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Diversity of freshwater ciliates (Protista) from Argentina

Gabriela C. Küppers[1,*] **& María C. Claps**[2]

[1]*Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", CONICET-UNLP, Argentina.*
[2]*Instituto de Limnología "Dr. R. A. Ringuelet", CONICET-UNLP, Argentina*
**Coreesponding author: gkuppers@fcnym.unlp.edu.ar*

Abstract. Diversity of ciliates from freshwater and soil were scarcely investigated in Argentina, in spite of their ecological role in these ecosystems and the huge environmental heterogeneity that can be found in this country. In the present study, we describe the morphology of nine species from a temporary pond in Buenos Aires province, by means of live observations and protargol impregnations. *Stentor igneus* Ehrenberg, *Pseudochilodonopsis piscatoris* (Blochmann), *Vorticella halophila* Stiller, *Intranstylum invaginatum* Stokes, and *Epistylis rotans* Švec were recorded for the first time in Argentina, and in most cases, are new for the Neotropical realm as well. In addition, an updated checklist on freshwater ciliates from Argentina is provided, based on ciliates listed for the Salado River basin in the Buenos Aires province, new findings from Rancho Hambre peat bog pools in Tierra del Fuego province and a pond from Misiones province.

Keywords. Argentina, Ciliophora, diversity, new records.

Introduction

According to the literature and based on own investigations, a total of 208 freshwater ciliate species were recorded in Argentina (Küppers & Claps, 2012). Unfortunately; diversity of this group of protists is highly underestimated, in spite of the ecological role of ciliates in microbial food webs and the huge environmental heterogeneity that can be found in Argentina. In marine ecosystems; several investigations on diversity, biogeography, phylogeny, and ecology of plankton ciliates, mostly on tintinnids, were conducted by Balech (Akselman Cardella, 2008, list of publications), Boltovskoy & Alder (1989, 1992), Boltovskoy *et al*. (1990), Alder & Boltovskoy (1991); and more recently, by Thompson *et al*. (1999, 2001, 2005), Santoferrara & Alder (2009a, b; 2012), and Santoferrara *et al*. (2011, 2012, 2013, 2014, 2015). Brackish water ciliates were mostly investigated by Souto (1974), Pettigrosso *et al*. (1997), Pettigrosso (2003), Pettigrosso & Popovich (2009), Barría de Cao (1992), and Barría de Cao *et al.* (1997, 2013). On the contrary, only few researchers focused on ciliates from freshwater and soil (Küppers & Claps, 2012 and citations therein).

The aim of the present study is to characterize biometrically and describe the morphology of nine ciliates from a temporary pond located in Buenos Aires province, by means of live observations and protargol impregnations. These

species were recorded over a 3-year survey along with other species that were described elsewhere and listed in Küppers & Claps (2012). In addition, this checklist on freshwater ciliates from Argentina is updated with species listed for the Salado River basin in the Buenos Aires province, new findings from Rancho Hambre peat bog pools in Tierra del Fuego province, and a new record from Misiones province.

Material and Methods

A temporary pond located near the city of Poblet, Buenos Aires province (35°05'S, 57°48'W), was surveyed during 2003-2005, where plankton and periphyton samples were obtained monthly. This pond went through drought phases mainly in summer and was colonized by hydrophytes like *Ludwigia peploides* (Kunth) Raven and *Alternanthera phyloxeroides* (Martius) Grisebach during desiccation. These macrophytes persisted over the filling phase in autumn, when periphytic samples were obtained. The rest of the hydroperiod was characterized by open waters. For detail description and location of this temporary pond see Küppers *et al*. (2006). During the publication process of the checklist by Küppers & Claps (2012), other freshwater ciliates were described or published that are listed in the present work as well (see Küppers & Claps, 2010; Küppers *et al*. 2011).

The Salado River is a lowland river located in the Pampean plain from Buenos Aires province, where land floodings over weeks or months occur seasonally; thus influencing the river regime and consequently, its electrical conductivity and transport of dissolved and particulate material (Claps *et al.*, 2009). Besides, sedimentary aquifers with high sodium-chloride concentrations in the headwater of the river influence the water chemistry of streams and lakes that also contribute to the water balance of the Salado River (Claps *et al*., 2009). From the headwater sector through the mouth of the river, the plankton of several tributaries, artificial channels, and backwater ponds were sampled since 1997 by Solari *et al*. (2002), Gabellone *et al*. (2005), and Claps *et al*. (2009), where several species of freshwater as well as brackish and marine ciliates were found. For detail information on the geographic location of sampling sites and water characteristics see Gabellone *et al*. (2008) and previously cited papers.

Rancho Hambre is a dome-shaped, ombrotrophic peat bog located along the southernmost ridges of the Andes in Tierra del Fuego province. Its landscape is dominated by a matrix of *Sphagnum magellanicum* Bridel mosses that holds pools of different size and with nutrient poor, colored, acid waters (Roig & Roig, 2004). Plankton samples were taken in five of these pools during a limnological survey in 2008-2010. For detail description of sampling sites, morphometric and physico-chemical characteristics of these pools see González Garraza *et al*. (2012).

A new ciliate was cited in Misiones province, northeast from Argentina, from a pond formed in the floodplain of the Garupá stream (Peso *et al*., 2015), which is also included in the list.

