New records and rare taxa of *Closterium* and *Spinoclosterium* (*Closteriaceae*, *Zygnematophyceae*) to Bahia, Brazil[1]

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ABSTRACT – Based on the taxonomic inventory of the genera *Closterium* Nitzsch *ex* Ralfs and *Spinoclosterium* Bernard (*Closteriaceae*, *Zygnematophyceae*) occurring in the North Coast Environmental Protection Area of Bahia, Northeastern Brazil, 40 taxa were identified belonging to the genus *Closterium* and one to the genus *Spinoclosterium*. Of these, 28 taxa were additions to the desmid flora of Bahia, and seven taxa are new records for Brazil: *Closterium aciculare* West var. *aciculare*, *C. angustatum* Kütz. *ex* Ralfs var. *angustatum*, *C. braunii* Reinsch, *C. idiosporum* West & G.S.West, *C. lineatum* Ehrenberg *ex* Ralfs var. *costatum* Wolle, *C. pseudolunula* Borge var. *pseudolunula* f. *pseudolunula* and *C. pseudolunula* var. *pseudolunula* f. *longius* Poljanski. Four taxa rarely found in Brazil were collected during the study: *Closterium macilentum* Brébisson var. *macilentum*, *C. kuetzingii* Brébisson var. *vittatum* Nordstedt, *C. semicirculare* Krieger & Scott and *C. strigossum* Brébisson var. *elegans* (G.S. West) Krieger.

Key words: Desmids, Floristic survey, Microalgae, Taxonomy

RESUMO – **Novos registros e raros táxons de *Closterium* e *Spinoclosterium* (*Closteriaceae*, *Zygnematophyceae*) para a Bahia, Brasil**. Com base no inventário taxonômico dos gêneros *Closterium* Nitzsch *ex* Ralfs e *Spinoclosterium* Bernard Closteriaceae, Zygnematophyceae) que ocorrem na Área de Proteção Ambiental Litoral Norte, Bahia, Brasil, foram identificados 40 táxons pertencentes ao gênero *Closterium* e um para o ***gênero*** *Spinoclosterium*. Destes, 28 táxons foram adições à flora de desmídias da Bahia e sete são novos registros para o Brasil: *Closterium aciculare* West var. *aciculare*, *C. angustatum* Kütz. *ex* Ralfs var. *angustatum*, *C. braunii* Reinsch, *C. idiosporum* West & G.S.West, *C. lineatum* Ehrenberg *ex* Ralfs var. *costatum* Wolle, *C. pseudolunula* Borge var. *pseudolunula* f. *pseudolunula* and *C. pseudolunula* var. *pseudolunula* f. *longius* Poljanski. Quatro táxons raramente encontradas no Brasil foram coletados durante o estudo: *Closterium macilentum* Brébisson var. *macilentum*, *C. kuetzingii* Brébisson var. *vittatum* Nordstedt, *C. semicirculare* Krieger & Scott and *C. strigossum* Brébisson var. *elegans* (G.S. West) Krieger.

Palavras-chave: desmídias, levantamento florístico, microalgas, taxonomia

INTRODUCTION

The family Closteriaceae (*Desmidiales, Zygnematophyceae*) is composed of individuals with cells that are longer than they are wide, which can either appear as fully curved (lunated), curved only at the poles or even straight. The cell wall varies in color from hyaline to brownish, and it can be smooth, grooved, ribbed or scored and may occasionally show polar thickening. The axial chloroplastid might be laminar or star-shaped and have one or many pyrenoids, which are organized in a median series or with no definite arrangement (Brook & John 2002).

Taxonomic studies published specifically on *Closterium* Nitzsch *ex* Ralfs and *Spinoclosterium* Bernard are rare in Brazil and are currently restricted to the southern and southeastern regions of the country. There is, therefore, a large gap in the

knowledge regarding the national desmid flora. The works of Bicudo & Castro (1994) and Sormus & Bicudo (1994) in São Paulo State and Bittencourt-Oliveira & Castro (1993), Felisberto & Rodrigues (2007) and Bortolini *et al.* (2009) in Paraná State stand out among the existing studies.

In Bahia State, the knowledge on the Closteriaceae family is distributed among taxonomic studies, including those of Förster (1964), Martins & Bicudo (1987), Bicudo & Martins (1989) and Martins *et al.* (1991), which together recorded 22 taxa of *Closterium* at the specific and infraspecific level. Currently, there is no record of the occurrence of representatives of *Spinoclosterium* in Bahia.

This work contributes to the knowledge of Closteriaceae in the North Coast Environmental Protection Area created by the Bahia State. Specifically, this study aims to broaden the knowledge the geographic distribution of the Closteriaceae species in Brazil.

MATERIAL AND METHODS

This study was conducted in the North Coast Environmental Protection Area (EPA), which was created by State Decree No. 1.046/1992 and covers an area of 144 km in length and 10 km in width across the counties of Mata de São João, Esplanada, Entre Rios, Conde and Jandaíra in northern Bahia, Brazil (Fig. 1).

Fifty-five samples of plankton and periphyton were collected in the North Coast EPA during summer (January-March 2009) and winter (June-August 2009), both in lotic and lentic environments. All collections were made using standardized techniques for taxonomic study of continental microalgae (Oliveira *et al.* 2011).

The metric limits of the specimens were obtained using an ocular micrometer, and the photomicrographs were acquired with a digital camera coupled to a light microscope; the angles of curvature were obtained using a closteriometer (Heimans, 1946). The species were identified based on specialized literature; the classification system adopted follows Brook (1981).

Samples were preserved in Transeau solution following Bicudo & Menezes (2006), and incorporated into the liquid collection at the Herbarium of the "Universidade Estadual de Feira de Santana (HUEFS)" (Table 1). The illustrations are organized in the plates according to the morphological similarities of taxa.

Table 1. List of samples of Closterium and Spinoclosterium studied and their respective collection number, municipalities, -State, Brazil.

Samples	HUEFS	Municipalities	Coordinates	Collectors	Date
Plankton	155598	[illegible]	[illegible]	I. B. Oliveira & C.W.N. Moura	11/I/ 2009
Periphyton	155602	Mata de São João	S 12º 29' 43" W 37º 57' 33,7"	I. B. Oliveira & C.W.N. Moura	11/I/ 2009
Periphyton	155611	Mata de São João	S 12º 26' 28,2" W 37º 57' 03,1"	I. B. Oliveira & C.W.N. Moura	11/I/ 2009
Plankton	155623	Mata de São João	S 12º 26' 24" W 37º 57' 13"	I. B. Oliveira & C.W.N. Moura	14/II/2009
Plankton	155632	Esplanada	S 12º 03' 48,2" W 37º 43' 07,1"	I. B. Oliveira & C.W.N. Moura	15/II/2009
Plankton	155637	Esplanada	S 12º 03' 34,2" W 37º 44' 51,8"	I. B. Oliveira & C.W.N. Moura	15/II/2009
Periphyton	155641	Esplanada	S 11º 58' 40,8" W 37º 40' 31,7"	I. B. Oliveira & J. T. Farias	28/II/2009
Periphyton	155650	Conde	S 11º 56' 46,4" W 37º 40' 10,1"	I. B. Oliveira & J. T. Farias	28/II/2009
Periphyton	155654	Conde	S 11º 49' 30,1" W 37º 33' 17,9"	I. B. Oliveira & J. T. Farias	28/II/2009

Continue

Table 1. Continuation

Samples	HUEFS	Municipalities	Coordinates	Collectors	Date
Periphyton	155662	Conde	S 11º 55' 09,8" W 37º 36' 01,4"	I. B. Oliveira & J. T. Farias	01/III/2009
Periphyton	155668	Conde	S 11º 51' 07,6" W 37º 34' 22,8"	I. B. Oliveira & J. T. Farias	01/III/2009
Plankton	155679	Esplanada	S 12º 06' 52,7" W 37º 42' 20,8"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Plankton	155680	Esplanada	S 12º 06' 49,6" W 37º 42' 23,2"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Plankton	155682	Esplanada	S 12º 06' 45,0" W 37º 42' 22,6"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Plankton	155686	Esplanada	S 12º 06' 48,9" W 37º 42' 29,1"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Periphyton	155689	Esplanada	S 12º 07' 01,9" W 37º 42' 32,4"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Periphyton	155691	Esplanada	S 12º 06' 55,7" W 37º 42' 26,5"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Plankton	155697	Esplanada	S 12º 04' 21,9" W 37º 45' 01,1"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Plankton	155702	Mata de São João	S 12º 14' 51,4" W 37º 51' 23,8"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Plankton	155706	Mata de São João	S 12º 21' 00,7" W 37º 54' 21,3"	I. B. Oliveira & C.W.N. Moura	14/III/2009
Periphyton	155714	Conde	S 11º 50' 39,9" W 37º 34' 51,1"	I. B. Oliveira et al.	11/VII/2009
Periphyton	155718	Conde	S 11º 53' 53,9" W 37º 35' 14,1"	I. B. Oliveira et al.	11/VII/2009
Periphyton	155722	Conde	S 12º 06' 49,9" W 37º 42' 22,1"	I. B. Oliveira et al.	12/VII/2009
Periphyton	155727	Conde	S 12º 06' 40,7" W 37º 42' 31,2"	I. B. Oliveira et al.	12/VII/2009
Plankton	155733	Esplanada	S 12º 06' 32,5" W 37º 42' 04,6"	I. B. Oliveira et al.	12/VII/2009
Periphyton	155736	Esplanada	S 12º 14' 26,9" W 37º 50' 56,6"	I. B. Oliveira et al.	12/VII/2009
Plankton	155739	Esplanada	S 11º 47' 29,2" W 37º 41' 26,6"	I. B. Oliveira & J. T. Farias	26/VII/2009
Periphyton	155742	Esplanada	S 11º 53' 03,8" W 37º 38' 58,6"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155748	Conde	S 11º 58' 40,8" W 37º 40' 41,3"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155750	Subaúma	S 12º 03' 13,8" W 37º 42' 58,7"	I. B. Oliveira & J. T. Farias	26/VII/2009
Periphyton	155755	Subaúma	S 12º 13' 53,2" W 37º 46' 38,2"	I. B. Oliveira & J. T. Farias	26/VII/2009
Periphyton	155756	Subaúma	S 12º 12' 58,6" W 37º 47' 50,9"	I. B. Oliveira & J. T. Farias	26/VII/2009
Periphyton	155757	Subaúma	S 12º 12' 56,9" W 37º 47' 52,6"	I. B. Oliveira & J. T. Farias	25/VII/2009
Periphyton	155758	Subaúma	S 12º 22' 51,4" W 37º 52' 54,6"	I. B. Oliveira & J. T. Farias	26/VII/2009

Continue

Table 1. Continuation

Samples	HUEFS	Municipalities	Coordinates	Collectors	Date
Periphyton	155761	Entre Rios	S 12º 21' 00,4" W 37º 54' 21,2"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155765	Entre Rios	S 12º 25' 49,0" W 37º 56' 28,2"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155769	Mata de São João	S 12º 26' 54,9" W 37º 57' 03,1"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155773	Mata de São João	S 12º 29' 34,4" W 37º 57' 28,1"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155775	Mata de São João	S 12º 29' 40,9" W 37º 57' 31,6"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155778	Mata de São João	S 12º 29' 28,3" W 37º 57' 22,6"	I. B. Oliveira & J. T. Farias	26/VII/2009
Plankton	155784	Mata de São João	S 12º 34' 37,8" W 38º 00' 45,6"	I. B. Oliveira & J. T. Farias	26/VII/2009
Periphyton	155787	Mata de São João	S 12º 34' 35,,5" W 38º 00' 52,4"	I. B. Oliveira & J. T. Farias	26/VII/2009
Periphyton	155788	Mata de São João	S 12º 34' 37,8" W 38º 00' 48,1"	I. B. Oliveira & J. T. Farias	26/VII/2009
Periphyton	155790	Mata de São João	S 12º 32' 57,6" W 38º 00' 08,4"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155792	Mata de São João	S 12º 34' 37,8" W 38º 00' 45,6"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155794	Conde	S 12º 34' 37,2" W 30º 50' 48,6"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Plankton	155802	Conde	S 11º 54' 03,2" W 37º 35' 19,9"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155804	Conde	S 11º 53' 51,8" W 37º 35' 13,1"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155808	Conde	S 11º 49' 55,5" W 37º 33' 25,6"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155812	Conde	S 11º 49' 4 2,2" W 37º 33' 16,7"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155813	Conde	S 11º 49' 36,6" W 37º 33' 15,7"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155816	Conde	S 11º 49' 23,1" W 37º 33' 05,5"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Plankton	155820	Conde	S 11º 51' 02,3" W 37º 34' 31,1"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009
Periphyton	155822	Conde	S 11º 50' 42,8" W 37º 34' 50,1"	I. B. Oliveira & C.W.N. Moura	2/VIII/2009

RESULTS AND DISCUSSION

The analysis of 55 sample units allowed the identification of 40 taxa among species, varieties and taxonomic forms belonging to *Closterium* and one species of *Spinoclosterium*. The taxa are described below.

