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Morphology of *Clapsiella magnifica* gen. n., sp. n., a new hypotrichous ciliate with a curious dorsal ciliary pattern

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Abstract

The present work describes the morphology and infraciliature of a new hypotrichous ciliate, *Clapsiella magnifica* gen. n., sp. n., found in rewetted soil from a temporal pond in Argentina. It was studied by means of live observation and protargol impregnation. Its main diagnostic features are: Flexible hypotrich measuring 250–320 μm × 70–140 μm in vivo; two macronuclear nodules and 4–6 micronuclei. Single contractile vacuole. Cytoplasm transparent, cortical granules absent. Somatic ciliature composed of a tricorona of cirri, three buccal(?) cirri, 6–9 ventral rows, 3–5 right marginal(?) rows, one left marginal row, and 12–17 transverse cirri. Dorsal pattern rather complicated, with about 14 kineties and kinety fragments, with scattered kinetids among them; 17–28 caudal cirri arranged in three rows on dorsal kineties 1, 3, and 7. Remarkably, dorsal kinetids have two or four basal bodies, bearing a stiff bristle arising from left anterior basal body. Adoral zone composed of 70–92 membranelles, occupying about 40% of body length in protargol preparations; paroral and endoral curved, resembling a cyrtohymenid pattern. The peculiar dorsal ciliary arrangement and the unique combination of other characters require the establishment of a new genus for this new species, which is considered incertae sedis in the Hypotricha but possibly related to the oxytrichids.

Keywords: Argentina; Ciliophora; Freshwater; Hypotricha; Soil; Taxonomy

Introduction

In South America, freshwater and particularly soil ciliates have been only scarcely studied through modern methods, such as silver impregnation, electron microscopy, and/or molecular-genetic techniques. Most recorded ciliates from Argentina are widely distributed, although there are some examples of species with restricted distributions and even 'flagship' ciliates were described in South America (Küppers and Claps 2012). Some of these ciliates with distinctive morphologies are *Neobursaridium gigas* Balech, 1941 from freshwater ponds in Argentina (Balech 1941) and *Stentor araucanus* Foissner & Wölfl, 1994 from Andean Lakes in Argentina and Chile (Foissner and Wölfl 1994). The sampling of this relatively unexplored region and especially the soil biotope contributes to the knowledge of biodiversity of ciliates, increasing the possibility of finding new or poorly known taxa. Even in intensively investigated regions, new flagship ciliates have been described in the last decade, such as *Rigidothrix goiseri* Foissner & Steock, 2006 and *Afrokeronopsis aurea* (Foissner & Stoeck, 2008) Foissner et al., 2010, among others, in agreement with the idea that the

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global number of ciliate species is still highly underestimated (Foissner 2006; Foissner and Stoeck 2006, 2008).

This study aims at describing the morphology of a new genus and species of a hypotrichous ciliate found in freshwater and soil of a temporary pond from Argentina. This ciliate has a very distinctive morphology because of its great size and particular arrangement of the ciliature.

Material and Methods

This new ciliate was isolated from rewetted soil samples, obtained from the dried bed of a temporary freshwater pond in October 2004. It also occurred in plankton samples collected during the hydroperiod of the same pond in September 2004. Descriptions are based on the soil population, since impregnation of the freshwater isolate was rather poor. The pond is located about 40 km south of the city of La Plata, Buenos Aires province, Argentina (see Küppers et al. 2007 for a detailed description of the sampling site). During the hydroperiod, physico-chemical conditions of the water were measured with a multiparameter probe (HORIBA U21, Kyoto, Japan). Soil samples were rewetted in the laboratory with distilled water following the non-flooded Petri dish method (Foissner 1992). Crushed wheat grains were added to the Petri dishes to promote bacterial growth as food source for the ciliates and to establish raw cultures. Ciliates were isolated with micropipettes, fixed in Bouin solution, and impregnated with protargol according to Wilbert (1975). Living and silver-impregnated ciliates were observed and measured under the stereomicroscope and the brightfiled microscope with a calibrated ocular micrometer, at magnifications of 100×, 400×, and at 1000× with a high power oil immersion objective. Illustrations of impregnated ciliates were made with the aid of a camera lucida, while the drawing of the living organism is a free-hand sketch. General terminology is according to Berger (1999). To distinguish ventral from right marginal rows of cirri, Berger et al. (2006) was followed; i.e., longitudinal rows on the right ventral surface that do not end in transverse cirri, probably correspond to marginal rows. The tricorona is formed by three arcs or pseudorows of frontal and frontoventral cirri (Berger 2006). For descriptive purposes, dorsal kineties were numbered consecutively from left to right.

Results

Clapsiella gen. n.

Diagnosis. Body flexible. Adoral zone of membranelles formed like a question mark; paroral and endoral membranes curved and intersect each other optically, resembling a cyrtohymenid pattern. Frontal field with a tricorona of frontal and frontoventral cirri. Ventral side with multiple longitudinal rows of cirri. Transverse and caudal cirri present. Dorsally with numerous (more than six) kineties, kinety fragments, and scattered kinetids. Kinetids from dorsal rows composed of two or four basal bodies, with left anterior basal body bearing a bristle. Dorsomarginal kineties and multiple fragmentation of dorsal kineties probably present.

