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Ciliates (Protozoa) from dried sediments of a temporary pond from Argentina

Ciliados (Protozoa) de sedimentos secos de una charca temporaria de la Argentina

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Abstract. Temporary ponds represent special environments that are inhabited by organisms adapted to changing environmental conditions. Ciliates are able to survive complete loss of water in these transient habitats through cyst formation. However, ciliates from the Neotropical region in general have been poorly studied with modern techniques. The main goal of this study is to describe the ciliates in dried sediments of a temporary pond from Buenos Aires Province, Argentina, through sampling efforts that were performed 2003-2005. Soil samples were obtained during drought phases and rewetted in laboratory to establish raw and enriched cultures. Ciliates were then studied both *in vivo* and after impregnation with protargol. In this study, we present 4 new records for Argentina (*Gonostomum affine* (Stein, 1859) Sterki, 1878, *Stylonychia bifaria* (Stokes, 1887) Berger, 1999, *Pleurotricha lanceolata* (Ehrenberg, 1835) Stein, 1859, *Meseres corlissi* Petz and Foissner, 1992), 1 for South America (*Blepharisma americanum* (Suzuki, 1954) Hirshfield, Isquith and Bhandary, 1965), and 2 for the Neotropical Realm (*Gonostomum strenuum* (Engelmann, 1862) Sterki, 1878, *Stylonychia lemnae* Ammermann and Schlegel, 1983).

Key words: ephemeral freshwater environment, soil samples, Ciliophora, Buenos Aires Province.

Resumen. Los cuerpos de agua temporarios son ambientes particulares que se encuentran habitados por organismos adaptados a condiciones fluctuantes. Los ciliados son capaces de sobrevivir a la pérdida completa de agua del ambiente gracias a la formación de estructuras de resistencia. Por otra parte, los ciliados de la región Neotropical han sido poco investigados con técnicas modernas. El objetivo de este estudio es referir los ciliados que se desarrollaron a partir de los sedimentos secos de una charca temporaria de la provincia de Buenos Aires, Argentina, en la que se realizaron muestreos durante el período 2003-2005. Las muestras de suelo fueron obtenidas durante las fases de sequía y luego resuspendidas en el laboratorio para realizar cultivos naturales y enriquecidos. Los ciliados fueron estudiados *in vivo* y luego de la impregnación argéntica con protargol. En este trabajo se presentan 4 nuevos registros de especies para la fauna de ciliados de la Argentina (*Gonostomum affine* (Stein, 1859) Sterki, 1878, *Stylonychia bifaria* (Stokes, 1887) Berger, 1999, *Pleurotricha lanceolata* (Ehrenberg, 1835) Stein, 1859, *Meseres corlissi* Petz and Foissner, 1992), 1 para América del Sur (*Blepharisma americanum* (Suzuki, 1954) Hirshfield, Isquith and Bhandary, 1965) y 2 para la región Neotropical (*Gonostomum strenuum* (Engelmann, 1862) Sterki, 1878, *Stylonychia lemnae* Ammermann and Schlegel, 1983).

Palabras clave: limnótopo efímero, muestras de suelo, Ciliophora, provincia de Buenos Aires.

Introduction

Ciliate assemblages from temporary ponds have been scarcely studied (Andrushchyshyn et al., 2003), especially those populations from ponds whose water supply comes mainly from rainfall. Freshwater ciliates in general have been poorly investigated in Argentina and in South America in general with most studies being based solely on live observations (Cela, 1972; Dioni, 1972; Claps and Modenutti, 1984, 1988; Modenutti and Claps, 1986; Pettigrosso and Cazzaniga, 1987; Foggetta and Boltovskoy, 1995; Zaleski and Claps, 1999, 2001; Modenutti and Pérez, 2001; Guillén et al., 2003; among others). Only recently have some researchers employed modern techniques to study the microorganisms from such aquatic environments in Brazil (Paiva and da Silva-Neto, 2004a; 2004b; 2004c; 2005; 2006; 2007) and in Argentina (Küppers et al., 2006a; 2006b; 2007a; 2007b). In temporary ponds, the bed becomes part of the terrestrial habitat during drought periods and the species adapted to survive

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such stressful conditions are forced either to migrate to another body of water or to produce quiescent structures (Williams, 1987). Many ciliates are able to form resting cysts (Foissner, 1987) that enable them to persist in the sediments of transient habitats and thereafter colonize the water body during the filling phase through excystment. Bamforth (1980) has stated that the ciliate assemblages that develop from rewetted sediments are similar to those found during the initial stages of colonization of transient habitats.

This study has the aim of describing the morphology of Argentinean populations of certain ciliates collected from the dried sediments of a temporary pond using observations made both *in vivo* and after protargol staining, and comparing the characteristics of these ciliates to populations from different geographical locations.

