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Taxonomic and ultrastructural study of the genera *Strombomonas* and *Trachelomonas* (Euglenophyta) from Colombia

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ABSTRACT – (Taxonomic and ultrastructural study of the genera *Strombomonas and Trachelomonas* (Euglenophyta) from Colombia). A floristic and ultrastructural study on loricated Euglenophyta was made in several freshwater bodies from the Amazonian and Caribbean regions of Colombia. A total of 114 taxa were recorded, 93 belonged to the genus *Trachelomonas* Ehr., and 21 to *Strombomonas* Defl. From the total taxa determined, 73 were recorded for the first time for Colombia, 19 for the Amazonian and 52 for the Caribbean region. Besides 43 taxa were examined by scanning electron microscopy (SEM) and details of its ultrastructure are illustrated.
Keywords: Euglenophyta, phytoplankton, Taxonomy, tychoplankton, ultrastructure

RESUMO – (Estudo taxonômico e de ultraestrutura dos gêneros *Strombomonas and Trachelomonas* (Euglenophyta) da Colombia). Um estudo florístico e ultraestrutural de Euglenophyta loricata de vários corpos de água doce nas regiões amazônica e caribenha da Colômbia foi realizado. Um total de 114 táxons foi registrado, 93 pertencentes ao gênero *Trachelomonas* Ehr. e 21 ao *Strombomonas* Defl. 73 táxons foram registrados pela primeira vez na Colômbia, 19 na região amazônica e 52 na região do Caribe. Além disso, detalhes da ultraestrutura de 43 táxons foram examinados por microscopia eletrônica de varredura (SEM).
Palavras-chave: Euglenophyta, fitoplâncton, Taxonomia, ticoplâncton, ultraestrutura

Introduction

The Amazon and Caribbean regions of Colombia have a rich biological diversity and an abundance of organic matter, making them ideal environments for Euglenophyta microalgae growth (Pringsheim 1956, Lackey 1968, Munawar 1972, Conforti 1998, Reynolds *et al.* 2002, Rosowski 2003, Wołowski & Hindák 2004). Although some research on these organisms was carried out in nearby countries such as Brazil and Bolivia (Thomasson 1971 and 1977, Uherkovich & Schmidt 1974, Uherkovich & Franken 1980, Couté & Thérézien 1985 and 1994, Thérézien 1989, Rodrigues 1992, Conforti 1993a, b, and 1994); for Colombia, only four scientific works were focused on them (Conforti & Nudelman 1994, Duque 1995, Duque & Nuñez Avellaneda 2000, Tolivia *et al.* 2012). On the other hand, the Caribbean region also presents excellent characteristics for the Euglenophyta (Guisande *et al.* 2008). Some works exist for Venezuela (Deflandre 1926, Yacubson 1980 and 1984, Yacubson & Bravo 1982-1983) and Mexico (Ortega *et al.* 1994), however there are no reports of them from this región of Colombia. In this paper, as a result of the samples analysed, 21 taxa belonging to *Strombomonas and* 93 to *Trachelomonas* were determined. In addition to this, the lorica ultrastructure of 46 of them were examined and photographed in detail by scanning electron microscopy (SEM).

Trachelomonas nigra was found for the first time in America in La Herradura, Putumayo River. Four taxa were examined and photographed by SEM for the first time ever: *T. acanthophora* var. *acanthophora*, *T. oblonga* var. *australica*, *T. parvicollis* and *T. raciborskii* var. *nova* f. *minor*. Our study significantly increased the number of records for these genera in both regions studied from Colombia.

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Materials and Methods

Study Area- The present study was undertaken in several water bodies from three basins of Colombia belonging to two areas: the Caribbean and the Amazonian River Basin (table 1).

The Magdalena River is the most important river of Colombia and the Caribbean region. It originates in the southern region of the country, near the Magdalena Lake in Páramo de las Papas. It flows northwards through Colombian territory to the Caribbean Sea in Bocas de Ceniza. It is the longest Inter-Andean River in South America, and it has about 500 tributary rivers and more than 5,000 streams drain into it. One of them is the Sinú River, regulated by the presence of Urrá dam. In this area samples were collected from Magdalena and Sinú rivers;

Table 1. Collect samples sites from three basins of Colombia belonging to two areas: the Caribbean and the Amazonian River Basin.

Location	River	Site	Site Number	Latitude		Longitude	
Caribbean Region	Sinú	Purísima	1	9° 13’ 33.0’’	N	75° 43’ 35.8’’	W
		San Sebastián	2	9° 13’ 20.1’’	N	75° 46’ 16.4’’	W
		Chima	3	9° 08’ 40.6’’	N	75° 38’ 20.8’’	W
		Boca	4	8° 24’ 18.0’’	N	75° 54’ 41.9’’	W
		Barbudo	5	9° 07’ 02.1’’	N	75° 41’ 15.1’’	W
		La Bareta	6	8° 24’ 32.2’’	N	75° 52’ 15.2’’	W
		Momil	7	9° 14’ 08.0’’	N	75° 41’ 05.2’’	W
		Hamaca	8	8° 25’ 24.8’’	N	75° 52’ 09.4’’	W
		Pozo Hondo	9	8° 24’ 27.6’’	N	75° 51’ 42.3’’	W
	Magdalena	Las Pavas	10	9° 11’ 51.89’’	N	74° 36’ 38.62’’	W
		Los Patos	11	9° 12’ 26.99’’	N	74° 34’ 30.4’’	W
		Los Mimbres	12	9° 13’ 09.87’’	N	74° 34’ 20.3’’	W
		Sangre afuera	13	9° 11’ 51.89’’	N	74° 39’ 50.6’’	W
		La Tortuga	14	9° 11’ 51.89’’	N	74° 38’ 15.01’’	W
		Mojarras	15	9° 11’ 51.89’’	N	74° 35’ 19.82’’	W
		Boquete	16	9° 11’ 51.89’’	N	74° 35’ 05.42’’	W
		Guayacanes	17	9° 11’ 51.89’’	N	74° 35’ 31.8’’	W
		El Gato	18	9° 11’ 51.89’’	N	74° 40’ 24.31’’	W
		Caño Violo Sur	19	9° 11’ 51.89’’	N	74° 38’ 29.01’’	W
		Caño Barranco	20	9° 11’ 51.89’’	N	74° 35’ 06.11’’	W
Amazon Region	Putumayo	Comajiña	21	0º 02’ 0.7’’	S	75° 15’ 22.2’’	W
		Lagartococha	22	0º 09’ 09.2’’	S	74° 49’ 57.0’’	w
		Limoncocha	23	0º 07’ 24.9’’	S	74° 54’ 39.9’’	W
		Viviano	24	0º 06’ 59.8’’	S	74° 56’ 38.6’’	W
		La Paya	25	0º 01’ 56.4’’	S	75° 16’ 06.7’’	W
		La Herradura	26	1° 20’ 31.3’’	N	75° 46’ 01.04’’	W
		Caucaya	27	0° 06’ 52.1’’	S	74° 56’ 22.3’’	W
	Putumayo Basin	Gaviota Lake	28	2° 44’ 38’’	S	69° 56’ 18’’	W
		Marangoa Lake	29	2° 18’ 45’’	S	71° 18’ 57’’	W
	Orteguaza, Caqueta Basin	Canaguchal Vereda Palmarito	30	1° 26’ 08.88’’	N	75° 42’ 17.12’’	W
		El Carmen lake	31	1° 33’ 16,49’’	N	75° 32’ 14.005’’	W
		Canaguchal Vereda “El Venado”	32	1° 32’ 31,09’’	N	75° 39’ 03.119	W
		Canaguchal Sinaí	33	1° 26’ 06,557’’	N	75° 44’ 24.324’’	W

in the latter, different lakes (locally known as ciénagas or swamps) of the Lorica marshy complex were sampled. The lakes from Magdalena River sampled are located in the Momposina depression; sector increased flooding in northern Colombia.

In the southwest of the Amazonian region samples were taken from two systems: Putumayo and Ortegüaza Rivers. The first one is a main tributary of the Amazon River, it's born in Nudo de los Pastos and flows 1,800 km eastwards, serving as a border between Colombia - Peru and Colombia - Ecuador. It is a major transportation artery, navigable for almost its total length. The samples were taken from lakes and the Putumayo River near Peru. Some of these lakes are located in the National Natural Park "La Paya".

Other samples were collected from canaguchales (small water bodies with predominance of palm *Mauritia* genus) and from flood lakes respectively, in Ortegüaza River, a tributary of the Caquetá River near to Andes.

Samples Collection - Materials were taken from two communities, phytoplankton sieved through a 24 µm mesh nets, and tychoplankton obtained by macrophytes crushed. All samples were immediately fixed and preserved in the Transeau solution. They were deposited in the Colección de Microalgas Acuáticas de la Amazonia Colombiana del Instituto Amazónico de Investigaciones Científicas - Sinchi and the Ficoteca Amazónica of the Laboratorio de Manejo y Gestión de Humedales, Universidad Nacional de Colombia, Sede Amazonia.

Qualitative analysis of the material was performed by taxonomic identification in an Olympus BX50 optical microscope provided with a drawing tube. Taxa were measured and illustrated. Specialised literature was consulted for taxa identification: Deflandre 1926, Balech 1944, Conrad & Van Meel 1952, Huber-Pestalozzi 1955, Popova 1966, Kiriakov 1983, Starmach 1983, Tell & Conforti 1986, Conforti & Tell 1988, 1993, 1999, Rino & Pereira 1989-1990, Conforti 1993a, b, 1999, 2009, 2010, Conforti & Joo 1994, Conforti & Nudelman 1994, Conforti & Perez 2000, Conforti & Ruiz 2001, Conforti & Zalocar de Domitrovic 2003, Wołowski & Hindák 2004, 2005, Wołowski & Grabowska 2007, Wołowski & Walne 2007, Da *et al*. 2009, Ciugulea & Triemer 2010, Garduño Solorzano *et al*. 2011.

For SEM observations, materials were fixed with 4 % formaldehyde, washed with bi-distilled water, filtered through Millipore filters (0.20 µm pore), and air-dried. Filter pieces were attached on stubs to be subsequently coated with gold/palladium. Specimens were examined and photographed by a Phillips 505 SEM at the Electron Microscopy Service of Institute of Scientific and Technical Research for Defense (CITEDEF), Argentina.

The characteristics used to delimit the different taxa were size and shape of the lorica, pore with or without collar, and type of ornamentation. Only those taxa whose ultrastructure was unknown, are described in their entirety in the text. Additionally, in some known taxa, particular morphologies, dimensions, and distribution patterns are detailed. The list of all records is presented in Table 2.

Results

Taxonomic Descriptions

CLASS EUGLENOPHYCEAE

Order Euglenales

Family Euglenaceae.

Genus *Strombomonas* Deflandre 1930

Strombomonas acuminata* var. *deflandreana Conrad, Mém. Mus. Royal d'Hist. Natur. Belg. 124:115, 152, pl.XV, fig.10. 1952.

Figure 8 d

Loricas broadly ovoid 33-34 µm long, 18.5-23 µm diam. Apical pore surrounded by a depressed enlarged neck (1.5-2×7-9 µm). Posterior end abruptly tapers into a conical cauda (10-13 µm long). Envelope covered by adhered external irregular particles. This taxon was analysed by SEM for the first time, as well as recorded for the first time for the Amazon region in Colombia. America: Argentina; Asia: Bangladesh and India, Oceania: Australia and New Zealand.

Strombomonas asymmetrica (Roll) Pop., Flora plant. Cryptog. 8(1):217, pl.20, fig.18. 1966.

Figure 7 f

Loricas ellipsoid 21-24 µm long, 12-13 µm diam., with a short collar (3-4×5-6 µm) oblique at the free end. Posterior end gradually tapering to a short (3-3.5x4-5µm) conical cauda. Envelope coarse, covered by adhered external very large particles, including a diatom frustule. It was cited previously in America: Brazil, Europe: Bulgaria, Netherlands and Ukraine. This is the first record for the Caribbean region in Colombia.

Strombomonas costata Def., Arch. Protistenk. 69:589, figs.76-80. 1930.

Figs. 1 j, 8 cxxx

The studied loricas showed lower dimensions than those analysed by SEM by Tell & Conforti (1988) in materials from Argentine, 48-50 µm long, 24-26 µm diam, neck 5.5-6×6-7.5 µm and cauda 11-13 µm long. Widespread. In America: Argentina, Brazil, and Mexico. This is the first record for the Caribbean region in Colombia.

Strombomonas eurystoma* f. *incurva (Buz.) Popova, Flora plant. Cryptog. 3(1):208, pl.20, fig.14,16-21. 1966.

Figs. 1 a-c, 7 a-b

Previously studied with SEM by Conforti (2009) but the lorica of our specimens showed smaller dimensions than those examined by this author, 24-28 µm long, 20.5-22 µm wide. Previously cited in America: Argentina and USA, Europe: Romania. Recorded in the Caribbean region and Colombia for the first time.

Strombomonas gibberosa* var. *gibberosa (Playf.) Defl., Arch. Protistenk., 69(3):595, fig.97-101,103. 1930.

Figure 1 o

Loricas 42-45 µm long, 22-24 µm wide. Widespread. Earlier mentioned for the Caribbean region in Cuba (Comas Gonzalez, 2009). Recorded in Colombia for the first time.

Table 2. Loricated Euglenophyta taxa from Colombia. The sites corresponding to Magdalena River are not shown since no Euglenophytes were found (sites 10 to 20 in table 1).

Taxa	Sample Sites																					Community	Figures
	Caribbean Region									Amazon Region													
	Sinú									Putumayo					Putumayo Basin			Ortegüaza, Caqueta Basin					
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33		
S. acuminata var. *deflandreana*															○								Phytoplankton	8d
S. asymmetrica var. *asymmetrica*					○																		Phytoplankton	7f
S. costata								○															Phytoplankton	1j, 8c
S. euristoma f. *incurva*								○															Tychoplankton	1a–c, 7a–b
S. fluviatilis				○	○			○	○				○										Tychoplankton/ Phytoplankton	1g–h, 8b
S. gibberosa var. *gibberosa*					○																		Tychoplankton	1o
S. gibberosa var. *major*				○																			Tychoplankton	1i
S. girardiana								○							○								Tychoplankton/ Phytoplankton	8e–g
S. globulosa					○																		Phytoplankton	7g
S. lanceolata						○			○														Phytoplankton	1l, 7d–e
S. maxima					○												○						Tychoplankton/ Phytoplankton	1p
S. napiformis var. *brevicollis*									○														Tychoplankton/ Phytoplankton	7h
S. ovalis								○															Tychoplankton	1m
S. scabra var. *hiperintermedia*								○															Tychoplankton	8h–i
S. scabra var. *longicollis*												○											Phytoplankton	1d

Tabela 2 (continuação)

Taxa	Sample Sites																						Community	Figures
	Caribbean Region									Amazon Region														
	Sinú									Putumayo							Putumayo Basin		Ortegüaza, Caqueta Basin					
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33		
S. scabra var. *scabra*	○			○									○			○							Tychoplankton/ Phytoplankton	1e
S. schauinslandii var. *schauinslandii*								○															Tychoplankton	8a
S. schauinslandii var. *minor*								○															Tychoplankton	1k
S. treubii					○				○														Tychoplankton/ Phytoplankton	1f
S. verrucosa var. *zmiewika*						○							○										Phytoplankton	1n, 7c
T. abrupta var. *abrupta*			○					○	○			○	○		○	○							Tychoplankton/ Phytoplankton	2a
T. abrupta var. *arcuata*			○			○		○					○										Tychoplankton/ Phytoplankton	2c
T. abrupta var. *minor*			○			○		○					○										Tychoplankton/ Phytoplankton	2d
T. abrupta var. *obesa*												○			○		○						Phytoplankton	2b
T. acanthophora var. *acanthophora*						○																	Phytoplankton	13f
T. acanthophora var. *minor*						○		○															Tychoplankton/ Phytoplankton	4j, 13g
T. allia	○																						Tychoplankton	12a
T. amphoriphormis var. *spinosa*															○								Phytoplankton	3o
T. armata var. *armata* f. *inevoluta*					○																		Tychoplankton	4a
T. armata var. *longispina*	○	○		○					○												○		Tychoplankton/ Phytoplankton	4d

Tabela 2 (continuação)