Type species. *Clapsiella magnifica* sp. n.

Species included. *Clapsiella magnifica* sp. n.

Dedication. This new genus is dedicated to my mentor, Dr. María Cristina Claps, for her support and friendship over all these years. Feminine gender because ending with the diminutive suffix *-ella* (ICZN 1999, Article 30.1.3).

Clapsiella magnifica sp. n.

Diagnosis. Body elongate ellipsoidal. Size in vivo 250–320 μm × 70–140 μm. Two macronuclear nodules and 4–6 micronuclei. Single contractile vacuole. Cortical granules absent. Tricorona formed by 9–12 (anterior arc), 5–8 (middle arc), and five or six (posterior arc) cirri; 6–9 longitudinal ventral rows of cirri and one left and 3–5 right marginal(?) rows; 12–17 transverse cirri, with 2–5 rightmost cirri slightly separated form the other transverse cirri and located at terminal ends of corresponding ventral rows. Dorsal pattern rather complicated and slightly variable, with about 14 kineties and kinety fragments, along with scattered kinetids among them. Three dorsal kineties each associated with more than one caudal cirrus, which range 17–28 cirri in total. Adoral zone with 70–92 membranelles, occupying about 40% of body length. Retention of parental ventral and dorsal ciliature probably present.

Type locality. Sediment from the bed of a dried temporary pond located about 40 km south of the city of La Plata, near the locality of Poblet, along the margins of Provincial Route 36 in the Buenos Aires province, Argentina (35°05′S, 57°48′W).

Etymology. From the Latin adjective *magnifica*; meaning great, distinguished.

Type material. The type slide containing the holotype specimen (Figs 1b, 2a–d) and several paratypes is deposited in the Colección Nacional de Invertebrados from the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (accession number MACN-In 39548). A slide containing paratype specimens is deposited in the Colección de Zoología Invertebrados from the Museo de La Plata (accession number MLP 96), Buenos Aires, Argentina. Relevant individuals were marked with black ink on the back of the slides, following Aescht (2008) and Foissner (2014) for the labeling of the slides.

Description of the holotype (Figs 1b, 2a–d). Body size after protargol impregnation 340 μm × 185 μm. Two macronuclear nodules and six micronuclei. Tricorona of frontal and frontoventral cirri with anterior arc formed by 12 frontal, middle arc by eight, and posterior arc by six cirri. Two cirri between posterior arc and the three cirri next to paroral (buccal cirri?). On left body half, four ventral rows