Closterium aciculare West var. ***aciculare,*** Trans. Roy. Microsc. Soc., II, 8: 153. pl. 7, fig. 16. 1860.

(Figs. 2-4)

Cell slightly curved, 68-70 times longer than wide, 550-700 µm long, 8-10 µm wide, apex measuring 4-5 µm wide; slightly curved in the apical region (30-40° arc), nearly straight dorsal and ventral margins and margins that are slightly attenuated at the apex with pointed poles becoming rounded and slightly curved; smooth cell wall, colorless; axial chloroplastid, laminar, 6-8 pyrenoids arranged in median series.

Examined material: HUEFS 155641, 155650, 155662, 155668, 155691, 155718, 155784, 155804, 155820.

Distribution in Brazil: this study.

Comments: Specimens collected from the State of Bahia are consistent with the morphological description, illustration and measurements presented in reports by Prescott *et al.* (1975) of material from North America and by Croasdale & Flint (1986) of material from New Zealand.

Grönblad (1945) published the only report of the occurrence of this species in Brazil in the Pará State. This author did not describe or illustrate the morphology of the material studied. Due to the lack of factual information contained in this study, the report by Grönblad was discarded, and the present study is considered as pioneer in Brazil.

Closterium acutum (Lyngb.) Bréb. *ex* Ralfs var. ***acutum,*** Brit. Desm., p. 177, pl. 30, fig. 5, pl. 34, fig. 5. 1848.

(Fig. 5)

Cell semi-straight, 20-25 longer than wide, 155-167 µm in length, 6-8 µm in width, apex measuring 2-3 µm wide; slightly curved at the poles, (10-20º arc), convex dorsal margin and nearly straight ventral margin, sharp-rounded poles; smooth cell wall, hyaline, without polar thickening; axial chloroplastid, laminar, 2-4 pyrenoids arranged in median series.

Examined material: HUEFS 155598, 155641, 155668, 155702, 155714, 155733, 155748, 155769, 155787, 155816, 155822.

Distribution in Brazil: Amazonas (Lopes & Bicudo, 2002); São Paulo (Sormus & Bicudo, 1994, Bicudo & Castro, 1994).

Comments: Sormus & Bicudo (1994) reported cells that were smaller than those of the present study (115-135 µm x 4.5-5 µm), while Bicudo & Castro (1994) encountered larger cells (185-205 µm x 8-9 µm).

Grönblad (1945) and Scott *et al.* (1965) published reports of this species but provided no comments or illustrations of the material studied. Therefore, due to the lack of sufficient information to re-study this material, the studies of Grönblad (1945) and Scott *et al.* (1965) are considered as pioneering in Brazil.

Closterim angustatum Kütz. ex Ralfs var. ***angustatum,*** Brit. Desm., p. 172, pl. 29, fig. 4. 1845.

(Figs. 6-8)

Cell curved, ca. 6.4 times longer than wide, 160-195 µm long, 25-28 µm wide, apex measuring 4-8 µm wide; curved (40-55º arc), convex dorsal margin, concave ventral margin, pointed poles; cell wall with ribs, yellowish to brownish; axial chloroplastid, 4-8 pyrenoids.

Examined material: HUEFS 155611, 155706, 155736, 155748, 155784, 155808, 155822.

Distribution in Brazil: this study.

Comments: Prescott *et al.* (1975) documented larger cell measurements (256-650 µm x 15-35 µm) for the material obtained in North America. The specimens analyzed in this study are consistent with those described by the authors above; however, the specimens were smaller. It is known that cell measurements alone are not sufficient to differentiate *Closterium* species.

Closterim baillyanum (Ralfs) Bréb. var. ***baillyanum, Mém. Soc. Imp. Sci. Nat. Cherbourg***, 4: 151. 1856

(Figs. 9, 10)

Cell semi-slightly, 8-9 times longer than wide, 300-700 µm long, 34-40 µm wide, apex measuring 5-5.5 µm wide; accentuated curvature (40-50º arc), slightly convex dorsal margin, slightly concave ventral margin, occasionally straight in the middle portion, truncated poles; apparently smooth or pointed cell wall, principally in the apical region, brownish hyaline, possibly exhibiting thickened apical and lateral poles; axial chloroplastid, 5-8 pyrenoids arranged in median series; terminal vacuole and corpuscles were not observed.

Examined material: HUEFS 155598, 155602, 155623, 155706, 155736, 155761, 155769, 155773, 155804, 155816.

Distribution in Brazil: Amazonas (Lopes & Bicudo, 2002); Minas Gerais (Oliveira, 2001); Pará (Scott *et al.,* 1965); Paraná (Bortolini *et al.,* 2009); São Paulo (Bicudo & Castro, 1994, Sormus & Bicudo, 1994).

Comments: Bicudo & Castro (1994) recorded accentuated cellular polymorphisms in this species, and polar and lateral thickening of the inner cell was present in some cases. *Closterium baillyanum* var. *baillyanum* could be easily confused with *C. abruptum* West var. *canadense* Bourrelly; however, the latter exhibits polar thickening only in the apical region, while the former exhibits apical and lateral polar thickening.

Closterium braunii Reinsch, Acta Soc. Senckenber., 6: 138, pl. 20, fig. CI, 1-5. 1867.

(Figs. 11-13)

Cell slightly curved, 11-12 times longer than wide, 720-855 µm long, 62,5-70 µm wide, apex measuring 15-18 µm wide; curved in the apical region (40-50º arc), concave dorsal and ventral margins, obtuse-rounded poles; brownish, grooved cell walls, puncta between grooves; axial chloroplastids, 4-5 lamella; 12-14 pyrenoids.

Examined material: HUEFS 155706, 155758, 155816, 155822.

Distribution in Brazil: this study.

Comments: Grönblad (1945) first observed the occurrence of *Closterium braunii* in Brazil based on material obtained in Pará State; however, the author presented no description or illustration of the material studied. Consequently, the present study is considered the first confirmed report of this species in Brazil.

Croasdale & Flint (1986) recorded cell measurements with a greater variation (450-1200 x 25-63 µm) than those obtained in the populations present in the State of Bahia.

Closterium calosporum Witrrock var. ***calosporum***, Acta Soc. Sci. Upsal., série 3, 7(3): 23, pl. 1, fig. 11. 1869.

(Fig. 14)

Cell curved, 14-19 times longer than wide, 135-140 µm long, 7.5-8.5 µm wide, apex measuring 2.5-3 µm wide; slight curvature (ca. 90º arc), convex dorsal margin, nearly straight in the middle region, concave ventral margin, pointed-rounded poles; hyaline to slightly brown smooth cell wall, potentially exhibiting polar thickening; axial chloroplastid, 2-6 pyrenoids, arranged in a median series.

Examined material: HUEFS 155623, 155641, 155650, 155679, 155686, 155706, 155758, 155784, 155788, 155808, 155820, 155822.

Distribution in Brazil: Pará (Förster, 1969); Paraná (Bittencourt-Oliveira & Castro, 1993); Rio Grande do Sul (Ungaretti, 1976); São Paulo (Bicudo & Castro, 1994).

Comments: Morphologically, *Closterium calosporum* var. *calosporum* is similar to *C. dianae* Ehrenb. *ex* Ralfs; however, the later differs by exhibiting obtuse-rounded poles, a smooth or punctuated cell wall and relatively smaller cell measurements. Bicudo & Castro (1994) studied material collected from various locations in the State of São Paulo and observed cellular variation in terms of polar thickening of the internal cell wall, which may or may not appear, and the middle region of the cell ventral margin, which could appear straight or concaved.

Closterium closterioides (Ralfs) A.Louis & Peeters var. ***closterioides***, Bull. Jard. Bot. Natn. Belg., 37: 410, pl. 18, fig. 119. 1967.

(Figs. 15, 16)

Cell slightly, 4.5-8 times longer than wide, 92.5-130 µm long, 17.5-22.5 µm wide, apex measuring 8.5-10 µm wide; equally concave dorsal and ventral margins, diminishing towards the apices, truncated apices; smooth, colorless cell wall; axial, constricted chloroplastid, 4-8 pyrenoids.

Examined material: HUEFS 155623, 155641, 155784, 155840.

Distribution in Brazil: Amazonas (Förster, 1969).

Comments: *Closterium closterioides* var. *closterioides* and *C. navicula* (Bréb.) Lütkm. are quite similar; however, the latter differs from the former by exhibiting an elliptical cellular contour, rounded poles and chloroplastids with 5-6 longitudinal lamella and 1-2 pyrenoids.

Closterium closterioides (Ralfs) A. Louis & Peeters var. ***intermedium*** (J. Roy & Bisset) Ruzicka, Preslia 45: 199, pl. 2, fig. 23. 1973.

(Fig. 17)

Cell slightly, ca. 13.5 times longer than wide, 135-142 µm long, 27.5-30 µm wide, apex measuring 10-12.5 µm wide; equally concave dorsal and ventral margins, diminishing towards the apex, truncated poles; smooth, colorless cell wall; axial chloroplastid, 2-4 pyrenoids.

Examined material: HUEFS 155623, 155706, 155757, 155784, 155792, 155812, 155820, 155822.

Distribution in Brazil: Amazonas (Förster, 1969, Martins, 1980); Bahia (Bicudo & Martins, 1989); Mato Grosso (De-Lamonica-Freire, 1985); Minas Gerais (Bicudo & Ventrice, 1968); Pará (Scott *et al.,* 1965); Roraima (Förster, 1963); São Paulo (Borge, 1918, Bicudo, 1969).

Comments: *Closterium closterioides* var. *intermedium* differs from the typical variety of the species by exhibiting transversely and incompletely divided chloroplastid. Borge (1925) and Grönblad (1945) registered the presence of *Closterium closterioides* var. *intermedium* in Mato Grasso and Pará States, respectively; however, they did not present measurements, descriptions or illustrations of the identified materials.

Closterium cynthia De Notaris var. ***cynthia***,

Desmid. Ital., p. 65, pl. 7, fig. 71. 1867.
(Fig. 18)

Cell lunated, 10-11 times longer than wide, 100-125 µm long, 10-11 µm wide, apex measuring 2.5-3 µm in width; accentuated curvature (100-130º arc), convex dorsal margin, concave ventral margin that might be slightly swollen in the middle region, striated cell wall, 9-12 striae in 10 µm, yellowish to brownish, with or without polar thickening; axial chloroplasts, 3 lamella, 4-7 pyrenoids arranged in a median series.

Examined material: HUEFS 155602, 155662, 155697, 155794, 155804, 155816, 155822.

Distribution in Brazil: Amazonas (Förster, 1969); Mato Grosso (Borge, 1903); Paraná (Picelli-Vicentim, 1984, Felisberto & Rodrigues, 2007, Bortolini *et al.,* 2009); São Paulo (Borge, 1918, Bicudo, 1969, Sormus & Bicudo, 1994).