Most ciliates described below were found in fresh samples from the pond located near Poblet (Buenos Aires province) and persisted in Petri dishes over 1-2 weeks. Ciliates from Rancho Hambre pools were kept in a culture chamber at 4 °C and 12 hs. light period. Observations were made at magnifications of 10× and 40× under the stereo microscope and at 100×, 400×, and 1000× under the bright field microscope. After observing

ciliates *in vivo*, cells were fixed in Bouin's solution and impregnated with protargol according to Wilbert (1975). Drawings of living cells are free-hand sketches, while impregnated ciliates were illustrated with the aid of a camera lucida. Peritrichs were only studied *in vivo*, because impregnations were too strong. Classification and terminology follow Lynn (2008). Identification of species in the genus *Stentor* Oken were performed according to Foissner & Wölfl (1994), *Vorticella* Linnaeus following Warren (1986), and specific taxonomic papers cited below.

Results and Discussion

Additions to the checklist of freshwater ciliates from Argentina is provided in Table 1. With these findings, the number of freshwater ciliates increases up to 229 species. In the Salado River basin a total of 34 identified species were recorded, from which 5 of the species reported here are new records for Argentina. Some of these ciliates are known to inhabit brackish and / or marine environments. The fluctuating water regime of the river and the chemical nature of the basin cause wide variations in electrical conductivity over wet and dry seasons; thus, probably conditioning ciliate assemblages and allowing the occurrence of euryhaline and halophile species.

Until the investigations of Küppers *et al*. (2011), Quiroga *et al*. (2013) and unpublished data (Küppers *et al*., unpubl.), only the peritrich *Epistylis* cf. *umbilicata* was known from lakes in Tierra del Fuego (Küppers & Claps, 2012). In the present contribution, a total of 28 identified species are listed in this province, with 13 ciliates being also new records for Argentina.

In Misiones province, Peso *et al*. (2015) found the peritrich *Ophrydium versatile* (O. F. Müller, 1786) Ehrenberg, 1830 for the first time in a pond formed from the Garupá stream floodplain. This is the only ciliate identified up to species level that was cited for this province.

The following nine species from a temporary pond near the city of Poblet in Buenos Aires province were mentioned in Küppers & Claps (2012) but were not biometrically characterized at that time. Five species were new for the freshwater ciliate fauna from Argentina and three of these, were also new for the Neotropical realm.

Phylum Ciliophora Doflein

Class Heterotrichea Stein
Order Heterotrichida Stein
Family Stentoridae Carus
***Stentor igneus* Ehrenberg, 1838 (Figure 1; Table 2)**

Body size *in vivo* 392-490 µm long, trumpet-shaped, with a short mucous lorica. Cortical granules pink-colored, arranged in longitudinal stripes between somatic kineties. Endosymbiotic algae absent. Contractile vacuole anteriorly on the left, with posterior collecting canal (Figure 1a). Nuclear apparatus formed by a single, spherical bead and 3 globular micronuclei. Oral ciliature with 142 membranelles and paroral membrane parallel to the adoral zone. Somatic ciliature composed of 32-36 longitudinal kineties and 7-8 kineties in peristomial region (Figure 1b).

Occurrence and autoecology. This species was recorded in autumn 2004, on *Alternanthera philoxeroides* and *Ludwigia peploides*, under the following physico-chemical conditions: conductivity 226.7 µS cm^{-1}, dissolved oxygen concentration 6.3 mg L^{-1}, temperature 8.6°C, pH 5.4.

Remarks. *Stentor igneus* is probably a cosmopolitan

Table 1. Additions to the checklist on freshwater ciliates from Argentina, recorded in Buenos Aires province (BA1, BA2, Salado River basin, SRB: S1-S12), Misiones province (M), and Tierra del Fuego province (TF). BA1, temporary pond near Poblet; BA2, temporary pond near Dolores; S1, Salado stream; S2, Piñeiro stream; S3, Junín; S4, Saladillo stream; S4a, Mercante Canal; S4b, Vinculación Canal; S4c, del Este Canal; S5, Achupallas; S6, Ruta 30; S7, Saladillo Vallimanca stream; S8, Roque Pérez; S9, Gorchs; S10, Belgrano; S11, Destino; S12, Guerrero; M, pond of the Garupá stream floodplain; TF, pools from Rancho Hambre peat bog.

Species	BA1	BA2	S1	S2	S3	S4	S4a	S4b	S4c	S5	S6	S7	S8	S9	S10	S11	S12	TF	M	References
Apoamphisiella hymenophora (Stokes, 1886) Berger, 1999	+	+																		Küppers & Claps (2013)
Ascobius lentus Henneguy, 1884																+				New record in SRB
Aspidisca cicada (O. F. Müller, 1786) Claparède & Lachmann, 1858					+	+	+		+	+		+	+	+						New record in SRB
Aspidisca lynceus (O. F. Müller, 1773) Ehrenberg, 1830					+				+									+		New record in SRB, TF
Balanion planctonicum (Foissner, Oleksiv & Müller, 1990) Foissner, Berger & Kohmann, 1994																		+		Quiroga *et al*. (2013)
Bryometopus sphagni (Penard, 1922) Kahl, 1932																		+		New record in Argentina

Table 1. Additions to the checklist on freshwater ciliates from Argentina.

Bursaridium pseudobursaria (Fauré-Fremiet, 1924) Kahl, 1927								+	New record in Argentina
Carchesium polypinum (Linnaeus, 1758) Ehrenberg, 1930			+	+					New record in SRB
Cinetochilum margaritaceum (Ehrenberg, 1831) Perty, 1849								+	New record in TF
Clapsiella magnifica Küppers, 2014	+								Küppers (2014)
Colpoda steini Maupas, 1883								+	New record in TF
Condylostoma cf. *spatiosum*					+				New record in Argentina
Deviata polycirrata Küppers & Claps, 2010	+	+							Küppers & Claps (2010)
Diophrys cf. *appendiculata*							+		New record in Argentina

Table 1. Additions to the checklist on freshwater ciliates from Argentina.