Taxa	Sample Sites																					Community	Figures
	Caribbean Region														Amazon Region								
	Sinú										Putumayo						Putumayo Basin		Ortegüaza, Caqueta Basin				
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33		
T. armata f. *pseudolongispina*						○		○		○													Tychoplankton/ Phytoplankton	4c
T. armata var. *steinii*	○	○	○	○		○	○	○	○	○			○		○	○	○						Tychoplankton/ Phytoplankton	4b
T. bacillifera var. *minima*					○				○						○								Tychoplankton/ Phytoplankton	6p
T. bulla								○															Tychoplankton	2k
T. caudata						○																	Phytoplankton	3m
T. cervicula		○						○	○								○	○					Tychoplankton/ Phytoplankton	5i
T. charkoviensis var. spinicollis						○																	Tychoplankton/ Phytoplankton	3j
T. conica f. *conica*	○																						Tychoplankton	2h
T. conica f. *punctata*				○																			Tychoplankton	2e
T. curta var. *curta*			○	○	○	○		○	○	○	○	○	○		○	○	○	○					Tychoplankton/ Phytoplankton	5k, 9a
T. curta var. *minima*								○															Tychoplankton	5l
T. cylindrica var. *decollata*										○													Phytoplankton	2i
T. dangeardii var. *glabra*																					○		Phytoplankton	4f
T. dastugueii						○			○														Phytoplankton	4i, 13i
T. diploperforata					○																		Phytoplankton	9h–i
T. duquei									○														Phytoplankton	2f
T. dybowskii																					○		Phytoplankton	6o
T. globularis f. *gigas*										○													Phytoplankton	6a
T. globularis f. *punctata*									○														Phytoplankton	5p

Tabela 2 (continuação)

Taxa	Sample Sites																						Community	Figures
	Caribbean Region									Amazon Region														
	Sinú									Putumayo							Putumayo Basin		Ortegüaza, Caqueta Basin					
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33		
T. gracillima						○							○										Phytoplankton	13d–e
T. granulosa var. *granulosa*			○		○				○														Tychoplankton/ Phytoplankton	5t
T. granulosa var. *subglobosa*				○					○														Tychoplankton/ Phytoplankton	6k, 11a–b
T. helvetica						○							○										Phytoplankton	3i
T. hirta	○		○			○		○	○														Tychoplankton/ Phytoplankton	6r, 12b–e
T. hispida var. *hispida* f. *hispida*	○	○		○		○	○	○	○	○	○	○	○	○	○	○	○	○					Tychoplankton/ Phytoplankton	6b, 10i–j
T. hispida var. *hispida* f. *minima*										○													Phytoplankton	6g
T. hispida var. *hispida* f. *minor*							○	○		○				○	○								Tychoplankton/ Phytoplankton	6e
T. hispida var. *coronata*	○					○			○						○	○							Phytoplankton	6h
T. hispida var. *crenulatocollis*			○							○			○										Tychoplankton/ Phytoplankton	6m
T. hispida var. *punctata*									○									○					Tychoplankton/ Phytoplankton	6f
T. intermedia	○			○	○				○			○											Tychoplankton/ Phytoplankton	6q
T. irregularis					○																		Tychoplankton	9j
T. kelloggii var. *effigurata*						○		○															Tychoplankton/ Phytoplankton	3a, 10k–l
T. komarovii								○									○						Tychoplankton/ Phytoplankton	5j
T. lacustris									○			○			○								Phytoplankton	2g

Tabela 2 (continuação)

Taxa	Sample Sites																					Community	Figures
	Caribbean Region									Amazon Region													
	Sinú									Putumayo							Putumayo Basin		Ortegüaza, Caqueta Basin				
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33	
T. lemmermannii var. *lemmermanii*								○						○									Tychoplankton	2p
T. lemmermannii var. *acuminata*										○													Phytoplankton	3e
T. megalocantha var. *crenulatocollis*									○														Phytoplankton	12g–h
T. molesta								○	○														Tychoplankton/ Phytoplankton	3n
T. nexilis	○	○		○		○		○							○								Tychoplankton/ Phytoplankton	5q, 9e–f
T. nigra															○								Phytoplankton	10h
T. oblonga var. *attenuata*								○							○								Tychoplankton/ Phytoplankton	5v
T. oblonga var. australica					○																		Tychoplankton	10f
T. oblonga var. *truncata*			○		○			○															Tychoplankton	5u
T. parvicollis								○															Tychoplankton	3l, 10d–e
T. pisciformis						○		○	○														Tychoplankton/ Phytoplankton	13h
T. planctonica var. *flexicollis*												○											Phytoplankton	3b
T. planctonica var. *oblonga*					○	○																	Tychoplankton/ Phytoplankton	3c, 11c
T. pulcherrima var. *minor*	○																						Tychoplankton	2j
T. pusilla var. *punctata*	○		○				○	○	○	○	○		○	○	○	○							Tychoplankton/ Phytoplankton	6j

Tabela 2 (continuação)

Taxa	Sample Sites																						Community	Figures
	Caribbean Region										Amazon Region													
	Sinú										Putumayo						Putumayo Basin		Ortegüaza, Caqueta Basin					
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33		
T. pusilla var. *pusilla*	○			○	○			○	○		○	○		○									Tychoplankton/ Phytoplankton	6i
T. pyramidata	○																						Tychoplankton	4e
T. raciborski var. *raciborskii*	○					○			○						○								Phytoplankton	2l, 11h
T. raciborskii var. *incerta*	○			○		○									○								Tychoplankton/ Phytoplankton	2o, 11g
T. raciborskii var. *nova* f. *minor*			○	○					○														Tychoplankton/ Phytoplankton	2n
T. raciborskii var. *nova* f. *nova*									○	○													Phytoplankton	2m
T. recticollis				○	○																		Tychoplankton/ Phytoplankton	3k
T. robusta	○	○				○		○	○	○				○	○	○							Tychoplankton/ Phytoplankton	6n, 12f
T. rotunda		○		○			○		○					○									Tychoplankton/ Phytoplankton	6l, 10c
T. rugulosa f. *steinii*					○										○								Tychoplankton/ Phytoplankton	5s, 9b
T. sculpta		○	○	○		○		○	○														Tychoplankton/ Phytoplankton	5r
T. similis var. *similis*		○						○							○								Tychoplankton/ Phytoplankton	3f, 11d
T. similis var. *hyalina*									○														Tychoplankton	3g
T. similis var. *spinosa*	○	○	○	○		○		○	○			○						○					Tychoplankton/ Phytoplankton	3h, 11e–f
T. sparsesetulosa									○														Phytoplankton	5o
T. spectabilis						○			○													○	Phytoplankton	4h

Tabela 2 (continuação)

Taxa	Sample Sites																						Community	Figures
	Caribbean Region											Amazon Region												
	Sinú											Putumayo					Putumayo Basin		Ortegüaza, Caqueta Basin					
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33		
T. spinosa var. *hirsuta*																					○		Phytoplankton	4g
T. stokesii								○															Tychoplankton/ Phytoplankton	11i
T. stokesiana var. *conradi*									○						○								Phytoplankton	9c–d
T. superba	○					○		○		○	○							○					Tychoplankton/ Phytoplankton	6c–d
T. sydneyensis var. sydneyensis						○									○								Phytoplankton	3d, 13b–c
T. sydneyensis var. *minima*															○								Phytoplankton	13a
T. verrucosa var. *macrotuberculata*							○		○														Phytoplankton	10a–b
T. verrucosa var. *verrucosa* f. *irregularis*									○														Phytoplankton	10g
T. volvocina var. *volvocina*	○		○	○	○	○	○	○	○	○		○	○	○		○							Tychoplankton/ Phytoplankton	5a
T. volvocina var. *derephora*								○	○	○		○											Tychoplankton/ Phytoplankton	5d, 9g
T. volvocina var. *punctata*								○		○				○									Tychoplankton/ Phytoplankton	5c
T. volvocina var. *scutella*								○															Tychoplankton	5b
T. volvocinopsis var. *volvocinopsis*		○	○	○	○	○	○	○	○			○	○		○	○	○	○			○		Tychoplankton/ Phytoplankton	5e
T. volvocinopsis var. *coronata*									○														Phytoplankton	5f

Tabela 2 (continuação)

Taxa	Sample Sites																						Community	Figures
	Caribbean Region											Amazon Region												
	Sinú											Putumayo					Putumayo Basin		Ortegüaza, Caqueta Basin					
	1	2	3	4	5	6	7	8	9	21	22	23	24	25	26	27	28	29	30	31	32	33		
T. volvocinopsis f. *punctata*	○		○						○	○		○	○	○		○							Tychoplankton/ Phytoplankton	5h
T. volvocinopsis var. *tubigera*	○								○														Tychoplankton/ Phytoplankton	5g
T. woycickii var. *woycickii*	○							○	○		○		○			○		○					Tychoplankton/ Phytoplankton	5m
T. woycickii var. *pusilla*									○														Phytoplankton	5n

Strombomonas gibberosa* var. *major Conf., Rev. Hydrobiol. Trop. 26(3):192, pl.II, figs.7 a-d; pl.VII, figs.5-6. 1993.

Figure 1 i

Loricas broadly rhomboidal 68-70 µm long, 30-33 µm wide, with a long cylindrical collar (16-18×6-9 µm) expanded and oblique at the free end, toward the posterior end abruptly tapering to a long inclined (19-21 µm) conical pointed cauda. This species was described by means of optic microscopy in materials from Camaleao Lake (Manaus - Brazil), it is the second record in the world.

Strombomonas girardiana (Playf.) Defl. Arch. Protistenk. 69(3):573, figs.33-35. 1930.

Figures 8 e-g

Loricas with parallel sides or a central depression 42-51 µm long, 22-24 µm wide, with a short cylindrical straight collar (5-6×5-7 µm) irregular and expanded at the free end. Posterior end abruptly tapering to a long (11.5-19.5 µm) conical pointed cauda. Wall clear to dark brown, very thick, covered by adhered external particles. Widespread. This taxon was analysed by SEM for the first time, as well as its registration for both studied areas of Colombia, Caribbean and Amazon for the first time.

Strombomonas globulosa Conf. & Joo, Rev. Hydrobiol. Trop. 27(1):274, fig.66 a,b. 1995.

Figure 7 g

Loricas 19-21 µm long, 11-13 µm diam., ellipsoid. Pore surrounded by a collar (3-4.5×3.5-5µm) slightly widened and irregular towards the free end. Posterior end tapering to a short conical cauda (2.5-3.5µm long). Envelope totally covered by adhering exogenous particles, including very large pieces. This species was described by means of optic microscopy in materials from the USA, it is the first time that it was studied by SEM and the only other known register in the world.

Strombomonas lanceolata (Playf.) Def., Arch. Protistenk. 69(3):582-583, figs.59-60. 1930.

Figs. 1l, 7 d-e

Loricas 23-29 µm long, 10-11.5 µm wide, elongate fusiform. Sides slightly arched, towards the anterior end they gradually form a short and wide neck (2-2.5×3-6 µm) oblique and expanded at the distal end. Posterior end is narrowed into a short conical cauda (3-4 µm long). Wall yellowish to light brown, totally covered by adhering exogenous particles, including very large pieces. Widespread. This is the first time that *S. lanceolata* was examined by SEM and recorded for the Caribbean region and Colombia.

Strombomonas maxima (Skv.) Defl., Arch. Protistenk. 69(3):583-584, figs.61-65. 1930.

Figure 1 p

Loricas 103-105 µm long, 39-42 µm wide. Widespread. This is the first record for the Caribbean region and Colombia. In Amazon region was mentioned earlier in Brazil (Rodrigues, 1992).

Strombomonas napiformis* var. *brevicollis (Playf.) Defl., Arch. Protistenk. 69(3):591, figs.83-84. 1930.

Figure 7 h

Loricas 47-48.5 µm long, 26-28 µm wide. Apical pore surrounded by a depressed enlarged neck (10-12 µm diam.). Posterior end is narrowed into a conical cauda (9-10 µm long). This taxon has been studied previously by SEM by Conforti (2009). It has been reported in America: Brazil and USA, Asia: Bangladesh and India; Australia and New Zealand. This is the first record for the Caribbean region and Colombia.

Strombomonas ovalis (Playf.) Defl., Arch. Protistenk. 69(3):577, fig.42-43. 1930.

Figure 1 m

Loricas 41.5-43 µm long, 26-27.5 µm wide. Widespread, in America: Argentina, Brazil and Uruguay, North America: USA, This is the first record for the Caribbean region and for Colombia.

Strombomonas scabra* var. *scabra (Playf.) Tell & Conf. Nov. Hedw. 46(3-4):545, pl.1, fig.1-6, pl.6, fig.1-3. 1988.

Figure 1 e

Loricas 20-23 µm long, 13.5-16 µm wide. This species was previously cited in the Amazon region of Brazil (Uherkovich & Schmidt 1974) and the Caribbean region of Venezuela (Yacubson 1980, Yacubson & Bravo 1982-1983), it is the first record for Colombia.

Strombomonas scabra* var. *hiperintermedia (Playf.) Tell & Conf., Cryptogam. Algol.10(1):74, figs.14 a-c. 1989.

Figures 8 h-i

Loricas ellipsoid 52-53 µm long, 19-21 µm diam. Collar cylindrical (9-10 x 4-4.5 µm), surrounded at its base by a strong thickening (8-9 µm diam.). This taxon has been already described with SEM by Conforti & Zalocar de Domitrovic (2003). This is the first record for the Caribbean region and Colombia. This variety has exclusively been found in Argentina.

Strombomonas scabra* var. *longicollis (Playf.) Tell & Conf., Nov. Hedw. 46(3-4):546, pl.2, fig.4, pl.7, fig.1. 1988.

Figure 1 d

Loricas 26-27 µm long, 20-21 µm wide. This is the first record of this variety for Colombia and the Amazon region.

Strombomonas schauinslandii* var. *schauinslandii (Lemm.) Defl., Arch. Protistenk. 69:594, figs.90-96. 1930.

Figure 8 a

Loricas rhomboidal with rounded sides, 30-31 µm long, 19-20 µm wide. Collar trunk-cone shape (6-7×5.5-7). Posteriorly cuneiform prolonged in a well-defined cauda (7.5-8.5 µm long). Envelope light brown, totally covered by adhering exogenous particles, including very large pieces. Widespread. This is the first time that this taxon was examined by SEM and recorded for the Caribbean region and Colombia.

Strombomonas schauinslandii* var. *minor Conf. & Joo, Cryptogam., Algol. 15(4):278, figs.69 a-b. 1994.

Figure 1 k

Loricas 17-18 µm long, 10-11 µm wide. This variety was described from materials from USA, this is the second time that it has been found.

Strombomonas treubii (Wołsz.) Def., Arch. Protistenk. 69:592, fig.86. 1930.

Figure 1 f

Loricas 31-33 µm long, 16-18 µm wide. Known in South America: Argentina, Brazil and Paraguay, Asia: Indonesia. This is the first record for the Caribbean region and Colombia.

Strombomonas verrucosa* var. *zmiewika (Swk.) Def., Arch. Protistenk. 69(3):566, figs.6-10, 1930.

Figs. 1 n, 7 c

Loricas 34-35µm long, 22-23 µm wide, trapezoid. Collar short (3-4×5-6 µm) with the free end widened, smooth or irregular, straight or oblique. Posterior ends with conical cauda (8-10 µm long). Envelope covered with adhered exogenous particles. This taxon has been studied previously by SEM by Conforti (1993b). Widespread. This is the first record for the Caribbean region.

Genus *Trachelomonas* Ehrenberg *emend.* Deflandre 1926

Trachelomonas abrupta* var. *abrupta (Swk.) Defl., Rev. Gén. Bot. 38:695. 1926.

Figure 2 a

Loricas 22-30 µm long, 12-19 µm wide. Widespread. Mentioned by Yacubson (1980) for the Caribbean region in Venezuela and Comas González (2009) in Cuba. This is the first record of the variety for the Amazon region of Colombia.

Trachelomonas abrupta* var. *arcuata (Playf.) Defl., Rev. Gén. Bot. 38:695, figs.367-368. 1926.

Figure 2 c

Loricas 23.5-25.5 µm long, 15.5-1 µm wide. Widespread. This is the first record of the variety in the Caribbean area, reported previously for Colombia in its Amazon region (Duque & Nuñez Avellaneda, 2000).