Comments: *Closterium cynthia* var. *cynthia* is similar to *C. jenneri* Ralfs; however, *C. cynthia* var. *cynthia* exhibits a smaller arc of curvature and a continuously striated cell wall. Its morphology is similar to that of *C. parvulum* Nägeli and *C. venus* Kütz. *ex* Ralfs but these two latter species differ by exhibiting a smooth cell wall.

Closterium dianae Ehrenberg. *ex* Ralfs var. ***dianae,*** Brit. Desm., p.168, pl. 28, fig. 5a-b. 1848.
(Fig. 19)

Lunated cell, 11-13.5 times longer than wide, 170-215 µm long, 12.5-19 µm wide, apex measuring 3-6 µm wide; accentuated curvature (100-120º arc), convex dorsal margin, concave ventral margin, obtuse-rounded apices; smooth, hyaline, yellowish to brownish cell wall; axial chloroplastid, 2 lamella, 4-8 pyrenoids in a median series.

Examined material: HUEFS 155623, 155718, 155733, 155739, 155758, 155716, 155784, 155790, 155792, 155794, 155820.

Distribution in Brazil: Bahia (Martins & Bicudo, 1987); Goiás (Förster, 1964); Pará (Grönblad, 1945, Förster 1969); Paraná (Bittencourt-Oliveira & Castro, 1993, Biolo *et al.,* 2008, Bortolini *et al*., 2009); Rio Grande do Sul (Ungaretti, 1976); São Paulo (Börgesen, 1890, Bicudo 1969, Bicudo & Castro, 1994, Sormus & Bicudo, 1994).

Comments: Wille (1884) reported the occurrence of this species in Rio de Janeiro State; however, no measurements, descriptions or illustrations were presented. Due to the lack of information to re-study this material, the report from Wille (1884) might not be considered the first for this species in Brazil.

Closterium dianae Ehrenberg.*ex* Ralfs var. ***brevius*** (Petkoff) Krieger. *In*: Rabenhorst, Krypt.-Flora Deutsch. 13(1): 296, pl. 19, fig. 13. 1935.
(Fig. 20)

Lunated cell, ca. 6 times longer than wide, 150-175 µm long, 25-28 µm wide, apex measuring 3-4 µm wide; accentuated curvature (100-115º arc), convex dorsal margin, concave ventral margin, slightly swollen in the middle region; oblique-truncated poles, with 1 pore on the dorsal margin; smooth, hyaline or yellowish cell wall; axial chloroplastid, 3-6 pyrenoids.

Examined material: HUEFS 155623, 155682, 155706, 155784, 155792.

Distribution in Brazil: Rio de Janeiro (Oliveira *et al*., 1951, Sophia, 2009); Pará (Förster, 1969); Paraná (Felisberto & Rodrigues, 2007, Bortolini *et al.,* 2009); São Paulo (Börgesen, 1890, Bicudo, 1969, Bicudo & Castro, 1994).

Comments: *Closterium dianae* var. *brevius* differs from the typical variety of the species because it exhibits shorter and wider cells and a swollen ventral margin in the median region.

Bicudo & Castro (1994) presented smaller cell measurements (114-118 x 16-20 µm) for material from the State of São Paulo as compared with those observed for the specimens in the present study.

Closterium ehrenbergii Meneghni. *ex* Ralfs var. ***ehrenbergii,*** Brit. Desm., p. 166, pl. 28, fig. 2. 1848.
(Figs. 21, 22)

Cell semi-lunated, 8-9 times longer than wide, 540-600 µm long, 62.5-75 µm wide, apex measuring ca. 9 µm wide; slight curvature (60-70º arc), convex dorsal margin, straight ventral margin, slightly swollen in the middle region, truncated poles; smooth cell wall, striated and difficult to visualize, punctated at the apices, polar thickening; axial chloroplastid, 3-4 lamella, numerous and random pyrenoids.

Examined material: HUEFS 155598, 155654, 155680, 155689, 155706, 155775, 155784, 155787, 155792, 155802, 155804, 155813.

Distribution in Brazil: Amazonas (Förster, 1969); Pará (Grönblad, 1945); Paraná (Picelli-Vicentim, 1984, Bittencourt-Oliveira & Castro, 1993, Felisberto & Rodrigues, 2007, Bortolini *et al.,* 2009); Rio Grande do Sul (Borge, 1903, Ungaretti, 1981, Rosa *et al.,* 1987, 1988, Franceschini, 1992, Sophia *et al.,* 2005).

Comments: Morphologically, *Closterium*

ehrenbergii var. *ehrenbergii* is quite similar to *C. laterale* Nordst., which differs by exhibiting pyrenoids arranged in a series with a striated cell wall. It also differs from *C. moniliferum* (Bory) Ehrenb. because this latter species exhibits rounded poles, smooth cell walls and pyrenoids arranged in a median series.

Closterium gracile Brébisson *ex* Ralfs var. ***gracile,*** Brit. Desm., p 221. 1848.

(Fig. 23)

Cell semi-straight, 30-33 times longer than wide, 112.5-200 µm long, 3.5-6 µm wide, apex measuring 2.5-4 µm wide; slightly curved (20-40º arc), convex dorsal margin, straight ventral margin in the middle region, with a slight curvature in the apical region; obtuse and truncated poles, with a single pore; smooth, hyaline cell wall, with or without polar thickening; axial chloroplastid, 5-6 pyrenoids.

Examined material: HUEFS 155602, 155702, 155733, 155742, 155787, 155804, 155812, 155813, 15520, 155822.

Distribution in Brazil: Mato Grosso (Borge, 1903, 1925); Minas Gerais (Bicudo, 1969); Pará (Förster, 1969); Paraná (Picelli-Vicentim 1984, Felisberto & Rodrigues, 2007); Rio Grande do Sul (Borge 1903, Bicudo & Ungaretti 1986, Franceschini, 1992, Sophia *et al.* 2005); São Paulo (Bicudo & Bicudo, 1965, Bicudo, 1969, Sormus & Bicudo, 1994, Marinho & Sophia, 1997).

Comments: Morphologically, *Closterium gracile* var. *gracile* is similar to *C. cornu* Ehrenberg. However, the latter differs by exhibiting uniform curvature at the poles and middle region retuse. It is also similar to *C. juncidum* Ralfs, but this species differs by exhibiting a brownish, striated and punctuated cell wall and obtuse-rounded to rounded-truncated poles.

Closterium gracile var. *gracile* is a common species in freshwater bodies of Brazil.

Closterium idiosporum West & G.S.West, Jor. Bot., 38: 290, pl. 412, fig. 6-7. 1900.

(Fig. 24)

Cell semi-straight, 22-34 times longer than wide, 170-200 µm long, 5-9 µm wide, apex measuring 1.5-2 µm wide; slightly curved, (10-20º arc), dorsal and ventral margins equally convex, nearly straight in the middle region, slightly pointed at the poles; pointed-rounded poles; smooth, hyaline cell wall; axial chloroplastid, restricted to the middle region of the cell; 3-5 pyrenoids in a median series.

Examined material: HUEFS 155641, 155757, 155769, 155787, 155808, 155820.

Distribution in Brazil: this study.

Comments: With regard to the morphology, *Closterium idiosporum* is similar to *C. pronum* Bréb.; however, it differs by exhibiting a larger cell length:width ratio that is up to 60 times longer than wide, truncated-rounded poles and slightly curved apices.

Closterium incurvum Brébisson var. ***incurvum,*** Mém. Soc. Imp. Sci. Nat. Cherbourg, 4: 150, pl. 2, fig. 47. 1856.

(Figs. 25, 26)

Cell lunated, 6.6-7.6 times longer than wide, 50-87.5 µm long, 7.5-11.5 µm wide, apex measuring 2.5-3 µm wide; accentuated curvature (140-160º arc), convex dorsal margin, concave ventral margin, pointed-rounded poles; smooth, hyaline to brownish cell wall, with or without polar thickening; axial chloroplastid, 3 lamella, 1-5 pyrenoids arranged in median series.

Examined material: HUEFS 155598, 155623, 155662, 155668, 155736, 155742, 155769, 155775, 155787, 155792, 155820, 155822.

Distribution in Brazil: Paraná (Picelli-Vicentim, 1984, Bittencourt-Oliveira & Castro, 1993, Felisberto & Rodrigues, 2007, Biolo *et al.,* 2008, Bortolini *et al.,* 2009); Rio Grande do Sul (Sophia *et al.,* 2005); São Paulo (Bicudo & Castro, 1994, Sormus & Bicudo 1994).

Comments: Morphologically, *Closterium incurvum* var. *incurvum* is similar to *C. venus* var. *incurvum* (Brébisson.) Krieger, differing only by the larger cellular curvature and pointed-rounded poles.

Closterium jenneri Ralfs var. ***jenneri,*** Brit. Desm., p 167, pl. 28, fig. 6. 1848.

(Fig. 27)

Cell lunated, 11-12 times longer than wide, 135-145 µm long, 11-12.5 µm wide, apex measuring 4-5 µm wide; moderate curvature (90-130º arc), convex dorsal margin, concave ventral margin, straight in the middle region and not swollen, rounded to obtuse-rounded poles; smooth, colorless to brownish cell wall; axial chloroplastid, 4 lamella, 4-9 pyrenoids in median series.

Examined material: HUEFS 155598, 155623, 155706, 155718, 55775, 155790, 155822.

Distribution in Brazil: Bahia (Bicudo &

Martins, 1989), Mato Grosso (Borge, 1925); Paraná (Picelli-Vicentim, 1984, Bittencout-Oliveira & Castro, 1993, Felisberto & Rodrigues, 2007); Rio Grande do Sul (Ungaretti, 1976, Bicudo & Ungaretti, 1986, Sophia *et al.,* 2005); São Paulo (Díaz, 1972, Sormus & Bicudo, 1994, Marinho & Sophia, 1997).

Comments: Grönblad (1945) cited this species in Pará State but reported no description or illustration of the cell. Due to the lack of sufficient information, it was not possible to re-study the variety type of the species.

Prescott *et al.* (1975) commented on the presence of fine striae on the cell wall of *C. jenneri* var. *jenneri*; however, in the specimens examined in the present study, no stria was visualized.

Closterium jenneri Ralfs var. ***robustum*** G.S. West, Jor. Bot., 37: 112, pl. 396, fig. 9. 1899.

(Fig. 28)

Cell lunated, 5-7 times longer than wide, 56-89 µm long, 11-12.5 µm wide, apex measuring 4-6 µm wide; accentuated curvature (130-160º arc), convex dorsal margin, concave ventral margin, obtuse-rounded poles; smooth, colorless cell wall, punctated; axial chloroplastid, 4-7 pyrenoids.

Examined material: HUEFS 155598, 155623, 155706, 155775, 155802.

Distribution in Brazil: Paraná (Felisberto & Rodrigues, 2007); São Paulo (Bicudo & Castro, 1994, Sormus & Bicudo, 1994).

Comments: *Closterium jenneri* var. *robustum* differs from the typical variety of the species by presenting relatively smaller cell measurements, proportionally wider cells, obtuse-rounded poles and a more accentuated arc of curvature.

Bicudo & Castro (1994) were the first authors to report the present variety in Brazil.

Closterium kuetzingii Brébisson var. ***kuetzingii,*** Mém. Soc. Imp. Sci. Nat. Cherbourg, 4: 156, pl. 2, fig. 40. 1856.

(Figs. 29-31)

Cell fusiform-lanceolated, 38-49 times longer than wide, 390-420 µm long, 8-11 µm wide, apex measuring 4-5 µm wide; convex dorsal and ventral margins where the ventral is slightly more curved, median fusiform region, slightly curved apices, setaceous, long apical processes (ca. 1/4 the total length of the cell), rounded poles; striated cell well, 10-14 striae in 10 µm, hyaline to brownish color; axial chloroplastid, 4-6 pyrenoids arranged in a median series.

Examined material: HUEFS 155598, 155611, 155637, 155727, 155733, 155739, 155775, 155784, 155790, 155816, 155820.

