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First records of epiphytic limnetic ciliates from Argentina

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ABSTRACT

Ciliates associated with *Myriophyllum quitense* were studied in a pond of Buenos Aires, Argentina, during the year 1998. Identifications were based on live observations. Twelve species are new records for Argentina: *Spirostomum teres, Stentor roeselii, Paramecium caudatum, Euplotopsis affinis, Acinetides triangularis, Kellicotta cuspidata, Epistylis articulata, E. pürneri, Opercularia nutans, Vaginicola crystallina, V. ingenita and Pseudovorticella difficilis.* Brief descriptions, illustrations and comments are provided.

RESUMEN

Primeros registros de ciliados limnéticos epifíticos de Argentina.

Los ciliados asociados a Myriophyllum quitense *fueron estudiados en una laguna de Buenos Aires, Argentina, durante 1998. Las identificaciones se basaron en observaciones en vivo. Doce especies se citan por primera vez para la Argentina:* Spirostomum teres, Stentor roeselii, Paramecium caudatum, Euplotopsis affinis, Acinetides triangularis, Kellicotta cuspidata, Epistylis articulata, E. pürneri, Opercularia nutans, Vaginicola crystallina, V. ingenita y Pseudovorticella difficilis. *Se incluyen descripciones breves, ilustraciones y comentarios de cada una de las especies.*

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INTRODUCTION

The ciliate fauna of Argentina has been scarcely studied. From the last decade, few papers can be mentioned (Claps & Modenutti, 1988; Foggetta & Boltovskoy, 1995; Modenutti, 1997). This contribution is based on the study of the microfauna associated with aquatic macrophytes in the San Miguel del Monte pond, located in the pampean region (province of Buenos Aires). Twelve species of ciliates, belonging to five orders, are cited for the first time in Argentina.

MATERIALS AND METHODS

The pond is characterised by shallow depth (maximum 2 m) low transparency, alkaline pH, high conductivity (over 1000 mS cm^{-1}) and total phosphorus concentration exceeding 130 $\mu g\ l^{-1}$. The oxygen concentration is variable (Table 1). Emergent and submersed macrophytes are present, the former being *Scirpus californicus* and the latter *Myriophyllum quitense, Potamogeton pectinatus* and *Ceratophylum demersum*. There are, as well, floating macrophytes such as *Azolla filiculoides, Spirodella* sp., *Wolffia* sp., *Wolfiella* sp. and *Lemna* sp.

Samples of *M. quitense* were collected in March, May, July, August and October 1998, and kept in an aquarium in the laboratory. Some physical and chemical parameters were measured in situ.

The methodology followed for the observation of the ciliates is the one recommended by Lee *et al.* (1985). The systematic scheme proposed by Small & Lynn (1985) was followed. The organisms were identified (Kent, 1881-1882; Kahl, 1934-35; Nenninger, 1948; López-Ochoterena, 1965; Stiller, 1971; Curds 1985; Warren, 1987), measured and illustrated alive

All measurements are from specimens of the pond described above. Minimum and maximum values are between brackets.

RESULTS

Stentor roeselii was the only species found at all sampling occasions. *Vaginicola crystallina, Paramecium caudatum* and *Epistylis articulata* occurred in autumn and winter with maximum transparency values. *Euplotopsis affinis, Epistylis pürneri* and *Pseudovorticella difficilis* were recorded only in autumn. *Kellicotta cuspidata* appeared during winter, when temperatures were lowest. *Opercularia nutans* and *Spirostomum teres* were collected in summer and autumn. *Vaginicola ingenita* was observed at all seasons, except for summer, when *Oedogonium* sp. associated to *M. quitense* was absent. *Acinetides triangularis* occured in summer and winter, when pH was lower (Table 2.).

All the species cited in this paper are typical of eutrophic waters. In the saprobic scheme, the majority, are considered α-ß mesosaprobic indicators (Sladecek 1973).