Trachelomonas abrupta* var. *minor Defl., Rev. Gén. Bot. 38:695, figs.371-378,381-388. 1926.

Figure 2 d

Loricas 16.5-18.5 µm long, 7.5-12 µm wide. Widespread. This is the first record of the variety in the Caribbean area. In the Colombian Amazon, this variety was cited previously by Duque & Nuñez Avellaneda (2000).

Trachelomonas acanthophora* var. *acanthophora Stokes, Proc. Amer. Philos. Soc. 33:340, pl.XXI:fig. 6. 1894.

Figure 13 f

Loricas 48.5-50.5 µm long, 26.5-28 µm wide, spindle shaped, punctate, with conical spines scattered (2-4 µm). Pore surrounded by a cylindrical collar (3.5-4×5-5.5 µm) surrounded at the distal end by a crown of 5 robust conical spines (4.5-5 µm long). Posterior end narrowed into a subconical tail (4-5 µm long) ornate with 3 spines (4-5 µm). This is the first time that this taxon was examined by SEM. This is the first record for Colombia. Known in America: Argentina, Venezuela, Mexico and USA.

Trachelomonas acanthophora* var. *minor Balech & Dast., Physis A 12:357, fig.2:6. 1938.

Figs. 4 j, 13 g

Loricas 40-41 µm long, 20-21.5 µm wide. The ultrastructure of the studied specimen was coincident with that shown by Conforti (1999). Only cited in Argentina, Poland and central east Africa. In Colombia previously recorded in Caño Pacatúa, Amazonas River (Duque, 1995; Duque & Nuñez Avellaneda, 2000). This is the first record of this variety for the Caribbean region.

Trachelomonas allia Drez., Kosmos 50(1):211, fig.71. 1925.

Figure 12 a

Loricas cylindrical-ellipsoid, 26-30 µm long, 17-21 µm wide. Their ultrastructure was coincident with the described by Conforti (1993a, 1999) and Da *et al.* (2009). Widespread. This species was previously cited by Brazilian Amazon (Conforti 1993a). It is the first record for the Caribbean region and Colombia.

Trachelomonas armata* f. *pseudolongispina Def., Rev. Gén. Bot. 38:691, fig.336. 1926.

Figure 4 c

Loricas without spines 36-38 µm long, 31-33 µm wide, ovoid, with rounded ends. Pore surrounded by a crown of short spines (2.5-3 µm long). Wall punctuated and ornate short conical spines, scattered distributed. The posterior end showed a group of long conical right spines (7-9 µm long). Known in America: Venezuela and Canada and Africa: Egipt. This is the first report for Colombia and the both regions studied.

Trachelomonas bacillifera* var. *minima Playf., Proc. Linn. Soc. N. S. W. 40:22, pl.III:figs.15-16. 1915.

Figure 6 p

Loricas 25-26 µm long, 20.5-21.5 µm wide. Cosmopolitan. This variety was previously cited in the Brazilian Amazon (Rodrigues, 1992). This is the first record for the Caribbean region and Colombia.

Trachelomonas bulla Stein, Der Organismus der Infusionsthiere, pl. XXII: figs.41-42. 1878.

Figure 2 k

The studied loricas were smaller than those described by Popova (1966), 30.5-32 µm long, 17-18.5 µm wide. Widespread. Only found in samples of the Sinú River, this is the first record for the Caribbean area and Colombia.

Trachelomonas caudata (Ehr.) Stein, Der Organismus der Infusionsthiere, pl.XXII, figs.39-40. 1878.

Figure 3 m

Loricas 48-50 µm long, 19-20.5 µm wide. Cosmopolitan. Cited previously in Colombia by Duque & Nuñez Avellaneda (2000). Only found in samples of Sinú River, this is the first record for the Caribbean region.

Trachelomonas cervicula Stokes, Proc. Amer. Philos. Soc. 28:75, fig.11. 1890.

Figure 5 i

Loricas 19-27 µm diam. Cosmopolitan. This species was previously cited for Brazilian Amazon (Rodrigues, 1992) and the Caribbean area in Mexico (Ortega *et al*., 1994). This is the first record for Colombia.

Trachelomonas charkoviensis **var.** ***spinicollis*** (Swk.) Conf., Rev. Hidrobiol. Trop. 26(1):8, pl III, fig. 22. 1993a.

Figure 3 j

The loricas studied were larger than those observed by Conforti (1993a), 48-51 µm long, 31-35.5 µm wide, pore surrounded by a collar 5-6.5×5-6 µm. Previously cited in Argentina and Brazilian Amazonian. This is the first record for Colombia and the Caribbean region.

Trachelomonas conica **f.** ***conica*** Playf., Proc. Linn. Soc. N. S. W. 40:17, pl.II, figs.8-9. 1915.

Figure 2 h

Loricas 21-23 µm long, 11-14 µm wide. Widespread. Previously found for the Caribbean area in Cuba (Comas González, 2009), this is the first record for Colombia.

Trachelomonas conica **f.** ***punctata*** (Playf.) Defl., Rev. Gén. Bot. 38:649, fig.198. 1926.

Figure 2 e

Loricas 20-21 µm long, 11-12 µm wide. In America: Cuba, Venezuela, in Africa: Cameroon and Ivory Coast. This is the first record for Colombia.

Trachelomonas curta **var.** ***curta*** Da Cunha, Mem. Inst. Oswaldo Cruz 5(2):111, pl.10:fig.5. 1913.

Figs. 5 k, 9 a

Loricas compressed globose, smooth 17-23 µm long, 12-20 µm wide. The ultrastructure were coincident with that shown by Conforti & Perez (2000), Wołowski & Walne (2007) and Conforti (2010). Widespread. This species was cited previously in the Brazilian Amazon (Thomasson, 1971) and the Caribbean region in: Venezuela (Yacubson, 1980) and Cuba (Comas González, 2009). This is the first record for Colombia.

Trachelomonas curta **var.** ***minima*** Tell & Zal. de Domit., Nov. Hedw. 41:364, pl.8 fig.21-22, pl.14 fig.3. 1985.

Figure 5 l

Loricas 11-12 µm long, 13-14 µm wide. Known in South America: Argentine and Brazil, in Europe: Slovakia. Previously cited in the phytoplankton community from Pozo Hondo, Amazonas River, Colombia (Duque 1995, Duque & Nuñez Avellaneda 2000). This is the first record in the Caribbean region.

Trachelomonas cylindrica **var.** ***decollata*** Playf., Proc. Linn. Soc. N. S. W. 40:13, pl.I fig.30. 1915.

Figure 2 i

Loricas 19-20 µm long, 11-12 µm wide. Widespread. This variety was cited previously for Bolivian Amazon (Couté & Thérézien, 1985) and Brazilian Amazon (Menezes *et al*., 1995). This is the first record for Colombia.

Trachelomonas dangeardii **var.** ***glabra*** (Playf.) Def., Rev. Gén. Bot. 38:90, figs.338-343. 1926.

Fig. 4 f

The observed loricas were bigger than those described by Duque, cited as *T. dangeardiana* var. *glabra*; 1995, 34-35 µm long, 32-34 µm wide. Known in South America: Brazil; Australia and New Zealand. This variety was previously reported in the Colombian Amazon (Duque 1995, Duque & Nuñez Avellaneda 2000).

Trachelomonas diploperforata Da & Couté, Cryptogam. Algol. 30(1):48, figs.41-42. 2009.

Figure 9 h-i

Loricas 13.5-14.5 µm long, 12.5-13 µm wide, ellipsoid. Wall ornate with fine punctuations, among which small depressions are distributed. Pore surrounded by an annular tronco-conic thickening (0.7-1×2.5-3 µm). The ultrastructure details of our specimens were coincident with those shown by Da & Couté (2009) in the original description of the species. This was found from materials of Ivory Coast, Africa. It is the second time that is registered. Found in Barbudo, Sinú River, Colombia.

Trachelomonas duquei Conf. & Nud., Rev. Hidrobiol. Trop. 27(4):304, pl.III, figs.1-2. 1994.

Figure 2 f

Loricas 37-38 µm long, 29-30 µm wide. This species was originally described from materials of Tarapoto Lake, Amazonas River, then was cited in Brazil and USA. It is the first record in the Caribbean region and Colombia.

Trachelomonas globularis (Awer.) Lemm. **f.** ***gigas*** Drez., Rozpr. I Wiad. Muz. Dzieduszyckich 7/8:5, 15, pl.I, fig.26. 1923.

Figure 6 a

Loricas spherical 34.5-36 µm diameter, regularly punctuated and ornamented with conical spines. Widespread. In America: Argentina and Bolivia, North America: USA. Although this species has already been mentioned in the Bolivian Amazon (Couté & Thérézien 1985), this is the first mention in the Colombian Amazon.

Trachelomonas globularis **f.** ***punctata*** (Skv.) Popova, Flora Plantarum Cryptogamarum URSS Vol VIII. Fasc. 1:95. 1966.

Figure 5 p

Loricas spherical 22-26 µm diam. Known in Africa: Ivory Coast and Sierra Leone, America: Argentine and USA, Asia: China. This is the first record of this variety for Colombia and for the Caribbean region.

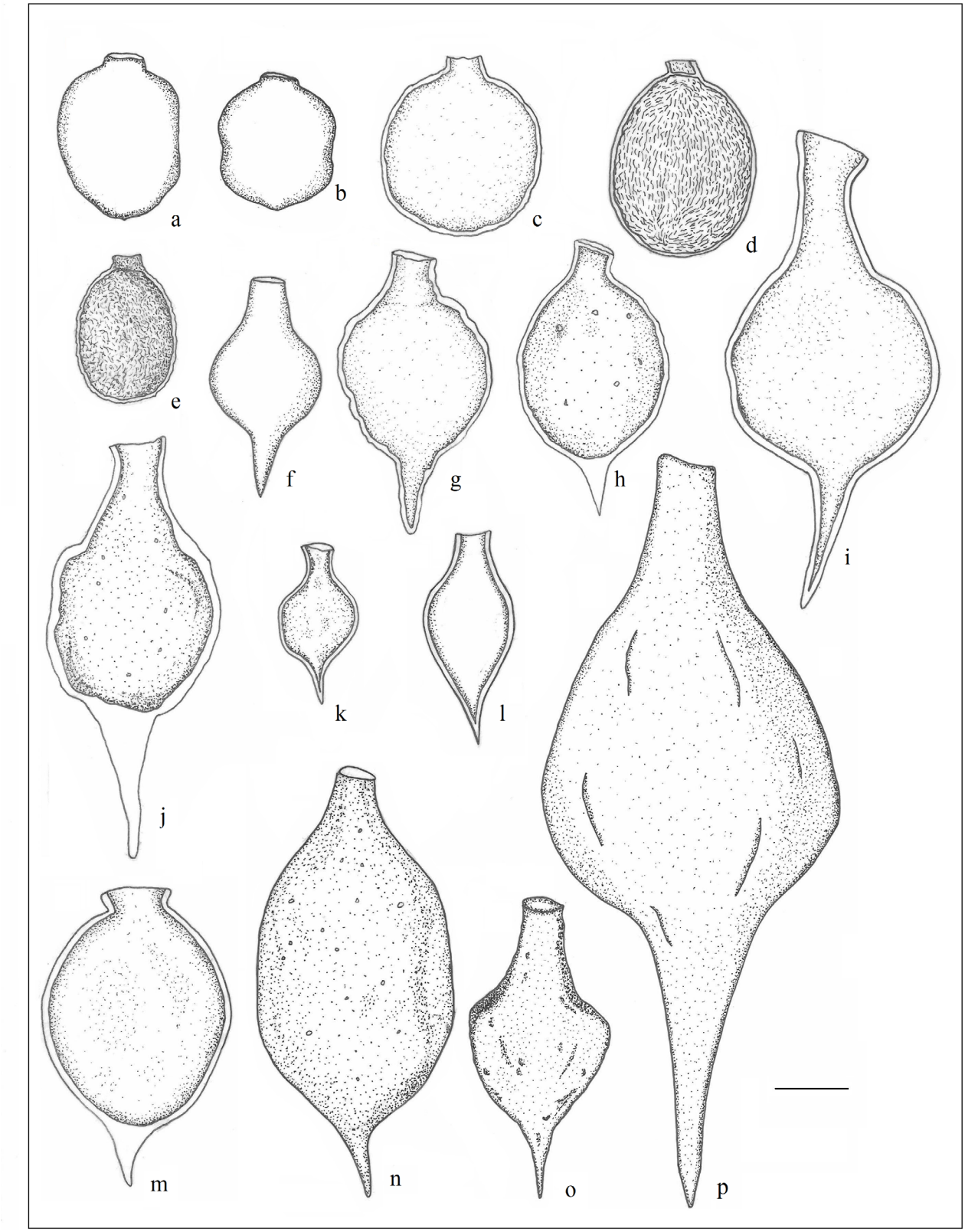

Figure 1. a-c. *Strombomonas eurystoma* f. *incurva*, d. *S. scabra* var. *longicollis*, e. *S. scabra* var. *scabra*, f. *S. treubii*, g-h. *S. fluviatilis*, i. *S. gibberosa* var. *major*, j. *S. costata*, k. *S. schauinslandii* var. *minor*, l. *S. lanceolata,* m. *S. ovalis*, n. *S. verrucosa* var. *zmiewika,* o. *S. gibberosa* var. *gibberosa*, p. *S. máxima.*

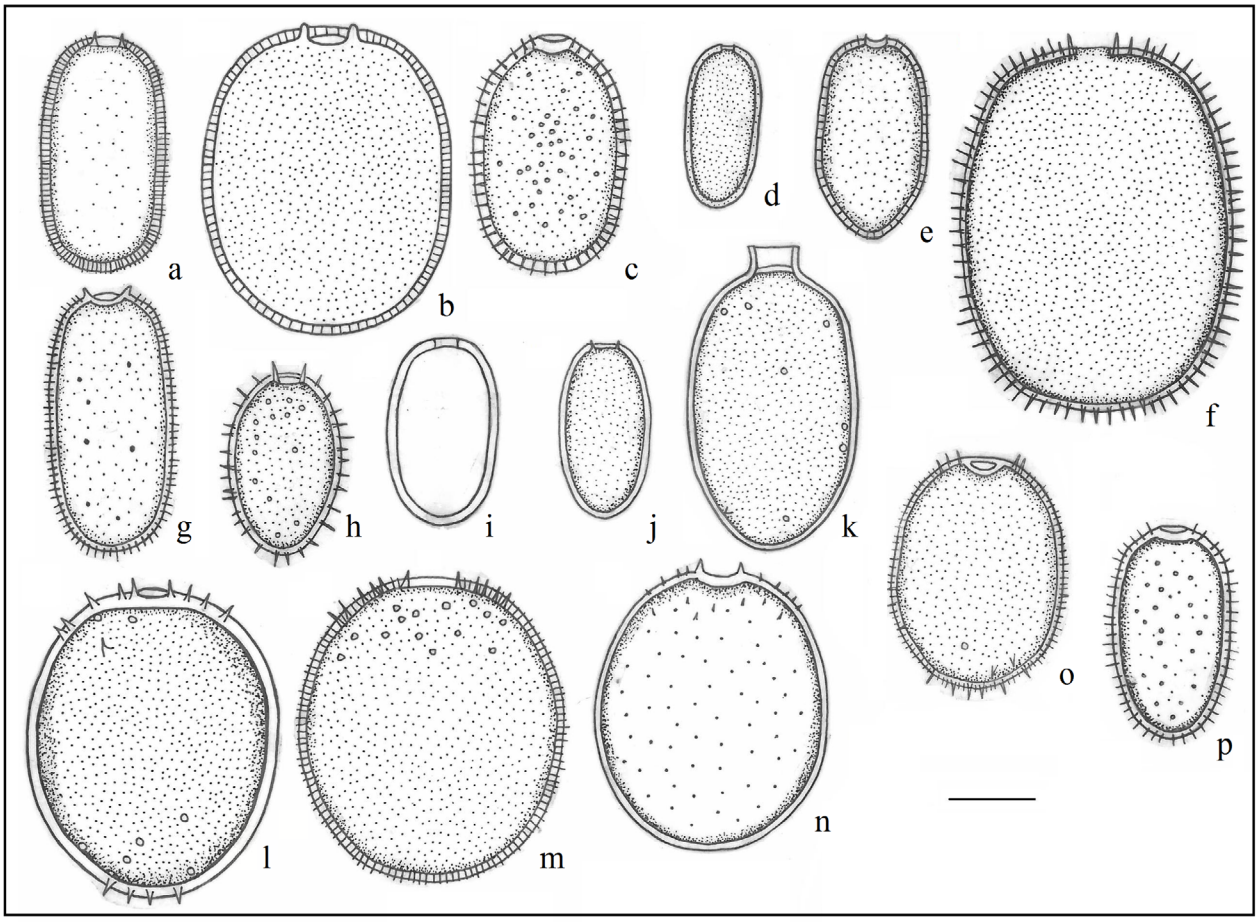

Figure 2. a. *Trachelomonas abrupta* var. *abrupta*, b. *T. abrupta* var. *obesa*, c. *T. abrupta* var. *arcuata*, d. *T. abrupta* var. *minor*, e. *T. conica* f. *punctata*, f. *T. duquei*, g. *T. lacustris*, h. *T. conica* f. *conica*, i. *T. cylindrica* var. *decollata*, j. *T. pulcherrima* var. *minor*, k. *T. bulla*, l. *T. raciborskii* var. *raciborskii*, m. *T. raciborskii* var. *nova* f. *nova*, n. *T. raciborskii* var. *nova* f. *minor*, o. *T. raciboskii* var. *incerta*, p. *T. lemmermanii* var. *lemmermanii*.

