EUGLENOPHYTA FROM LOWER BASIN OF THE CAURA RIVER, VENEZUELA

Euglenophyta de la cuenca baja del Río Caura, Venezuela

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ABSTRACT

This study gives information on taxonomy and presence of Euglenophyta occurring in various types of water bodies from the lower basin of the Caura River and its floodplain, Bolívar State, Venezuela. Specimens were collected between March 1998 and February 2000. Twenty one species were identified, among them 13 taxa new for Venezuela. All taxa are illustrated using original drawings. The new taxa for Venezuela are: *Euglena gasterosteus* Skuja, *E. gaumei* Allorge & Lefèvre, *E. rustica* Schiller, *Strombomonas napiformis* (Playfair) Deflandre, *Trachelomonas piscatoris* var. *sparsespinosa* Huber-Pestalozzi, *T. ovalis* (Daday) Lemmermann, *T. acanthophora* Stokes var. *speciosa* Swirenko, *Phacus margaritatus* Pochmann, *P. acuminatus* var. *discifera* (Pochmann) Huber-Pestalozzi, *P. rodriguesiae* Conforti, *P. onyx* Pochmann, *P. orbicularis* f. *communis* Popova and *P. horridus* Pochmann.

Key words: Bolívar, Caura River, Euglenophyta, Floodplain lakes, Taxonomy, Venezuela

RESUMEN

Este estudio presenta información sobre la taxonomía y presencia de las euglenofitas en varios cuerpos de agua pertenecientes a la cuenca baja del Río Caura y su planicie de inundación, estado Bolívar, Venezuela. Los especímenes fueron recolectados entre marzo de 1998 y febrero de 2000. Se identificaron 21 especies, de las cuales 13 taxa son nuevos registros para Venezuela. Todos los taxa son ilustrados usando dibujos originales. Los taxa nuevos para Venezuela son: *Euglena gasterosteus* Skuja, *E. gaumei* Allorge & Lefèvre, *E. rustica* Schiller, *Strombomonas napiformis* (Playfair) Deflandre, *Trachelomonas piscatoris* var. *sparsespinosa* Huber-Pestalozzi, *T. ovalis* (Daday) Lemmermann, *T. acanthophora* Stokes var. *speciosa* Swirenko, *Phacus margaritatus* Pochmann, *P. acuminatus* var. *discifera* (Pochmann) Huber-Pestalozzi, *P. rodriguesiae* Conforti, *P. onyx* Pochmann, *P. orbicularis* f. *communis* Popova y *P. horridus* Pochmann.

Palabras clave: Bolívar, Euglenophyta, Lagunas de inundación, Río Caura, Taxonomía, Venezuela

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INTRODUCTION

In tropical regions various works on Euglenophyte flora have been done by Bourrelly & Couté (1982) from French Guiana; Thérésien (1989) from the Amazonian system in Bolivia; Conforti (1994) in Camaleão Lake, Brazil; Menezes (1986) and Menezes & Fernandes (1987) from Mato Grosso, Brazil; Conforti (1977, 1979a, b, 1981, 1986a, b) in water bodies of Argentina and Yacubson (1984-85) in the River Tocuco and other water bodies of Venezuela.

Specific studies on Euglenophyta were made in South America: in Argentina and Brazil on *Euglena* (Tell & Conforti 1986; Menezes 1989); on *Trachelomonas* in Bolivia and Argentina (Couté & Thérésien 1985; Conforti 1986b), and in Venezuela on *Phacus* (Yacubson & Bravo 1986-88).

However, few studies on this flora have been done in Venezuela. Yacubson & Bravo (1986-1988) recorded some species of *Phacus* in several aquatic environments from Zulia State. Yacubson (1980, 1984-85) studied some Euglenophyta of Zulia State. Varela *et al*. (1983) and Blanco & Sánchez (1986) recorded some species of Orinoco River and its floodplain. Gonzalez de Infante & Riehl (1992) studied various species of Guri Dam, Bolívar State. Wołowski (1998) mentioned some records for Venezuela, and Delgado & Sánchez (2002) studied the Euglenophyte from the lower basin of Caura River, Venezuela.