Epispathidium amphoriforme (Greeff, 1888) Foissner, 1984																+	New record in TF
Fabrea salina Henneguy, 1890	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		New record in Argentina
Frontonia cf. *acuminata*																+	New record in Argentina
Frontonia atra (Ehrenberg, 1833) Bütschli, 1889																+	New record in TF
Halteria grandinella (O. F. Müller, 1773) Dujardin, 1841		+		+	+	+	+	+			+	+	+		+	+	Quiroga *et al*. (2013)
Lembadion lucens (Maskell, 1887) Kahl, 1931																+	New record in Argentina
Limnostrombidium viride (Stein, 1867) Krainer, 1995						+											New record in SRB

Table 1. Additions to the checklist on freshwater ciliates from Argentina.

Linostomella vorticella (Ehrenberg, 1833) Aescht in Foissner, Berger & Schaumburg, 1999	+				New record in SRB
Mesodinium acarus Stein, 1867			+		New record in Argentina
Ophrydium versatile (O. F. Müller, 1786) Ehrenberg, 1830			+	+	New record in TF, M
Paramecium aurelia complex			+		New record in TF
Paramecium bursaria (Ehrenberg, 1831) Focke, 1836			+		New record in TF
Parasterkiella thompsoni (Foissner, 1996) Küppers, da Silva Paiva, do Nascimento Borges, Harada, González Garraza & Mataloni, 2011			+		Küppers *et al*. (2011)
Pelagostrombidium fallax (Zacharias, 1896) Krainer, 1991			+		Quiroga *et al*. (2013)

Table 1. Additions to the checklist on freshwater ciliates from Argentina.

Plagiopyla nasuta Stein, 1860																		+		New record in TF
Podophrya fallax Dingfelder, 1961																		+		New record in TF
Rimostrombidium hyalinum (Mirabdullaev, 1985) Petz & Foissner, 1992																		+		Quiroga *et al*. (2013)
Stentor coeruleus (Pallas, 1766) Ehrenberg, 1831,																		+		New record in TF
Stentor cf. *araucanus*																		+		TF
Stichotricha aculeata Wrzesniowski, 1866																		+		New record in Argentina
Strobilidium caudatum (Fromentel, 1876) Foissner, 1987					+		+	+		+								+		New record in SRB, TF
Strombidium sulcatum Claparède & Lachmann, 1859							+	+	+											New record in Argentina
Strombidium cf. *stylifer*						+	+	+	+											New record in Argentina

Table 1. Additions to the checklist on freshwater ciliates from Argentina.

Tetrahymena pyriformis complex																	+		New record in TF
Thylakidium pituitosum Foissner, 1980																	+		New record in Argentina
Tokophrya cf. *infusionum*																	+		New record in Argentina
Uroleptus willii Sonntag, Strüder-Kypke & Summerer, 2008																	+		New record in Argentina
Vorticella microstoma Ehrenberg, 1830		+		+	+				+	+		+	+	+	+	+			New record in SRB

species; although, it was not yet found in Australia and Antarctica (Foissner *et al.*, 1992). In the Neotropical realm, it was previously recorded in México (Aladro Lubel *et al*., 2006, 2009), Perú (Foissner *et al.*, 1992), and Brazil (Regali-Seleghim *et al*., 2011), while represents a new finding for Argentina. Morphometric features coincide with those provided by Foissner *et al.* (1992). The populations studied by Song & Wilbert (1989) from Bonn, Germany, had a lower number of adoral membranelles (76-96 *vs.* 142, respectively) and somatic kineties (23-29 *vs.* 32-36, respectively). According to Foissner & Wölfl (1994), most important features to identify species within the genus *Stentor* are the presence/absence of endosymbionts, morphology of the nuclear apparatus, and color of cortical granules. In this context, the species recorded in this study coincides with *S. igneus*.

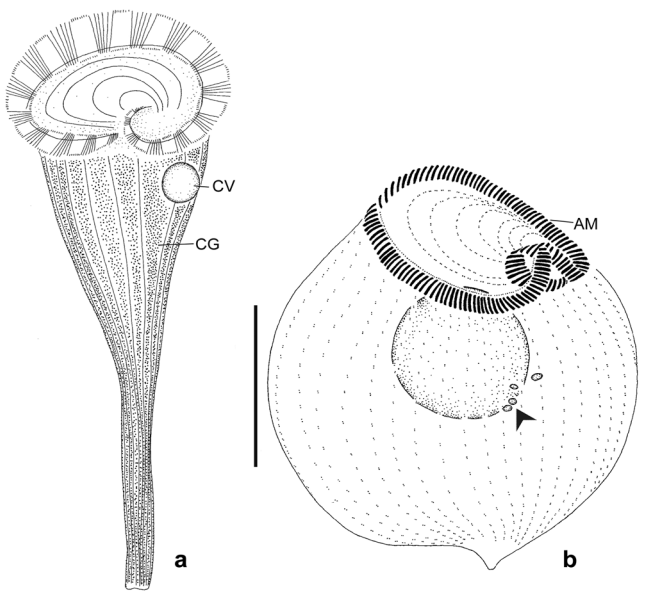

Figure 1. Morphology of *Stentor igneus* in vivo (a) and after protargol impregnation (b). Arrowhead indicates micronuclei. AM, adoral membranelles; CG, cortical granules; CV, contractile vacuole. Scale bar = 50 µm.

***Stentor roeselii* Ehrenberg, 1835 (Figure 2; Table 2)**

Body size *in vivo* 462-1344 µm in length; trumpet-shaped. With posterior mucous lorica. Cortical granules colorless, arranged in longitudinal stripes between somatic kineties. Endosymbiotic algae absent. Contractile vacuole on left of buccal funnel, with posterior collecting canal (Figure 2a). Nuclear apparatus formed by vermiform macronucleus and 4-8 globular micronuclei. Oral ciliature composed of 142-177 membranelles and paroral membrane parallel to adoral zone. Somatic ciliature composed of 42-63 longitudinal and 9-12 peristomial kineties (Figure 2b).