Phyllum Ciliophora
Subphyllum Postciliodesmatophora
Class Spirotrichea
Subclass Heterotrichia
Order Heterotrichida
Family Spirostomidae
Spirostomum teres Claparede & Lachmann, 1858 (Fig. 1)

Table 1

Physical and chemical parameters measured in San Miguel del Monte pond during the sampling period (March-October 1998).

	March	May	July	August	October
pH	9.07	10.2	8.79	9	9.35
Temperature (°C)	17	15	11.9	12.4	22
Dissolved O_2 ($mg\ l^{-1}$)	3.16	7.2	11.12	7.9	11.2
O_2(saturation%)	33	71	103	72	135
Transparency (cm)	45	50	65	48	38
Total phosphorus ($\mu g\ l^{-1}$)	294	182.4	229.9	135.3	147.1
$NO_2 + NO_3$ ($\mu g\ l^{-1}$)	132	100.7	85.8	80.9	113.7

Table 2

Seasonal distribution of the ciliate species in San Miguel del Monte pond during the sampling period (March-October 1998).

Species	March	May	July	August	October
Acinetides triangularis	*		*	*	
Epistilis articulata		*	*		
E. pürneri		*			
Euplotopsis affinis		*			
Kellicotta cuspidata			*	*	
Opercularia nutans	*	*			
Paramecium caudatum		*		*	
Pseudovorticella difficilis		*			
Spirostomum teres	*	*			
Stentor roeselli	*	*	*	*	*
Vaginicola crystallina		*	*		
V. ingenita		*	*		*

The most important characteristic of this heterotrich is its ellipsoidal macronucleus. Peristome in upper third of body.
Measurements (n: 4): average body length 244 μm (159-286), average body width 19 μm (18-23), macronucleus length 22 μm, diameter of contractile vacuole 36 μm (32-41), average buccal length 89 μm (91-100).
Family Stentoridae
Stentor roeselii Ehrenberg, 1835 (Fig. 2)

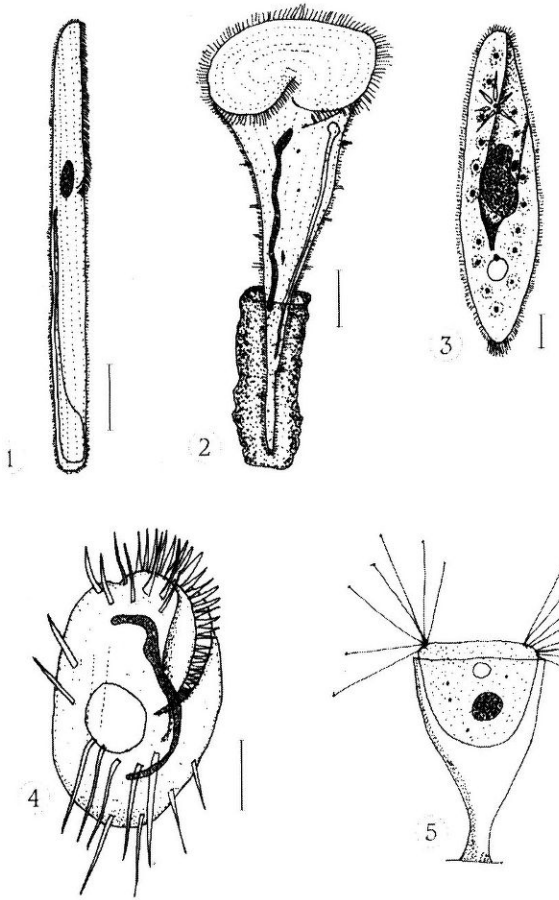
Body trumpet-like, colourless. Occasionally with a mucilaginous tube. Vermiform macronucleus, which extends through most of the body length. Contractile vacuole situated in upper third of body with a long canal. Body ciliation uniform except for some groups of longer cilia.
Measurements (n: 9): average maximum length 698 μm (558-892); average peristome width 146 μm (121-167); average mucilagenous tube length 275 μm (181-390).
Observations: *Stentor roeselii* lacks endosymbiotic algae as seen in other species of the genus living in oligotrophic lakes (Foissner & Wölfl, 1994; Modenutti, 1997).