Materials and methods

Samplings were made from a freshwater temporary pond in Buenos Aires Province, Argentina (35° 05' S, 57° 48' W) during 2003-2005. For a detailed description of the study site, see Küppers et al. (2006a). During droughts, which occur mainly in summer, dried sediments of the pond bed were collected along with leaf litter and the decomposing macrophytes from the pond. Some samples were re-suspended soon after sampling, while the rest of the samples were stored for subsequent re-suspension during the years 2006, 2007, and 2008. Some species were also recorded during hydric phases, when conductivity, temperature, and pH were measured with a multiparameter sensor and dissolved oxygen estimated by the Winkler method (Clesceri et al., 1998). In the laboratory, soil samples were air-dried for almost a month and then rewetted with distilled water in Petri dishes for qualitative examination, following the so-called nonflooded Petri dish method (Foissner, 1992). Crushed wheat kernels were added to the cultures, kept at room temperature (ca. 15 ºC), to promote bacterial growth and thus facilitate ciliate development. Ciliates were taken from the cultures with micropipettes under the stereomicroscope in order to make live observations with a bright-field microscope at magnifications of 100X, 400X, and 1 000X. The organisms were also fixed in Bouin's solution and treated by the protargol technique according to the protocol of Wilbert (1975). Photographs were then taken under bright-field microscopy. Drawings of impregnated cells were made with the aid of a tracing device, while drawings of the live specimens were sketched freehand. Measurements were obtained with a calibrated ocular micrometer in the bright-field microscope. The abbreviations in the biometric tables are as follows: Ant., anterior; AZM, adoral zone of membranelles; M, median; N, number of observations; post., posterior; SD, standard deviation; $\overline{X}$, arithmetic mean; Xm, minimum observation; XM, maximum observation. Voucher slides have been deposited in the Colección de Invertebrados from the Museo de La Plata, Argentina, and have the catalogue numbers: *Blepharisma americanum* MLP32; *Gonostomum affine* MLP39; *G. strenuum* MLP38; *Stylonychia bifaria* MLP35; *S. lemnae* MLP36; *Pleurotricha lanceolata* MLP40; *Meseres corlissi* MLP44.

Results

Seven ciliate species from the sediments of the dried pond bed were recorded for the first time in Argentina, and in some instances these ciliates were also new for the Neotropical region as well. Their morphology is briefly described in the following paragraphs.

***Blepharisma americanum* (Suzuki, 1954)** Hirshfield, Isquith and Bhandary, 1965 (Table 1; Figs. 1, 6a)

The body *in vivo* measured 182-280 µm in length and 42-84 µm in width and the cytoplasm was pale to dark pink-colored. The contractile vacuole was normal for the species. The nuclear apparatus had 5-8 interconnected macronuclear nodules and 6-15 micronuclei. The oral ciliature was composed of 53-63 membranelles and a paroral membrane typical of this genus. There were 20-29 somatic kineties, of which 12-17 abutted on the adoral zone membranelles, plus 3 short ventral postoral kineties.

Data on the frequency of occurrence and the physicochemical variables describing the conditions in which the species was found are detailed in Table 8.

***Gonostomum affine* (Stein, 1859) Sterki, 1878** (Table 2; Figs. 2a, b)

After protargol impregnation the body measured 56-80 µm in length and 26.6 µm in width. Unfortunately, the cell could not be measured in its living state. The contractile vacuole and nuclear apparatus were typical of the species. The oral ciliature was composed of 24-27 oral membranelles and paroral and endoral membranes typical of the genus. Somatic ciliature was normal for the species and consisted of 3 frontal cirri, 1 buccal cirrus, 5 anterior ventral cirri, 2 fronto-terminal cirri, 2 pretransverse cirri, 2 transverse cirri, 2 rows of marginal cirri, 3 rows of dikinetids, and 3 caudal cirri.

Data on the frequency occurrence of the species are

Table 1. Morphometric data on *Blepharisma americanum*

in vivo	$\bar{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	212.8	210	182	280	26.8	10
Body width	61.6	63	42	84	13.5	10
Protargol	$\bar{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	195.8	189	154	245	30.7	15
Body width	82.4	84	56	105	11.8	15
Distance between ant. end of cell and post. end of AZM	88	87.5	77	98	6.2	15
Macronuclear nodules, number	6.6	7	5	8	0.8	20
Macronuclear nodules, length	13	12.6	9.8	18.2	2.6	15
Macronuclear nodules, width	10.4	9.8	7	15.7	2.3	15
Micronuclei, number	8.5	8.5	6	15	2.2	10
Micronuclei, width	2.1	2.1	1.7	2.4	0.2	15
Oral polykineties, number	60	61	53	63	3.1	10
Somatic kineties, number	23.1	23	20	29	2.7	10
Cortical granules stripes, width	8.2	8.2	8.2	8.2	0	4
Cortical granules, width	0.7	0.7	0.7	0.7	0	3

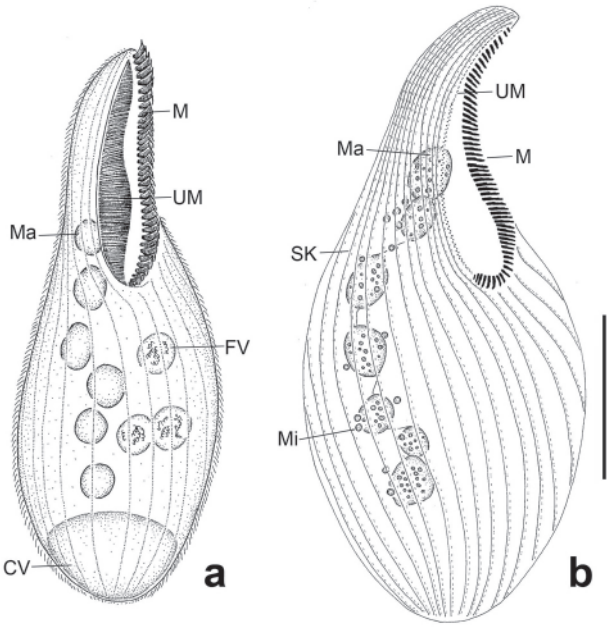

Figure 1. Morphology of *Blepharisma americanum* from life (a) and after protargol impregnation (b). CV, contractile vacuole; FV, food vacuole; M, membranelles; Ma, macronucleus; Mi, micronucleus; SK, somatic kineties; UM, undulating membrane. Scale bar = 50 µm.

detailed in Table 8.