Distribution in Brazil: Amazonas (Förster, 1969, 1974, Martins, 1982); Bahia (Martins & Bicudo, 1987); Minas Gerais (Oliveira, 2001); Rio Grande do Sul (Ungaretti, 1981, Rosa *et al.,* 1987, Franceschini, 1992, Garcia & Vélez, 1995, Sophia *et al.,* 2005); Paraná (Andrade & Rachou, 1954, Picelli-Vicentim, 1984, Bittencourt-Oliveira, 1993); São Paulo (Sormus & Bicudo, 1994).

Comments: Morphologically, *Closterium kuetzingii* var. *kuetzingii* is similar to *C. setaceum* Ehrenberg *ex* Ralfs and *C. rostratum* Ehrenberg *ex* Ralfs, which differ by exhibiting truncated and oblique-truncated poles, respectively. They also differ in the length of the setaceous processes.

Grönblad (1945) identified this species in Pará State, but reported no description or illustration of the material examined. Therefore, the lack of sufficient information to re-study this material suggests that the citation by Grönblad (1945) it is not being included in the list of geographical distribution of the species.

Closterium kuetzingii Brébisson var. ***vittatum*** Nordstedt, K-Svenska Vet.-Akad. Handl., 22(8): 70, pl. 3, fig. 21. 1888.

(Fig. 32)

Cell fusiform-lanceolated, ca. 27 times longer than wide, 410-430 µm long, 14-15 µm wide, apex measuring ca. 5 µm wide; dorsal and ventral margins equally convex, fusiform middle region, setaceous apical processes, slightly curved, rounded-truncated poles; striated cell wall, 5-6 striae in 10 µm, hyaline to brownish; axial chloroplastid, 4-6 pyrenoids arranged in median series.

Examined material: HUEFS 155598, 155702, 155758, 155792, 155820.

Distribution in Brazil: São Paulo (Bicudo & Castro, 1994).

Comments: Similar to the case of *Closterium kuetzingii* var. *kuetzingii*, Grönblad (1945) presented no description or illustration of the *C. kuetzingii* var. *vittatum* material from Pará State. Without this information, it is practically impossible to re-evaluate the species.

Closterium lagoense Nordstedt, Viden. Medd. Dansk natur. For. Kjobenh. 1869 (14/15): pl. 2, fig. 2. 1870.

(Figs. 33, 34)

Cell lunated, 5-7 times longer than wide, 130-210 µm long, 25-30 µm wide, apex measuring 9-11 µm wide; moderate curvature (120-160º arc), concave dorsal margin, convex ventral margin; striated cell wall, 8-10 striae in 10 µm, yellowish or brownish; conical poles, axial chloroplastid, 3-4 lamella, 4-6 pyrenoids in median series.

Examined material: HUEFS 155727, 155775, 155778, 155802.

Distribution in Brazil: Amazonas (Förster, 1974, Martins, 1980); Bahia (Martins & Bicudo, 1987, Bicudo & Martins, 1989); Paraná (Bittencourt-Oliveira & Castro, 1993); São Paulo (Börgesen, 1890, Bicudo & Castro, 1994).

Comments: Förster (1964) reported the first occurrence of *Closterium lagoense* in Brazil from the analysis of material obtained from Conceição, in Goiás State, where our material is consistent.

Prescott *et al.* (1975) registered species with arcs measuring up to 250º in material from North America, i.e., they were much more curved than those observed in the present study.

Closterium lineatum Ehrenberg. *ex* Ralfs var. ***lineatum***, Brit. Desm., p. 173, pl. 30, fig. 1. 1848.

(Figs. 35, 36)

Cell semi-straight, 25-30 times longer than wide, 360-420 µm long, 12-16 µm wide, apex measuring 4-6 µm wide; slightly curved in the apical region (20-30º arc), straight dorsal margin in nearly its entire extension, nearly straight ventral margin; yellowish to brownish, slightly striated cell wall, striations difficult to visualize; truncated-rounded poles, axial chloroplastid, various pyrenoids.

Examined material: HUEFS 155697, 155718, 155756, 155802, 155808, 155822.

Distribution in Brazil: Amazonas (Förster, 1974, Martins, 1980); Bahia (Martins & Bicudo, 1987, Bicudo & Martins, 1989); Paraná (Bittencourt-Oliveira & Castro, 1993); São Paulo (Börgesen, 1890, Bicudo & Castro, 1994).

Comments: Morphologically, *Closterium lineatum* var. *lineatum* is similar to *C. juncidum* var. *elongatum* H. Roy & Bisset; however, the latter differs by exhibiting amply truncated poles.

Borge (1918) and Grönblad (1945) cited only the occurrence of the present species in São Paulo and Pará States, respectively. However, neither author presented descriptions, measurements or illustrations of the materials identified; therefore, the re-identification was not possible.

Closterium lineatum Ehrenberg *ex* Ralfs var. ***costatum*** Wolle, Fresh-w. Alg. U. S. 25, pl. 61, fig. 3. 1887.

(Figs. 37-39)

Cell semi-straight, 35-39 times longer than wide, 390-690 µm long, 10-22.5 µm wide, apex measuring 7.5-9 µm wide; slightly curved (40-70º arc), slightly convex dorsal margin, slightly concave ventral margin, truncated-rounded poles, slightly curved apices, with thickening; ribbed cell wall, 4-5 ribs in 10 µm, punctations between the ribs, yellowish to brownish; axial chloroplastid, 4-8 pyrenoids.

Examined material: HUEFS 155706, 155736, 155755, 155784.

Distribution in Brazil: this study.

Comments: *Closterium lineatum* var. *costatum* differs from the typical variety of the species by exhibiting proportionally longer and narrower cells with a ribbed cell wall and punctations between the ribs.

Morphologically, *C. lineatum* var. *costatum* is similar to *C. juncidum* Ralfs; however, it is sufficiently different by exhibiting parallel ventral and dorsal margins in the middle region and striated cell wall, with 5-20 striae in 10 µm.

Closterium macilentum Brébisson var. ***macilentum***, Mém. Soc. Imp. Sci. Nat. Cherbourg, 4: 153, pl. 2, fig. 36. 1856.

(Figs. 40, 41)

Lunated cell, 29-32 times longer than wide, 440-560 µm long, 15-17.5 µm wide, apex measuring 4-5 µm wide; moderated curvature (120-130º arc), convex dorsal margin, concave ventral margin, pointed-rounded poles; smooth, brownish cell wall, slightly thickened poles; axial chloroplastid, 6-12 pyrenoids arranged in median series.

Examined material: HUEFS 155680, 155691, 155714, 155813.

Distribution in Brazil: Mato Grosso (De-Lamonica-Freire, 1985); São Paulo (Bicudo & Castro, 1994).

Comments: Regarding morphology, this species is similar to *C. juncidum* and *C. lineatum*, *C. juncidum* is different by exhibiting truncated or truncated-rounded poles and a striated cell wall; however, *C. lineatum* is different by exhibiting parallel margins in the middle region of the cell, softened apices and

truncated poles and a striated and punctuated cell wall.

Material from Bahia State studied herein is consistent with that described by Förster (1974) for material from the Amazon, by Prescott *et al.* (1975) for specimens from North America and by Croasdale & Flint (1986) for specimens from New Zealand.

Closterium malmei Borge var. ***semicirculare*** Borge, Ark. Bot., 1: 79, pl. 1, fig. 22. 1903.

(Fig. 42)

Cell lunated, 4.5-5 times longer than wide, 210-235 µm long, 42.5-44 µm wide, apex measuring 12.5-14 µm wide; accentuated curvature (150-180º arc), convex dorsal margin, concave ventral margin, conical-rounded poles; brownish, ribbed cell wall, 4-6 ribs in 10 µm, punctuae between ribs; axial chloroplastid, 6-9 pyrenoids in axial series.

Examined material: HUEFS 155598, 155748, 155755, 155769, 155792, 155802, 155812.

Distribution in Brazil: Mato Grosso (De-Lamonica-Freire, 1985); São Paulo (Bicudo & Castro, 1994).

Comments: *Closterium malmei* var. *semicirculare* differs from the typical variety of this species, in that the cells are proportionally longer and more curved and have fewer number of ribs on the cell wall.

The material analyzed herein is consistent with the description by Prescott *et al.* (1975); however, these authors reported larger cell measurements (345-547 x 40-60 µm).

Closterium moniliferum (Bory) Ehrenberg var. ***moniliferum***, Die Infus.Volk. Org. p. 91, pl. 5, fig. 16. 1838.

(Fig. 43)

Cell lunated, 4-5.3 times longer than wide, 165-180 µm long, 31-35 µm wide, apex measuring 5-10 µm wide; accentuated curvature (90-125º arc), extremely convex dorsal margin, concave ventral margin, sometimes swollen in the middle region, rounded poles; apparently smooth, hyaline cell wall, with or without polar thickening; axial chloroplastid, 3-4 lamella, 4-7 pyrenoids, arranged in a median series, terminal vacuole.

Examined material: HUEFS 155598, 155623, 155662, 155790, 155792, 155802, 155812, 155813, 155820.

Distribution in Brazil: Mato Grosso (Borge, 1925, De-Lamonica-Freire & Herckman,1996); Rio de Janeiro (Marinho & Huszar, 1990, Sophia 2009); Paraná (Picelli-Vicentim, 1984, Biolo *et al.* 2008, Bortolini *et al.* 2009); São Paulo (Borge, 1918, Bicudo & Bicudo, 1962, Sormus & Bicudo, 1994).

Comments: Morphologically, *Closterium moniliferum* var. *moniliferum* is similar to *C. ehrenbergii*, which differs due to a greater number and random distribution of pyrenoids in the chloroplastid.

Förster (1982), Coesel (1983) and Sormus & Bicudo (1994) commented on the variation in the cell wall of this species, varying from finely striated to apparently smooth. Biolo *et al.* (2008) and Prescott *et al.* (1975) reported larger cell measurements (130-610 x 28-90 µm) than those obtained from the specimens studied herein.

Closterium moniliferum (Bory) Ehrenberg *ex* Ralfs (1848) var. ***concavum*** Klebs, Sch. Physik.-ökon. Gesells. König., 5(20): 10, pl. 1, fig. 5 a-b. 1879.

(Figs. 44, 45)

Cell lunated, ca. 5.8 times longer than wide, ca. 280 µm long, ca. 47.5 µm wide, apex measuring ca. 16 µm wide; accentuated curvature (130-150º arc), convex dorsal margin, concave ventral margin, swollen in the middle region, rounded poles; smooth, brownish cell wall, without polar thickening; axial chloroplastid, numerous pyrenoids.

Examined material: HUEFS 155611, 155662, 155765, 155784, 155802, 155822.

Distribution in Brazil: Paraná (Felisberto & Rodrigues, 2007, Biolo *et al.,* 2008); São Paulo (Bicudo & Bicudo, 1962, Bicudo, 1969, Bicudo & Castro, 1994).

Comments: *Closterium moniliferum* var. *concavum* differed from the typical variety by exhibiting cells that were longer than wide, a swollen ventral region, pointed-rounded poles, striated cell wall and more accentuated arc of curvature.

In the samples analyzed herein, there is the occurrence of individuals with a swollen middle region, which is similar to those of *C. leibleinii* Kütz. *ex* Ralfs and individuals without a swollen middle region. These species, however, exhibit amply rounded poles, while *C. moniliferum* var. *concavum* has pointed-rounded poles.

Closterium navicula (Brébisson) Lütkem. var. ***navicula***, Beitr. Biol. Pflanz. Breslau, 8(3): 395, 405, 408. 1902.

(Fig. 46)

Cell straight, elliptical and fusiform, 4-4.5 times longer than wide, 60-67.5 µm long, 15 µm wide, apex measuring ca. 6 µm wide; equally convex dorsal and ventral margins, diminishing towards the apex, rounded-truncated poles; smooth, colorless cell wall, without thickening; axial chloroplastid, 4-5 lamella, 1-3 pyrenoids, arranged in median series.

Examined material: HUEFS 155611, 155706, 155718, 155769, 155775, 155812, 155820, 155822.