Class Nassophorea
Subclass Nassophoria
Order Penniculida
Family Parameciidae
Paramecium caudatum Ehrenberg, 1833 (Fig. 3)

Body elongated. Posterior region bearing longer cilia. Vestibulum conspicuous. Two contractile vacuoles in both ends of the body. Peanut-like macronucleus in the middle of the body. Micronuclei were not observed.
Measurements (n: 6): average length 260 μm (180-300).
Observations: *Paramecium caudatum* was recorded previously for Argentina by Modenutti (1986) without description and illustration as a planktonic member of a polluted stream.

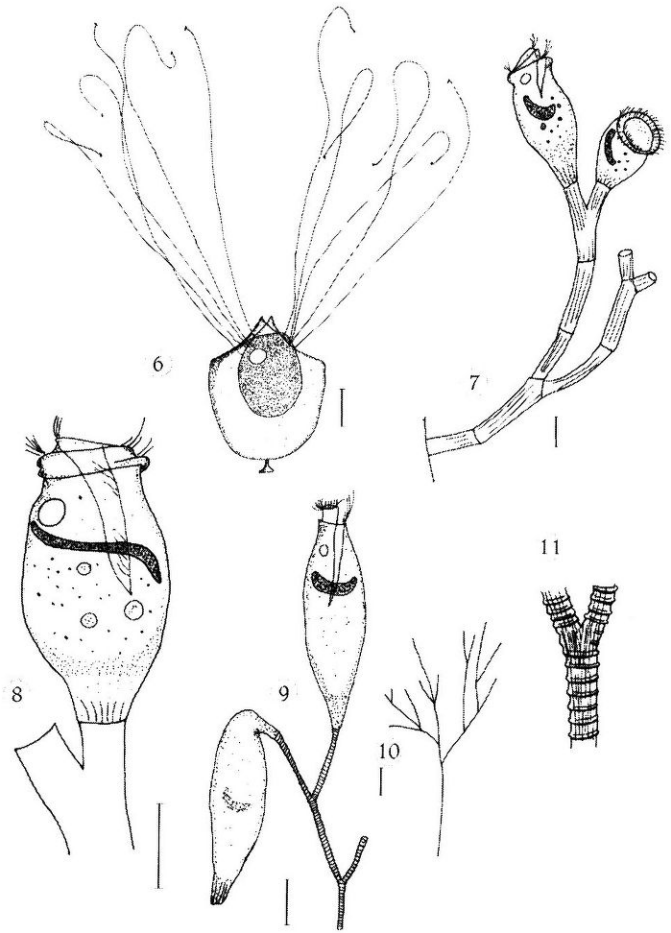
Subclass Hypotrichia
Order Euplotida
Family Euplotidae
Euplotopsis affinis (Dujardin, 1841) Borror & Hill, 1995 (Fig. 4)

This fresh water hypotrich has 9 frontoventral cirri, 5 transverse cirri and 4 caudal cirri. Small ovoid body. Dorsal surface with 5 longitudinal ridges; ventral with