Occurrence and autoecology. This species was found in plankton samples obtained in spring 2003 and 2004, under the following ranges of physico-chemical parameters: conductivity 156.3-226.7 µS cm^{-1}, dissolved oxygen concentration 4.5-7.1 mg L^{-1}, temperature 8.6-19.2°C, pH 5.4-9.5. Food vacuoles contained green algae. Occasionally, this species was observed to live in great numbers, in mucous masses formed by individual loricae.

Remarks. *Stentor roeselii* is probably cosmopolitan; although, it was not yet found in Australia and Antarctica (Foissner *et al.*, 1992). This species was previously recorded in México (Aladro Lubel *et al*., 2006, 2009) and Brazil (Pauleto *et al*., 2009; Regali-Seleghim *et al*., 2011; Velho *et al*., 2013). In Argentina, Modenutti (1991) found *S. roeselii* in lotic environments of del Plata sub-catchment and Zaleski & Claps (1999) in San Miguel del Monte lake (Buenos Aires province), epiphytic on *Myriophyllum quitense* Kunth. Morphometric features provided by different authors are somewhat variable and in some cases are different from those observed in the present study; although, important features to identify species within the genus according to Foissner & Wölfl (1994) are coincident. In

the revision of the species, Foissner *et al.* (1992) mentioned a higher number of micronuclei than those observed in the present study (7-20 *vs.* 4-8, respectively), somatic kineties (about 80 *vs.* about 50 on average, respectively), and peristomial kineties (14-42 *vs.* 9-12, respectively). The Argentinean population, however, is similar to that described by Song & Wilbert (1989) from a stream in Bonn, Germany.

Class Phyllopharingea de Puytorac *et al.*
Subclass Phyllopharyngia de Puytorac *et al.*
Order Chlamydodontida Deroux
Family Chilodonellidae Deroux
***Pseudochilodonopsis piscatoris* (Blochmann, 1895) Foissner, 1979 (Figure 3; Table 3)**

Body size 81-105 × 26-42 µm after protargol impregnation; dorsoventrally flattened, with a

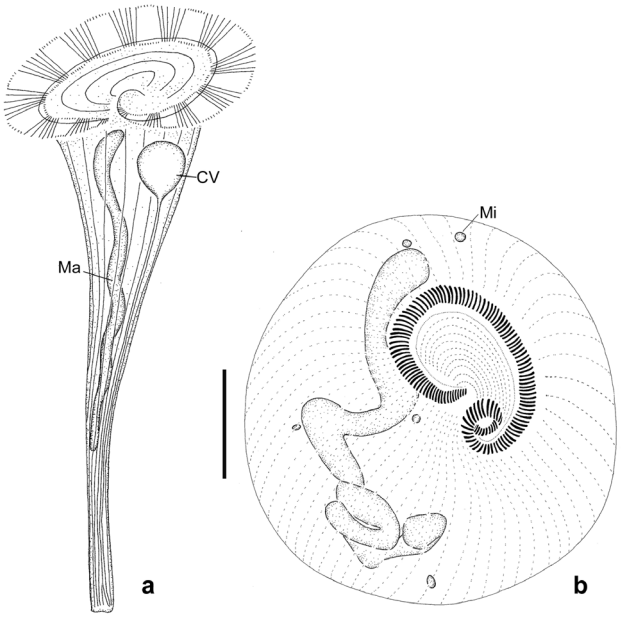

Figure 2. Morphology of *Stentor roeselii* in vivo (a) and after protargol impregnation (b). CV, contractile vacuole; Ma, macronucleus; Mi, micronucleus. Scale bar = 50 µm.

Table 2. Morphometric data on *Stentor igneus* (first line) and *S. roeselii* (second line). M, median; Max., maximum observation; Min, minimum observation; n, number of observations; SD, standard deviation. Measurements are in µm and correspond to protargol impregnated specimens, unless indicated.

Character	Mean	M	Min.	Max.	SD	n
Body length *in vivo*	441.0 919.3	441.0 1015.0	392.0 462.0	490.0 1344.0	69.3 323.4	2 18
Peristome diameter *in vivo*	--- 120.5	--- 112.0	--- 98.0	--- 154.0	--- 15.3	--- 18
Lorica length *in vivo*	--- 774.2	--- 770.0	--- 630.0	--- 1008.0	--- 110.0	--- 18
Macronuclear nodules number	1 1	1 1	1 1	1 1	0 0	3 18
Macronucleus length	32.7 ---	30.8 ---	28.0 ---	39.2 ---	5.8 ---	3 ---
Macronucleus width	27.8 ---	25.9 ---	22.4 ---	35.0 ---	6.5 ---	3 ---
Micronuclei number	3 5.6	3 5	3 4	3 8	0 1.5	1 5
Micronuclei width	1.8 3.5	1.7 3.8	1.7 2.4	2.1 5.0	0.2 0.9	3 7
Membranelles number	142.0 164.5	142.0 165.5	142.0 142	142.0 177	0 13.1	1 6

Table 2. Continuation.

Somatic kineties number	34 48.7	34 47.0	32 42	36 63	2.8 7.4	2 7
Peristomial kineties number	7.5 10.9	7.5 11.0	7 9	8 12	0.7 1.2	2 7

preoral beak in anterior left margin and posterior end pointed, sometimes rounded. Cytoplasm colorless. Two contractile vacuoles; one located in midbody on right cell margin, and other one in posterior third on left body margin (Figure 3a). With conspicuous dorsal cytoplasmic protrusion or spine posteriorly. Macronucleus ellipsoidal; micronucleus not observed. Cyrtos formed by about 14 rods. Ventral ciliature composed of 5-6 left and 5-6 right kineties, separated by a bare postoral field. One fragmented preoral kinety and 2 circumoral kineties. Preoral kinety consists of 4 fragments; fourth fragment extends around cytopharynx opening (Figure 3b). Dorsal brush arched anteriorly (Figure 3c).