***Gonostomum strenuum* (Engelmann, 1862) Sterki, 1878** (Table 3; Figs. 2c-e)

The body *in vivo* measured 98-119 µm in length and 21-42 µm in width and had refractive cortical granules. The contractile vacuole and nuclear apparatus were typical of the species. The adoral zone of membranelles and paroral and endoral membranes were in a pattern characteristic of the genus. There were 25-30 oral polykineties. Somatic ciliature was normal for the species; being composed of 3 frontal cirri, 1 buccal cirrus, 10-11 anterior ventral cirri, 4-5 fronto-terminal cirri, 2-3 pretransverse cirri, 2 transverse cirri, and 2 rows marginal cirri. The dorsal side presented 3 rows of dikinetids and 3 caudal cirri.

Data on the occurrence frequency of the species are detailed in Table 8.

***Stylonychia bifaria* (Stokes, 1887) Berger, 1999** (Table 4; Figs. 3a-c, 6b)

The body *in vivo* measured 98-119 µm in length and 35-42 µm in width. The contractile vacuole and nuclear apparatus were typical of the species. The micronuclei were either faintly impregnated or not at all. One specimen (N = 32) presented 3 spherical macronuclear nodules (Fig. 6b). The oral ciliature consisted of 25-32 membranelles and paroral and endoral membranes in a pattern typical of the genus. The ventral and dorsal ciliature were characteristic of the species.

Data on the occurrence frequency of the species are detailed in Table 8.

***Stylonychia lemnae* Ammermann and Schlegel, 1983** (Table 5; Figs. 3d-f, 6c-e)

The body *in vivo* measured 133-168 µm in length and 42-63 µm in width. The dorsal side presented a postperistomial

Table 2. Morphometric data on *Gonostomum affine*

Protargol	$\bar{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	68	68	56	80	17	2
Body width	26.6	26.6	26.6	26.6	0	2
AZM, length	37.1	37.1	35	39.2	3	2
Macronuclear nodules, number	2	2	2	2	0	2
Macronuclear nodules, length	12.6	12.6	11.2	14	1.4	3
Macronuclear nodules, width	7	7	7	7	0	3
Micronuclei, number	2	2	2	2	0	2
Micronuclei, length	2.1	2.1	2.1	2.1	0	3
Micronuclei, width	1.7	1.7	1.7	1.7	0	3
Oral polykineties, number	25.5	25.5	24	27	2.1	2
Frontal cirri, number	3	3	3	3	0	2
Buccal cirri, number	1	1	1	1	0	2
Anterior ventral cirri, number	5	5	5	5	0	2
Fronto-terminal cirri, number	2	2	2	2	0	2
Pre-transverse cirri, number	2	2	2	2	0	2
Transverse cirri, number	2	2	2	2	0	2
Left marginal row, number of cirri	9	9	8	10	1.4	2
Right marginal row, number of cirri	15	15	15	15	0	1
Dorsal kineties, number	3	3	3	3	0	2
Caudal cirri, number	3	3	3	3	0	2

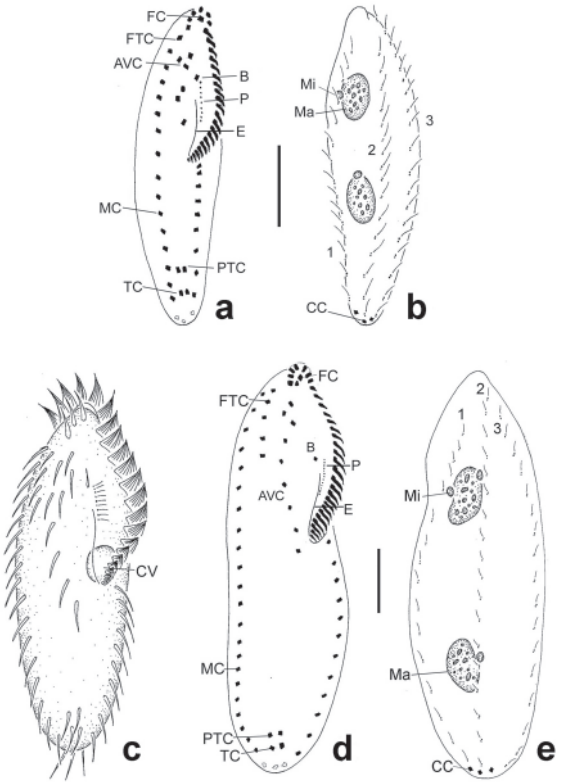

Figure 2. Morphology of *Gonostomum affine* after protargol impregnation (a, b) and *G. strenuum* from life (c) and after protargol impregnation (d, e). a, c, d. Ventral view. b, e. Dorsal view. AVC, anterior ventral cirri; B, buccal cirrus; CC, caudal cirri; CV, contractile vacuole; FC, frontal cirri, FTC, fronto-terminal cirri; Ma, macronucleus; MC, marginal cirri; Mi, micronucleus; P, paroral membrane; PTC, pre-transverse cirri; TC, transverse cirri; 1-3, dorsal kineties 1 to 3. Scale bars = 20 μm.