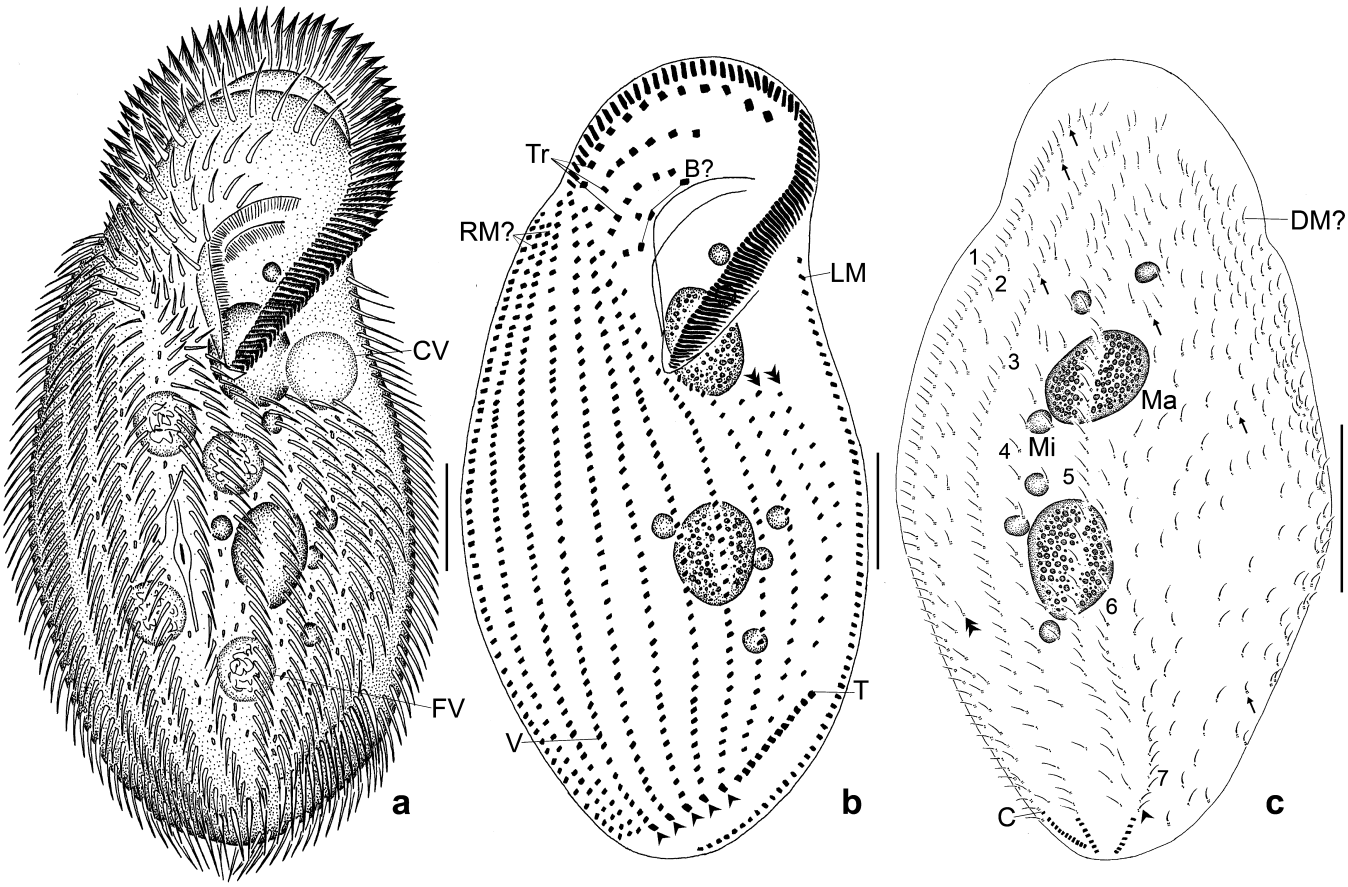

Fig. 1. Morphology of *Clapsiella magnifica* gen. n., sp. n. in vivo (a) and after protargol impregnation (b, c). **(a)** Ventral view of a typical specimen. **(b)** Ventral infraciliature and nuclear apparatus of the holotype, showing numerous rows of ventral and marginal(?) cirri, the tricorona, transverse cirri (T and arrowheads), buccal(?) cirri, and oral apparatus. Double arrowheads point to left rows with wider spaced cirri and arrowheads to transverse cirri located at rear ends of ventral rows. **(c)** Infraciliature of dorsal side and nuclear apparatus of a paratype specimen, showing kinetids with four basal bodies (arrows); kinety fragment (arrowhead); scattered kinetid (double arrowhead). B?, buccal(?) cirri; C, caudal cirri; CV, contractile vacuole; DM?, dorsomarginal(?) rows; FV, food vacuole; LM, left marginal row; Ma, macronucleus; Mi, micronucleus; RM?, right marginal(?) rows; T, transverse cirri; Tr, tricorona; V, rightmost ventral row of cirri; 1–7, dorsal kineties 1 to 7. Scale bars = 50 μm.

not extending anteriorly beyond buccal vertex; on right body half, five ventral rows that extend anteriorly beyond buccal vertex. One left marginal and three right marginal(?) rows that do not end in transverse cirri. Seventeen transverse cirri, of which five rightmost ones slightly separated from the others and located exactly at rear ends of corresponding ventral rows. Dorsal infraciliature unclear at posterior end of cell, with detached caudal cirri at ends of kineties 1 and 3. Dorsal kinety 1 with densely packed kinetids, bipolar and anteriorly curved to the right; kinety 2 with loosely and irregularly arranged kinetids (retained parental?); kinety 3 with densely packed kinetids, bipolar, and slightly shortened anteriorly; kinety 4 with wider spaced kinetids, anteriorly shortened, and posteriorly unclear; kinety 5 extends form anterior region, posteriorly unclear; kineties 6 and 7 unclear; on right body half one kinety reaches posterior third of body, another kinety ends at midbody, and two shorter kineties in anterior third on right side of body (dorsomarginal rows?); scattered kinetids among left and right kineties. In total 23 caudal cirri. Adoral zone with 87 membranelles.

Description of the soil population. Body flexible, measuring in vivo 250–320 μm in length and 70–140 μm in width; length to width ratio about 2.5:1 in vivo and 2:1 after protargol impregnation; dorsoventrally flattened. Body shape elongate ellipsoidal, with convex right margin and anterior cell end slightly directed to the left, with both anterior and posterior ends broadly rounded. Nuclear apparatus composed of two ellipsoidal macronuclear nodules, sometimes truncated at both ends or pyriform; and 4–6 globular to ellipsoidal micronuclei. Macronuclear nodules about in midbody or slightly left of it. Contractile vacuole located on left body margin, at level of buccal vertex (Fig. 1a). Cortical granules absent. Cytoplasm colorless, with cytoplasmic inclusions such as 1.0–1.5 μm refractive crystals. Food vacuoles contained wheat starch in individuals from raw cultures, bacteria, euglenids, ciliates, and pennate diatoms. Movement