Occurrence and autoecology. This species was found in winter-spring 2004 and autumn-spring 2005, in plankton as well as periphyton samples, under the following ranges of physico-chemical parameters: conductivity 133-243 µS cm^{-1}, dissolved oxygen concentration 4.5-8.0 mg L^{-1}, temperature 4.0-19.2 °C, pH 5-9.5.

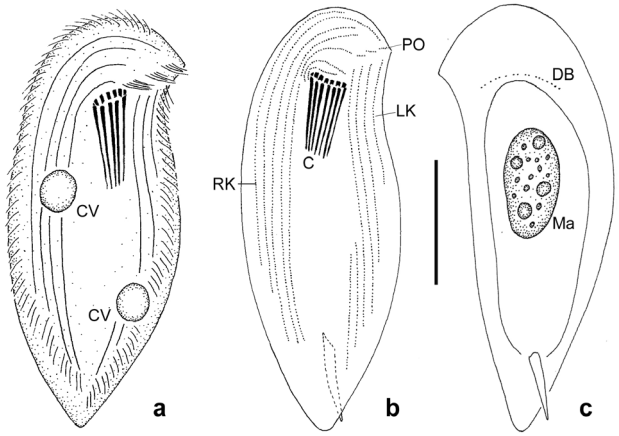

Figure 3. Morphology of *Pseudochilodonopsis piscatoris* in vivo (a) and after protargol impregnation (b, c). a, b. Ventral view; c. Dorsal view. C, cyrtos; CV, contractile vacuole; DB, dorsal brush; LK, left ventral kineties; Ma, macronucleus; PO, fragmented preoral kinety; RK, Right ventral kineties. Scale bar = 30 µm.

Remarks. *Pseudochilodonopsis piscatoris* was previously found in Europe (Foissner *et al.*, 1991). For Argentina and the Neotropical realm, it represents a new record. Morphometric features coincide with those observed by Foissner (1979) and those provided by Foissner *et al.* (1991); although the dorsal spine from Argentinean population is distinctly more conspicuous.

Class Oligohymenophorea de Puytorac *et al.*
Subclass Peritrichia Stein
Order Sessilida Kahl
Family Vorticellidae Ehrenberg
***Vorticella convallaria* Linnaeus, 1758**
(Figure 4a; Table 4)

Zooid *in vivo* 63-98 × 49-70 µm, inverted bell-shaped. Peristomial disc not elevated above peristome; maximum body width less than peristomial lip diameter. Pellicle finely striated and with normal ribbing between striations. Contractile vacuole below peristome. Contractile stalk with evident thecoplasmic granules on myoneme. Macronucleus J-shaped.

Occurrence and autoecology. This species was found in spring 2003 and autumn-winter 2004 on *Alternanthera philoxeroides* and *Ludwigia peploides*, under the following ranges of physico-

Table 3. Morphometric data on *Pseudochilodonopsis piscatoris*. Abbreviations are indicated in Table 2. Measurements correspond to protargol impregnated specimens.

Character	Mean	M	Min.	Max.	SD	n
Body length	94.5	94.0	81.0	105.0	8.2	8
Body width	37.6	39.5	26.0	42.0	5.6	8
Macronucleus length	25.4	27.0	20.0	28.0	2.8	7
Macronucleus width	13.0	13.0	11.0	15.0	1.5	7
Dorsal spine length	14.1	14.0	10.5	17.0	2.6	5
Dorsal spine width	2.8	2.8	2.8	2.8	0	1
Circumoral kineties number	2	2	2	2	0	7
Kineties in left ventral field number	5.2	5.0	5	6	0.4	6
Kineties in right ventral Field number	5.2	5.0	5	6	0.4	5

chemical parameters: conductivity 145-227 µS cm^{-1}, dissolved oxygen concentration 5.5-8.8 mg L^{-1}, temperature 2.4-24.1 °C, pH 5.0-8.4.

Remarks. *Vorticella convallaria* belongs to a cosmopolitan species complex that occur in Europe, Asia, Antarctica, and America (Foissner *et al.*, 1992). In South America, it was mentioned by Guillén *et al.* (2003) in swamps from Villa in Perú, in freshwater environments from México (Aladro Lubel *et al*., 2009) and Brazil (Regali-Seleghim *et al*., 2011; Velho *et al*., 2013). In Argentina, this species was previously recorded in Buenos Aires province by Cela (1972) in ponds from Berisso, by Claps (1984) on *Scirpus californicus* (Meyer) Steud. from Atalaya (Río de la Plata estuary), by Claps & Modenutti (1984) on *S. californicus* from San Miguel del Monte Lake, on *Stuckenia striata* (Ruiz & Pav.) Holub from Chascomús Lake, and on *Pistia stratiotes* L. from Punta Lara (Río de la Plata estuary); finally, Modenutti (1987) found *V. convallaria* in plankton samples of Rodríguez stream from La Plata city. Morphometric features coincide with those mentioned by Warren (1986) and Foissner *et al.* (1992).

Vorticella pulchella Sommer, 1951 (Figure 4b; Table 4)

Zooid size *in vivo* 30.0-43.3 µm × 26.6-33.3 µm. Peristomial disc prominently elevated above peristome and maximum body width approximately equal to peristomial lip diameter; body constricted below peristomial lip. Pellicle conspicuously striated and with convex ribbing between striation. Contractile vacuole in the center of body. Contractile stalk with inconspicuous thecoplasmic granules on myoneme, but evident upon contraction. Macronucleus C-shaped, located horizontally below peristome.