bulge. The contractile vacuole and nuclear apparatus were characteristic of the species. The oral ciliature consisted of 38-58 polykineties and paroral and endoral membranes in a pattern typical of *Stylonychia*. The ventral and dorsal somatic ciliature were typical of the species, but the dorsal kinety 3 is composed of 21-27 (N = 6) dikinetids and the dorsal kinety 4 of 18-22 (N = 4) dikinetids.

Data on the occurrence frequency and the physicochemical variables pertaining to the conditions under which the species was found are detailed in Table 8.

***Pleurotricha lanceolata* (Ehrenberg, 1835) Stein, 1859**
(Table 6; Figs. 4a-c, 7a)

The body *in vivo* measured 196 μm in length and 70 μm in width. Although these ciliates usually have 2 macronuclear nodules and 2 micronuclei, 3 specimens here possessed 3 macronuclear nodules and 1 micronucleus while another specimen 3 micronuclei. The adoral zone of membranelles consisted in 45-68 polykineties. The paroral and endoral membranes were arranged in a pattern typical

Table 3. Morphometric data on *Gonostomum strenuum*

in vivo	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	106.4	105	98	119	7.2	10
Body width	35	35	21	42	5.7	10
Protargol	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	120.1	117.6	112	135.8	8	10
Body width	36.3	35.7	25.9	49	8.3	10
AZM, length	54.1	53.9	50.4	58.8	2.6	10
Macronuclear nodules, number	2	2	2	2	0	10
Macronuclear nodules, length	20	19.6	16.8	26.6	2.7	10
Macronuclear nodules, width	7.6	7	7	9.8	0.9	10
Micronuclei, number	3	3	2	4	0.5	8
Micronuclei, length	2.7	2.8	2.1	3.1	0.4	7
Micronuclei, width	2.5	2.4	2.1	2.8	0.2	7
Oral polykineties, number	28.1	28	25	30	1.8	9
Frontal cirri, number	3	3	3	3	0	10
Buccal cirri, number	1	1	1	1	0	10
Anterior ventral cirri, number	10.9	11	10	11	0.3	10
Fronto-terminal cirri, number	4.4	4	4	5	0.5	10
Pre-transverse cirri, number	2.5	2.5	2	3	0.5	10
Transverse cirri, number	2	2	2	2	0	10
Left marginal row, number of cirri	16.1	16.5	14	18	1.4	10
Right marginal row, number of cirri	23.8	24	21	26	1.7	10
Dorsal kineties, number	3	3	3	3	0	10
Caudal cirri, number	3	3	3	3	0	10

Table 4. Morphometric data on *Stylonychia bifaria*

in vivo	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	109.2	112	98	119	8	5
Body width	40.6	42	35	42	3.1	5
Protargol	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	100.2	98	85.4	119	12.5	10
Body width	45.5	40.6	35	56	9.2	10
AZM, length	47.1	48.3	42	50.4	2.9	10
Macronuclear nodules, number	2	2	2	2	0	10
Macronuclear nodules, length	18.8	19.6	14	22.4	2.7	10
Macronuclear nodules, width	12.2	12.6	10.5	14	1	10
Micronuclei, number	2	2	2	2	0	1
Micronuclei, length	4.2	4.2	4.2	4.2	0	1
Micronuclei, width	3.5	3.5	3.5	3.5	0	1
Oral polykineties, number	29.1	29.5	25	32	1.9	10
Frontal cirri, number	3	3	3	3	0	10
Buccal cirri, number	1	1	1	1	0	10
Fronto-ventral cirri, number	4	4	4	4	0	10
Postoral cirri, number	2	2	2	2	0	10
Pre-transverse cirri, number	3	3	3	3	0	7
Transverse cirri, number	5	5	5	5	0	10
Left marginal row, number of cirri	12.6	12.5	12	14	0.7	10
Right marginal row, number of cirri	14.6	15	13	16	1	10
Dorsal kineties, number	6	6	6	6	0	10
Caudal cirri, number	3	3	3	3	0	10