Trachelomonas gracillima Bal. & Dast., Physis Sec. A 12:355, fig.2:7. 1938.

Figures 13 d-e

Loricas 37-41 µm long, 14-19 µm wide, cauda 4-5 µm long. Their ultrastructure was similar to that described by Conforti & Tell (1986) and Conforti (1999). The species was only cited for the subtropical and temperate region of Argentina. This is the first record for both regions studied and Colombia.

Trachelomonas granulosa* var. *granulosa Playf., Proc. Linn. Soc. N. S. W. 40:18, pl.II, fig.18. 1915.

Figure 5 t

Loricas 18-21.5 µm long, 17-18.5 µm wide. Widespread. This is the first record for Colombia and the Caribbean region.

Trachelomonas granulosa* var. *subglobosa Playf., Proc. Linn. Soc. N. S. W. 40:19, pl.II: fig.19. 1915.

Figs. 6k, 11 a-b

Loricas 21.5-31 µm long, 20-27 µm wide. The ultrastructure of their wall showed more densely granularly ornamented (114/100 µm^2) than those described by Conforti & Nudelmann (1994) and Conforti & Ruiz (2001). Widespread. Cited in Lago Tarapoto, Colombia Amazon by Conforti & Nudelmann (1994), this is the first record of this variety for the Caribbean area.

Trachelomonas helvetica Lemm., Kryptfl. Mark Brandenburg 3:529. 1910.

Figure 3 i

Loricas 34-37 µm long, 15-17 µm wide, elongated ellipsoid, densely punctuated and ornamented with conical spines. Anterior end concave, wide, without neck surrounded by some spines. Sides attenuated towards the posterior end, ending into a short trunk conical cauda. Known in South America: Brazil; Europe: Czech Republic, Germany, Scandinavia; Australia. This is the first record for the Caribbean and Amazon region in Colombia.

Trachelomonas hispida* var. *hispida* f. *minor Bourr. & Manguin, Alg. Guad.:183, pl.XXIII, fig.316. 1952.

Figure 6 e

The loricas 16.5-23.5 µm long, 14-18 µm wide. Widespread. It was previously cited by the Colombian Amazon region (Conforti & Nudelmann 1994). This is the first record for the Caribbean region.

Trachelomonas hispida* var. *coronata Lemm., Pascher, Süsswasserfl. Deutschl. 2:150. 1913.

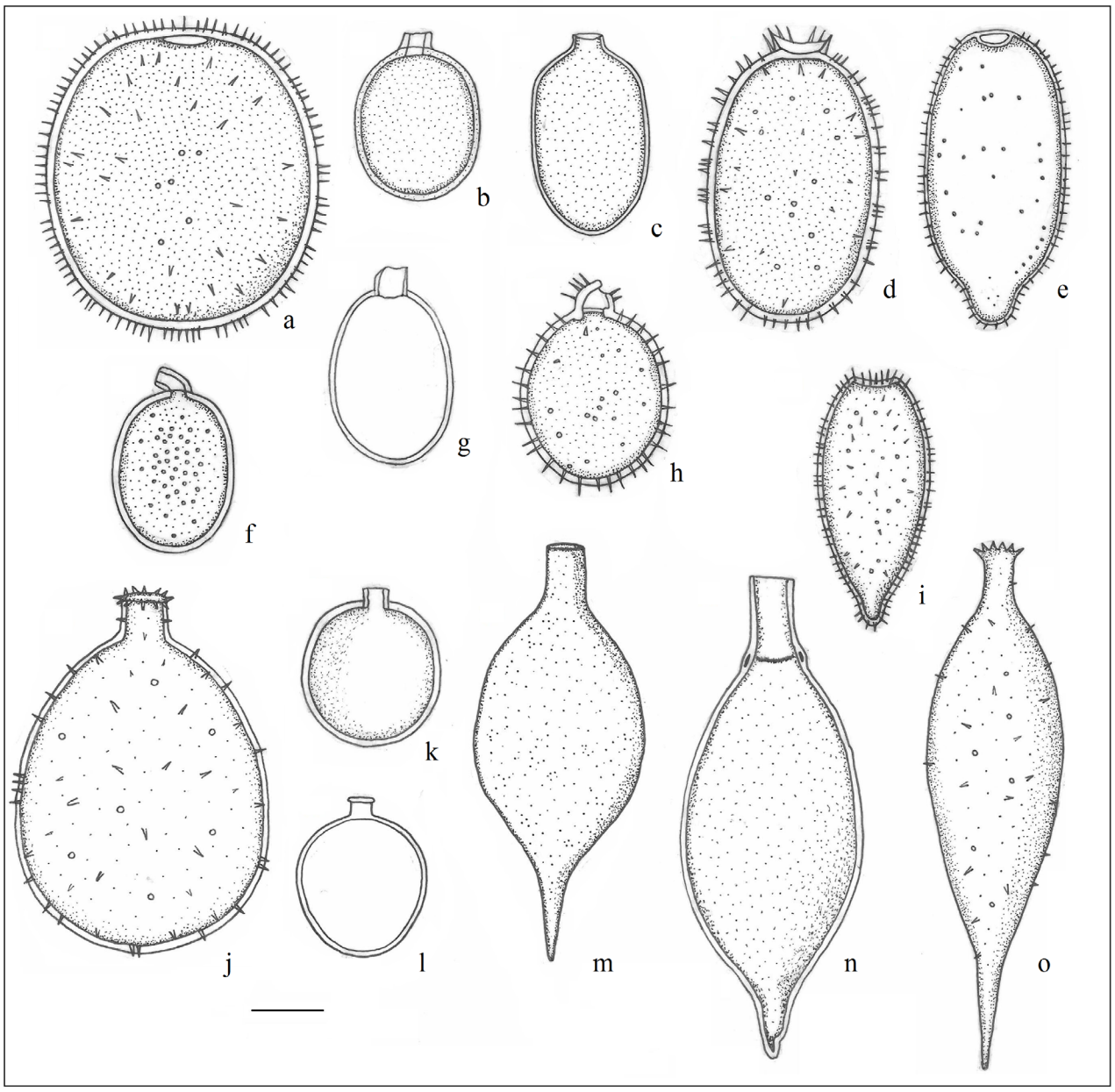

Figure 3. a. *Trachelomonas kellogii* var. *efigurata*, b. *T. planctónica* var. *flexicollis*, c. *T. planctonica* var. *oblonga*, d. *T. sydneyensis* var. *sydneyensis*, e. *T. lemmermanii* var. *acuminata*, f. *T. similis* var. *similis*, g. *T. similis* var. *hyalina*, h. *T. similis* var. *spinosa*, i. *T. helvetica* , j. *T. charkoviensis* var. *spinicollis*, k. *T. recticollis*, l. *T. parvicollis*, m. *T. caudata*, n. *T. molesta*, o. *T. amphoriphormis* var. *spinosa*.

Figure 6 h

Loricas 21-36 µm long, 13.5-21.5 µm wide. Widespread. This variety was previously cited by the Brazilian Amazon (Thomasson 1971, Uherkovich & Schmidt 1974, Bittencourt-Oliveira 1997) and the Caribbean region of Venezuela (Yacubson 1980, Yacubson & Bravo 1982-1983, Prescott 1955) and Cuba (Comas González, 2009). This is the first record for Colombia.

Trachelomonas irregularis Swk., Arch. Hydrobiol. 9:634, pl.19, fig.9. 1914.

Figure 9 j

Loricas 17.5-18.5 µm long, 15-16 µm wide. Their ultrastructure was totally coincident with the described by Conforti (1999) in materials from Chaco, Argentina. Widespread. In South America: Colombia, Argentina and Brazil. It is the first record for the Caribbean region.

Trachelomonas kelloggii* var. *efFigureta Skv., J. North-China Branch Roy. Asiat. Soc. Ser. 2(50):99, pl.1, fig.6. 1919.

Figs. 3 a, 10 k-l

Loricas 40-41 µm long, 38-39 µm wide. South America: Argentine and Brazil, Asia: China, Europe: France. It was cited previously by the Amazon region of Colombia (Duque 1995, Duque & Nuñez Avellaneda 2000). It is the first record of this variety in the Caribbean region.

Trachelomonas komarowii Skv., J. North-China Branch Roy. Asiat. Soc. Ser. 2(50):98. 1919.

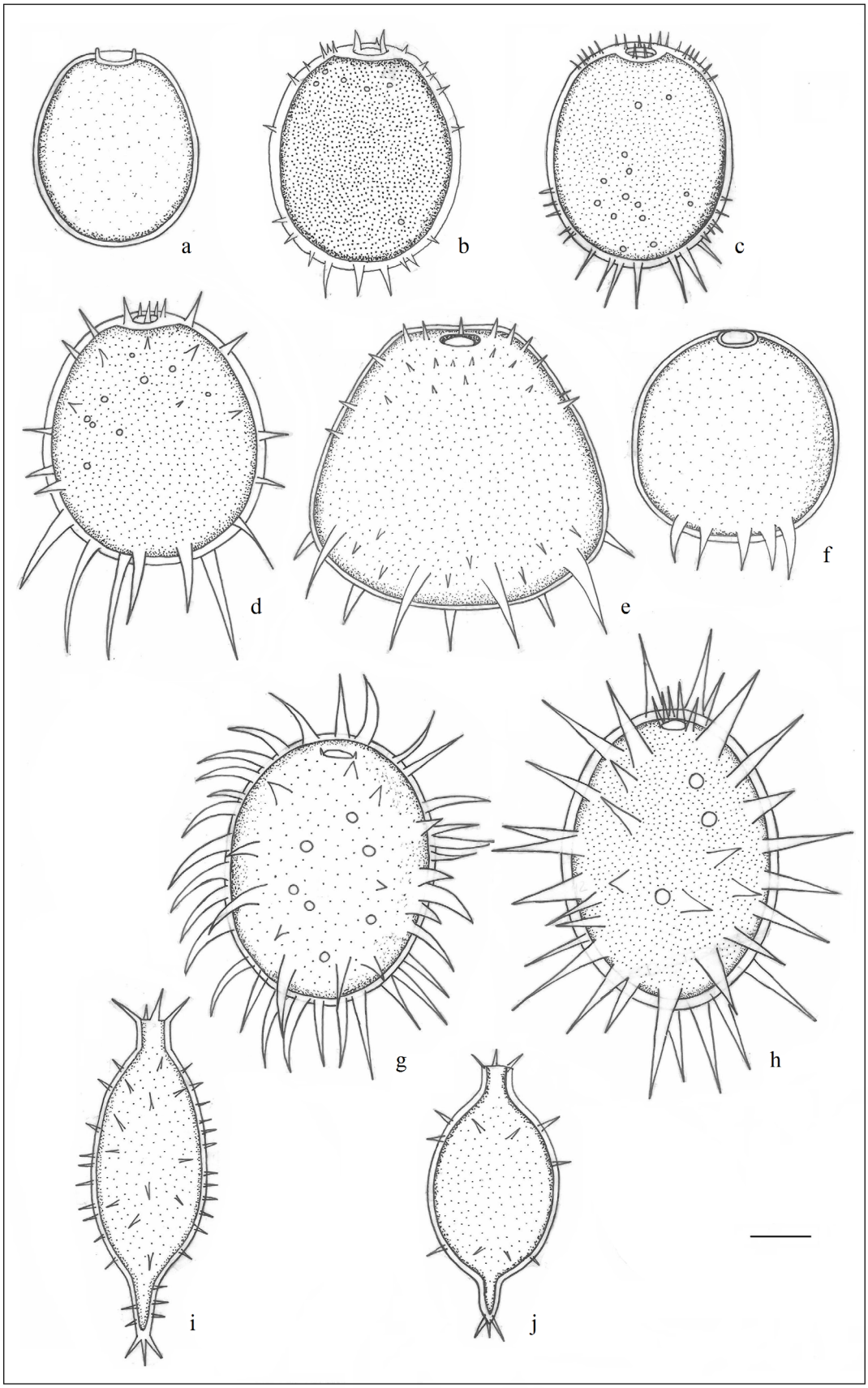

Figure 4. a. *Trachelomonas armata* var. *armata* f. *inevoluta*, b. *T. armata* var. *steinii*, c. *T. armata* f. *pseudolongispina*, d. *T. armata* var. *longispina*, e. *T. pyramidata*, f. *T. dangerdii* var. *glabra*, g. *T. spinosa* var. *hirsuta,* h. *T. spectabilis*, i. *T. dastugueii*, j. *T. acanthophora* var. *minor*.

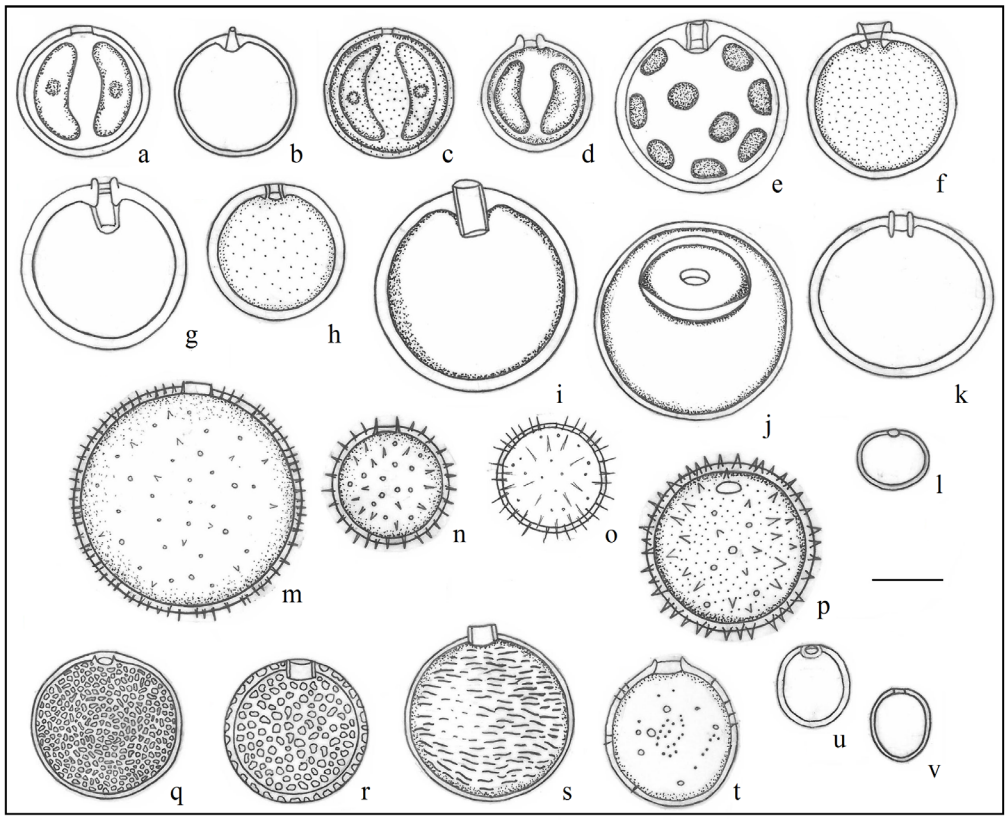

Figure 5. a. *Trachelomonas volvocina* var. *volvocina*, b. *T. volvocina* var. *scutella*, c. *T. volvocina* var. *punctata*, d. *T. volvocina* var. *derephora*, e. *T. volvocinopsis* var. *volvocinopsis*, f. *T. volvocinopsis* var. *coronata*, g. *T. volvocinopsis* var. *tubigera*, h. *T. volvocinopsis* f. *punctata*, i. *T. cervicula*, j. *T. komarovii*, k. *T. curta* var. *curta*, l. *T. curta* var. *minima*, m. *T. woicikii* var. *woicikii*, n. *T. woicikii* var. *pusilla*, o. *T. sparsesetulosa*, p. *T. globularis* f. *punctata*, q. *T. nexilis*, r. *T. sculpta*, s. *T. rugulosa* f. *steinii*, t. *T. granulosa* var. *granulosa*, u. *T. oblonga* var. *truncata*, v. *T. oblonga* var. *attenuata.*