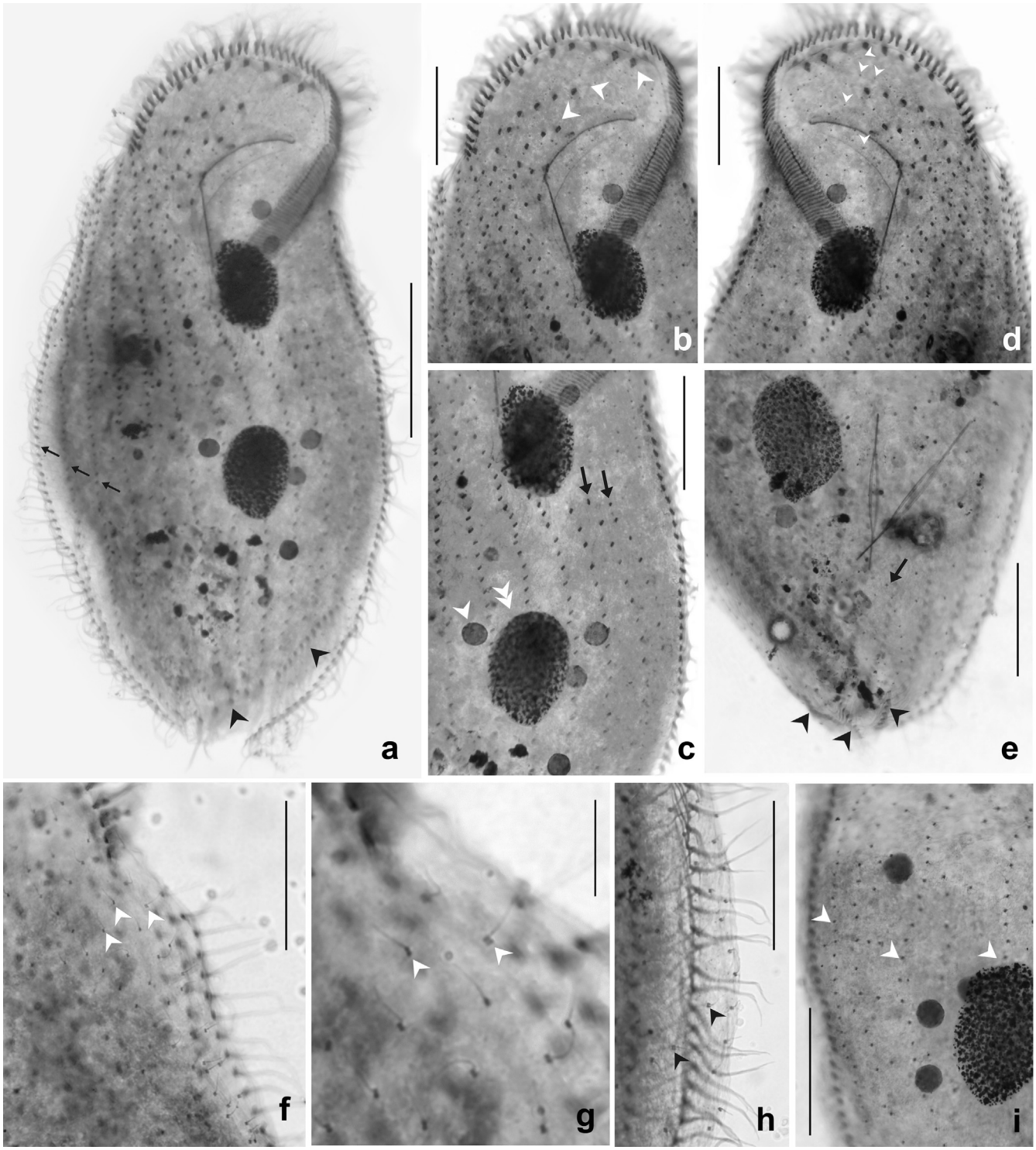

Fig. 2. Micrographs of *Clapsiella magnifica* gen. n., sp. n. after protargol impregnation in ventral (a–c) and dorsal (d–i) views. **(a)** Ventral infraciliature and nuclear apparatus of the holotype. Arrows indicate marginal(?) rows; arrowheads point to transverse cirri. **(b)** Detail of anterior region of the holotype; arrowheads indicate the tricorona. **(c)** Magnification of middle and left ventral region of the holotype; showing micronucleus (arrowhead), macronucleus (double arrowhead), and left ventral rows with wider spaced cirri (arrows). **(d)** Anterior dorsal region of the holotype; dorsal kineties 1 to 5 indicated by arrowheads. **(e–g)** Illustrated paratype specimen showing **(e)** posterior region, arrow points to kinety 7 and arrowheads indicate caudal cirri; **(f)** detail of right anterior dorsal side, arrowheads point to di- and tetrakinetids from dorsomarginal(?) kineties; **(g)** magnification of right anterior dorsal side, indicating di- and tertrakinetids (arrowheads). **(h)** Detail of right body margin of a different paratype specimen, showing tetrakinetids with left anterior basal body bearing the bristle (arrowheads). **(i)** Detail of left margin of another paratype specimen, showing, inter alia, kineties 1, 3, and 5 (arrowheads) with basal bodies more densely packed than other kineties. Scale bars = 50 μm (a), 10 μm (g), 30 μm (b–i).

rather fast, crawling on particles of sediment from the cultures and also gliding on the water surface.