Occurrence and autoecology. *Vorticella pulchella* was found in winter 2004, on *L. peploides*, under the following ranges of physico-chemical parameters:

conductivity 163.3-227.0 µS cm^{-1}, dissolved oxygen concentration 5.5-8.8 mg L^{-1}, temperature 2.4-7.6 °C, pH 5-6.

Remarks. *Vorticella pulchella* is distributed in Switzerland (Sommer, 1951) and Hungary (Stiller, 1971). In Argentina, it was previously recorded by Zaleski & Claps (2001) on *Myriophyllum quitense* and suspended detritus from San Miguel del Monte Lake, Buenos Aires province. Stiller (1971) found *V. pulchella* as epibiont on copepod crustaceans. Morphometric features are coincident with those mentioned by Warren (1986) and those observed by Zaleski & Claps (2001).

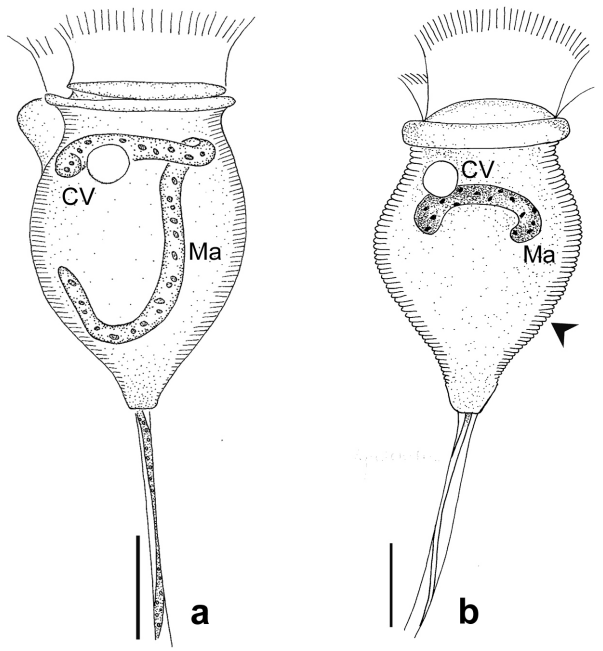

Figure 4. Morphology of *Vorticella convallaria* (a) and *V. pulchella* (b) in vivo. Arrowhead in (b) indicate conspicuously striated pellicle and convex ribbing between striations. CV, contractile vacuole; Ma, macronucleus. Scale bars = 20 µm.

Vorticella striata Dujardin, 1841 (Figure 5a,b; Table 4)

Zooid size *in vivo* 56-84 µm × 35-49 µm. Peristomial disc not elevated above peristome and maximum body width less than peristomial lip diameter. Pellicle conspicuously striated and with convex ribbing between striations. Contractile vacuole just below peristome. Contractile stalk with evident thecoplasmic granules on myoneme. Macronucleus C-shaped, located horizontally below peristome.

Occurrence. This species was recorded in summer 2005, in rewetted soil samples obtained from the pond bed during a drought period.

Remarks. *Vorticella striata* belongs to the *Vorticella aquadulcis* complex, which species were recorded in Eurasia and America (Foissner *et al.*, 1992). In 2008, Kovalchuk redescribed *V. striata* based on a population from Ukraine. In Argentina, this species was previously found by Claps & Modenutti (1984) on *Azolla filiculiodes* Lam. in Las Víboras stream from Magdalena and on *A. filiculoides*, *Ricciocarpus natans* L., *Lemna* sp., and *Wolfiella* sp. in Chascomús Lake, Buenos Aires province. The occurrence of this peritrich on different type of aquatic macrophytes indicates its low specificity for the substrate. Moreover, this species was also observed as epibiont on subitaneous eggs of the social rotifer *Sinantherina semibullata* (Thorpe) in temporary ponds from Punta Lara and Magdalena, Buenos Aires province (Küppers, unpub.). In agreement with our observations, Warren (1986) mentioned that this species could occasionally be found as epibiont. Fernández-Leborans & Tato-Porto (2000) mentioned *V. striata* on cladocerans and copepods and it was also found on a crayfish crustacean from México (Mayén Estrada & Aladro Lubel, 2002). In the present study, the finding of this species in rewetted soil samples indicate that it developed from resting cysts, which were also observed (Figure 5b). Morphometric features are in agreement with those mentioned by Warren (1986) and those observed by Claps & Modenutti (1984).

***Vorticella halophila* Stiller, 1941**
(Figure 5c; Table 4)

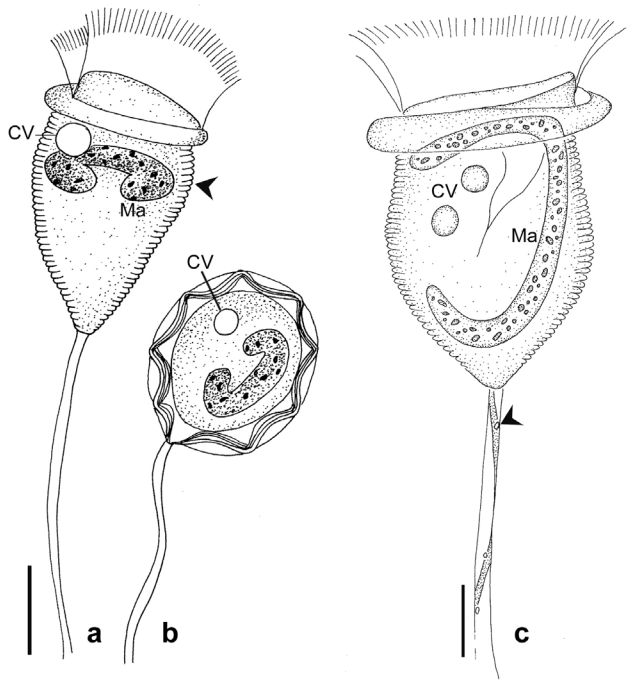

Figure 5. Morphology of *Vorticella striata* (a, b) and *V. halophila* (c) in vivo. a, c. Zooids. b. Cyst with pulsating contractile vacuole. Arrowheads indicate pellicle conspicuously striated (a) and thecoplasmic granules (c). CV, contractile vacuole; Ma, macronucleus. Scale bars = 20 µm.