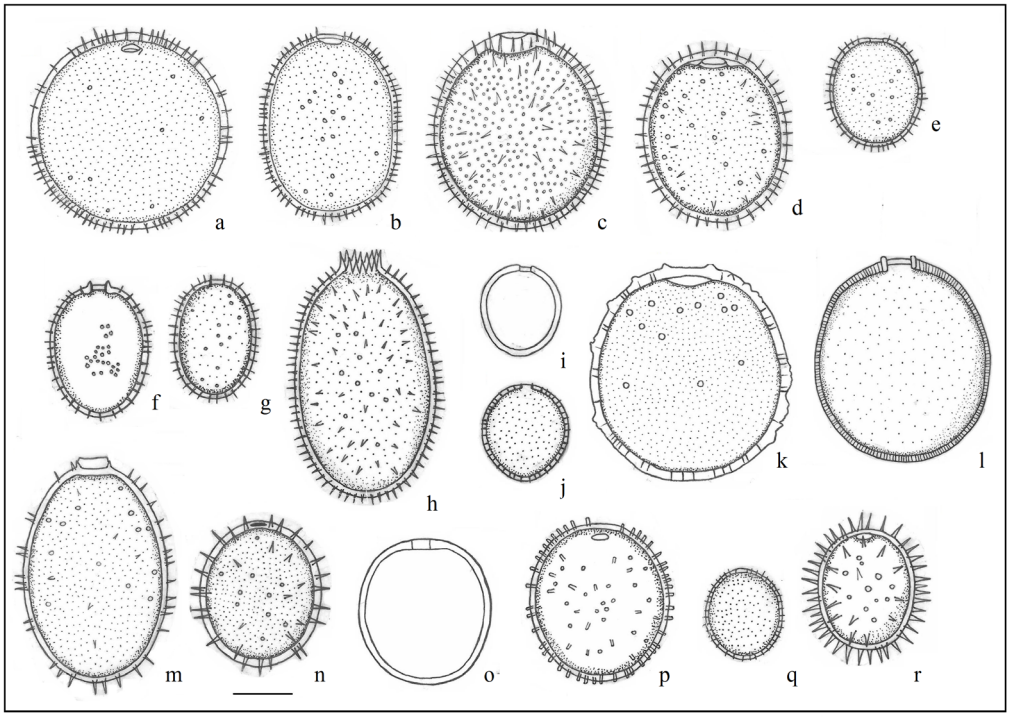

Figure 6. a. *Trachelomonas globularis* f. *gigas*, b. *T. hispida* var. *hispida*, c-d. *T. superba*, e. *T. hispida* var. *hispida* f. *minor*, f. *T. hispida* var. *punctata*, g. *T. hispida* f. *minima*, h. *T. hispida* var. *coronata*, i. *T. pusilla* var. *pusilla*, j. *T. pusilla* var. *punctata*, k. *T. granulosa* var. *subglobosa*, l. *T. rotunda*, m. *T. hispida* var. *crenulatocollis*, n. *T. robusta*, o. *T. dybowski*, p. *T. bacillifera* var. *minima*, q. *T. intermedia*, r. *T. hirta.*

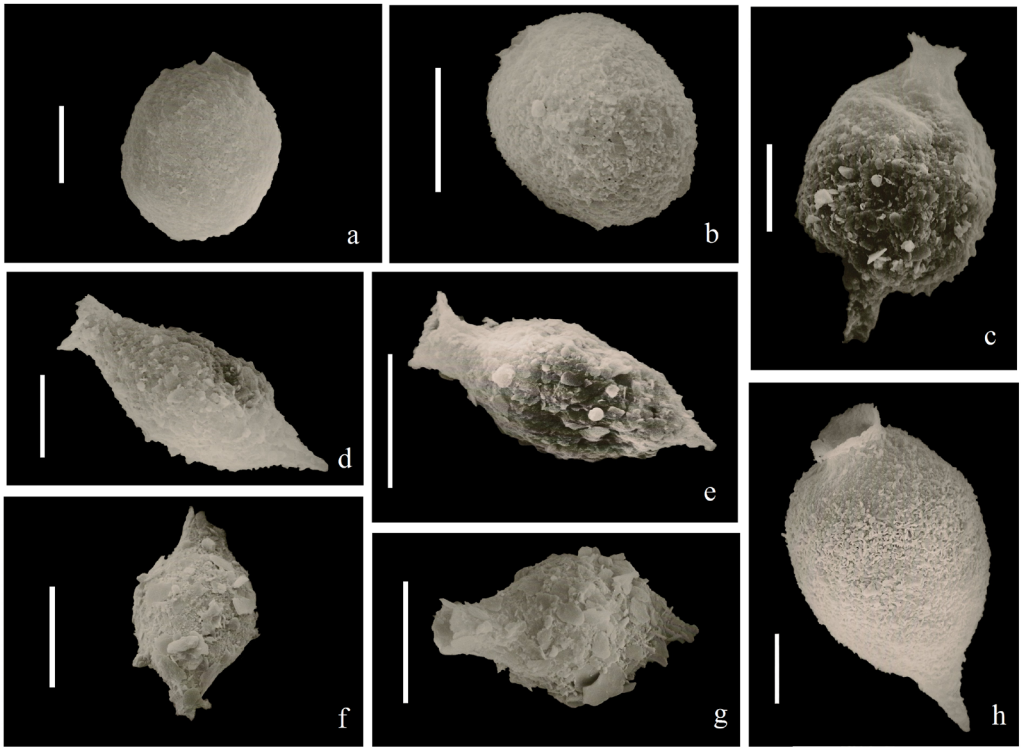

Figure 7. a-b. *Strombomonas eurystoma* f. *incurva*, c. *S. verrucosa* var. *zmiewika*, d-e. *S. lanceolata*, f. *S. asymmetrica*, g. *S. globulos*a, h. *S. napiformis* var. *brevicollis*.

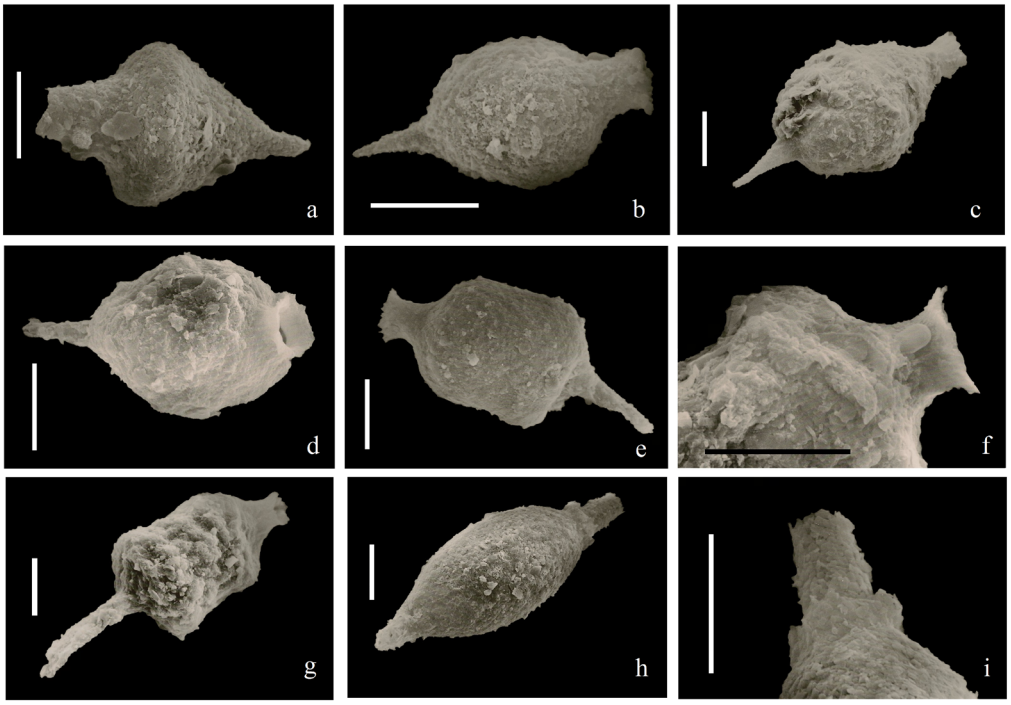

Figure 8. a. *Strombomonas schauinslandii* var. *schauinslandii*, b. *S. fluviatilis*, c. *S. costata*, d. *S. acuminata* var. *deflandeana*, e-g. *S. girardiana*, e. general view, f. detail of neck, g. lorica showing surface covered by particulate material, h-i. *S. scabra* var. *hiperintermedia*, h. general view showing lorica surface covered by particulate material, i. detail of neck.

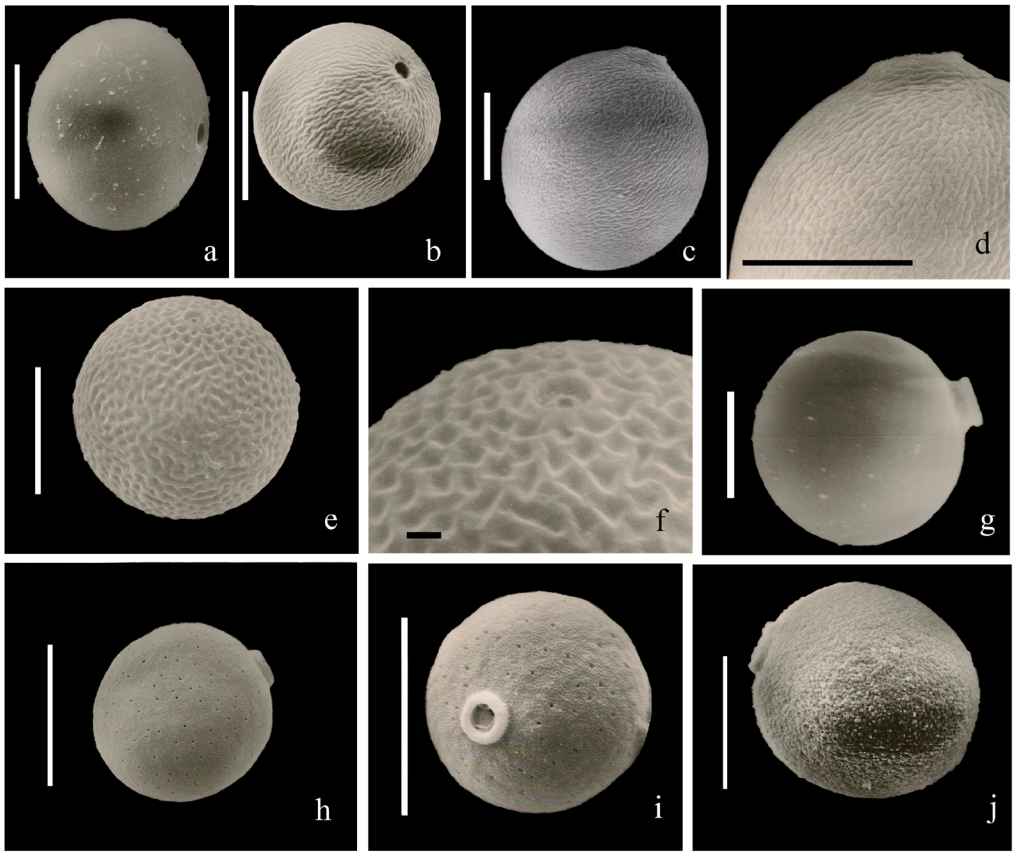

Figure 9. a. *Trachelomonas curta* var. *curta*, b. *T. rugulosa* f. *steinii*, c. *T. stokesiana* var. *conradi*, d. detail of the lorica surface, e-f. *T. nexilis*, e. general view, f. detail of lorica surface and apical pore, g. *T. volvocina* var. *derephora*, h-i. *T. diploperforata*, j. *T. irregularis*.

Figure 5 j

Loricas spherical, smooth, they presented a wider range of dimensions than those described by Huber-Pestalozzi (1955), 15-34.5 µm in diameter. Known in Europe: Czech Republic, Poland, Slovakia; North America: USA; Asia: Manchuria. It is the first record in Colombia, Caribbean and Amazon regions.

Trachelomonas lacustris Drez., Kosmos, 50:217, pl.2, fig.67. 1925.

Figure 2 g

Loricas 25.5-27 µm long, 15.5-17 µm wide. Cosmopolitan. It was cited in the Brazilian Amazon (Rodrigues 1992, Menezes *et al.* 1995) and the Caribbean region in Cuba (Comas González, 2009). This is the first record for Colombia.

Trachelomonas lemmermannii* var. *lemmermannii Wołosz., Bull. Int. l'Acad. Sci. Crac., Cl. Sc. Mat. Nat. Ser. B, Sc. Nat: 696, fig.19D. 1912.

Figure 2 p

Loricas 21.5-23.5 µm long, 13-14 µm wide. Widespread. This species was previously cited in the Amazon region from Bolivia (Couté & Therezién 1985) and Brazil (Rodrigues 1992). In the Venezuela Caribbean region previously cited by Yacubson & Bravo (1982). It is the first record for Colombia.

Trachelomonas lemmermannii* var. *acuminata (Wołosz.) Defl., Nemours: 95, pl.7, fig.404,407-409. 1926.

Figure 3 e

The studied specimens were longer than those described by Balech (1944), loricas 39-41 µm long, 17-19 µm wide. This variety differs from the type because the sides of the posterior cone are straight or concave rather than convex. Known in France and Argentina. It is the first record for Colombia and its Amazon region.

Trachelomonas megalacantha* var. *crenulatocollis (Cunha) Bourr. & Manguin, Soc. d'Edition d'Enseignement sup. 184, pl. 23, fig.322-323. 1952.

Figures 12 g-h

Loricas 48-50 µm long, 23-29 µm wide. Their ultrastructure was coincident with the described by Conforti & Nudelman (1994) and Conforti (1999). This species was only cited from South America: Argentina and Brazil. It is the first record for Colombia and the Caribbean region.

Trachelomonas molesta Defl., Rev. Algol. 3(1-2): 223, fig.74. 1928.

Figure 3 n

The loricas were smaller than those described by (Yacubson 1980, Yacubson & Bravo 1982-1983), 68-69 µm long, 22-23 µm wide. Previously recorded in Venezuela and Mexico. It is the first record for Colombia.