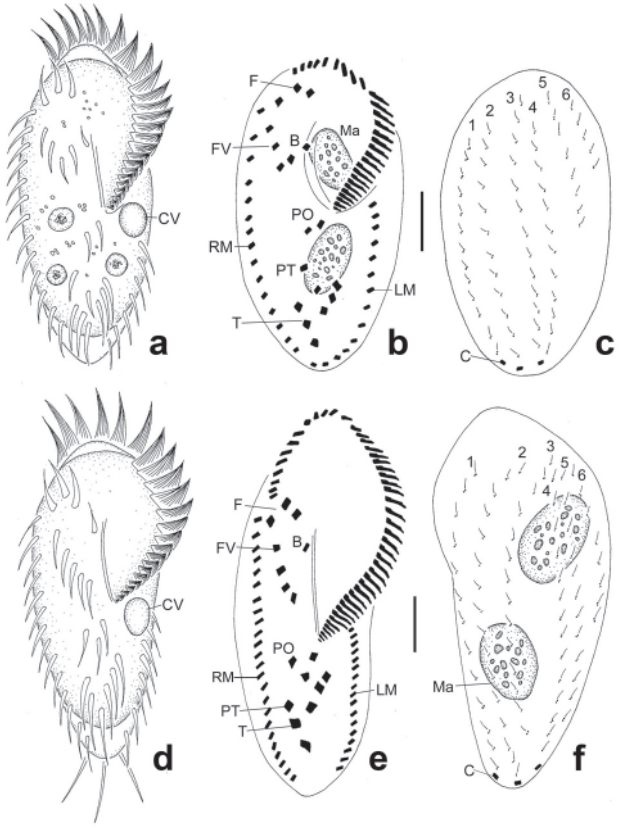

Figure 3. Morphology of *Stylonychia bifaria* (a-c) and *S. lemnae* (d-f) from life (a, d) and after protargol impregnation (b, c, e, f). a, b, d, e. Ventral view. c, f. Dorsal view. B, buccal cirrus; C, caudal cirri; CV, contractile vacuole; F, frontal cirri, FV, fronto-ventral cirri; LM, left marginal cirri; Ma, macronucleus; PO, postoral cirri; PT, pre-transverse cirri; RM, right marginal cirri; T, transverse cirri; 1-6, dorsal kineties 1 to 6. Scale bars = 20 µm.

of the genus. The ventral and dorsal somatic ciliature was normal for the species, but there were either 2 or 3 rows of marginal cirri on the right side of the body (27 specimens, though, with 2 and 11 with 3), the third of which rows (the innermost one), when present, possessed fewer and wider-spaced cirri.

Pleurotricha lanceolata was also collected during the filling phase of the pond and its food vacuoles contained small ciliates, such as *Tetrahymena* sp. and *Cyclidium glaucoma*, along with pennate diatoms.

Data on the occurrence frequency and the physicochemical variables pertaining to the conditions under which the species was found are detailed in Table 8.

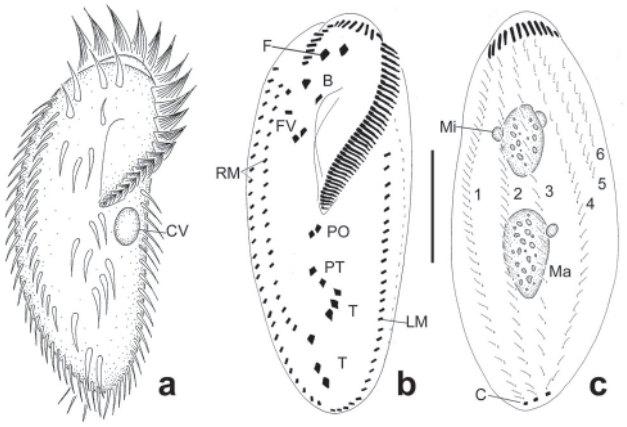

Figure 4. Morphology of *Pleurotricha lanceolata* from life (a) and after protargol impregnation (b, c). a, b. Ventral view. **c.** Dorsal view. Legends as in fig. 3. Scale bar = 50 µm.

***Meseres corlissi* Petz and Foissner, 1992** (Table 7; Figs. 5, 7b-c)

The body after protargol impregnation measured 84-126 µm in length and 66.5-112 µm in width. Unfortunately, the cell could not be measured in its living state. The contractile vacuole and the nuclear apparatus were typical of the species. The oral apparatus consisted of 16 anterior polykineties, 13-18 ventral polykineties, and the endoral membrane. A pair of cilia-bearing kinetosomes was observed to the right of the proximal end of the endoral membrane (reduced paroral membrane). The somatic ciliature was normal for the species, being composed of 7-8 kineties with 16-21 pairs of kinetosomes (N = 17) within each kinety.

The food vacuoles of *M. corlissi* contained pennate diatoms.

Data on the occurrence frequency of the species are detailed in Table 8.

Discussion

Temporary ponds constitute special kinds of habitats where organisms from various freshwater and soil communities can develop depending upon the conditions of the pond. During droughts, resistant structures from certain freshwater species remain in the sediments and are later able to colonize the pond during the filling phase. By contrast, a genuine soil community can possibly develop during prolonged drought periods. Soil ciliates from the Neotropical region have been scarcely investigated, with South America being almost completely unexplored.