Distribution in Brazil: Amazonas (Scott *et al.,* 1965, Förster, 1974); Minas Gerais (Bicudo, 1969, Scott *et al.,* 1965, Förster, 1969); Pará (Scott *et al.,* 1965, Förster, 1969); Paraná (Felisberto & Rodrigues, 2007, Bortolini *et al.,* 2009); Rio de Janeiro (Bicudo & Picelli-Vicentim, 1988, Sophia, 2009); Rio Grande do Sul (Ungaretti, 1981, Sophia *et al.* 2005); São Paulo (Borge, 1918, Bicudo & Bicudo, 1962, Bicudo, 1969, Bicudo & Castro, 1994, Sormus & Bicudo, 1994).

Comments: *Closterium navicula* var. *navicula* might be confused with *C. closterioides* (Ralfs) Louis & Peeters, which is distinct because the latter exhibits much larger cell measurements (170-512 µm long).

Borge (1925) and Grönblad (1945) cited the occurrence of *C. navicula* in Mato Grosso and Pará States, respectively; however, the authors did not present descriptions, measurements or illustrations of the identified material.

Closterium parvulum Nägeli var. ***parvulum,*** Gatt. Algen. p. 106, pl. 5C, fig. 2. 1849.

(Fig. 47)

Cell semi-lunated, 10-13.5 times longer than wide, 87.5-145 µm long, 8-11 µm wide, apex measuring 4-5.5 µm wide; moderate curvature (90 140º arc), convex dorsal margin, concave ventral margin, sometimes nearly straight in the middle; pointed-rounded poles; smooth, hyaline to brownish cell wall; axial chloroplastid, 2-6 pyrenoids in median series.

Examined material: HUEFS 155598, 155727, 155775, 155792, 155802, 155812.

Distribution in Brazil: Amazonas (Förster, 1969); Bahia (Martins & Bicudo, 1987, Bicudo & Martins, 1989); Goiás (Prescott *et al.,* 1957); Mato Grosso (Borge, 1903, 1925); Minas Gerais (Bicudo, 1969); Paraná (Picelli-Vicentim, 1984); Rio Grande do Sul (Borge, 1903); São Paulo (Bicudo & Bicudo, 1962, Bicudo 1969, Sormus & Bicudo, 1994).

Comments: *Closterium parvulum* var. *parvulum* is morphologically similar to *C. dianae* but differs because the latter presents oblique truncated poles.

According to Sormus & Bicudo (1994), *C. parvulum* might exhibit pointed, pointed-rounded to obtuse-rounded poles, and the cell wall may appear brownish in color. Such variation was not observed in the material examined from the State of Bahia; however, a relatively large number of individuals was observed.

Closterium porrectum Nordstedt. var. ***porrectum,*** Vid. Medd. Dansk natur. Foren. Kjobenh. 1869: 203, pl. 2, fig. 1. 1870.

(Figs. 48, 49)

Cell lunated, 11-12 times longer than wide, 300-335 µm long, 25-32.5 µm wide, apex measuring 6-8 µm wide; accentuated curvature (140-150º arc), convex dorsal margin, concave ventral margin, rounded poles; brownish, ribbed cell wall, 2 ribs in 10 µm, without punctuation, with or without polar thickening; axial chloroplastid, 6-9 pyrenoids, distributed in median series.

Examined material: HUEFS 155598, 155714, 155758, 155784, 155780, 155802.

Distribution in Brazil: Mato Grosso (Borge, 1903); Pará (Scott *et al.,* 1965, Förster, 1969); São Paulo (Bicudo & Castro, 1994).

Comments: Morphologically, *Closterium porrectum* var. *porrectum* is similar to *C. archerianum* Cleve *ex* P. Lundell, but the latter exhibits obtuse-rounded cellular poles, which are sometimes slightly thickened at the dorsal margin of the apex with a striated cell wall.

Bicudo & Castro (1994) observed a morphological variation in the species in relation to the cellular pole, which appears capitulated at times, and polar thickening, which may be variably present.

Closterium pseudolunula Borge var. ***pseudolunula*** f. ***pseudolunula,*** Ark. Bot., 8(13): 3, pl. 1, fig. 2. 1909.

(Figs. 50-52)

Cell semi-lunated, ca. 6-7 times longer than wide, 290-340 µm long, 45-47.5 µm wide, apex measuring 11-12.5 µm wide; slight curvature (40-60º arc), convex dorsal margin, slightly concave ventral margin, truncated-rounded, nipple-shaped poles, without polar thickening; hyaline to yellowish, smooth cell wall, slightly constricted near the apex; axial chloroplastid, 5-6 pyrenoids arranged in a median series.

Examined material: HUEFS 155758, 155765, 155775, 155808.

Distribution in Brazil: this study.

Comments: With regard to morphology, *Closterium pseudolunula* var. *pseudolunula* f. *pseudolunula* is similar to *C. pritchardianum* W. Archer var. *pritchardianum* f. *laever* Hughes, however, this last differs by having a length greater width (11-17 times longer than wide) with grooves and pits in the midline.

The material examined is consistent with the descriptions, measurements and illustrations in Prescott *et al.* (1975) for specimens observed in North America.

Closterium pseudolunula Borge var. ***psudolunula*** f. ***longius*** Poljanski, Bot. Crypt. Pl. Sec. Acad. Sci. USSR 5(7-9): 106, fig. 1. 1941.

(Figs. 53-55)

Cell semi-lunated,, 9-11 times longer than wide, 360-470 µm long, 37.5-42.5 µm wide, apex measuring 10 µm wide; slightly curved, (ca. 50-70º arc), convex dorsal margin, slightly concave ventral margin, truncated poles without thickening in the apices; striated, smooth and brownish cell wall; axial chloroplastid, 5 lamella, 5-10 pyrenoids arranged in a median series.

Examined material: HUEFS 155804, 155812, 155822.

Distribution in Brazil: this study.

Comments: *Closterium pseudolunula* var. *pseudolunula* f. *longius* differs from the typical form of the species by exhibiting longer cells that are 9-11 times longer than wide. The taxonomical form is morphologically similar to *Closterium pritchardianum* W. Archer, which differs by exhibiting cells up to 25 times longer than wide, a striated cell wall, striations in the middle region arranged in a sub-spiral shape, chloroplastid with 6-8 lamella and 7-16 pyrenoids per plastid.

The material identified herein is consistent with the descriptions, measurements and illustrations presented in Prescott *et al.* (1975) based on specimens from North America.

Closterium pusillum Hantzsch var. ***pusillum,*** *In*: Rabenhorst, Algae europ. Exsic. 1008, Fig. a-e. 1861.

(Figs. 56, 57)

Cell semi-lunated, ca. 5 times longer than wide, 52.5-58 µm long, 11-12.5 µm wide, apex measuring 6-7.5 µm wide; slightly curved (40-50º arc), convex dorsal margin, nearly straight ventral margin, colorless, smooth cell wall; truncated-rounded poles; axial chloroplastid, 1-2 pyrenoids arranged in median series.

Examined material: HUEFS 155623, 155641, 155702, 155736, 155784.

Distribution in Brazil: Mato Grosso (Borge, 1925); Paraná (Felisberto & Rodrigues, 2007, Bortolini *et al.,* 2009); São Paulo (Bicudo & Castro, 1994).

Comments: *Closterium pusillum* var.*pusillum* is morphologically similar to *C. pygmaeum* Gutw. However, it differs by exhibiting pointed-rounded cellular poles, a smaller arc of curvature and a constitutively concave region in the middle ventral margin.

Bicudo & Castro (1994) reported a polymorphism at the cellular poles, which were rounded-truncate; a middle region of the ventral margin straight or concave, and occasionally polar thickening was also observed.

Closterium rostratum Ehrenberg *ex* Ralfs var. ***rostratum,*** Brit. Desm. p. 175, pl. 30, fig. 3. 1848.

(Figs. 58-60)

Cell semi-lunated, 10-12 times longer than wide, 385-400 µm long, 32.5-40 µm wide, apex measuring 8-9 µm wide; slight curvature (35-50º arc), convex dorsal and ventral margins, that the ventral is more curved, fusiform middle region, setaceous apical processes (1/5 the total cell length),slightly curved, oblique-truncated poles; striated cell wall, 10-12 striae in 10 µm, punctae between striations in the apical region; axial chloroplastid, 3-8 lamella; 3-7 pyrenoids in median series.

Examined material: HUEFS 155668, 155689, 155706, 155769, 155792, 155812, 155820.

Distribution in Brazil: Minas Gerais (Bicudo & Ventrice, 1968, Oliveira, 2001); Paraná (Bittencourt-Oliveira & Castro, 1993); São Paulo (Bicudo & Castro, 1994).

Comments: *Closterium rostratum* var. *rostratum* is morphologically similar to *C. setaceum* and *C. kuetzingii,* which differ by exhibiting truncated and rounded poles, respectively.

In the material they examined, Bicudo & Castro (1994) detected polymorphisms in the striae, which at times appeared to be interrupted by punctae. These authors commented that the differences might be related to the age of the cells and, consequently,

the higher and lower level of salt impregnation in its wall.

Closterium semicirculare Krieger & Scott, Hydrob., 9(2-3): 131, pl. 1, fig. 6. 1957.

(Figs. 61, 62)

Cell lunated, 5-5.3 times longer than wide, 280-295 µm long, 55-57.5 µm wide, apex measuring 7-8 µm wide; accentuated curvature (110-160º arc), convex dorsal margin, concave ventral margin, pointed-rounded apices; smooth, hyaline cell wall; axial chloroplastid, 4 lamella; 4 pyrenoids.

Examined material: HUEFS 155623, 155668, 155775, 155790, 155792, 155813, 155820.

Distribution in Brazil: Paraná (Picelli-Vicentim, 1984).

Comments: Regarding morphology, *Closterium semicirculare* and *C. flacidum* Delponte are a similar species. This latter differs from the former, by exhibiting cells with rounded apices, curved dorsal margins and smaller cell measurements.

Picelli-Vicentim (1984) reported specimens from Paraná, which exhibited a striated cell wall and 8 pyrenoids, thus differing from the material of the present study. However, this material is consistent with the descriptions, measurements and illustrations in Prescott *et al.* (1975) based on the specimens from North America.

Closterium setaceum Ehrenberg *ex* Ralfs var. ***setaceum***, Brit. Desm.p. 176, pl. 30, fig. 4. 1848.

(Figs. 63-65)

Cell fusiform-lanceolated, 13-16 times longer than wide, 255-350 µm long, 10-20 µm wide, apex measuring 2.5-3 µm wide; nearly straight, equally convex dorsal and ventral margins, fusiform middle region, slightly curved apices, setaceous, long apical processes (ca. 1/3 of the total cell length), truncated, rounded or obtuse poles; striated cell wall, 8-10 striae in 10 µm, sometimes difficult to visualize, hyaline to brownish, polar thickening; axial chloroplastid, 2 lamella, 2-3 pyrenoids arranged in median series.

Examined material: HUEFS 155598, 155632, 155647, 155702, 155714, 155722, 155748, 155769, 155778, 155820.

Distribution in Brazil: Amazonas (Förster, 1974, Martins, 1982); Bahia (Bicudo & Martins, 1989); Mato Grosso (De-Lamonica-Freire, 1985); Minas Gerais (Oliveira, 2001); Pará (Förster, 1969); Paraná (Picelli-Vicentim, 1984, Bittencourt-Oliveira & Castro, 1993, Felisberto & Rodrigues, 2007, Bortolini *et al.,* 2009); Rio Grande do Sul (Ungaretti, 1976); São Paulo (Bicudo & Castro, 1994, Sormus & Bicudo, 1994).

Comments: Morphologically, *Closterium setaceum* var. *setaceum* is similar to *C. kuetzingii* but differs by exhibiting rounded poles, setaceous processes measuring ¼ the total length of the cell and 8-16 striae in10 µm. It is different from *C. rostratum* by exhibiting oblique truncated poles, smooth, curved apices, greater cell length and a larger length:width ratio.