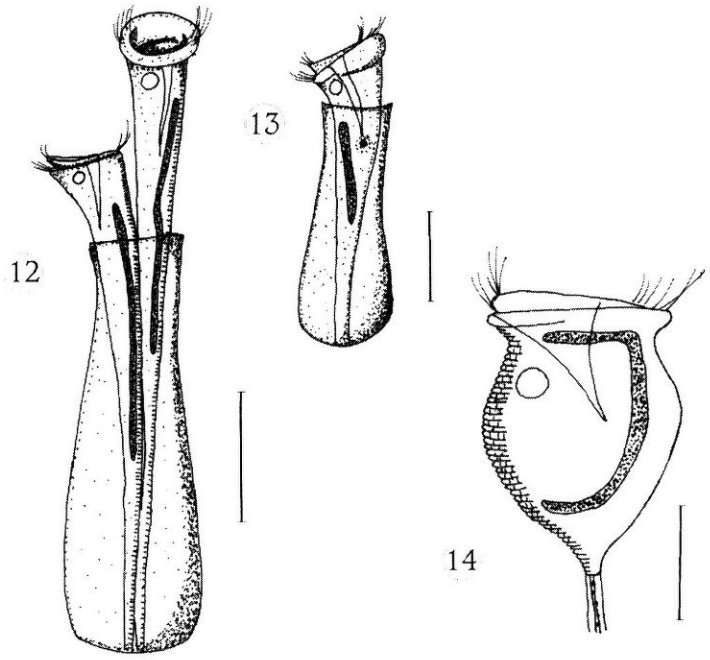
Figures 1-5

1, *Spirostomum teres*. 2, *Stentor roeselii*. 3. *Paramecium caudatum*. 4, *Acinetides triangularis*. Scales: 40 μm (Fig. 1); 100μm (Fig. 2); 20μm (Figs. 3, 4); 10 μm (Fig. 5).



Figures 6-11

6, *Kellicotta cuspidata*. 7, *Epistylis articulata*. 8, *Epistylis pürneri*. 9-11, *Opercularia nutans*. 10, Detail of colony. 11, Detail of stalk. Scales: 10 μm (Figs. 6-7); 50 μm (Fig. 8); 20 μm (Fig. 9); 30 μm (Fig. 10).



Figures 12-14

12, Vaginicola crystallina. 13, *Vaginicola ingenita*. 14, *Pseudovorticella difficilis*. Scales: 50 μm (Fig. 12); 20 μm (Fig. 13); 30 μm (Fig. 14)

3 ridges. Macronucleus "3" shaped. Contractile vacuole on right side of the body (ventral view).
Measurements (n: 7): average maximum length 74 μm (68-82); average maximum width 48 μm (41-50); average buccal cavity length 27 μm (23-32)
Subphyllum Cyrtophora
Class Phyllopharingea
Subclass Suctoria
Order Endogenida
Family Acinetidae
Acinetides triangularis (Penard, 1920) Curds, 1985 (Fig. 5)

Lorica triangular and laterally compressed. Capitate tentacles arranged in two fascicles. Absence of a true peduncule, but presence of a prolongation of the lorica (stylotheca). Contractile vacuole apically located. Spherical macronucleus in centre of cell.
Measurements (n: 15): average total length (including stylotheca) 55 μm (43-64); average width 23 μm (14-33); average stylotheca length 12 μm (9-17); average stylotheca width11 μm (7-12); average macronucleus length 8 μm (6-10).
Observations: It was found in late summer and winter; the lack of this species in spring may be related with the absence of *Oedogonium* sp., where it was most frequently found.

Kellicotta cuspidata (Kellicott, 1885) Curds, 1985 (Fig. 6)

Small, ovoid loricate suctorian. Lorica with two cusps and short stalk. Long, capitate tentacles in two fascicles, capable of contortion and exploring movements. Contractile vacuole in anterior third of body.
Measurements (n: 8): Lorica: average length 39 μm (31-45), average width 34 μm (31-36), average stalk length 5 μm (2-5). Zooid: average length 23 μm (18-27), average width 16 μm (9-22), average maximum tentacle length 156 μm (120-190).
Discussion: *Kellicotta cuspidata* was attached to filamentous chlorophytes (*Oedogonium* sp.) as typical for the species (Curds, 1985). For the first time, the reproduction of this species has been observed by circum-invaginative endogenous budding, resulting in ovoid swarmers. The reproductive sequence agrees with that given by Batisse (1975) for the acinetins.