Table 5. Morphometric data on *Stylonychia lemnae*

in vivo	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	154.7	154	133	168	11.6	10
Body width	51.6	52.5	42	63	7.4	8
Protargol	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	146.5	140	126	182	14.8	15
Body width	47.1	42	42	63	7.7	15
AZM, length	75.1	70	70	84	6.2	15
Macronuclear nodules, number	2	2	2	2	0	15
Macronuclear nodules, length	26.6	28	21	35	4.4	10
Macronuclear nodules, width	14	14	14	14	0	10
Micronuclei, number	2.5	2.5	2	3	0.6	4
Micronuclei, width	1.87	1.87	1.87	1.87	0	10
Oral polykineties, number	46.8	47	38	58	4.9	11
Frontal cirri, number	3	3	3	3	0	15
Buccal cirri, number	1	1	1	1	0	15
Fronto-ventral cirri, number	4	4	4	4	0	15
Postoral cirri, number	3	3	3	3	0	12
Pre-transverse cirri, number	2	2	2	2	0	12
Transverse cirri, number	5	5	5	5	0	14
Left marginal row, number of cirri	17.5	18	15	19	1.4	12
Right marginal row, number of cirri	25.3	26	22	27	1.6	12
Dorsal kineties, number	6	6	6	6	0	10
Caudal cirri, number	3	3	3	3	0	13

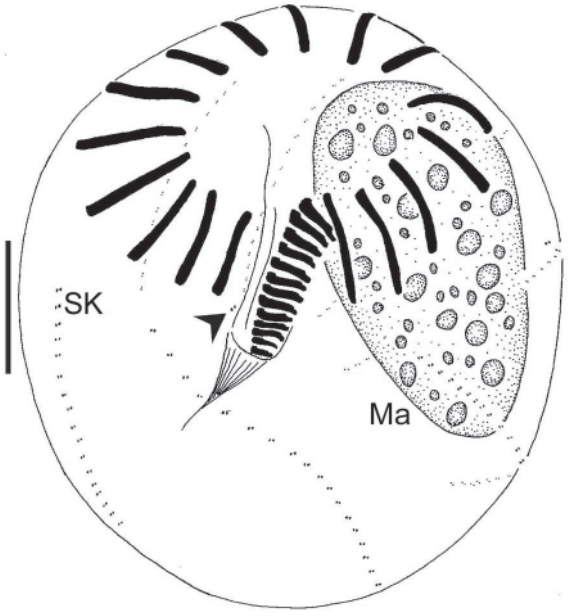

Figure 5. Morphology of *Meseres corlissi* after protargol impregnation. Ma, macronucleus; SK, somatic kineties. Arrowhead points to reduced paroral membrane. Scale bar = 20 µm.

Only a few studies on soil ciliates can be cited, including one from Peru (Hemberger, 1985) and another from Venezuela, Peru, Brazil, and Costa Rica (Foissner, 1997a). Although most ciliates have a cosmopolitan distribution, species with restricted distributions also exist (Foissner et al., 2005a). In the end, the further survey of unexplored regions and particular habitats will serve to increase our knowledge about the true extent of the diversity of free-living ciliates.

Blepharisma americanum was described based on specimens cultured from North American freshwater samples (Suzuki, 1954), and Foissner and O'Donoghue (1990) presented a detailed description of the morphology and infraciliature of specimens from an Australian freshwater population. Aladro-Lubel et al. (2007) also recorded this species in freshwaters from Mexico. In terms of soil biotopes, although Aescht and Foissner (1998) found *B. americanum* in soil samples from Costa Rica in Central America, our finding here represents a new recording for South America. Its morphometric characters generally coincide with those observed by the above cited authors and its infraciliature with the data of Foissner and O'Donoghue (1990). The number of somatic kineties observed by Wilfert (1972) in a German population, however, is lower than in the specimens studied in the present investigation (14 ± 2 vs. 23 ± 3).

Gonostomum affine is a cosmopolitan and very

Figure 6. Micrographs of *Blepharisma americanum* (a), *Stylonychia bifaria* (b), and *S. lemnae* (c-e) after protargol impregnation (a, b, e) and *in vivo* (c, d). a, b. Ventral view. Arrowheads (b) point to 3 macronuclear nodules. c, e. Ventral view. Arrowhead (e) points to cirrus III/2. d. Dorsal view. AZM, adoral zone of membranelles; CV, contractile vacuole; Ma, macronucleus; Mi, micronucleus. Scale bars = 50 µm (a), 20 µm (b-e).

abundant species in terrestrial habitats or in limnetic environments with terrestrial influences (Berger, 1999). Moreover, several morphotypes exist (Foissner et al., 2001). Within South America, the species was previously found by Foissner (1997a) and Foissner et al. (2001) in soil samples from Brazil, Venezuela, and Peru. In Argentina, however, *G. affine* represents a new finding. Although few specimens were measured *in vivo* or were even well impregnated, the species could nevertheless be identified. Most of the morphological variability in this ciliate is in body size and in the number and arrangement of the fronto-ventral-transverse cirri. The morphometric characteristics of our Argentinean isolates coincide with those observed by other authors in other geographical regions, and particularly with the morphotypes recorded by Foissner et al. (2001) in Venezuela and Brazil (South America) and in Namibia (Africa).

Gonostomum strenuum was recorded by other authors in Mexico (Morelos State), Eurasia, Australia, and Africa (Madrazo-Garibay and López-Ochoterena, 1973; Berger, 1999; Foissner et al., 2001, 2005a). This species is, however, a new record for the Neotropical region. Generally, *G. strenuum* prefers limnetic environments, but it has also been found in edaphic biotopes (Berger, 1999; Foissner et al., 2001, 2005a). Its morphometric characteristics coincide with those observed by Foissner et al. (2001) in Australian populations.

