transapical ribs, but the bifurcation occurs closer to the median region of the valve, different from those present in *S. amazonica* and *S. delicatula*.

***Simonsenia bodoquenensis* Tusset, Tremarin, L.S. Cardoso et T. Ludwig sp. nov. (Figs 33–59)**
Description
LM (Figs 33–47): Frustules small with symmetry typically nitzschioid; valves linear–lanceolate (in larger frustules) to lanceolate (in smaller frustules), with ends acute, slightly protracted apices; transapical ribs parallel in the median region of the valve, becoming slightly radiate

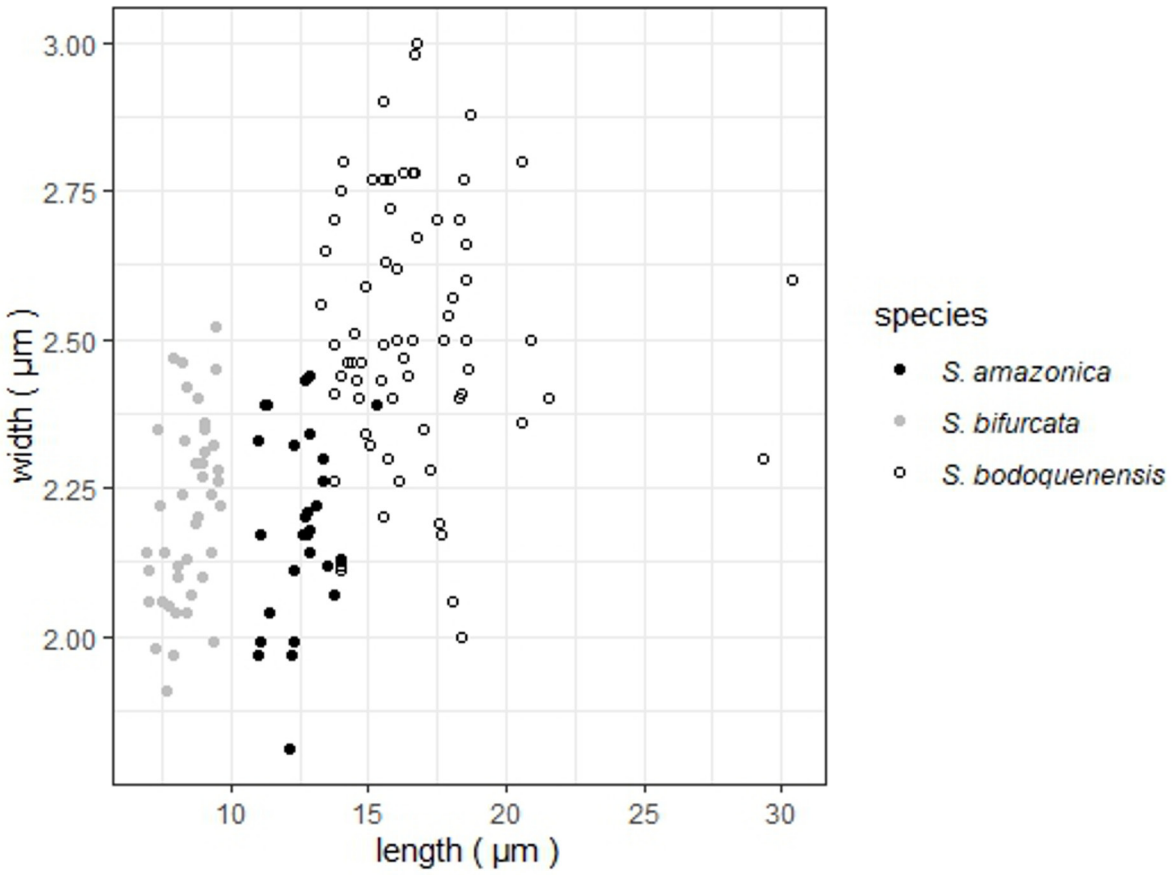


Fig. 68. Relationship between valve dimensions (length and width) for *Simonsenia amazonica* (black circles; n=28), *S. bifurcata* (gray circles; n=42) and *S. bodoquenensis* (white circles; n=68) populations in Brazil.

towards the ends; other details of valve ornamentation not resolvable in LM. Length: 13.2–30.4 µm (16.7 ± 3.0; n=68), width: 2.1–3.0 µm (2.5 ± 0.2; n=68), 16–18 transapical ribs in 10 µm.