Zooid *in vivo* 63-102.5 µm × 35-56 µm. Peristomial disc not elevated above peristome and maximum body width less than peristomial lip diameter. Body constricted below peristome. Pellicle conspicuously striated and with convex ribbing between striations. Two contractile vacuoles, located below peristome. Contractile stalk with scarce colorless thecoplasmic granules on myoneme. Macronucleus J-shaped.

Occurrence and autoecology. This species was found in summer 2005, in rewetted soil samples obtained from the dried pond bed. It was also observed in spring 2005 in plankton samples, under the following physico-chemical conditions: conductivity 206.7 µS cm^{-1}, dissolved oxygen concentration 4.5 mg L^{-1}, temperature 11.6 °C, pH 8.7.

Remarks. *Vorticella halophila* was recorded in Hungary (Stiller, 1971). In Argentina and the rest of South America, it represents a new finding. The development of this species from rewetted soil samples from the dried bed of the pond, indicate that it is able to form resting cysts. Moreover, this is the first time *V. halophila* is recorded in soil samples. Unfortunately, resting cysts were not observed. Morphometric characteristics coincide; in general, with those mentioned by Warren (1986); although, specimens from the present study had greater size (40-50 µm *vs*. 63-102 µm, respectively).

***Intranstylum invaginatum* Stokes, 1886**
(Figure 6; Table 4)

Zooid size *in vivo* 70-98 µm × 21-28 µm; inverted elongated bell-shaped. With peristomial lip. Peristomial disc slightly convex, with a central button-like protuberance, and slightly elevated above peristome (Figure 6a). Maximum body width less than peristomial lip diameter. Upon contraction, with an anterior snout-like protuberance and slightly folded posteriorly (Figure 6b). Pellicle smooth, without evident striation. Contractile vacuole on the peristome. Macronucleus C-shaped, horizontally located in anterior third of body. Stalk very short, with inconspicuous myoneme and posterior adhesive disc.

Occurrence and autoecology. This species was found in winter 2004, epibiont on ostracods in the genus *Cypris* O. F. Müller (Fig. 6c), under the following water conditions: conductivity 227 µS cm^{-1}, dissolved oxygen concentration 5.5 mg L^{-1}, temperature 2.4°C, pH 5.

Remarks. *Intranstylum invaginatum* was recorded in North America and Germany on the ostracods

Cypris and *Candona* Baird and also on cladocerans in Germany, England, Finland, and Italy (Kahl, 1935; Pätsch, 1974; Fernández-Leborans & Tato-Porto, 2000; Chatterjee *et al*., 2013). In Argentina and the rest of South America, it represents a new finding. Morphology is coincident with specimens recorded on *Cypris* by other authors; although, stalk is much shorter in the Argentinean population. On the contrary, epibionts on *Candona* have greater stalk length and those specimens found on cladocerans lack the button-like protuberance on center of peristomial disc (Kahl, 1935). To our knowledge, this species has rarely been described morphologically after its original description by Stokes (1886) and the observations of Kahl (1935). Unfortunately, protargol impregnations were very strong in order to observe its infraciliature.

Family Epistylididae Kahl

Epistylis rotans Švec, 1897 (Figure 7; Table 4)

Colony size *in vivo* about 4 mm high; arbustive, with principal stalk noncontractile and dichotomously branched. Zooid *in vivo* 196-252 µm × 77-98 µm; inverted bell-shaped, with anterior end of body curved or inclined. With peristomial lip; peristomial disc slightly convex, not elevated above peristome. Maximum body width less than peristomial lip diameter. Pellicle conspicuously striated, with convex ribbing between striations, and with small warts that become evident in peristomial zone. Upon contraction, zooid globular-shaped and peristomial lip covers the peristome completely. Contractile vacuole on the peristome. Macronucleus

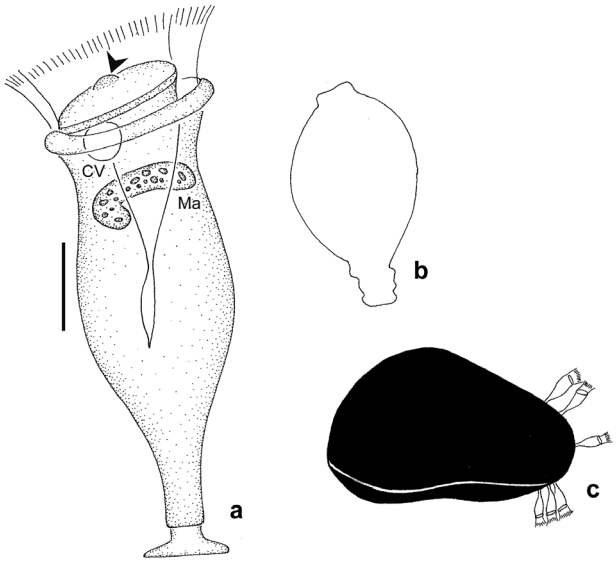

Figure 6. Morphology of *Intranstylum invaginatum* in vivo. a. Zooid with button-like protuberance in center of peristomial disc (arrowhead). b. Zooid upon contraction. c. Basibiont ostracod (*Cypris* sp.), showing zooids in posterior region of the valves. CV, contractile vacuole; Ma, macronucleus. Scale bar = 20 µm.