Stylonychia bifaria is possibly cosmopolitan and was previously recorded by other authors for South America in Colombia, Venezuela, and Brazil, although these findings were not substantiated by morphometric data (Berger, 1999). The species is recorded here for the first time in Argentina. *Stylonychia bifaria* was generally

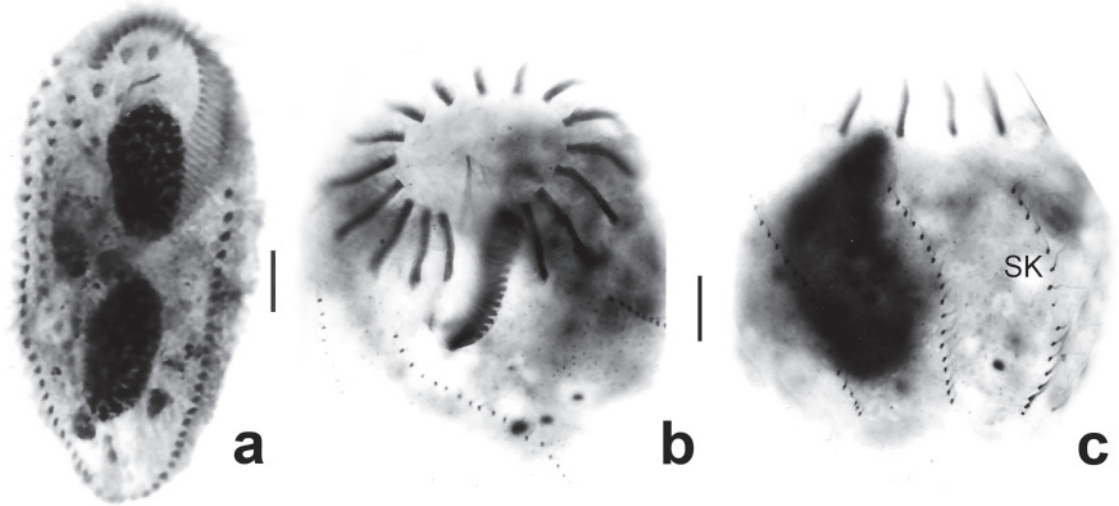

Figure 7. Micrographs of *Pleurotricha lanceolata* (a) and *Meseres corlissi* (b, c) after protargol impregnation. a, b. Ventral view. c. Dorsal view. SK, somatic kineties. Scale bars = 20 µm.

Table 6. Morphometric data on *Pleurotricha lanceolata*

in vivo	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	196	196	196	196	0	1
Body width	70	70	70	70	0	1
Protargol	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	180.2	182	133	210	17.1	25
Body width	78	77	70	98	9.5	25
AZM, length	84.8	84	70	98	7.3	25
Macronuclear nodules, number	2	2	2	2	0	25
Macronuclear nodules, length	39.2	37.8	26.6	53.2	6.4	25
Macronuclear nodules, width	18.3	18.2	13.3	25.2	3.2	25
Micronuclei, number	2	2	2	3	0.2	17
Micronuclei, length	7	7	4.9	8.4	1	25
Micronuclei, width	5.3	4.9	4.2	7	0.7	25
Oral polykineties, number	53.3	51.5	45	68	5.4	24
Frontal cirri, number	3	3	3	3	0	25
Buccal cirri, number	1	1	1	1	0	25
Fronto-ventral cirri, number	4	4	4	4	0	25
Postoral cirri, number	2	2	2	2	0	20
Pre-transverse cirri, number	3	3	3	3	0	8
Transverse cirri, number	5	5	5	5	0	25
Left marginal row, number of cirri	27.8	28	19	34	2.8	25
Right marginal row 1, number of cirri	30.8	30	25	41	3.8	23
Right marginal row 2, number of cirri	18.4	18	5	27	5	20
Right marginal row 3, number of cirri	8.4	9	4	14	4.4	5
Dorsal kineties, number	6	6	6	6	0	16
Caudal cirri, number	3	3	3	3	0	25

Table 7. Morphometric data on *Meseres corlissi*

Protargol	$\overline{X}$	*M*	*Xm*	*XM*	*SD*	*N*
Body length	99.3	98	84	126	11.9	25
Body width	87.8	91	66.5	112	10.4	25
Macronucleus, length	35.9	35	30	45	5.6	5
Macronucleus, width	29.3	24.5	17.5	49	12.1	5
Micronuclei, number	1	1	1	1	0	6
Micronucleus, length	4.9	4.9	4.5	5.2	0.3	3
Micronucleus, width	4.2	4.2	3.5	4.9	0.7	3
Anterior polykineties, number	16	16	16	16	0	25
Ventral polykineties, number	15.4	15	13	18	1.1	21
Somatic kineties, number	7.8	8	7	8	0.4	17

found in stagnant freshwater environments (Berger, 1999), although records of this species in edaphic biotopes from Brazil do also exist (Foissner, 1997a). Its morphometric characteristics generally coincide with the observations of other authors (Berger, 1999).