Closterium strigossum Brébisson var. ***elegans*** (G.S. West) Krieger, *In* Rabenhorst Krypt.-Fl. Deutsch. 13(1): 300, pl. 20, fig. 12. 1937.

(Figs. 66-68)

Cell semi-lunated, 15.4-16 times longer than wide, 170-240 µm long, 11-15 µm wide, apex measuring 4-5 µm wide; slightly curved (50-60º arc), convex dorsal and ventral margins, fusiform middle region, truncated poles, setaceous, slightly curved apices; smooth, brownish cell wall with polar thickening; axial chloroplastid, 4 pyrenoids arranged in a median series.

Examined material: HUEFS 155790, 155792, 155898, 155812, 155816.

Distribution in Brazil: São Paulo (Bicudo & Castro, 1994).

Comments: *Closterium strigrossum* var. *elegans* differs from the typical variety of the species by exhibiting a middle region of the cell that is proportionally longer as well as truncated poles.

The variety under consideration is morphologically similar to *Closterium rostratum* var. *subrostratum* Krieger, but this species exhibits a striated cell wall, axial chloroplastid and 6-8 pyrenoids per plastid.

The material analyzed herein is consistent with the descriptions, measurements and illustrations presented by Bicudo & Castro (1994) based on specimens from the State of São Paulo and by Prescott *et al.* (1975) for specimens of North America.

Closterium tumidum Johnson var. ***tumidum***, Bull. Torrey Bot. Club, 22(1): 291, pl. 239, fig. 4. 1895.

(Figs. 69, 70)

Cell semi-lunated, 6.8-7.8 times longer than wide, 117.5-120 µm long, 15-17.5 µm wide, apex

measuring 4-5 µm wide; accentuated curvature (40-60º arc), convex dorsal margin, concave ventral margin, straight, truncated poles; smooth cell wall, yellowish to brownish, exhibiting polar thickening; axial chloroplastid, 2-4 pyrenoids arranged in median series.

Examined material: HUEFS 155706, 155750, 155773, 155812.

Distribution in Brazil: Mato Grosso (Borge, 1903, 1925, De-Lamonica-Freire & Heckman, 1996); Mato Grosso do Sul (Borge, 1903); Rio de Janeiro (Borge, 1925, Sophia, 2009); São Paulo (Borge, 1918, Bicudo & Castro, 1994).

Comments: Morphologically, *Closterium tumidum* var. *tumidum* is similar to *C. cornu,* but the latter differs from the former by exhibiting a cell that is 8-16 times longer than wide and lacks a swollen region in the middle of the cell.

In the populations analyzed in the present study, polymorphisms were observed regarding the degree of curvature of the ventral margin of the cell, which is straight and slightly concave. These facts were already registered by Bicudo & Castro (1994), who also reported polymorphisms in relation to the middle region of the ventral margin, which might potentially appear swollen.

Closterium turgidum Ehrenberg *ex* Ralfs var. ***turgidum***, Brit. Desm. p. 165, pl. 27, fig. 3. 1848.

(Figs. 71-73)

Cell semi-lunated, 11-12 times longer than wide, 490-520 µm long, 40-42.5 µm wide, apex measuring 10-11 µm wide; slight curvature (40-60º arc), convex dorsal margin, concave ventral margin, rounded-truncated poles; striated cell wall, 8-12 striae in10 µm, punctuae between striae, brownish, polar thickening; axial chloroplastid, 4 lamella, 12-14 pyrenoids in median series.

Examined material: HUEFS 155598, 155623, 155775, 155790, 155802, 155812, 155822.

Distribution in Brazil: Bahia (Bicudo & Martins, 1989); Mato Grosso (Borge, 1925); Pará (Scott *et al.,*1965); Paraná (Picelli-Vicentim, 1984, Bittencourt-Oliveira, 1993); São Paulo (Wittrock & Nordstedt, 1880, Borge, 1918, Bicudo, 1969, Bicudo & Castro, 1994).

Comments: Regarding the shape of the cell, *Closterium turgidum* var. *turgidum* could be confused with *C. pritchardianum*; however, the latter differs from the former by exhibiting a smaller arc of curvature, curved cellular apices and truncated poles.

Grönblad (1945) noted the occurrence of the species in Pará State; however, the author cited this occurrence without a proper description or illustration of the identified material. Since it is impossible to re-evaluate this material, we do not consider it for the distribution of the species in Brazil.

Closterium turgidum Ehrenberg ex Ralfs var. ***giganteum*** (Nordst.) de Toni, Syll. Algar., 1: 828. 1889.

(Figs. 74-76)

Cell semi-lunated, 5.8-12.5 times longer than wide, 880-1260 µm long, 70-210 µm wide, apex measuring 2.5-3.5 µm wide; slight curvature (50-60º arc), convex dorsal margin, concave ventral margin, rounded-truncated poles; striated cell wall, 5-10 striations at an interval of 10 µm, punctuae between striations, brownish to yellowish-brown, polar thickening; axial chloroplastid, 4 lamella, numerous, diffuse pyrenoids.

Examined material: HUEFS 155598, 155775, 155784, 155802, 155808, 155812, 155820.

Distribution in Brazil: Mato Grosso (Borge, 1925); Rio de Janeiro (Borge, 1925); São Paulo (Wittrock & Nordstedt, 1880, Bicudo & Bicudo, 1965, Sormus & Bicudo, 1994).

Comments: *Closterium turgidum* var. *giganteum* differs from the typical variety of the species by exhibiting proportionally longer cells, a pointed cell wall and numerous pyrenoids distributed across the chloroplastid.

Closterium venus Kützing *ex* Ralfs var. ***venus***, Brit. Desm.p.220, pl. 35, fig. 12. 1848.

(Fig. 77)

Cell lunated, 7.5-8 times longer than wide, 75-88 µm long, 10-11 µm wide, apex measuring 2.5-4 µm wide; slight curvature (120-150º arc), slightly convex dorsal margin, concave ventral margin, nearly straight, without middle swelling, pointed-rounded poles, apical pore; smooth cell, hyaline to yellowish, with or without polar thickening; axial chloroplastid, 2-3 pyrenoids, arranged in median series.

Examined material: HUEFS 155598, 155623, 155632, 155679, 155802, 155812.

Distribution in Brazil: Amazonas (Förster, 1969); Mato Grosso (Borge, 1903, 1925); Rio Grande do Sul (Borge, 1903); São Paulo (Bicudo & Bicudo, 1962, Bicudo, 1969, Sormus & Bicudo, 1994).

Comments: *Closterium venus* var. *venus* is morphologically similar to *C. parvulum* var. *maius* West; however, it differs by exhibiting smaller cell

measurements, pointed poles and 5-6 pyrenoids organized in a median series.

Spinoclosterium cuspidatum (Bailey) Hirano, Acta Phytot. Geobot., 14(1): 1, fig. 5. 1949.

(Figs. 78, 79)

Cell lunated, 5.5-7 times longer than wide, 250-262.5 µm long, 90-62.5 µm wide, apex measuring 4-5 µm wide; accentuated curvature (180-210º arc), convex dorsal margin, concave ventral margin, amply rounded poles, a single solid, thick spine, practically straight; smooth cell wall, hyaline; axial chloroplastid, styloid, 2-3 lamella, various pyrenoids.

Examined material: HUEFS 155598, 155706, 155722, 155761.

Distribution in Brazil: Goiás (Förster, 1964); São Paulo (Bicudo & Castro, 1994).

Comments: The first report of the occurrence of this species in Brazil was by Förster (1964) from material collected in Goiás State, and it was identified as *Closterium cuspidatum*. Bicudo & Castro (1994) reported the only other occurrence of the species in Brazil when analyzing material obtained in the State of São Paulo and noted the rare occurrence of this species in Brazil. Different from reports in literature, samples of *Spinoclosterium* studied herein were not obtained from lakes of *Sphagnum*, known as bogs, but from rivers and costal lakes.

Of the 41 taxa identified, 28 taxa were additions to the desmid flora of Bahia and seven taxa were new records in Brazil: *Closterium aciculare* var. *aciculare*, *C. angustatum* var. *angustatum*,, *C. braunii*, *C. idiosporum*, *C. lineatum* var. *costatum*, *C. pseudolunula* var.*pseudolunula* f. *pseudolunula* and *C. pseudolunula* var.*pseudolunula* f. *longius*.

This is the first report of *Spinoclosterium cuspidatum* in the northeast region of Brazil, and this taxon is considered to be rare and is scarcely reported in specialized literature around the world. According to Bicudo & Castro (1994), *Spinoclosterium* has a sparse geographical distribution, having been documented in Japan, Sumatra, Singapore, Australia, Canada, United States, Argentina and Brazil.

The number of species identified in the present study was high compared with that of Bicudo & Castro (1994), who cited 47 species and 26 varieties originating from 183 sites in the State of São Paulo, and similar to the report by Sormus & Bicudo (1994), who recorded 25 species and eight varieties for the Fontes do Ipiranga Park, São Paulo, São Paulo State.

Closterium macilentum was recorded by Förster (1974), *C. semicirculare* by Picelli-Vicentim (1984) and *C. kuetzingii* var. *vittatum* and *C. strigosum* var. *elegans* by Bicudo & Castro (1994), which are all rare in Brazil and were collected in this study.

This study allowed the addition of seven new records of *Closterium* for the Brazilian territory and extends the geographic distribution of the genus in Northeastern Brazil.