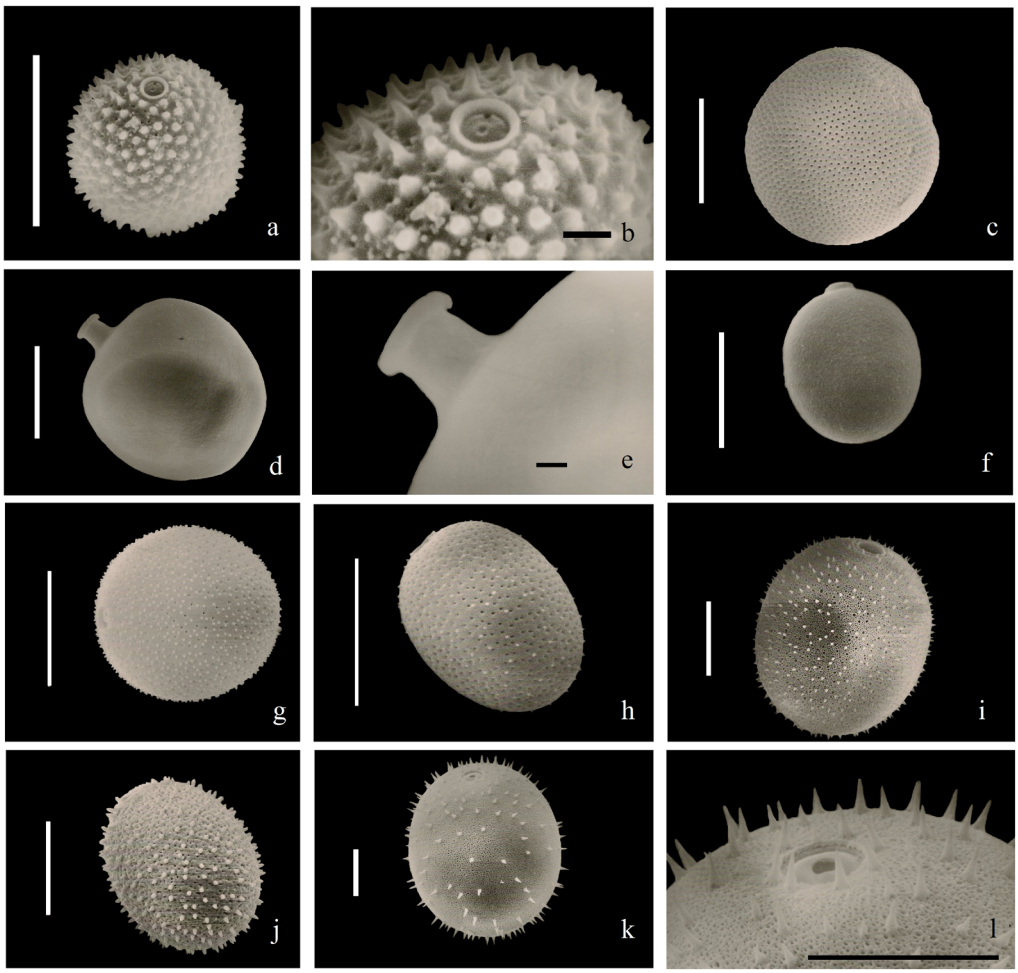

Figure 10. a-b. *Trachelomonas verrucosa* var. *macrotuberculata*, a. general view, b. apical view, showing detail of the pore, c. *T. rotunda*, d-e. *T. parvicollis*, d. general view, e. detail of the apical pore, f. *T. oblonga* var. *australica*, g. *T. verrucosa* var. *verrucosa* f. *irregularis*, h. *T. nigra*, i-j. *T. hispida* var. *hispida*, i. immature specimen, j. mature specimen, k-l. *T. kellogii* var. *effigurata*, k. general view of the lorica, l. detail of the apical pore.

Trachelomonas nexilis Palmer, Proc. Acad. Nat. Sci: 16, pl.I, fig.1. 1925.

Figs. 5 q, 9 e-f

Loricas 18-19 µm diameter. Their ultrastructure was coincident with the described by Conforti & Tell (1986, 1989), Conforti (1993a, 2010), Conforti & Pérez (2000), Duangjan *et al.* (2012). Widespread. This species was previously cited for the Brazilian Amazon by Rodrigues (1992) and Conforti (1993a). It is the first record for Colombia and the Caribbean region.

Trachelomonas nigra Swk., Arch. Hydrobiol. 9: 635, pl.19: figs.13-14. 1914

Figure 10 h

Loricas 15-20 µm long, 11-14 µm wide, broadly ellipsoid, irregularly punctuated (235/100 µm^2), slightly and irregularly papillate. Pore (2.5-3 µm diam.) surrounded by an annular thickening. Widespread. This record is the first in America.

Trachelomonas oblonga **var.** ***attenuata*** (Lemm.) Playf., Proc. Linn. Soc. N. S. W. 40: 12, pl.I, figs. 22-23. 1915.

Figure 5 v

Loricas 8.5-15 µm long, 7-9 µm wide, ovoid, smooth. Widespread. In America: Brazil and Panama. It is the first record for Colombia.

Trachelomonas oblonga **var.** ***australica*** (Lemm.) Playf., Proc. Linn. Soc. N. S. W. 40: 12, pl.I, figs.17-21. 1915.

Figure 10 f

Loricas 14-15.5 µm long, 12-13.5 µm wide, ovoid, smooth. Pore surrounded by a very short collar (0.5-1×2.5-3 µm). This is the first time that this taxon was examined by SEM. Widespread. This variety was previously cited from the Caribbean region of Venezuela by Yacubson (1980), it is the first record for Colombia.

Trachelomonas oblonga **var.** ***truncata*** Lemm., Abh. Naturw. Ver. Bremen, 16:344. 1899.

Figure 5 u

Loricas 10-13 µm long, 8.5-10 µm wide. Widespread. This is the first record of this variety for Colombia and the Caribbean region.

Trachelomonas parvicollis Defl., Rev. Gén. Bot. 38:704, pl.23, fig.493. 1926.

Figs. 3 l, 10 d-e

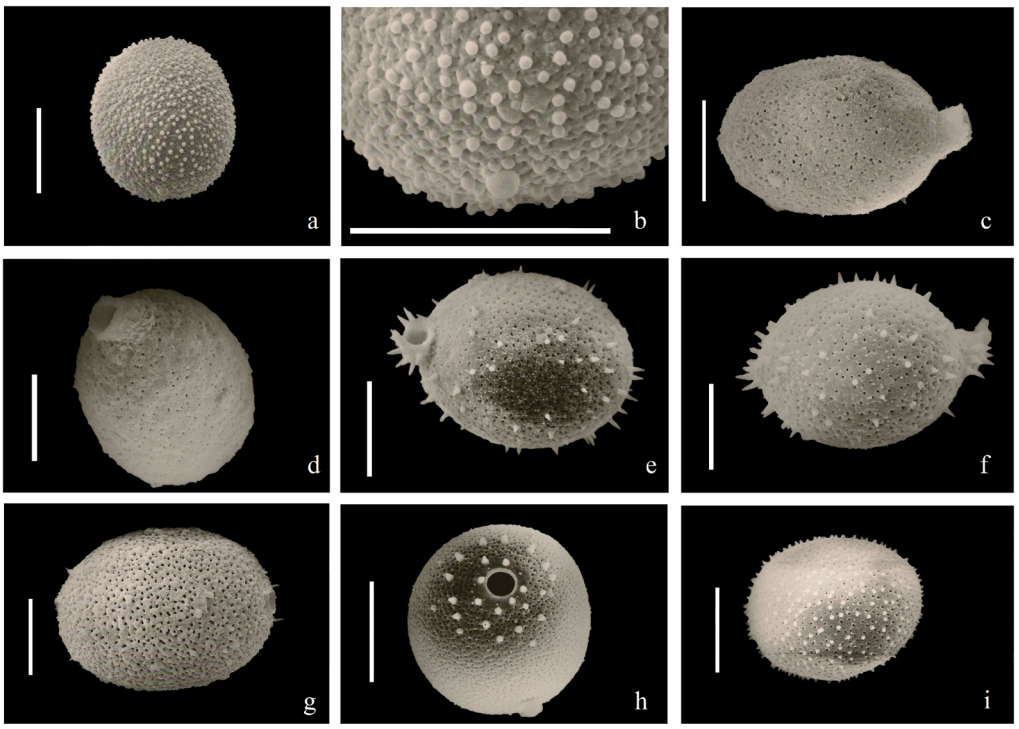

Figure 11. a-b. *Trachelomonas granulosa var. subglobosa,* a. general view, b. detail of the lorica ornamentation, c. *T. planctonica* var. *oblonga*, d. *T. similis var. similis*, e-f. *T. similis* var. *spinosa*, g. *T. raciborski* var. *incerta*, h. *T. raciborski* var. *raciborski*, i. *T. stokesii*.

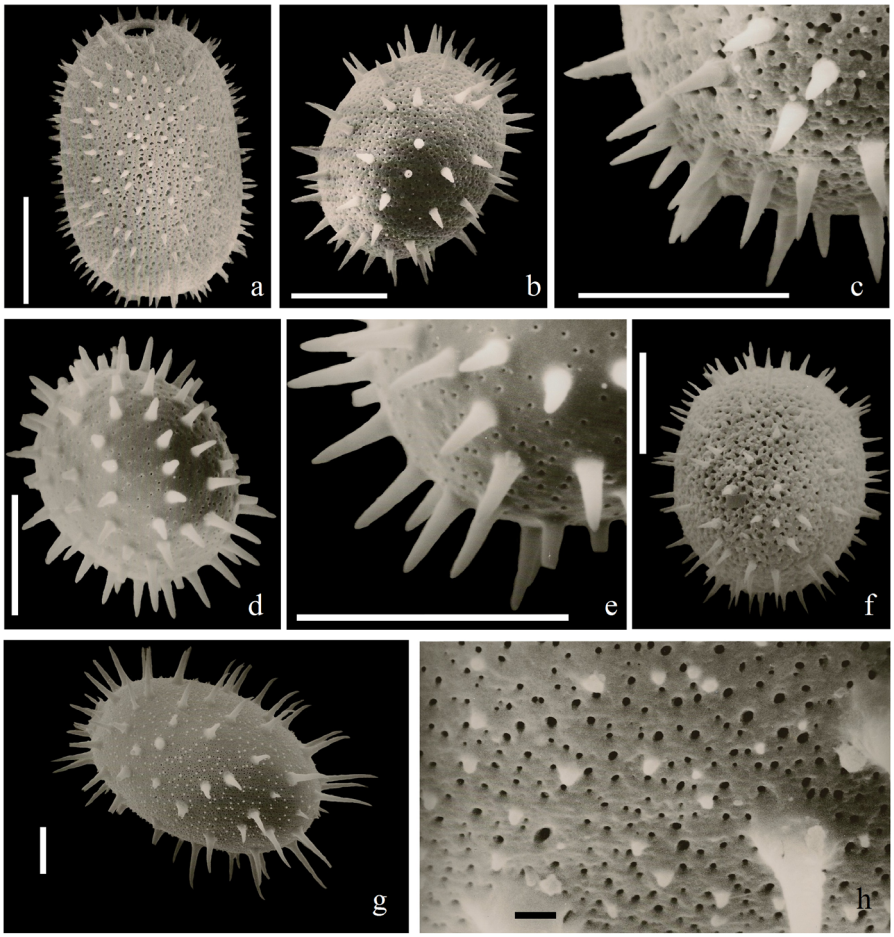

Figure 12. a. *Trachelomonas allia*, b-e. *T. hirta,* b. general view of an immature lorica, c. detail of lorica of an immature lorica, d. general view of a mature lorica, e. detail of lorica of a mature lorica, f. *T. robusta*, g-h. *T. megalocantha* var. *crenulatocollis*, g. general view, h. detail of lorica ornamentation.

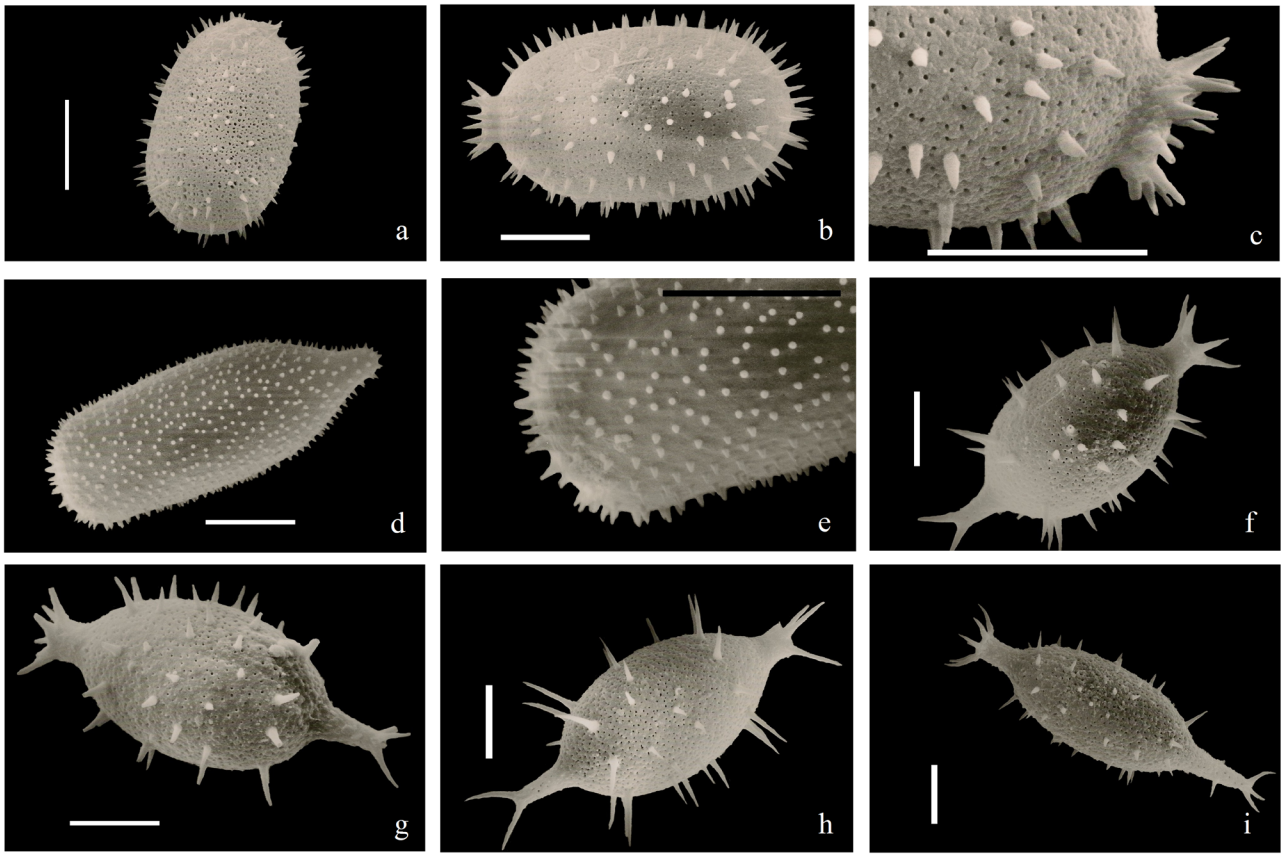

Figure 13. a. *Trachelomonas sydneyensis* var. *minima*, b-c. *T. sydneyensis* var. *sydneyensis*, b. general view, c. apical view, showing detail of the neck, d-e. *T. gracillima*, d. general view, e. detail of lorica surface, f. *T. acanthophora* var. *acanthophora*, g. *T. acanthophora* var. *minor*, h. *T. pisciformis*, i. *T. dastuguei*.

Loricas 17-19.5 µm long, 16-17 µm wide, from subspherical to broadly ellipsoidal, anterior end somewhat flattened, posterior end rounded. Pore surrounded by a neck of very characteristic shape (3-3.5×2-2.5 µm), cylindrical, right, with a wide annular thickening at its distal edge (3.5-4 µm diam.). It is the first time that this taxon was examined by SEM. It was only recorded from warm areas of Argentina, and the Caribbean region of Venezuela, this is the first record for Colombia.

Trachelomonas pisciformis Prescott, Ohio J. Sc. 55:117, pl.I, fig.20. 1955.

Figure 13 h

Loricas 43-48 µm long, 19-25 µm wide, spindle shaped, punctate, with long conical spines scattered (6-8.5 µm). Anterior end narrowed into a cylindrical collar (4.5-5.5 × 5-5.5 µm) surrounded at the distal end by a crown of 4-5 robust conical spines (6.5-7 µm long). Posterior end with a subconical tail (5.5-6 µm long) ornate with 3 spines (6.5-7 µm). Previously reported by Prescott (1955) in the Panama Canal, this is the first registration for Colombia.

Trachelomonas planctonica **var.** ***oblonga*** Drez., Rozpr. Wiad. Muz. Dzieduszyckich 7/8:6,15, pl.I, fig.14. 1923.

Figures 3 c, 11 c

Loricas 24.5-28 µm long, 15-20 µm wide. Cosmopolitan. Known in America: Argentina, Venezuela, and USA. This is the first record for Colombia.

Trachelomonas pulcherrima **var.** ***minor*** Playf., Proc. Linn. Soc. N.S.N. 40:14, pl.I, figs.37-38. 1915.