The purpose of this study is to describe the Euglenophyte flora occurring in the lower basin of Caura River and its floodplain, Venezuela.

MATERIALS AND METHODS

The Caura River basin, one of the last major tropical watersheds still under virtually pristine conditions, is located in Bolívar State in southern Venezuela between 3°37' and 7°47' Lat. N and 63°23' and 65°35' Long. W (Fig. 1). The total surface drained by the Caura river basin is estimated to be 45,330 km^2 and it resembles a trapezoid rectangle that stretches approximately 415 km from northwest to southeast and 130 km from east to west (Peña 1996; Montoya 1999).

The longitudinal profile of the Caura River basin is usually subdivided into the following three sections: the Lower Caura (section where the Euglenophyta were collected), stretching from its mouth in the Orinoco River up to Salto Pará; the Middle Caura, from Salto Pará to the confluence of the Waña and Merewari rivers; and the Upper Caura, extending from the confluence of the Waña and Merewari rivers to the headwaters in the southern up and highlands (Rosales & Huber 1996).

The Caura River is the second most important tributary of the right margin of the Orinoco and discharges on average 3,500 m^3 of water per second. The estimated sediment load of 2 x 10^6 t/a is high in comparison with other rivers of the Guayana Shield, but low in comparison with other tributaries of the Orinoco. The Caura has been classified as a blackwater river due to its brown color and its lack of