Ventral somatic ciliature composed of an anterior tricorona of frontal and frontoventral cirri; anterior arc formed by 9–12 frontal cirri located below distal membranelles and with distinctly larger cirri, middle arc by 5–8 cirri, and posterior arc by five or six cirri. Additionally, two to three cirri between posterior arc and cirri next to paroral. Invariably with three buccal(?) cirri close to paroral membrane (Figs 1b, 2a, b). With 6–9 obliquely arranged longitudinal rows of cirri, of which 3–5 rows are located on left body half, not extending anteriorly beyond buccal vertex; two leftmost ventral rows shortened posteriorly, without reaching transverse cirri. Row 1 (leftmost row) composed of 3–9 cirri, slightly more separated from each other than the cirri of other rows (retained parental cirri?). Row 2 also with cirri slightly more separated than others. On right body half, 3–5 ventral rows extend anteriorly beyond buccal vertex (Figs 1b, 2a, c). One left marginal row and 3–5 right marginal(?) rows that do not end in transverse cirri (Figs 1b, 2a). In total 12–17 transverse cirri, with rightmost 2–5 cirri somewhat separated from the others and located exactly at rear ends of ventral rows (Figs 1b, 2a); rightmost cirri protrude posteriorly. With more transverse cirri than frontoventral rows. Some variations in the ventral pattern were observed, mostly in the length of cirral rows and because of the presence of extra cirri. One individual presents three extra cirri right anteriorly to the left marginal row and the fourth ventral row from the left is anteriorly shortened; another individual has two isolated cirri next to proximal membranelles on the right; yet another specimen with an anteriorly shortened row on the right margin.

Dorsal ciliary pattern with about 14 kineties and kinety fragments, along with scattered kinetids among them (Figs 1c, 2d–f, i). Dorsal kineties on left body half, i.e. kineties 1–4, extend from anterior to posterior body end; kinety 5 is anteriorly shortened. Kinetids in dorsal kineties 2 and 4 more widely spaced than in kineties 1, 3, and 5 (retained parental kineties?; Figs 1c, 2i). Kinety 6 is a fragment overlapping kinety 5, extending from midbody and being posteriorly shortened; kinety 7 extends from midbody up to the posterior end, overlapping the terminal part of kinety 6. Probably, kinety 7 also fragmented due to the presence of an overlapping short fragment located on its right side (Figs 1c, 2e). On right body half, three kineties extend up to posterior cell end but are anteriorly shortened, one kinety reaches midbody, and three short kineties extend along anterior third of the cell (dorsomarginal rows?; Figs 1c, 2f). A field of scattered kinetids between these two right and left groups of dorsal kineties and fragments. Some other isolated kinetids between kineties on left side of cell (Figs 1c, 2i). Remarkably, dorsal kinetids composed of two or four basal bodies, with the anterior left basal body bearing a short, stiff cilium. Each dorsal kinety composed of dikinetids as well as tetrakinetids. Tetrakinetids located anteriorly, among dikinetids, and/or posteriorly along a dorsal kinety; most kineties with more tetrakinetids than dikinetids (Figs 1c, 2f–h). In total 17–28 caudal cirri, arranged in three rows of 5–14 cirri at end of dorsal kinety 1, 3–10 at end of kinety 3, and 4–9 at end of kinety 7 (Figs 1c, 2e). Possibly, retained parental ventral cirri, dorsal kineties, and kinetids remain among newly generated ones.

Buccal cavity large and rather deep, with inconspicuous buccal lip covering proximal membranelles. Adoral zone of membranelles representing about 40% of total body length and composed of 70–92 membranelles, with lateral cilia extending to the right. Paroral strongly curved anteriorly forming an arc; endoral intersects paroral optically at level or behind posteriormost buccal(?) cirrus, being also slightly curved, resembling a cyrtohymenid pattern (Figs 1a, b, 2b). Membranelles composed of four rows of basal bodies; endoral and paroral with dikinetids.

Occurrence and ecology. The species was found in plankton samples during the hydroperiod in September 2004 and in rewetted soil samples from the dried bed of the pond in October 2004 (for details, see material and methods and type locality). The freshwater population was found under the following water conditions: electrical conductivity 1450 μS cm^{-1}, dissolved oxygen concentration 8 mg L^{-1}, temperature 10.7 °C, and pH 8.4 (Table 1).

Discussion

Suprageneric classification of *Clapsiella* gen. n.

The suprageneric position of this new isolate is difficult to ascertain because dividing individuals were not found and molecular data are lacking. Some features indicate a relationship with the Oxytrichidae, namely the possible fragmentation of dorsal kineties because of the presence of overlapping fragments. Likewise, the short rows of kinetids in the anterior third on the right side of the dorsal surface very likely correspond to dorsomarginal kineties. Unfortunately, without detailed morphogenetic studies, the inclusion of *Clapsiella* gen. n. in the Dorsomarginalia Berger, 2006 cannot be unequivocally determined. The relative length of the adoral zone of membranelles (about 40%) and the absence of a midventral complex exclude this new ciliate from the urostyloids (Berger 2006). Amphisiellids have an "amphisiellid median cirral row", lack dorsomarginal kineties and dorsal kinety fragmentation (Berger 2008). Probably the latter two features are present in the new genus described here. Unlike *Clapsiella* gen. n., trachelostylids have 18 frontoventral-transverse cirri with the body distinctly cephalised, multiple fragmentation of some dorsal kineties, and lack dorsomarginal kineties (Berger 2008). The new genus is also different from the gonostomatids, which have a typical gonostomatid oral apparatus, usually three bipolar dorsal kineties, and lack dorsomarginal kineties (Berger 2011). *Clapsiella* gen. n. shares with kahliellids the presence of multiple longitudinal ventral rows of cirri and probably the retention of parental cirri and dorsal kineties, but kahliellids are still not

Table 1. Morphometric data on *Clapsiella magnifica* gen. n., sp. n.