SEM (Figs 48–59): The valve face is regularly undulated internally and externally (Figs 54, 59). Transapical ribs are robust, 16–18 in 10 µm, and separated by transapical striae (Figs 48–53). The striae are bi– to multiseriate (composed by 2–3 irregular rows of circular areolae, usually there are 3). Externally, the costae are simple towards the edge of the valve opposite the keel (see Figs 48–50, 53). Fibulae perforated, 8–9 in 10 µm (Fig. 51), fenestral bars 16–18 in 10 µm (Fig. 52). Areolae are small and circular, occluded by hymens (Fig. 57). Girdle composed of perforated bands (Figs 49–50).

Holotype: UPCB collection No. 78422 (here depicted in Fig. 43), deposited in Federal University of Paraná, Botany Department, Brazil.

Type locality: BRAZIL. Mato Grosso do Sul: Bodoquena, Boca da Onça waterfall, 20°44'23.5"S, 56°44'04.6"W, November 2019, E. Tusset s.n.

Paratypes: BRAZIL. Mato Grosso do Sul: Bonito, Chapena waterfall, epiphyton, UPCB 78248; Mato Grosso do Sul: Bonito, Cachoeiras Park, epilithon, UPCB 78434; Mato Grosso do Sul: Bonito, Cachoeiras Park, epilithon, ICN 203545.

Habitat: periphytic (epiphyton, epilithon), in lotic freshwater environments.

Etymology: The species was named in homage to the environment in which the species was found, in the Bodoquena karst.

Ecology: *Simonsenia bodoquenensis* was abundant in the type material. The population was observed in periphytic habitat (epiphyton, epilithon) in lotic environments. It was found in neutral waters (pH 7.3–8.3), conductivity 382–476 µS.cm^{-1}, and water temperature of 24–28 ºC, NO3–N 0.10–0.21 mg.L^{-1}, Total P 0.01–0.02 mg.L^{-1}, Ca 26.8–64.6 mg.L^{-1}, Mg 27.60–44.6 mg.L^{-1}, SiO_2 11.2–17.2 mg.L^{-1}.

Comments: *Simonsenia bodoquenensis* is similar to *S. delognei* and *S. maolaniana* by the valve face undulated and not bifurcated transapical ribs. *Simonsenia maolaniana* is distinguished by the valve shape, lanceolate in larger frustules to elliptic–lanceolate in the smaller ones, and by the transapical ribs and fibulae densities (Table S1). In addition, the striae in *S. maolaniana* becomes multiseriate near the raphe canal, while in *S. bodoquenensis* the striae are totally multiseriate or become multiseriate near the median region of the valve. *Simonsenia bodoquenensis* is similar to *S. delognei* in outline, linear in the center

of the valve with slightly prolonged apices, but differs from *S. delognei* with lower dimensions (length and width), and higher number of fibulae in relation to the new species (Lange–Bertalot 1979).

***Simonsenia delicatula* Mikhailov et Makarova in Mikhailov & Makarova (1983, Botanicheskii Zhurnal, 68(9): 1246, figs 4–6) (Figs 60–67)**

Description

LM (Figs 60–64): Frustules small with symmetry typically nitzschioid; valves lanceolate with acute ends, slightly protracted apices; transapical ribs parallel in the median region of the valve, becoming slightly convergent towards the ends; other valve ornamentation details are not resolvable in LM. Length: 8.2–12.2 µm (9.84 ± 1.48; n=5), width: 1.9–2.2 µm (2.07 ± 0.12; n=6), 18–21 transapical ribs in 10 µm.

SEM (Figs 65–67): Valve face with slight longitudinal undulation. Externally, the transapical ribs are robust and bifurcated towards the valve margin opposite to the keel. Bifurcations are short, reaching ca. 1/5 of the transapical ribs length. The striae are multiseriate and depressed below the transapical ribs, barely discernible in the valves observed in SEM. Fibulae 9 in 10 µm, fenestral bars 20 in 10 µm.