Figure 2 j

Loricas 17.5-19 µm long, 9-11 µm wide. Widespread. Known in South America: Argentina, Brazil; North America: Laurentian Great Lakes and Northwest Territories in Canada. This is the first record of the variety for Colombia and the Caribbean region.

Trachelomonas pusilla **var.** ***punctata*** Playf., Proc. Linn. Soc. N. S. W. 40: 12, pl.I, fig.27. 1915.

Figure 6 j

Loricas 13-17 µm long, 10.5-13 µm wide. Known in South America: Argentina and Brazil, Caribbean Islands: Cuba, North America: USA, Asia: Taiwan, Australia and New Zealand. This is the first record of the species for the Amazon region of Colombia.

Trachelomonas pusilla **var.** ***pusilla*** Playf., Proc. Linn. Soc. N. S. W. 40: 12, pl.I, fig.25. 1915.

Figure 6 i

Loricas 13-17 µm long, 10.5-13 µm wide. Widespread. This is the first record of the species for the Caribbean and Amazon regions of Colombia.

Trachelomonas pyramidata Couté & Thérézien, Rev. Hydrobiol. Trop. 18(2): 115, pl.VI, figs.7-8. 1985.

Figure 4 e

Loricas trapezoidal, 35-47 µm long, the observed specimens were broader than those described by Couté & Thérézien (1985) 48-50 µm wide. This species was only recorded in temperate regions of America: Argentina and Brazil (as *T. armata* var. *litoralensis*), Bolivia, Venezuela (as *T. armata* var. *trapeciformis*), previously registered from Colombia by Duque 1995; Duque & Nuñez Avellaneda 2000, this is the first record for the Caribbean region.

Trachelomonas raciborskii* var. *raciborskii Wołosz., Bull. Int. l'Acad. Sci. Crac., Cl. Sc. Mat. Nat. Ser. B, Sc. Nat: 696, fig.19F. 1912.

Figures. 2 l, 11 h

Loricas 32-34.5 µm long, 25.5-28 µm wide. Widespread. Previously reported in the Amazon region from Brazil (Rodrigues 1992, Conforti 1993a) and Bolivia (Couté & Thérézien 1985). Earlier cited for the Caribbean area in Cuba (Comas González, 2009). This is the first record for Colombia.

Trachelomonas raciborskii* var. *incerta Drez. Kosmos 50(1): 221, fig. 55. 1925.

Figs. 2 o, 11 g

Loricas 28-30 µm long, 20-21 µm wide, strongly punctuated, ornate by very few and short conical spines (1-1.5 µm long) located on both ends. Pore 3-3.5 µm diam. surrounded by a fine annular thickening. The ultrastructure of the studied specimens differ from that described by Conforti & Nudelman (1994), probably we observe young loricas. Known in Argentina, Colombia, Venezuela and Poland. Previously cited in the Colombian Amazon by Conforti & Nudelman (1994) in materials from Lago Buutaa, Rio Cotuhé.

Trachelomonas raciborskii* var. *nova* f. *minor Hortob., Magyar. Biol. Kutatóint. Munk 15:93, pl. III, fig. 74. 1943.

Figure 2 n

Loricas 21-30 µm long, 17-24.5 µm wide, finely punctuated, ornate by short conical spines (1-1.5 µm long) distributed only around the anterior end. Pore 2.5-3 µm diam. surrounded by a fine annular thickening. This is the first time that this variety is studied by SEM. Known in Argentina, Brazil and Hungary. It is the first record for Colombia and the Caribbean region.

Trachelomonas raciborskii* var. *nova* f. *nova Drez., *Kosmos* 50(1):221, fig. 52. 1925.

Figure 2 m

The loricas dimensions were coincident with those indicated by Duque (1995) description, 31-33 µm long, 27-29 µm wide. Known in Argentina, Colombia and Poland. In Colombia was cited in its Amazon area by Duque (1995) and Duque & Nuñez Avellaneda (2000), this is the first record for the Caribbean region.

Trachelomonas recticollis Defl., Rev. Gén. Bot. 38:703. 1926.

Figure 3 k

Loricas 19-21 µm long, 16.5-18 µm wide. Widespread. Known in South America: Argentina and Brazil.This species was previously cited in the Caribbean region of Venezuela (Yacubson & Bravo 1982-1983), this is the first record for Colombia.

Trachelomonas robusta (Swk.) Defl., Rev. Gén. Bot. 38:657. 1926.

Figs. 6 n, 12 f

Loricas 19-23 µm long, 16-20.5 µm wide. Their ultrastructure was coincident with others previous MEB studies (Couté & Iltis 1981, Conforti & Tell 1986, Couté & Thérézien 1985, Conforti 1993a, Conforti & Nudelman 1994, Conforti & Ruiz 2001, Wołowski & Walne 2007 and Da *et al*. 2009). Cosmopolitan. In South America: Argentina, Bolivia, Brazil, Colombia and Venezuela. This species was previously cited in the Colombian Amazon (Duque & Nuñez Avellaneda 2000), this is the first record by the Caribbean region.

Trachelomonas rotunda Swk., Arch. Hydrobiol. 9:636, pl.9, fig.19. 1914.

Figs. 6 l, 10 c

Loricas 30-34 µm long, 27-31 µm wide. Widespread. In South America: Argentina and Brazil. This species was cited for the Amazon region in Brazil (Rodrigues 1992). This is the first record for the Caribbean and Amazon regions of Colombia.

Trachelomonas rugulosa* f. *steinii Defl., Rev. Gén. Bot. 38:581, pl.16, fig.88. 1926.

Figs. 5 s, 9 b

The loricas studied were smaller than those studied by Conforti & Nudelman (1994), 17-18 µm diam, but they showed similar ultrastructure. Known in America: Colombia; Europe: France and Austria. In the Amazon region of Colombia this forma was previously cited by Conforti & Nudelman 1994 and Duque & Nuñez Avellaneda 2000. This is the first record for the Caribbean region.

Trachelomonas sculpta Balech, An. Mus. Argent. Cienc. Nat. 41:245. fig.32, 167. 1944.

Figure 5 r

Loricas were smaller than those described by Conforti (1993a), 16-18 µm diameter. This species was only recorded in South America: Argentina and the Amazon region of Brazil (Rodrigues, 1992; Conforti, 1993a). This is the first record of this species for the Caribbean and Amazon regions of Colombia.

Trachelomonas similis* var. *similis Stokes, Proc. Am. Phil. Soc., 28:76. fig.12. 1890.

Figs. 3 f, 11 d

Loricas 23-25.5 µm long, 15-17.5 µm wide. Their ultrastructure was coincident with those described by Conforti & Tell (1986), Couté & Thérézien (1985), Conforti (1993a), Conforti & Nudelman (1994), Wołowski & Walne (2007), Conforti (2010). Widespread. In the Caribbean region, it was recorded for Venezuela (Yacubson & Bravo

1982-1883) and Panama (Prescott 1955). In the Amazon region was recorded from Bolivia (Couté & Thérézien 1985) and Brazil (Rodrigues 1992, Bittencourt-Oliveira 1997 and Conforti 1993a). It is the first record for Colombia.

Trachelomonas similis* var. *hyalina Skv., Arch. Protistenk 90:80, pl.10, fig.27. 1937.

Figure 3 g

Loricas 23-24.5 µm long, 14.5-15.5 µm wide, smooth, hyaline. This variety showed the same characteristics as the species type but without punctuations. Known by the Czech Republic, Thailand and India. This is the first record of this species for America.

Trachelomonas similis Stokes var. ***spinosa*** Hub.-Pest., Phytoplank. Süsswasser, v. 16, n. 4, p. 342, pl. 73, fig. 722a, 1955.

Figures 3 h, 11 e-f

Loricas 25-28 µm long, 15-18. 5 µm wide. Their ultrastructure was coincident with those described by Couté & Thérézien (1985), Conforti & Tell (1986), Rino & Pereira (1989-1990), Conforti (1993a), Conforti & Nudelman (1994), Conforti (1999), Conforti & Ruiz (2001), Wołowski & Walne (2007), Conforti (2010). Widespread. For the Amazon region was recorded in Bolivia (Couté & Thérézien 1985), Brazil (Conforti 1993a) and Tarapoto Lake, Amazonas River, Colombia (Conforti & Nudelman 1994). It is the first record for the Caribbean region of Colombia.

Trachelomonas sparsesetulosa Hub.-Pest., Phytoplankton Süsswassers 4:257, fig.370. 1955.

Figure 5 o

The observed organisms were similar to those described by their author, 17-18.5 µm diameter. Known by Switzerland and India. This is the first record of this species for America, found in Pozo Hondo, Sinu River, Colombia.

Trachelomonas spectabilis Defl., Rev. Gén. Bot. 38:687, pl.19, figs.284-285. 1927.

Figure 4 h

Loricas 51-67 µm long, 31-45 µm wide. Known in North America: Laurentian Great Lakes, Asia: India, Australia and New Zealand. In the Caribbean region this species was previously cited by Presscot (1955). This is the first record for Colombia and its Amazon region.

Trachelomonas spinosa* var. *hirsuta Couté & Thérézien., Rev. Hydrobiol. Trop. 18(2):116, pl.III,

fig.5-8, pl. XIII, fig.4 .1985.

Figure 4 g

The observed loricas, without spines, were longer than those studied by Conforti (1993a), 45-47 µm long, 30-33 µm wide. This variety was described in materials from warm zones of Bolivian Amazonian (Couté & Thérézien, 1985), Camaleão Lake, Brazil (Conforti, 1993a) and Chaco, Argentina (Conforti, 1999). It is the first record for Colombia.

Trachelomonas stokesii Drez. Kosmos 50(1): 222, fig. 84. 1925.

Figure 11 i

Loricas 9-22 µm long, 14-17 µm wide, ovoid, anterior end wide rounded, posterior end shaper, finely punctuated, ornate by short conical spines (1-1.5 µm long). The study of their ultrastructure showed spines longer than those present in the specimen photographed by Rino & Pereira (1989-90). Pore without a neck. Widespread. Known in South América: Argentina. It is the first record for Colombia, and the Caribbean region.

Trachelomonas stokesiana var. conradi (Defl.) Hub.-Pest., Phytoplankton Süsswassers 4:265. 1955.

Figures 9 c-d

Loricas broadly ellipsoid to ovoid, they were bigger than those described by Conforti (2010) as *T. conradi*, 21-26 µm long, 20-23.5 µm wide. The study of their ultrastructure showed similar ornamentation than those photographed by the mentioned author, but the depressions were less pronounced. Known in América: USA; Europe: Belgium, France. It is the first record for Colombia, the Caribbean and Amazon regions.

Trachelomonas sydneyensis* var. *sydneyensis Playf., Proc. Linn. Soc. N. S. W. 40: 22, pl. IV, figs. 15-16. 1915.

Figures 3 d, 13 b-c

Loricas 36.5-44 µm long, 23-26 µm wide. Their ultrastructure was coincident with those described by Conforti & Tell (1986), Conforti (1993a), Conforti (1999), Da *et al*. (2009). Widespread. This species was previously cited in the Amazon region from Brazil (Thomasson 1971, Rodrigues 1992 and Conforti 1993a). From the Caribbean region was previously cited by Yacubson (1980) in Venezuela. This is the first record for Colombia.

Trachelomonas sydneyensis* var. *minima Playf., Proc. Linn. Soc. N. S. W. 40: 23, pl. IV, fig. 18. 1915.

Figure 13 a

Loricas 23-25 µm long, 15.5-18 µm wide. Their ultrastructure was coincident with those described by Conforti & Tell (1989), Conforti (1999), Conforti & Pérez, (2000), Conforti & Ruiz (2001), Wołowski & Walne (2007), Conforti (2010). Widespread. Known in America: Argentina, Brazil, Uruguay and USA. This is the first record of the species for the Caribbean region and Colombia.

Trachelomonas verrucosa* var. *macrotuberculata (Stokes) Grandori, Bachic. R. Ist. sup. agr. Milano, 4. 1935.

Figures 10 a-b

Loricas 10-12 µm diam., pore 1.5-2 µm diam. Their ultrastructure was similar to that shown by Wołowski & Walne (2007). Known in Spain, Italy and the USA. This species is recorded for the first time in Colombia and its Caribbean region.

Trachelomonas verrucosa* var. *verrucosa* f. *irregularis
Defl., Rev. Gén. Bot. 38:580, pl.16: fig.80. 1926.

Figure 10 g

Loricas subspherical, 16-17 µm long, 15-16 µm wide. Pore 1.5-2 µm diameter. Their ultrastructure was similar to those showed by Couté & Iltis (1981), Rino & Pereira (1989-1990), Conforti & Joo (1994), Conforti & Ruiz (2001), Da *et al.* (2009) and Conforti (2010). Widespread. Known in America: USA. This is the first record of the species for the Caribbean region and Colombia.

Trachelomonas volvocina* var. *volvocina Ehr., Abh. K. Ak. Wiss. Berlin, Physik KI: 315, pl.VII, Figures III. 1834.

Figure 5 a

Loricas spherical 15-22.5 µm diameter, smooth. Cosmopolitan. This variety was previously reported in the Amazon region of Brazil (Thomasson 1971, 1977, Uherkovich y Schmidt 1974, Rodrigues 1992, Menezes *et al.* 1995, Bittencourt-Oliveira 1997) and in the Caribbean region of Venezuela (Yacubson 1980, Yacubson & Bravo 1982-1983), Panama (Prescott 1955) and Cuba (Comas González, 2009). This is the first record for Colombia.

Trachelomonas volvocina* var. *derephora Conrad, Ann. Biol. Lacustre 8: 201, pl.I, fig.3. 1916.

Figures 5 d, 9 g

Loricas 15-23 µm diameter, spherical, smooth. Collar 1.5-2×4.5-5 µm. Their ultrastructure was coincident with those described by (Conforti 1993a, 1999; Wołowski & Walne 2007; Da et *al.* 2009; Conforti 2010). Widespread. This variety was previously cited in the Caribbean region for Venezuela (Yacubson 1980, Yacubson & Bravo 1982-1983), Cuba (Comas González, 2009) and the Amazon region of Brazil (Rodrigues 1992, Conforti 1993a). It is the first record for Colombia.

Trachelomonas volvocina* var. *punctata Playf., Proc. Linn. Soc. N. S. W. 40: 9, pl. I, fig. 2. 1915.

Figure 5 c

Loricas 15-18.5 µm diameter. Widespread. This variety was previously cited in the Amazon region from Brazil (Rodrigues 1992, Conforti 1993a) and Colombia (Duque & Nuñez Avellaneda 2000). This is the first record for the Caribbean region.

Trachelomonas volvocina* var. *scutella Schiller, Arch. Protistenk. 56(1):32, fig.28b. 1926.

Figure 5 b

Loricas 14.5-16 µm diameter. This variety presents an anterior slit surrounded by a thin, short neck. Known for South America: Brazil; Europe: Belgium and Germany; Asia: Indonesia. This variety is recorded for the first time for Colombia and the Caribbean region.

Trachelomonas volvocinopsis* var. *volvocinopsis Swk., Arch. Hydrobiol. Planktonic., 9:633. pl. 19. Figs. 1-3. 1914.

Figure 5 e

Loricas spherical 13-22 µm diameter, smooth. This variety was previously cited in the Amazon region from Bolivia (Couté & Thérézien 1985), Brazil (Rodrigues 1992) and Colombia (Duque & Nuñez Avellaneda 2000). This taxon was cited in the Caribbean region by Yacubson (1980) for Venezuela and by Comas González (2009) for Cuba. It is recorded for the first time in Colombia.

Trachelomonas volvocinopsis* var. *coronata (Skv.) Bourr., Hub.-Pest. Phytoplank. Süsswasser 4:260. 1955.

Figure 5 f

Loricas spherical, 18-19.5 µm diameter. This taxon was registered in India and Burma. It is their first record for America, it was found in the Sinú River, Caribbean region of Colombia.

Trachelomonas volvocinopsis* f. *punctata (Roll) Pop., Opred. Presnov. Vodor. USSR 7:85, pl. I, fig. 19. 1955.

Figure 5 h

Loricas 17-21 µm diameter. Known in South America: Argentina and Brazil; Europe: Netherlands; Australia. This variety was previously cited in Antilles (Guadeloupe Island by Bourrelly & Manguin 1952) and the Amazon region of Brazil (Rodrigues 1992, Menezes *et al.* 1995). It is the first record for Colombia.