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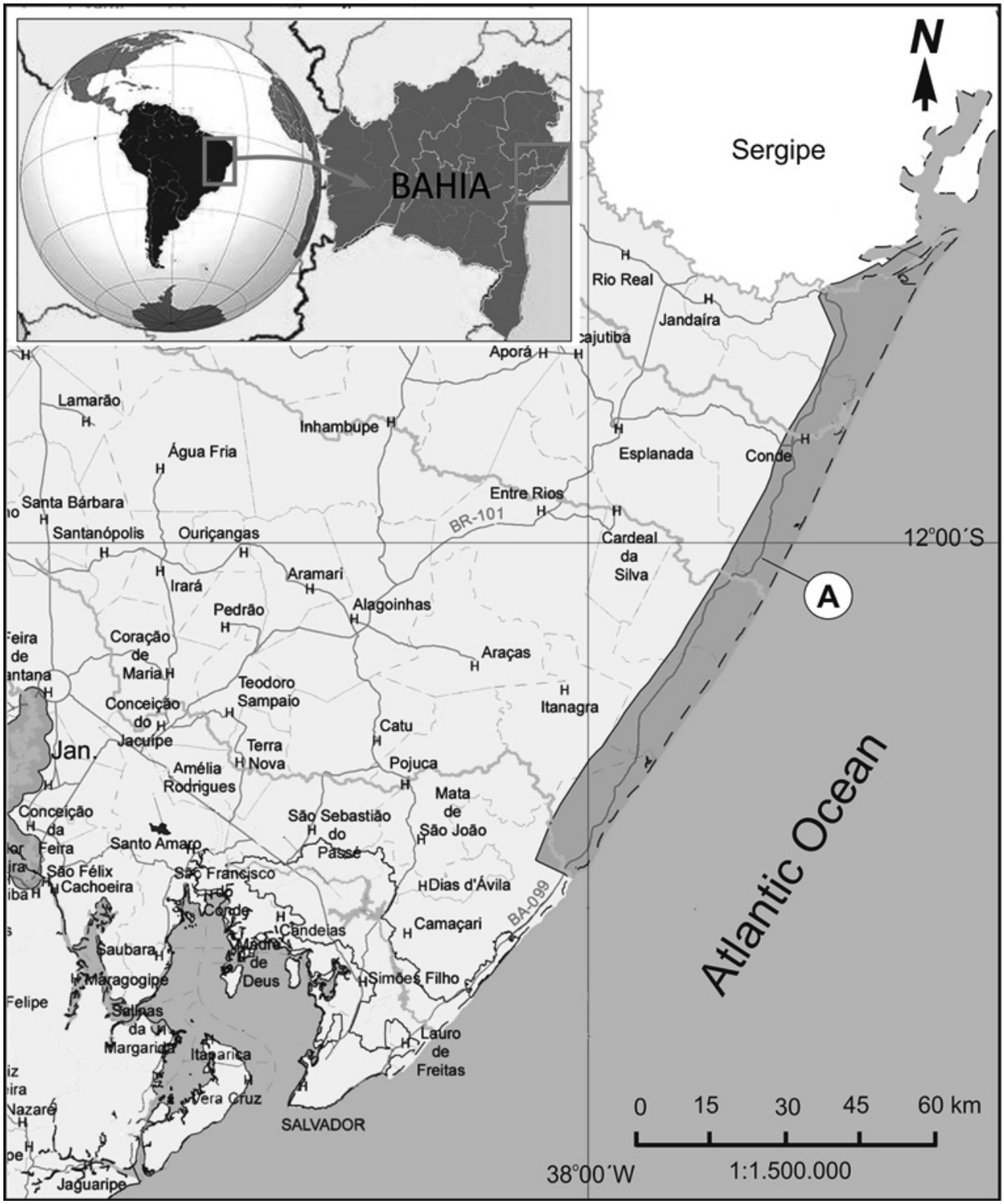
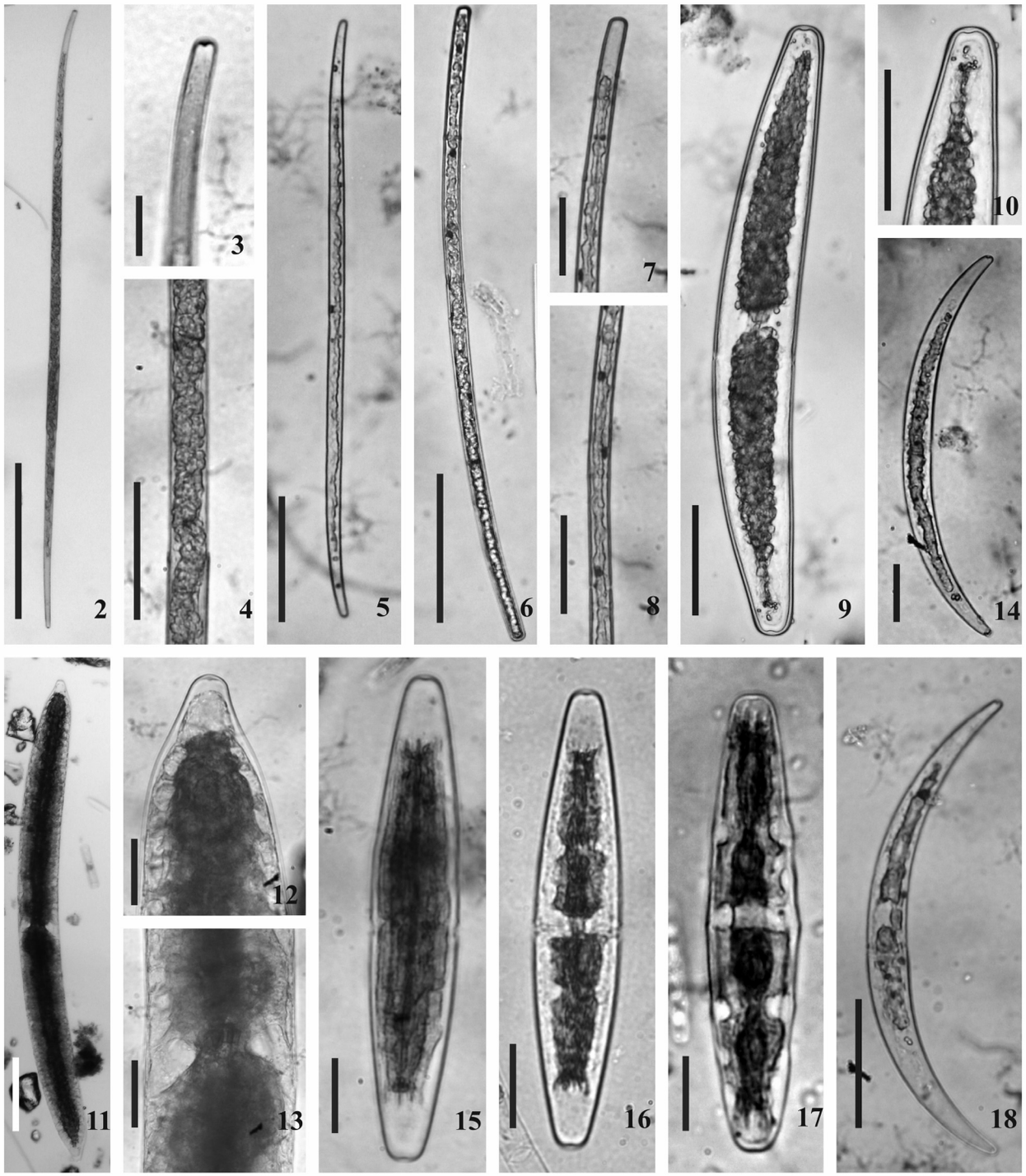
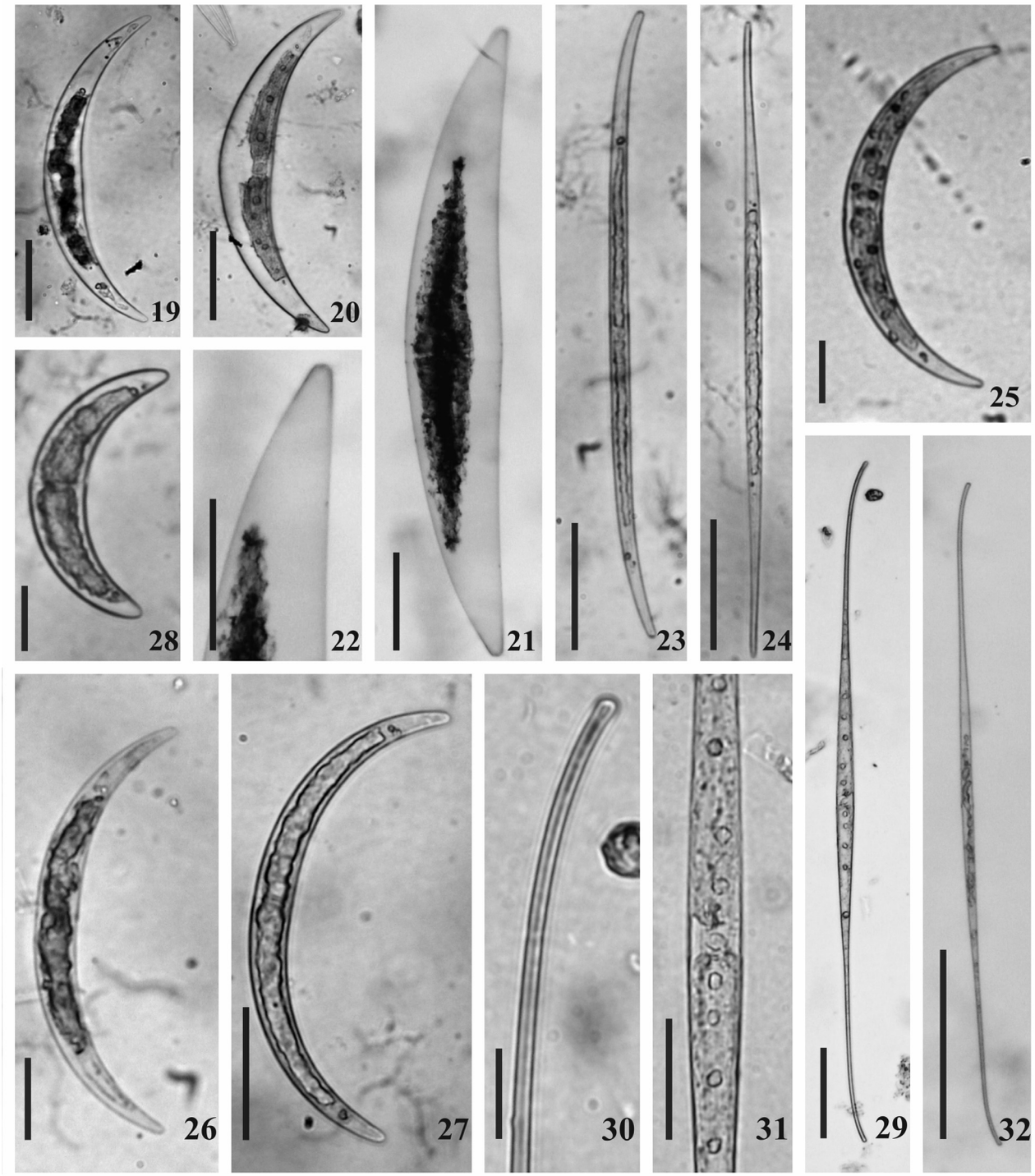


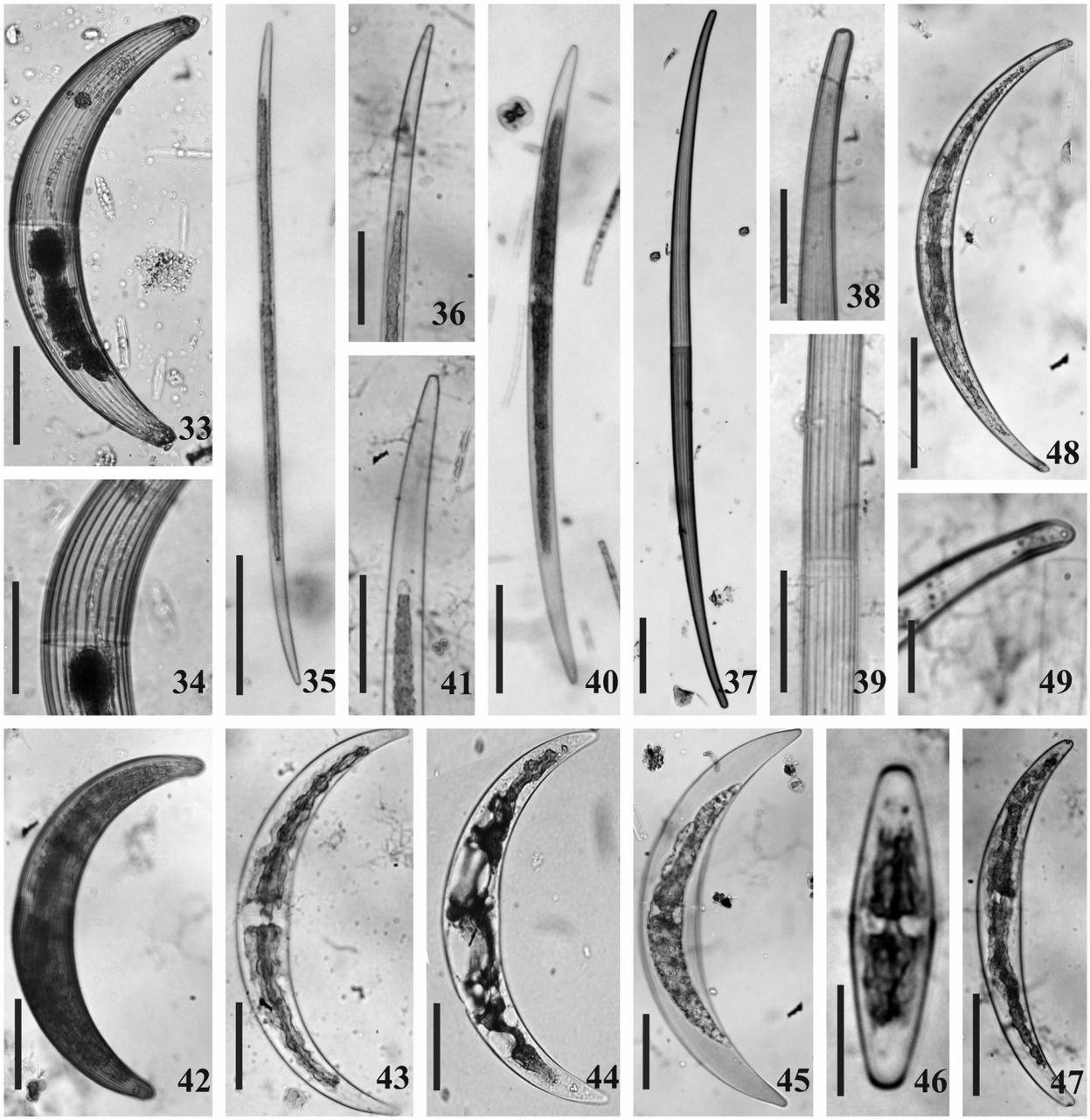
Fig. 1. A. Map of the Environmental Protection Littoral Area in the coastal plains of northern Bahia State, Brazil.