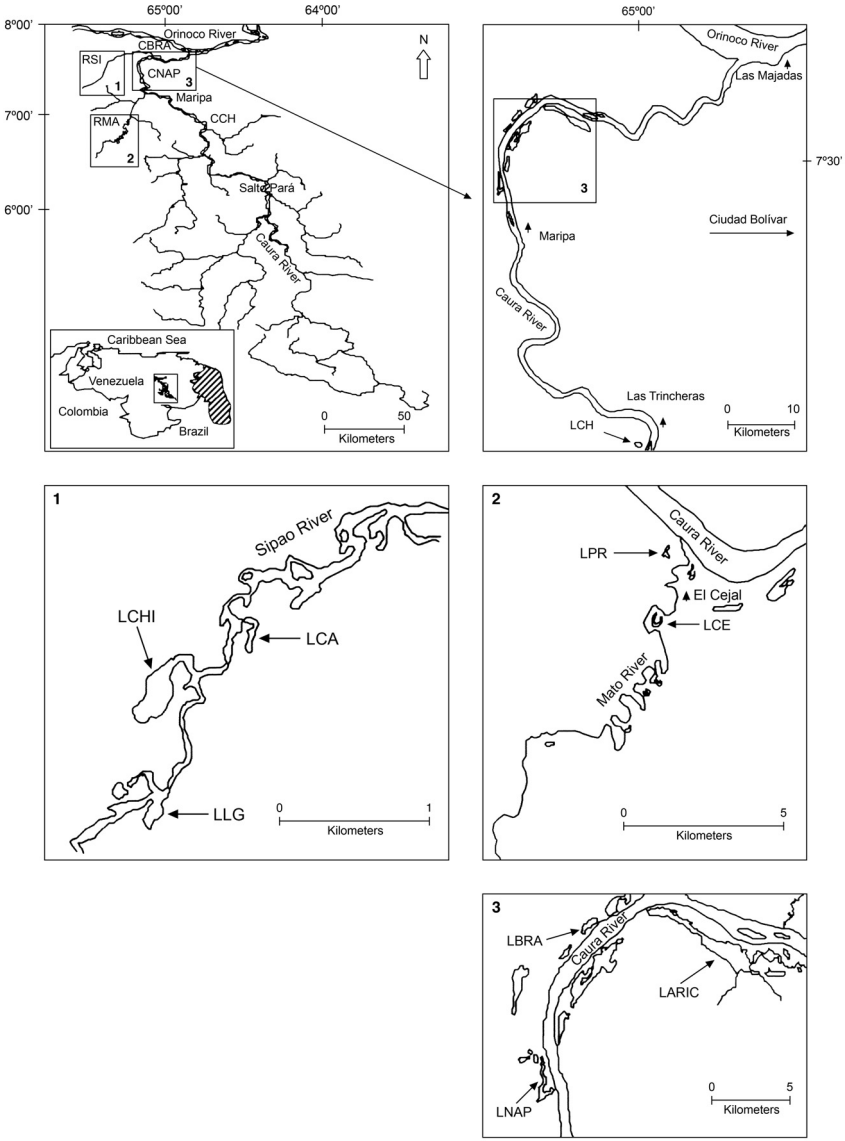

Fig. 1. Map of the basin of the Caura River and its floodplain, Venezuela. CBRA = Caura Brava; CCH = Caura Chuapo; CNAP = Caura Naparaico; LARIC = Aricagua Lake; LBRA = Brava Lake; LCA = Caramatico Lake; LCE = El Cejal Lake; LCH = Chuapo Lake; LCHI = Chiribital Lake; LLG = Los Garzones Lake; LNAP = Naparaico Lake; LPR = Pozo Rico Lake; RMA = Mato River; RSI = Sipao River.

nutrients and suspended materials, however, not all of its characteristics fit this classification cleanly (Rosales & Huber 1996).

The Euglenophyta were collected of surface (50 cm of depth) and medium depth samples of water (monthly since February 1998 to February 2000) integrate of three stations of main channel of Caura River (Caura Chuapo: CCH, Caura Naparaico: CNAP and Caura Brava: CBRA), three of its floodplain lakes (Chuapo: LCH, Naparaico: LNAP and Brava: LBRA) and in two of its main tributaries and floodplain lakes: Mato River, RMA (El Cejal Lake: LCE and Pozo Rico Lake: LPR) and Sipao River, RSI (Caramacatico Lake: LCA; Los Garzones Lake: LLG and Chiribital Lake: LCHI) (Fig. 1). The algae were fixed in 4% Lugol's solution.

Taxonomic studies of the Euglenophyte flora were made with an Olympus BX40 microscope. New taxa for the Venezuelan flora are briefly described and the cell shape and dimensions mentioned. For the taxa remaining only is mentioned the cell dimensions. Original drawings were made with the aid of a camera lucida. All measurements were made with a digital camera Pro-Series 128 and the Image-Pro Plus software version 4.0.

The literature used for the identification of the Euglenophyta was: Huber-Pestalozzi (1955), Bourrelly (1970), Conforti (1979a, b, 1986a, b, 1994), Yacubson (1980, 1984-1985, 1986-1988), Starmach & Siemińska (1983), Bourrelly & Couté (1992), Wołowski (1998).

RESULTS AND DISCUSSION

Table 1 shows the physical and chemical parameters determined at the freshwater bodies surveyed.

Twenty one species were identified for the lower basin of the Caura River and its floodplain. Thirteen of these taxa are new reports for Venezuela. These are marked with an asterisk.

Table 1. Physical and chemical characteristics (mean values) of the water body surveyed in the basin of the Caura River and its floodplain, Venezuela.