Stylonychia lemnae has been cited by other authors in Germany, China, North America, and Japan (Berger, 1999); but the documentation of its presence here represents a new finding for the Neotropical region. This species is common in freshwater environments and has also previously been found in soil samples from Japan (Berger, 1999). With respect to its morphology, the most significant difference from that of *S. mytilus* is the position of the posteriormost frontoventral cirrus (Berger, 1999). Gupta et al. (2001) established a new Indian species, *S. ammermanni*, which belongs to the *Stylonychia mytilus-lemnae* complex, but differs from *S. lemnae* by lacking a postperistomial bulge and because there is a gap between the last frontoventral cirri and the anterior ones. Most morphometric characteristics of the specimens studied by

Table 8. Data on collection and treatment of soil samples, and physical-chemical variables measured during hydric phases, under which conditions some species were found. Cond., conductivity (μS cm^{-1}); DO, dissolved oxygen (mg L^{-1}); T, temperature (ºC)

Species	*Biotope*	*Sampling date*	*Rewetting date*	*Observations*	*Cond.*	*T*	*DO*	*pH*
Blepharisma americanum	Soil	10/2004; 01/2005	11/2004; 02/2005		--	--	--	--
	Freshwater (plankton)	06/2005; 08/2005	--		133-276	3.3-6.4	5.6-9.6	8.6-8.7
Gonostomum affine	Soil	01/2004; 01/2005	01/2004, 02/2005; 08-09/2006		--	--	--	--
G. strenuum	Soil	01/2004; 01/2005	01/2007		--	--	--	--
Stylonychia bifaria	Soil	01/2005	02/2005		--	--	--	--
S. lemnae	Soil	10/2004; 05/2008	11/2004; 06/2008		--	--	--	--
	Freshwater (periphyton plankton)	07/2004; 04/2005	--	*Alternanthera philoxeroides* and *Typha* sp.	227-243	2.4-5.5	5.5-6.3	5-8.5
Pleurotricha lanceolata	Soil	10/2004	11/2004	Short drought	--	--	--	--
	Freshwater (periphyton)	04, 07/2004	--	*Alternanthera philoxeroides* and *Typha* sp.	227	2.4-5.4	5.5-6.3	5-5.4
Meseres corlissi	Soil	10/2004	11/2004	Short drought	--	--	--	--

us coincide with those observed by other authors, although the number of dikinetids in the third and fourth dorsal kineties was lower than those mentioned in Berger (1999; i. e., 21-27 and 18-22 vs. 33-40 and 30-39, respectively).

Pleurotricha lanceolata is probably cosmopolitan and was recorded by other authors in freshwater environments from Germany, Africa, Spain, China, India, Mexico, and the USA (Rico-Ferrat et al., 1987; Berger, 1999). Cunha (1913), moreover, recorded this species in Brazil, but without describing or illustrating its morphology. The present report constitutes the first finding of *P. lanceolata* in Argentina. The morphometric data of the specimens studied coincide with those observed by Jeffries and Mellot (1968), but with an important difference being in the number of right marginal rows of cirri. The ventral infraciliature is also variable, according to the cited authors, and coincides with specimens a-c from Fig. 189, p. 704 in Berger (1999).

Meseres corlissi is considered a rare species, although it does have a global distribution. It was previously found by other authors in Austria, Namibia, Australia, China, Venezuela, Brazil, and the Dominican Republic, in a variety of habitats such as in the sediments of a temporary pond, in a salt pan with regular floodings, in a river floodplain, in flooded soils, and within a bromeliad (Weisse, 2004; Müller et al., 2006). As in the present study, the species was sporadically found in unstable environments (Weisse, 2004). This present finding, however, is the first recording of *M. corlissi* in Argentina. Although its morphometric characteristics coincide with those observed by Petz and Foissner (1992), the Argentinean specimens presented a greater size (65.6 μm vs. 99.3 μm in their average length), and the numbers of their somatic kineties were more variable (8 constantly, N = 30 vs. 7-8, respectively). The morphology of the resting cysts and the processes of cyst formation and excystment have been well documented for this species (Foissner, 2005; Foissner et al., 2005b, 2006), while their resistance within completely dried edaphic material has been estimated to be several months and even 2 years in soil samples from the type locality (Müller et al., 2006). In the present study, the species was found only once in soil samples that were rewetted soon after its collection, but not in later resuspensions of the same soil material (1 year later). Although *M. corlissi* exhibits a global distribution, this species is not adapted to wide ranges of environmental conditions. Weisse (2004) stated that *M. corlissi* prefers unstable habitats with warm temperatures, where it survives through its characteristic resting cysts. As was shown by the cited author, the process of excystment of *M. corlissi* from a tree bromeliad was influenced by conditions of warm temperature. Other authors, however, proposed that the excystment of *M. corlissi* depended on a "soil factor", probably a soluble soil component and/or certain bacterial metabolites present (Müller et al., 2006).

Most species in the present report are cosmopolitan; nevertheless new isolates were also found among those published previously (Küppers et al., 2006b, 2007a, b). Although the majority of free-living ciliates are globally distributed, there are also unexplored geographical regions and specific environments that could be inhabited by organisms with restricted distributions. Within the soil biotope, ciliates remain as resting cysts most of the time, but the techniques used for the reactivation of these structures usually lead to an undersampling, thus resulting in an underestimation of the soil ciliate diversity (Foissner, 1997b). In spite of this limitation, almost 50% of the species discovered by Foissner (1997b) in African soils were new ones. This fact points to a great underestimation of soil ciliate biodiversity, an assessment that will increase as new regions are explored. Nevertheless, there are few ciliate taxonomists presently working in the Neotropical region, and soil ciliates in particular have been poorly investigated.

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