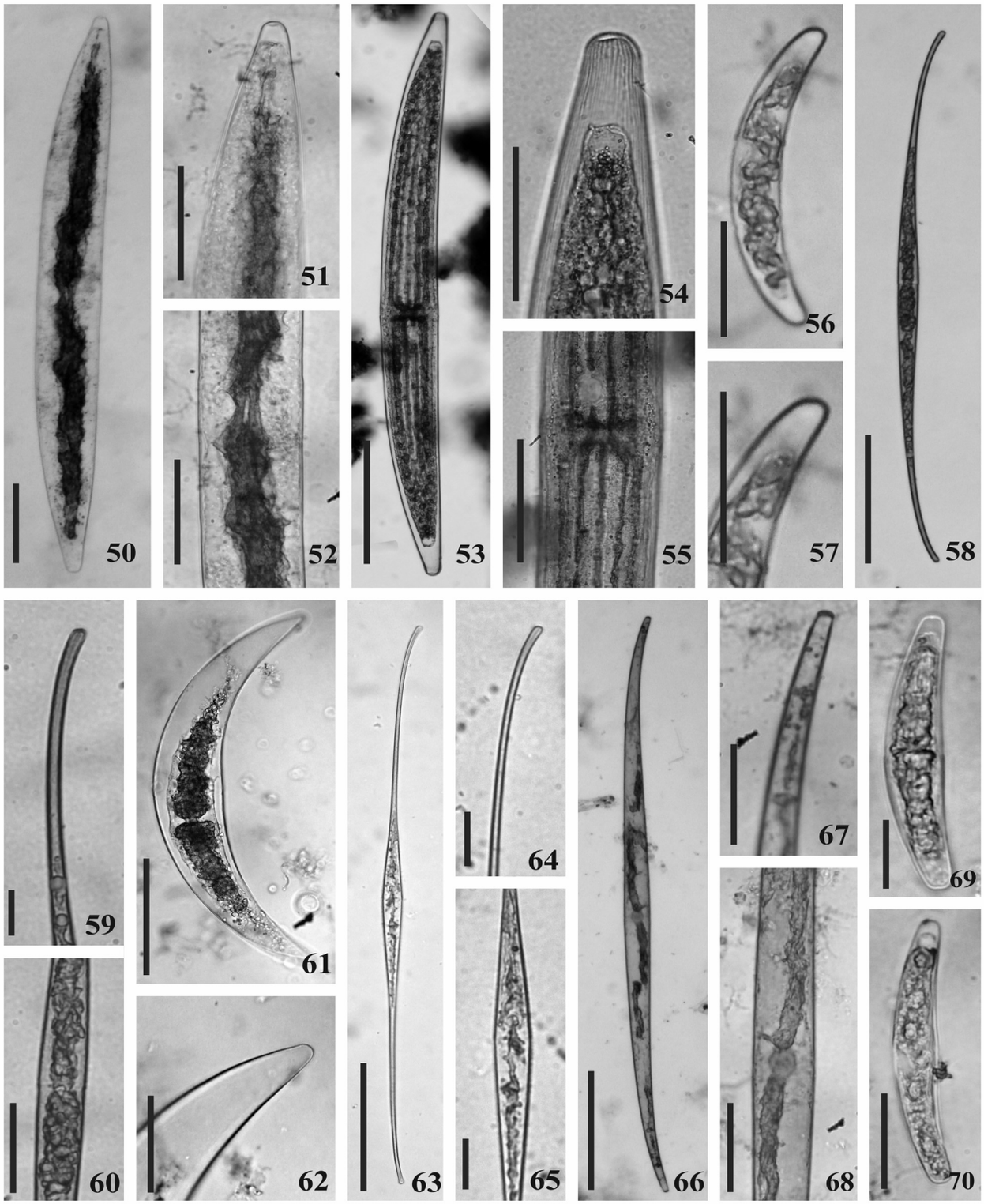
Figs. 2-18. 2-4. *Closterium aciculare* var. *aciculare*; **3.** Detail of apex; **4.** Detail of the isthmus; **5.** *C. acutum* var. *acutum*; **6-8.** *C. angustatum* var. *angustatum*; **7.** Detail of apex; **8.** Detail of the isthmus; **9, 10**. *C. baillyanum* var. *baillyanum*; **10.** Detail of apex; **11-13.** *C. braunii*; **12.** Detail of apex; **13.** Detail of the isthmus; **14.** *C. calosporum* var. *calosporum*; **15, 16.** *C. closterioides* var. *closterioides*; **17.** *C. closterioides* var. *intermedium*; **18.** *C. cynthia* var. *cynthia*. Scale Bars: **Figs. 7, 8, 14, 16, 17** = 20 µm; **Figs. 3-6, 15, 18** = 50 µm; **Figs. 2, 9-13** = 100.



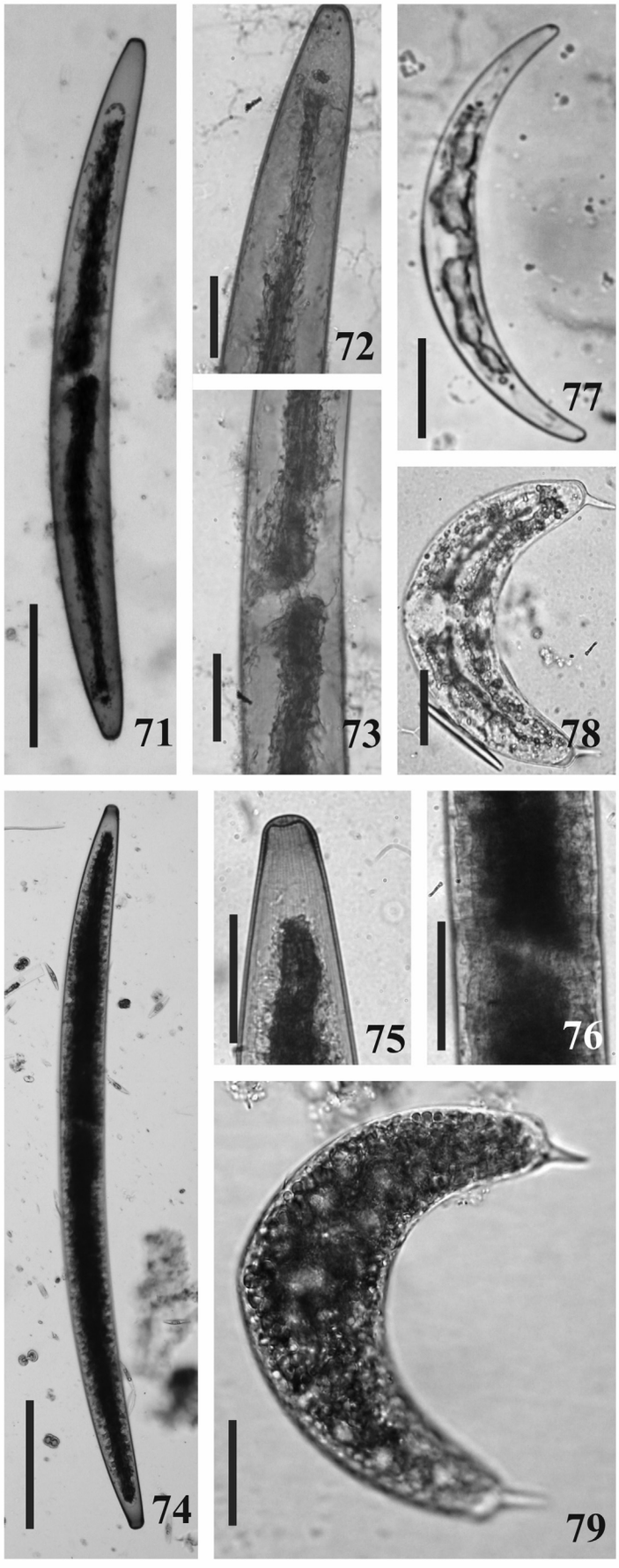
Figs. 19-32. 19. *Closterium dianae* var. *dianae;* **20.** *C. dianae* var. *brevius*; **21, 22**. *C. ehrenbergii* var. *ehrenbergii*; **22.** Detail of apex; **23.** *C. gracile* var. *gracile*; **24.** *C. idiosporum*; **25, 26.** *C. incurvum* var. *incurvum;* **27**. *C. jennerii* var. *jennerii*; **28.** *C. jennerii* var. *robustum*; **29-31.** *C. kuetzingii* var. *kuetzingii*; **32.** *C. kuetzingii* var. *vittatum*; Scale Bars: **Figs. 25, 26, 28** = 20 µm; **Figs. 19, 20, 23, 24, 27, 29** = 50 µm; **Figs. 21, 22, 30-32** 100 µm.



Figs. 33-49. 33, 34. *Closterium lagoense*; **34.** Detail of striae; **35, 36.** *C. lineatum* var. *lineatum*; **36.** Detail of apex; **37-39.** *C. lineatum* var. *costatum*; **37.** Detail of apex; **39.** Detail of the isthmus; **40, 41.** *C. macilentum* var. *macilentum*; **41.** Detail of apex; **42.** *C. malmei* var. *semicirculare;* **43.** *C. moniliferum* var. *moniliferum*; **44, 45.** *C. moniliferum* var. *concavum*; **46.** *C. navicula* var. *navicula*; **47.** *C. parvulum* var. *parvulum;* **48, 49.** *C. porrectum* var. *porrectum*; **49.** Detail of apex; Scale Bars: **Figs. 46** = 20 µm**; Figs. 33, 34, 48, 49** = 30 µm; Figs. **43-45, 47** = 40 µm; **Figs. 35-42** = 50 µm.



Figs. 50-70. 50-52. *Closterium pseudolunula* var. *pseudolunula* f. *pseudolunula*; **51.** Detail of apex; **52.** Detail of the isthmus; **53-55.** *C. pseudolunula* var. *pseudolunula* f. *longius*; **54.** Detail of apex; **55.** Detail of the isthmus; **56, 57.** *C. pusillum* var. *pusillum*, **57.** Detail of apex; **58-60.** *C. rostratum* var. *rostratum*; **59.** Detail of apex; **60.** Detail of the isthmus; **61. 62.** *C. semicirculare*; **62.** Detail of apex; **63-65.** *C. setaceum* var. *setaceum*; **64.** Detail of apex; **65.** Detail of the isthmus; **66-68.** *C. strigosum* var. *elegans*; **67.** Detail of apex; **68.** Detail of the isthmus; **69, 70.** *C. tumidum* var. *tumidum*; Scale Bars: **Figs. 50-53, 56, 57, 64-70** = 20 μm; **Figs. 59, 60, 63** = 50 μm; **Figs. 54, 55, 58, 61, 62 =** 100 μm.



Figs. 71-79. 71-73. *Closterium turgidum* var. *turgidum*; **72.** Detail of apex; **73.** Detail of the isthmus; **74-76.** *C. turgidum* var. *giganteum;* **75.** Detail of apex; **76.** Detail of the isthmus; **77.** *C. venus* var. *venus*; **78, 79.** *Spinoclosterium cuspidatum*. Scale Bars: **Figs. 77** = 20 µm; **Figs. 72, 73, 75, 76, 78, 79** = 50 µm; **Figs. 71, 74** = 100 µm.