Character[a]	$\bar{X}$	*M*	Min	Max	SD	CV (%)	*n*
Body, length in vivo	277.7	273.0	252.0	322.0	24.1	8.7	6
Body, width in vivo	109.7	112.0	70.0	140.0	24.1	22.0	6
Body, length	300.2	310.0	230.0	350.0	34.2	11.4	20
Body, width	146.0	147.5	110.0	180.0	18.5	12.7	20
AZM, length	116.0	120.0	80.0	130.0	13.5	11.6	20
Anterior end to transverse cirri, distance	234.8	237.5	180.0	270.0	24.1	10.3	20
Posterior most transverse cirri to posterior end, distance	13.8	14.0	10.0	20.0	2.2	15.9	20
Macronuclear nodules, number	2.0	2.0	2	2	0	0	20
Anterior macronuclear nodule, length	39.2	39.5	31.0	48.0	5.1	13.0	20
Anterior macronuclear nodule, width	30.0	30.5	23.0	39.0	3.9	13.2	20
Posterior macronuclear nodule, length	40.4	39.0	33.0	51.0	5.9	14.7	20
Posterior macronuclear nodule, width	28.7	27.5	22.0	37.0	4.9	17.0	20
Micronuclei, number	4.5	4.0	4	6	0.9	19.7	20
Micronuclei, length	9.8	10.0	8.0	11.5	1.2	12.5	20
Micronuclei, width	9.3	9.5	7.0	11.5	1.1	12.5	20
Adoral membranelles, number	83.5	84.5	70	92	6.3	7.5	20
Bases of largest membranelles, length	13.3	13.2	12.0	15.0	1.0	7.4	20
Frontal cirri in anterior arc, number	9.7	10.0	9	12	0.8	8.1	20
Frontal cirri in middle arc, number	5.9	6.0	5	8	0.7	12.7	20
Frontal cirri in posterior arc, number	5.5	6.0	5	6	0.5	9.3	15
Buccal(?) cirri, number	3.0	3.0	3	3	0	0	20
Ventral rows, total number	7.6	8.0	6	10	1.1	14.5	15
Left marginal rows, number	1.0	1.0	1	1	0	0	20
Right marginal(?) rows, number[b]	3.7	4.0	3	5	0.5	14.7	20
Cirri in ventral row 1, number[c]	6.3	6.0	3	9	1.6	24.9	9
Cirri in ventral row 2, number	14.5	14.0	9	21	3.1	21.5	9
Cirri in ventral row 3, number	20.0	20.0	14	30	5.9	29.4	9
Cirri in ventral row 4, number	26.0	25.0	21	32	4.4	16.9	7
Cirri in ventral row 5, number	26.0	26.0	26	26	0	0	1
Cirri in ventral row 6, number	37.2	37.5	30	45	5.8	15.7	8
Cirri in ventral row 7, number	37.7	37.0	33	45	4.3	11.4	8
Cirri in ventral row 8, number	41.5	40.5	37	47	3.6	8.6	8
Cirri in ventral row 9, number	45.5	45.5	42	49	4.9	10.9	2
Cirri in ventral row 10, number	77.0	77.0	77	77	0	0	1
Cirri in left marginal row, number	76.0	75.5	61	96	13.9	18.3	8
Cirri in right marginal(?) row 1 (leftmost), number	49.9	48.0	43	71	9.1	18.3	8
Cirri in right marginal(?) row 2, number	49.0	48.5	25	79	14.9	30.5	8
Cirri in right marginal(?) row 3, number	55.5	54.0	35	80	15.5	28.0	8
Cirri in right marginal(?) row 4, number	47.7	49.5	39	53	4.9	10.4	6
Cirri in right marginal(?) row 5, number	61.0	61.0	61	61	0	0	1
Transverse cirri, total number	13.5	13.5	12	17	1.0	7.7	20
Separated transverse cirri, number	3.4	3.0	2	5	0.7	19.9	20
Dorsal bristles, length	4.3	4.5	3.5	5.0	0.4	9.2	20
Caudal cirri, total number	21.2	19.5	17	28	3.7	17.3	10
Caudal cirri at end of dorsal row 1, number	8.5	8.5	5	14	3.0	35.6	10
Caudal cirri at end of dorsal row 3, number	6.0	5.5	3	10	2.1	35.1	10
Caudal cirri at end of dorsal row 7, number	6.4	6.0	4	9	1.4	22.3	10

[a] All data are based on protargol-impregnated specimens unless otherwise indicated. AZM, adoral zone of membranelles; CV, coefficient of variation; *M*, median; Max, maximum observed value; Min, minimum observed value; *n*, number of observations; SD, standard deviation; $\bar{X}$, arithmetic mean.

[b] Rows located on the right body margin that do not end in transverse cirri.

[c] Ventral row 1 is the row right of the left marginal row.

well defined and probably do not represent a monophyletic assemblage (Berger 2011).

Very likely, dorsal kineties 1, 3, and 7 of *Clapsiella* gen. n. are homologous with kineties 1, 2, and 3 of the last common ancestor of the hypotrichs (Berger 2008) and with kineties 1, 2, and 4 of "ordinary" oxytrichids (Berger 1999).