Trachelomonas volvocinopsis* var. *tubigera (Skv.) Bourr. Hub.-Pest. Phytoplank. Süsswasser 4: 254. 1955.

Figure 5 g

Loricas 20-21.5 µm diam. This variety was previously cited in India and Burma. It is their first record for America; from Purísima and Pozo Hondo, Sinu River, Colombia.

Trachelomonas woycickii* var. *woycickii Koczwara, Kosmos 40(7-12):260, pl.1, fig.10. 1915.

Figure 5 m

Loricas spherical, 20-29.5 µm diameter. Widespread. This is the first record for Colombia and the Caribbean region.

Trachelomonas woycickii* var. *pusilla Drez., Kosmos 50(1):225, fig.15. 1925.

Figure 5 n

Loricas 11.5-16.5 µm diam. Widespread. This is the first record for Colombia and the Caribbean region.

Discussion

The tychoplanktonic algae community present in the Sinú River was composed of 78 taxa belonging to *Trachelomonas* (67) and *Strombomonas* (11). In addition, the same community in Putumayo River and its basin presented 36 taxa belonging to *Trachelomonas* (32) and *Strombomonas* (4). Only two species integrated this community in the Ortegüaza and Caqueta basins. Fifty-three taxa were found exclusively in the Sinú River. In the Amazonian region, 11 taxa were found exclusively in Putumayo River and its basin, and 3 in the Orteguaza and Caqueta basins.

The phytoplanktonic community in the Sinú River was composed of 78 taxa belonging to *Trachelomonas* (67) and *Strombomonas* (11). The same community in Putumayo River and its basin was composed of 56 taxa belonging to *Trachelomonas* (49) and *Strombomonas* (7). In Orteguaza and Caqueta basins the phytoplanktonic

community was represented by only 8 taxa belonging to genus *Trachelomonas*. In the Magdalena River no euglenoids were found.

Table 2 lists the total taxa found in the materials studied. Among the taxa described for the first time seventy-nine were from Colombia, seventeen and sixty were from the Amazonian and Caribbean regions respectively. Six species were recorded for the first time in America: *T. nigra* was found in La Herradura (Putumayo River), *T. diploperforata* in Barbudo (Sinú River), *T. similis* var. *hyalina*, T. *sparsesetulosa* and *T. volvocinopsis* var. *coronata* in Pozo Hondo (Sinú River) and *T. volvocinopsis* var. *tubigera* in Purísima and Pozo Hondo (Sinú River).

Among the total studied taxa, 46 were examined and photographed by scanning electron microscopy, 9 of them were studied for the first time: *S. acuminata* var. *deflandreana*, *S. girardiana*, *S. globulosa*, *S. lanceolata*, *S. schauinslandii* var. *schauinslandii, T. acanthophora* var. *acanthophora*, *T. oblonga* var. *australica*, *T. parvicollis* and *T. raciborskii* var. *nova* f. *minor*.

The present work provides a taxonomic survey of species previously recorded in studies developed in the Amazon and Caribbean regions and greatly increases the knowledge of its biodiversity. Additionally, new taxonomic data such as new metric limits and ultrastructural details of the loricas are described.

Although the Euglenophyta are better represented in the phytoplankton community, this work shows clearly that its biodiversity is underestimated if the tychoplankton community is not also included.

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Conflict of interests

There is no conflict of interest.

Authors contributions

Analía Alejandra Tolivia: Contribution in the concept and design of the study; observation and drawings of species under an optical microscope and their identifications. Contribution to data analysis and interpretation. Contribution to manuscript preparation.

Visitación Conforti: Contribution in the concept and design of the study; preparation of materials to be observed by means of MEB and identifications of species. Contribution to data analysis and interpretation. Contribution to manuscript preparation.

Marcela Núñez: Contribution to samples and data collection. Contribution to manuscript preparation.

Santiago Roberto Duque: Contribution to samples and data collection. Contribution to manuscript preparation.

Literature cited

Balech, E. 1944. Trachelom*onas* de la Argentina. Anales del Museo Argentino de Cs. Naturales "Bernardino Rivadavia" 41: 221-322.

Bittencourt-Oliveira, M.C. 1997. Euglenophyceae do reservatório de Balbina, Estado do Amazonas, Brasil. Hoehnea 24 (1): 21-35.

Bourrelly, P. & Manguin, E. 1952. Algues d'eau douce de la Guadeloupe et dépendances. Paris, Société d'Edition d'Enseignement Supérieur.

Ciugulea, I. & Triemer, R. 2010. A Color Atlas of Photosynthetic Euglenoids. Michigan State University Press, East Lansing.

Comas González, A. 2009. Catálogo de las algas y cianoprocariotas dulceacuícolas de Cuba. Cienfuegos: Editorial Universo Sur.

Conforti, V. 1989. Algunos euglenoideos nuevos o interesantes de la Argentina. Cryptogamie: Algology 10(1): 69-79.

Conforti, V. 1993a. Study of the Euglenophyta from Camaleâo lake (Manaus-Brazil). I. *Trachelomonas* Ehr. Revue d'hydrobiologie Tropicale 26 (1): 3-18.

Conforti, V. 1993b. Study of the euglenophyta from the Camaleão lake (Manaus, Brasil) II. *Strombomonas* DEFL. Revue d'hydrobiologie Tropicale 26 (3): 187-197.

Conforti, V. 1994. Study of the euglenophyta from the Camaleão lake (Manaus, Brasil) III. *Euglena* EHR., *Lepocinclis* PERTY, *Phacus*, DUJ. Revue d'hydrobiologie Tropicale 27 (1): 3-21.

Conforti, V. 1998. Morphological changes of Euglenophyta in response to organic enrichment. Hydrobiologia 369/370: 277-285.

Conforti, V. 1999. Taxonomic and ultrastructural study of *Trachelomonas* Ehr. (Euglenophyta) from subtropical Argentina. Cryptogamie Algologie 20: 167-207.

Conforti, V. 2009. Floristic and ultrastructural study of the genus *Strombomonas* (Euglenophyta) from New Jersey fresh waters. Algological Studies 132:1-20.

Conforti, V. 2010. Ultrastructure of the lorica of *Trachelomonas* species (Euglenophyta) from New Jersey, U.S.A. Algological Studies 135: 15-40.

Conforti, V. & Joo, G.J. 1994. Taxonomic and ultrastructural study of *Trachelomonas* Ehr. and *Strombomonas* Defl. (Euglenophyta) from Oxbow Lakes in Alabama and Indiana (USA). Cryptogamie Algologie 15 (4): 267-286.

Conforti, V. & Nudelman, A. 1994. Ultrastructure of lorica of *Trachelomonas* Ehr. from Colombian Amazonia. Revue d'hydrobiologie Tropicale 27 (4): 301-314.

Conforti, V. & Peréz, M.C. 2000. Euglenophyceae of Negro River, Uruguay, South America. Algological Studies 97: 59-78.

Conforti, V. & Ruiz, L. 2001. Euglenophytes from Chunam reservoir (South Korea) II. *Trachelomonas* Ehr. Algological Studies 102: 117-145.

Conforti, V. & Tell, G. 1986. Ultraestructura de la loriga de *Trachelomonas* Ehr. (Euglenophyta) en Microscopio Electrónico de Barrido (MEB). Nova Hedwigia 43: 45-79.

Conforti, V & Tell, G. 1988. Les Euglenophytes de Terre de Feu (Argentine). Nova Hedwigia 46 (3-4): 305-319.

Conforti, V. & Tell, G. 1989. Ultrastructure of the pellicle and the envelope of some euglenoid flagellates from Argentina by means of S.E.M. Nova Hedwigia 48 (1-2): 187-206.

Conforti, V. & Zalocar de Domitrovic, Y. 2003. Ultrastructural study of *Strombomonas* (Euglenophyta) from the province of Chaco (Argentina). Boletín de la Sociedad Argentina de Botánica 38 (1-2): 5-12.

Couté, A. & Iltis, A. 1981. Ultraestructure stéréoscopique de la logette de *Trachelomonas* (Algae, Euglenophyta) récoltés en Côte d'Ivoire. Revue d'hydrobiologie Tropicale 14 (2): 115-133.

Couté, A. & Thérézien, Y. 1985. Première contribution à l'étude des *Trachelomonas* (Algae, Euglenophyta) de l'Amazonie bolivienne. Revue d'hydrobiologie Tropicale 18 (2): 111-131.

Couté, A. & Thérézien, Y. 1994. Nouvelle contribution à l'étude des Euglénophytes (Algae) de l'Amazonie bolivienne. Nova Hedwigia 58 (1-2): 245-272.

Da, K.P., Mascarell, G. & Couté, A. 2009. Étude au microscope électronique à balayage du genre *Trachelomonas* (Euglenophyta) dans le Sud-Est de la Côte d'Ivoire (Afrique de l'Ouest). Cryptogamie Algologie 30 (1): 31-90.

Deflandre, G. 1926. Sur quelques Euglenacees Nouvelles du Venezuela. Revue Algologique 1: 235-243.

Duangjan, K., Wołowski, K. & Peerapornpisal Y. 2012. A taxonomic and ultrastructural study of *Trachelomonas* spp. (Euglenophyta) from agricultural area pond, Lamphun Province. Journal of Microscopy Society of Thailand 5 (1-2): 23-27.

Duque, S. 1995. Euglenofitas pigmentadas de la Amazonia Colombiana. Revista de la Academia Colombiana de Ciencias Exactas, Físicas y Naturales 19 (75): 651-659.

Duque, S. & Nuñez Avellaneda, M. 2000. Microalgas acuáticas de la Amazonia Colombiana. Biota Colombiana 1 (2): 208-216.

Garduño Solórzano, G., Oliva Martínez M.G., Lugo Vázquez A., Mendoza Garfías M.B., Quintanar Zúñiga R. & Conforti, V. 2011. *Trachelomonas* (Euglenophyta) from an eutrophic reservoir in Central México. Journal of Environmental Biology 32: 463-471.

Guisande C., Barreiro A., Acuña A., Marciales, L., Hernández, E., Torres, A., Aranguren, N., López, W., Duque, S., Gallo, L., Aguirre, N., Mogollón, M. & Rueda-Delgado, G. 2008. Testing of the CHEMTAX program in contrasting Neotropical lakes, lagoons and swamps. Limnology & Oceanography: Methods 6: 243-252.

Huber-Pestalozzi, G. 1955. Das Phytoplankton des Süβwassers. Systematik und Biologie. 4. Teil, Euglenophyceen. E. Schweizerbart'sche Verlagsbuchhandlung.

Kiriakov I. 1983. Le genre *Strombomonas* Deflandre (Euglenophyta) en Bulgarie. Cryptogamie, Algologie IV (1-2): 127-139.

Lackey, J.B. 1968. Ecology of *Euglena*. In: Buetow, D. (Ed.) The Biology of *Euglena*. Acad. Press, New York 1: 27-44.

Menezes, M., Fonseca, C.G. & Nascimento, E.P. 1995. Algas de três ambientes de águas claras do município de Parintins, estado do Amazonas, Brasil: Euglenophyceae e Dinophyceae. Hoehnea 22 (1/2): 1-15.

Munawar, M. 1972. Ecological studies of Eglenineae, in certain polluted and unpolluted environments. Hydrobiologia 39: 307-320.

Ortega, M.M., Godínes, J.L., Garduño, G. & Oliva, M.G. 1994. Ficología de Méjico. Algas Continentales. AGT Editor.

Popova, T.G. 1966. Euglenophyta. *Trachelomonas*, *Strombomonas*, *Eutreptia*, *Euglena*. Flora Plantarum Cryptogamarum URSS 3 (1): 1-410. Izq. Nauka, Leningrad.

Prescott, G.W. 1955. Algae of the Panama Canal and its tributaries I. Flagellated organisms. The Ohio Journal of Science 55 (2): 99.

Pringsheim, E.C. 1956. Contributions towards a monograph of the genus *Euglena*. Nova Acta Leopoldina 18: 1-168.

Reynolds C., Huszar V., Kruk C., Naselli-Flores L. & Melo S. 2002. Towards a functional classification of the freshwater phytoplankton. Journal of Plankton Research 24: 417-428.

Rino, J.A. & Pereira, M.J. 1989-90. Euglenophyta da região centro de Portugal. II. Género *Trachelomonas* Ehr. 1833 *emend*. Defl. 1926. II. Estrutura da lorica em microscopia electronica de varrimento. Revista Biologia Universidade de Aveiro 3: 139-187.

Rodrigues, M.S. 1992. A Comunidade Fitoplanctônica de um lago de várzea da Amazônia Central (Lago Camaleão, Ilha de Marchantaria): Variação temporal e espacial, Biomassa, composição de espécies e produtividade. Tese de Doutorado. Instituto Nacional de Pesquisas da Amazônia. Fundação Universidade de Amazonas.

Rosowski, J.R. 2003. Photosynthetic Euglenoids. In: JD Wehr, RG Sheath, eds. Freshwater algae of North America: ecology and classification. Academy Press, New York: 383-422.

Starmach, K. 1983. Euglenophyta-Eugleniny. Flora Slodkowodna Polski, 3: 1-594. Państwowe Wydawnictwo Naukowe, Warszawa -Kraków.

Tell, G. & Conforti, V. 1986. Euglenophyta pigmentadas de la Argentina. Bilbliotheca Phycologica. J. Cramer. Berlin. Stuttgart.

Tell, G. & Conforti, V. 1988. Quelques *Strombomonas* Defl. (Euglenophyta) del' Argentine au microscope photonique et électronique à balayage. Nova Hedwigia 46: 541-556.

Tell, G. & Zalocar de Domitrovic, Y. 1985. Euglenophyta pigmentadas de la Provincia del Chaco (Argentina). Nova Hedwigia 41: 353-391.

Thérézien, Y. 1989. Algues d'eau douce de la partie Amazonienne de la Bolivie. Bilbliotheca Phycologica, J. Cramer, Berlin-Stuttgart.

Thomasson, K. 1971. Amazonian algae. Studies on South American fresh-water plankton. 8. Mémoire de l´Instute Royal des Sciences Naturelles de Belgique 86: 1-57.

Thomasson, K. 1977. Two conspicuous desmids from Amazonas. Notiser Stockholm 130: 41-51.

Tolivia, A., Nuñez Avellaneda, M., Duque, S. & Conforti, V. 2012. A taxonomic and Ultrastructural Study of naked Euglenophyta from Colombia. Algological Studies 140: 3-21.

Uherkovich, G. & Schmidt, G.W. 1974. Phytoplanktontaxa in dem zentralamazonischen Schwemmlandsee Lago de Castanho. Amazoniana V: 243-283.

Uherkovich, G. & Franken, M. 1980. Aufwuchsalgen aus zentralamazonischen Regenwaldbächen. Amazoniana VII (I): 49-79.

Wołowski, K. & Grabowska, M. 2007. *Trachelomonas* species as the main component of the euglenophyte community in the Siemianówka reservoir (Narew River, Poland). Annales de Limnologie - International Journal of Limnology 43(3): 207-218.

Wołowski, K. & Hindák, F. 2004. Taxonomic and ultrastructure studies of *Trachelomonas* Ehrenberg emend. Deflandre (Euglenophyta) from Slovakia. Nova Hedwigia 78: 179-207.

Wołowski, K. & Hindák, F. 2005. Atlas of Euglenophytes. Veda, Bratislava, Slovak Republic.

Wołowski, K. & Walne, P. 2007. *Strombomonas* and *Trachelomonas* species (Euglenophyta) from south-eastern USA. European Journal of Phycology 42: 409-431.

Yacubson, S. 1980. The Phytoplankton of some freshwater bodies from Zulia State (Venezuela). Nova Hedwigia 23: 279-339.

Yacubson, S. 1984. Algas del río Tucuco y ambientes acuáticos de sus alrededores (Estado Zulía, Venezuela). Boletín del Centro de Investigaciones Biológicas 16: 19-95.

Yacubson, S. & Bravo C.R. 1982-83. Especies de *Trachelomonas* (Euglenophyta) de algunos cuerpos de agua de los Distritos Urdaneta y Perijá (estado Zulia, Venezuela). Boletín del Centro de Investigaciones Biológicas 15: 17-47.

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