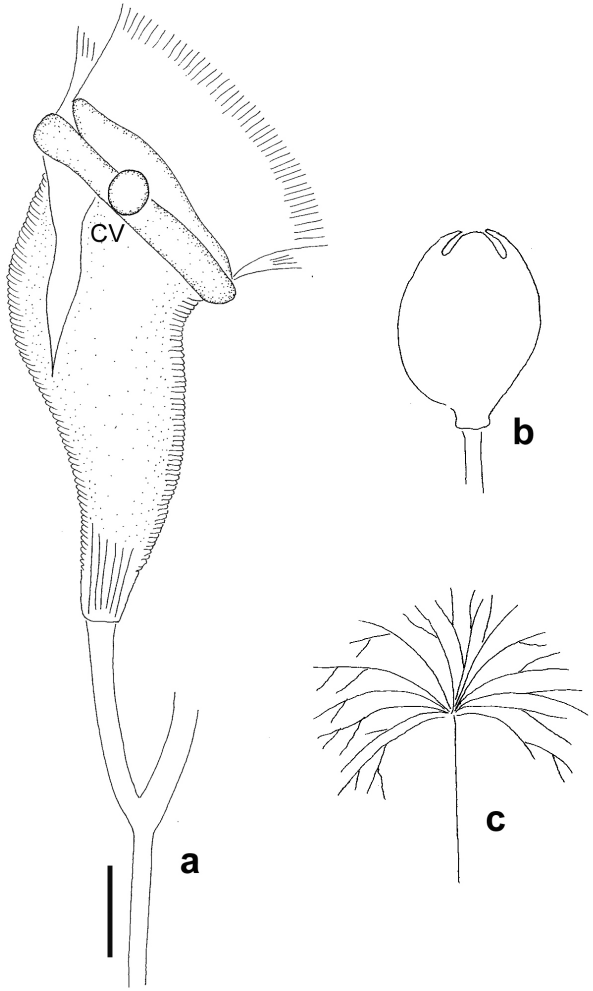

Figure 7. Morphology of *Epistylis rotans* in vivo. a. Zooid. b. Zooid upon contraction. c. General view of the colony. CV, contractile vacuole. Scale bar = 20 µm

C-shaped, horizontally located with respect to cell major axis. Stalk smooth and iridescent at low magnification (less than 40×), colonized by epibiont choanoflagellates.

Occurrence and autoecology. This species was found in autumn 2004; on *A. philoxeroides*, *L. peploides*, and suspended organic matter, under the following water characteristics: conductivity

Table 4. Morphometric data on *Vorticella convallaria* (Vc), *V. pulchella* (Vp), *V. striata* (Vs), *V. halophila* (Vh), *Intranstylum invaginatum* (Ii), and *Epistylis rotans* (Er) *in vivo*. Spp., species; other abbreviations as in Table 2.

Character	Spp.	Mean	M	Min.	Max.	n
Zooid length	Vc	80.5	80.5	63.0	98.0	20
	Vp	38.3	40.0	30.0	43.3	7
	Vs	63.0	59.5	56.0	84.0	8
	Vh	82.3	84.0	63.0	102.5	15
	Ii	89.3	91.0	70.0	98.0	11
	Er	231.5	238.0	196.0	252.0	15
Zooid width	Vc	56.7	56.0	49.0	70.0	20
	Vp	28.2	28.0	26.6	33.3	7
	Vs	39.4	38.5	35.0	49.0	8
	Vh	47.2	49.0	35.0	56.0	12
	Ii	26.1	28.0	21.0	28.0	11
	Er	85.9	84.0	77.0	98.0	15
Peristome diameter	Vc	73,8	70	63	84	20
	Vp	23.6	23.3	20.0	28.0	5
	Vs	32.4	31.5	28.0	42.0	8
	Vh	57.2	56.0	42.0	70.0	12
	Ii	30.5	28.0	28.0	35.0	11
	Er	117.1	112.0	105.0	126.0	15
Stalk length	Vc	276,8	266	210	378	20
	Vp	162.5	156.5	86.6	223.0	5
	Vs	244.0	266.0	140.0	294.0	7
	Vh	223.6	210.0	168.0	350.0	5
	Ii	---	---	---	---	---
	Er*	2000.0	2000.0	2000.0	2000.0	1
Stalk width	Vc	---	---	---	---	---
	Vp	2.7	3.3	1.7	3.3	5
	Vs	---	---	---	---	---
	Vh	---	---	---	---	---
	Ii	---	---	---	---	---
	Er*	21.0				
Adhesive disc diameter	Ii	24.5	24.5	21.0	28.0	2

226.7 µS cm^{-1}, dissolved oxygen concentration 6.3 mg L^{-1}, temperature 8.6°C, pH 5.4.

Remarks. *Epistylis rotans* was recorded by other authors in Hungary, Switzerland, Germany, Czech Republic, and Russia (Kahl, 1935; Nenninger, 1944-48; Stiller, 1971). This species was also found in México (Aladro Lubel *et al*., 2006), while it represents a new record in Argentina. Kahl (1935) and Stiller (1971) found this peritrich in plankton samples, while Nenninger (1944-48) recorded it on bryozoans and *Lemna* sp. Morphometric characteristics coincide with those observed by other authors from different geographic locations (Kahl, 1935; Nenninger, 1944-48), mainly in the

typical shape of zooids. The iridiscent coloration of the main stalk of colony was not mentioned by other authors.

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