The discussion demonstrates that the higher level classification of *Clapsiella* gen. n. is uncertain. Thus, it is

preliminary classified as incertae sedis in the Hypotricha sensu Berger (2006). However, morphogenetic and molecular studies will probably show that it belongs to the oxytrichids as indicated by the highly complex dorsal infraciliature (Berger 1999).

The new genus and comparison with other genera

Clapsiella magnifica is characterized by a unique combination of traits; such as the flexible body, frontal and frontoventral cirri arranged in a tricorona, the presence of multiple ventral and possibly right marginal rows, and the complex dorsal pattern with numerous kineties, kinety fragments, and scattered kinetids. The presence of dorsal kinetids with two or four basal bodies is unique to this new ciliate and was not observed in other hypotrichs. Nevertheless, the possibility that parasomal sacs could have been impregnated cannot be excluded; however, parasomal sacs are smaller than basal bodies (Foissner 1991) and structures forming the dorsal kinetids of *Clapsiella magnifica* seem to be of equal size.

Among flexible oxytrichids with numerous ventral cirral rows, *Clapsiella* gen. n. must be compared with *Paraurostyla* Borror, 1972. They differ in the oral apparatus (cyrtohymenid vs. oxytrichid), the frontal ciliature (corona-like vs. isolated frontal cirri), the presence of several right marginal(?) rows of cirri that do not end in transverse cirri (vs. only one right marginal row), and the dorsal pattern (composed of more than six dorsal kineties and kinety fragments, plus scattered kinetids vs. only six dorsal kineties, with simple fragmentation of kinety 3), respectively (Berger 1999; Borror 1972). Otherwise, both genera are similar in having numerous ventral rows and transverse and caudal cirri.

Clapsiella gen. n. resembles the flexible incertae sedis hypotrich *Saudithrix* Foissner, Al-Rasheid and Berger in Berger, Al-Rasheid and Foissner, 2006 in having numerous ventral and very likely right marginal rows of cirri, and in the presence of transverse cirri (Berger et al. 2006). On the other hand, these two genera differ in the relative length of the adoral zone of membranelles (occupying ca. 40% of body length vs. 29%), in the presence vs. absence of caudal cirri, and in the dorsal pattern (more than six dorsal kineties, kinety fragments, and scattered kinetids vs. mainly three dorsal kineties), respectively (Berger 2011; Berger et al. 2006).

At first glance, *Clapsiella* gen. n. resembles the monotypic, marine kahliellid *Pseudokahliella* because of having many long ventral rows of cirri and a prominent adoral zone of membranelles; but they differ in the arrangement of cirri in the frontal field (corona-like vs. in rows), the presence (vs. absence) of transverse and caudal cirri, the dorsal kinety pattern (more than six dorsal kineties, kinety fragments, and scattered kinetids vs. three bipolar dorsal kineties), and curved and optically intersecting each other (vs. straight and parallel) undulating membranes, respectively (Berger 2011; Berger et al. 1985; Hu and Song 2003).

Among rigid oxytrichids with numerous ventral rows of cirri, this new isolate should be compared with *Onychodromus* Stein, 1859, *Laurentiella* Dragesco and Njine, 1971, and *Gigantothrix* Foissner, 1999. The most similar to the new isolate is *Gigantothrix*; although *Clapsiella* gen. n. differs fundamentally from *Gigantothrix* in the consistency of the cortex (flexible vs. rigid), the presence vs. absence of transverse and caudal cirri, the presence of a tricorona of frontal and frontoventral cirri vs. a multicorona, and in the absence vs. presence of morphogenetically inactive cirral rows located on the left of left marginal cirral row, respectively (Foissner 1999). Nevertheless, these two ciliates are similar in having numerous dorsal cilia arranged in irregular rows and the presence of left ventral rows that are shorter and less densely cirrated than cirral rows in midline and right side of the body. These left ventral rows and the irregular dorsal pattern possibly resulted from retained parental rows and dorsal kinetids as in *Gigantothrix* (Foissner 1999) but unfortunately, morphogenetic stages of the new isolate were not found. Compared to *Onychodromus*, *Clapsiella* gen. n. is different in the absence of dorsal horns (vs. presence), the undulating membrane pattern (cyrtohymenid vs. stylonychid), and the absence of clustered pretransverse cirri (vs. present; Berger 1999; Foissner et al. 1987). Otherwise, both genera are similar in the relative length of the adoral zone of membranelles (more than 40%) and in the presence of numerous ventral rows of cirri in *Onychodromus quadricornutus* Foissner, Schlegel and Prescott, 1987. The new genus is different from *Laurentiella* in the oral pattern (cyrtohymenid vs. stylonychid) and the corona-like frontal and frontoventral cirri (vs. three distinctly enlarged frontal cirri), respectively (Berger 1999; Dragesco and Njine 1971). Both genera are similar in the relative length of the adoral zone of membranelles (more than 40% of total body length) and because the dorsal pattern shows numerous kineties and kinety fragments, which in the case of *Laurentiella strenua* (Dingfelder, 1962) Berger and Foissner, 1989 result from multiple fragmentation of dorsal kineties and the presence of dorsomarginal rows (Berger 1999; Martin et al. 1983).