Occurrence in samples: Brazil. Ceará: Ipu, Bica do Ipu, epilithon, UPCB 78396, HUVA 24520.

Ecology: *Simonsenia delicatula* was very rare in the samples. The population was observed in periphytic habitat (epilithon) in a subaerial environment. It was found in neutral waters (pH 6.6), conductivity 257 µS.cm^{-1}, water temperature 26 ºC (Table 1).

Comments: Although the *S. delicatula* was very rare in the studied material, it was possible to observe the transapical ribs in SEM and differentiate this species from *S. delognei*. The transapical ribs of *S. delicatula* are bifurcated near the distal margin of the valve, while the transapical ribs in *S. delognei* are simple, without a fork (Mikhailov & Makarova 1983).

The distribution and ecology of *Simonsenia* are still poorly understood, so far most species occur in marine environments (*S. crawfordii*, *S. dolmeoriana*, *S. eileencoxiae, S. medlinia, S. paucistriata*), and others in brackish–marine (*S. aveniformis*), freshwater to slightly brackish (*S. delognei*, *S. delicatula*) and freshwater (*S. maolaniana*) (Mikhailov & Makarova 1983; Witkowski et al. 2014, 2015, 2021; You et al. 2016; Kim et al. 2019). The taxonomic characterization and morphological separation among closer species is not possible in LM. Only ultrastructural details observed under electron microscopy (SEM and TEM) revealed the transapical ribs details (bifurcated or simple), and the number of areolae rows composing the stria (uniseriate to multiseriate), crucial to distinguish species of *Simonsenia* (Table S1). However, the combination of some morphometric features of the valve can help to separate the species. In this case, we used the length and width of the valves of the three Brazilian taxa and observed the formation of three distinct clusters (see Fig. 68) that confirm the new propositions.

In Europe, *Simonsenia delognei* occurs in freshwater habitats in rivers, lakes and ponds, often in abundance, having a wide tolerance for conductivity, and preferring waters with moderate electrolyte content and circumneutral pH (7.0–7.5) (Lange–Bertalot 1977; Witkowski et al. 2014). In Turkish samples, *S. delognei* was observed to be very rare, the relative abundance of the species was less than 1%. On the other hand, this taxon occurred in abundance, in rivers from Central Poland, the Porsuk (665 µS.cm^{-1}) and Felent rivers (913 µS.cm^{-1}), in sites influenced industrial and domestic effluents (Witkowski et al. 2014). Also, in Brazil, *Simonsenia delognei* was considered tolerant to high levels of pollution and eutrophication, in a study developed close to cultivated areas, receiving inputs of fertilizers and organic matter, occurring associated with species of epilithic diatom flora, such as: *Adlafia drouetiana* (R.M. Patrick) Metzeltin et Lange–Bertalot, *Amphipleura lindheimeri* Grunow; *Fallacia monoculata* (Hustedt) D.G. Mann, *Navicula cryptotenell*a Lange–Bertalot, *Navicula symmetrica* R.M. Patrick, *Nitzschia palea* (Kützing) W. Smith and *Sellaphora auldreekie* D.G. Mann et S.M. McDonald (Heinrich et al. 2014).

Actually, the specific diversity of *Simonsenia* consists of ten taxa according to AlgaeBase (Guiry & Guiry 2022), however, the accepted subspecies *Simonsenia delognei* ssp. *rossii* Lange–Bertalot et Krammer (Lange–Bertalot & Krammer 1993) was synonymized with *S. delicatula* by Witkowski et al. (2015), totaling nine accepted taxa. From this study, with the proposal of three more species, the total taxa of the genus reaches twelve.

We found the specimens of *Simonsenia* in periphytic habitats (epiphyton, epilithon) of estuarine and freshwater lentic and lotic environments. *Simonsenia* species were rare in this study, *S. amazonica* sp. nov., *S. bifurcata* sp. nov., and *S. delicatula* occurring in only one sample, while *S. bodoquenensis* sp. nov. was detected in three (Table 1).

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Supplementary material

The following supplementary material is available for this article:

Table S1. Morphometric data of the *Simonsenia* species.

This material is available as part of the online article (http://fottea.czechphycology.cz/contents)

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