Class Oligohymenophorea
Subclass Peritrichia
order Sessilida
Family Epistylididae
Epistylis articulata Fromentel, 1876 (Fig. 7)

Gregarious species forming small colonies. Zooids conical. Pellicle smooth. Stalk dichotomous, with longitudinal striation and regularly positioned transverse septa. Macronucleus sausage -like, near infundibulum. Contractile vacuole in the upper third, beneath peristome.
Measurements (n: 2): zooid length 41-45 μm; maximum width 18-20 μm; minimum width 11-13 μm; peristome width 15.9-18 μm.

Epistylis pürneri Nenninger, 1948 (Fig. 8)

Big organisms with unstriated pellicle. Peristomial lip with two folds. Cylindrical in shape, maximum body width measured in the middle. Infundibulum reaches half of the length and has conspicuous ciliation. Contractile vacuole in upper third of body. Horizontal, sinuous, band-like macronucleus in middle of zooid. Stalk thick, hyaline. Colonies with 4 or 8 zooids
Measurements (n: 10): average zooid length 174.5 μm (141-204), average maximum width 85 μm (64-100), average peristomal lip height 69 μm (57-82), peristomal disc height 43 μm (32-50).
Discussion: *Epistylis pürneri* was found as an epizoic of trichopteran larvae in Europe (Nenninger, 1948).

Family Operculariidae
Opercularia nutans (Ehrenberg, 1831) Stein, 1854 (Figs. 9-11)

Big, dichotomously branched colonies Stalk annulated and longitudinally striated. Zooids elongated, fusiform. Peristomial disc emerges clearly over peristomial border. Large infundibulum surrounded distally by horseshoe-shaped macronucleus. Zooids nodding or pendent during contraction.
Measurements (n: 8): average zooid length 97 μm (84-114), average maximum width 26.5 μm (23-34), average colony length 239 μm (204-336).
Discussion: The absence of the symbiotic algae was noted in opposition to Kent's (1881-82) observations.

Family Vaginicolidae
Vaginicola crystallina Ehrenberg, 1830 (Fig. 12)

Lorica transparent, vase shaped, with round posterior end. Zooids clearly projecting beyond lorica opening. Band like macronucleus extending through most body length. Pellicle finely striated. Contractile vacuole in upper third of the body.
Measurements (n: 6): Case: average length 165 μm (150-182), average maximum width 42 μm (41-45), average aperture width 42 μm (36-45). Zooids: average length 223 μm (186-263), average peristomal width 35 μm (32-36).
Discussion: The measures correspond to the maximum values given by Nenninger (1948).

Vaginicola ingenita (O.F. Muller, 1786) (Fig. 13)

Lorica transparent and cylindrical. Zooid remains inside lorica, only the peristomial disc protruds. Contractile vacuole in upper third of body. Macronucleus band-like.

Measurements (n: 6): Lorica: average length: 54.9 μm (51.4-59.1), average maximum width 22 μm (20.4-23), aperture 18.2. μm Zooid: average length 65 μm (54-73), average maximum width 15 μm (14-18), average minimum width 4.8 μm (4.5-5.4), average peristomal width 19 μm (18-22).
Discussion: *Vaginicola ingenita* was found attached to filamentous chlorophytes instead of diatoms (Sommer, 1951).

Family Vorticellidae
Pseudovorticella difficilis (Kahl, 1933) Jankowski, 1987 (Fig. 14)

The diagnostic character of the genus is the reticulated silverline system (Warren 1976). Inverted bell-shaped with maximum width in middle of body. Infundibulum reaches half of body. Single contractile vacuole in upper third, near the infundibulum. Macronucleus band-like, "J " shaped. Spasmoneme with thecoplasmatic granules. Measurements (n: 1): Length 77 μm, maximum width 54.5μm, peristome width 50μm, spasmoneme length 272.7μm, spasmoneme width 5.45μm.
Discussion: ecological data and measures of this single individual are coincident with those given by Kusters (1974).

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