The new species and comparison with other species

Clapsiella magnifica gen. n., sp. n. is a very conspicuous species in vivo because of its great body size and its almost completely cirrated ventral surface. The overall appearance of the species compared below resembles that of *C. magnifica*, although important generic differences exist among them that have been already discussed.

Among *Paraurostyla* species, *Clapsiella magnifica* must be compared to the *P. weissei* complex and *P. coronata* Arora, Gupta, Kamra and Sapra, 1999. On the contrary to *C. magnifica*, *P weissei* has conspicuous yellow-greenish

cortical granules (vs. cortical granules absent), a lower number of ventral rows (3–6 vs. 6–9 plus 3–5 right marginal(?) rows), transverse cirri (6–9 vs. 12–17), caudal cirri (10–18 vs. 17–28), and adoral membranelles (28–63 vs. 70–92), respectively (Berger 1999; Wirnsberger et al. 1985). *Paraurostyla coronata* has numerous ventral rows (6–8) and a corona-like arrangement of frontal and frontoventral cirri like *C. magnifica*, but lacks multiple right marginal(?) rows (Arora et al. 1999). This species is also different from *C. magnifica* in having green and pink cortical granules (vs. cortical granules absent), a lower number of transverse cirri (6–10 vs. 12–17), caudal cirri (15–18 vs. 17–28), and adoral membranelles (65–78 vs. 70–92), respectively (Arora et al. 1999).

Saudithrix terricola Foissner et al. in Berger et al., 2006 shares several features with *Clapsiella magnifica*, such as the presence of two macronuclear nodules, several right ventral rows that do not form transverse cirri (marginal rows?), the absence of cortical granules, and the arrangement of transverse cirri in an oblique row (Berger et al. 2006). Nevertheless, both species have important generic differences that were previously discussed. In addition, *C. magnifica* and *S. terricola* differ in the number of ventral rows (6–9 plus 3–5 right marginal(?) rows vs. a total of 7–9 ventral and possibly right marginal rows), transverse cirri (12–17 vs. 6–9), and adoral membranelles (70–92 vs. 53–64), respectively (Berger et al. 2006).

Clapsiella magnifica differs from *Gigantothrix herzogi* Foissner, 1999 in having two macronuclear nodules (vs. 25–58), 4–6 micronuclei (vs. 5–21), one contractile vacuole on the left body margin vs. two or three along left and anterior margin of the cell, leftmost ventral cirral rows shorter than other ventral rows but not increasingly shortened from right to left as in *G. herzogi*, and 6–9 ventral cirral rows plus 3–5 right marginal(?) rows that do not end in transverse cirri vs. 14–20 ventral rows, respectively (Foissner 1999).

Compared to the species assigned to the stylonychine genus *Onychodromus*, *Clapsiella magnifica* is more similar to *O. quadricornutus* than to *O. grandis* Stein, 1859 because in the latter the frontoventral cirri are not arranged in highly ordered rows (Berger 1999; Szabó and Wilbert 1995). Contrarily to *O. quadricornutus*, the new species has two macronuclear nodules vs. 11–28 macronuclear segments, 4–6 micronuclei vs. 4–26, one contractile vacuole on the left body margin vs. four or five along left and anterior margin of the cell, 6–9 ventral cirral rows plus 3–5 right marginal(?) rows that do not end in transverse cirri vs. 14–20 ventral rows, rightmost 2–5 transverse cirri somewhat separated from the others vs. arranged in a J-shaped pattern, and the presence of several right marginal(?) rows of cirri that do not end in transverse cirri vs. 2–3 rightmost ventral rows that are produced by splitting of some of the rightmost frontal-ventral-transverse cirri anlagen, respectively (Berger 1999; Foissner et al. 1987). According to Foissner et al. (1987), in *O. quadricornutus* all ciliary organelles that do not participate in morphogenesis disappear after cytokinesis.

Clapsiella magnifica differs from *Laurentiella strenua* in the body shape (elongate ellipsoidal with both ends rounded vs. almost triangular with posterior end narrowly rounded), the number of macronuclear nodules (two vs. usually four and up to 12) and micronuclei (4–6 vs. 7–9), the number of ventral cirral rows (6–9 ventral plus 3–5 right rows that do not end in transverse cirri vs. usually six frontoventral rows), the number and arrangement of transverse cirri (12–17 vs. 5–7; rightmost 2–5 cirri somewhat separated from the others vs. arranged almost longitudinally in the median of the cell), in the presence of several right marginal(?) rows of cirri that do not end in transverse cirri vs. absence of these rows, the number of caudal cirri (17–28 vs. invariably 3), and adoral membranelles (70–92 vs. 64–70), respectively (Berger 1999; Berger and Foissner 1989; Martin et al. 1983).

In conclusion, *Clapsiella magnifica* is a very conspicuous ciliate that deserves to be treated as new genus and species but considered incertae sedis within the Hypotricha sensu Berger (2006). The supposed dorsal kinety fragmentation and presence of dorsomarginal rows would indicate a classification within the oxytrichids (Berger 1999), but morphogenetic and molecular data are needed to support or disprove this hypothesis.

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