	Trans (m)	pH	Cond ($^{o}s.cm^{-1}$)	T (^{o}C)	OD ($mg.l^{-1}$)	CL- ($mg.l^{-1}$)	Tb ($mg.l^{-1}SiO_2$)	SS ($mg.l^{-1}$)	Geographic location Lat. N - Long. W
CCH	0.71	6.63	12.73	26.87	7.43	0.88	8.10	18.33	7°03'30" - 65°12'17"
CNAP	0.76	6.54	12.02	26.89	7.11	1.18	7.20	25.15	7°28'31" - 65°13'06"
CBRA	0.81	6.49	11.43	26.97	7.06	1.13	7.16	15.90	7°34'13" - 65°11'39"
LCH	0.67	6.39	15.20	29.22	4.59	1.78	10.69	23.32	7°03'30" - 65°01'40"
LNAP	0,85	6.08	9.97	28,09	5.19	1.70	7.48	14.37	7°31'28" - 65°13'53"
LBRA	0,88	6.31	9.17	29.06	5.22	1.43	9.19	11.33	7°33'05" - 65°12'43"
LARIC	1.24	6.39	9.46	29.13	6.40	1.42	7.37	16.83	7°34'05" - 65°09'04"
RMA	0.84	6.40	20.48	25.67	4.40	1.86	5.13	6.00	7°10'54" - 65°10'22"
RSI	0.98	6.17	11.30	27.13	5.75	1.37	5.00	2.70	7°34'55" - 65°05'29"

Table 1. Continuation

	Trans (m)	pH	Cond ($^{o}s.cm^{-1}$)	T (^{o}C)	OD ($mg.l^{-1}$)	CL- ($mg.l^{-1}$)	Tb ($mg.l^{-1}SiO_2$)	SS ($mg.l^{-1}$)	Geographic location Lat. N - Long. W
LCE	0.80	6.27	16.25	26.00	4.77	2.26	7.00	8.40	7°10'58" - 65°09'51"
LPR	0.95	6.33	15.80	25.00	6.00	2.00	4.56	13.30	7°11'54" - 65°09'43"
LCHI	0.95	6.15	11.88	28.38	6.38	1.99	11.38	13.30	7°36'25" - 65°05'38"
LLG	1.04	6.11	11.53	27.88	5.04	2.67	3.90	10.55	7°36'10" - 65°05'57"
LCA	1.07	6.12	11.35	28.65	6.00	2.44	6.75	9.70	7°35'54" - 65°04'43"

Trans = Transparence; Cond = Conductivity; T = Temperature; OD = Dissolved Oxygen; CL- = Chloride; Tb = Turbidness; SS = Suspend solids. CCH = Caura Chuapo; CNAP = Caura Naparaico; CBRA = Caura Brava; LCH = Chuapo Lake; LNAP = Naparaico Lake; LBRA = Brava Lake; LARIC = Aricagua Lake; RMA = Mato River; RSI = Sipao River; LCE = El Cejal Lake; LPR = Pozo Rico Lake; LCHI = Chiribital Lake; LLG = Los Garzones Lake; LCA = Caramatico Lake.

Euglenophyta
Orden Euglenales

Euglena Ehrenberg 1830

Euglena acus Ehrenberg (Fig. 2a)

Cells 99.9-101.3 µm long, 8.2-8.6 µm wide

Locality: LCH (March 1998, pH 6.41; March 1999, pH 6.28), RMA (November 1998, pH 6.40), LCE (November 1998, pH 5.95), LCHI (March 1999, pH 6.28).

General distribution: Cosmopolitan.

Habitats: Fresh water, rarely from saline waters, planktonic, in small water bodies, ricefield, swamps, village ponds, fish-and field ponds (Wołowski 1998).

***Euglena gasterosteus** Skuja (Fig. 2b, d)

Cells 44.4-56.5 µm long, 9.6-12.3 µm wide, fusiform; each cell obliquely truncate at the anterior end and terminating in a sharp at the posterior end. Pellicle finely striated. Flagellum shorter than cell length. Paramylon in form of large and short cylindrical rods.

Locality: LBRA (February 1999, pH 6.53), LCHI (March 1999, pH 6.28).

General distribution: Europe (Skuja 1948; Popova 1966; Asaul 1975; Uherkovich 1979, 1982; Wołowski 1998), America (Tell & Conforti 1986).

Habitats: Reservoirs, lakes, puddles and ponds (Wołowski 1998).

***Euglena gaumei** Allorge & Lefèvre (Fig. 2c)

Cells 66.4 µm long, 11.3 µm wide, fusiform, truncate at the anterior end and

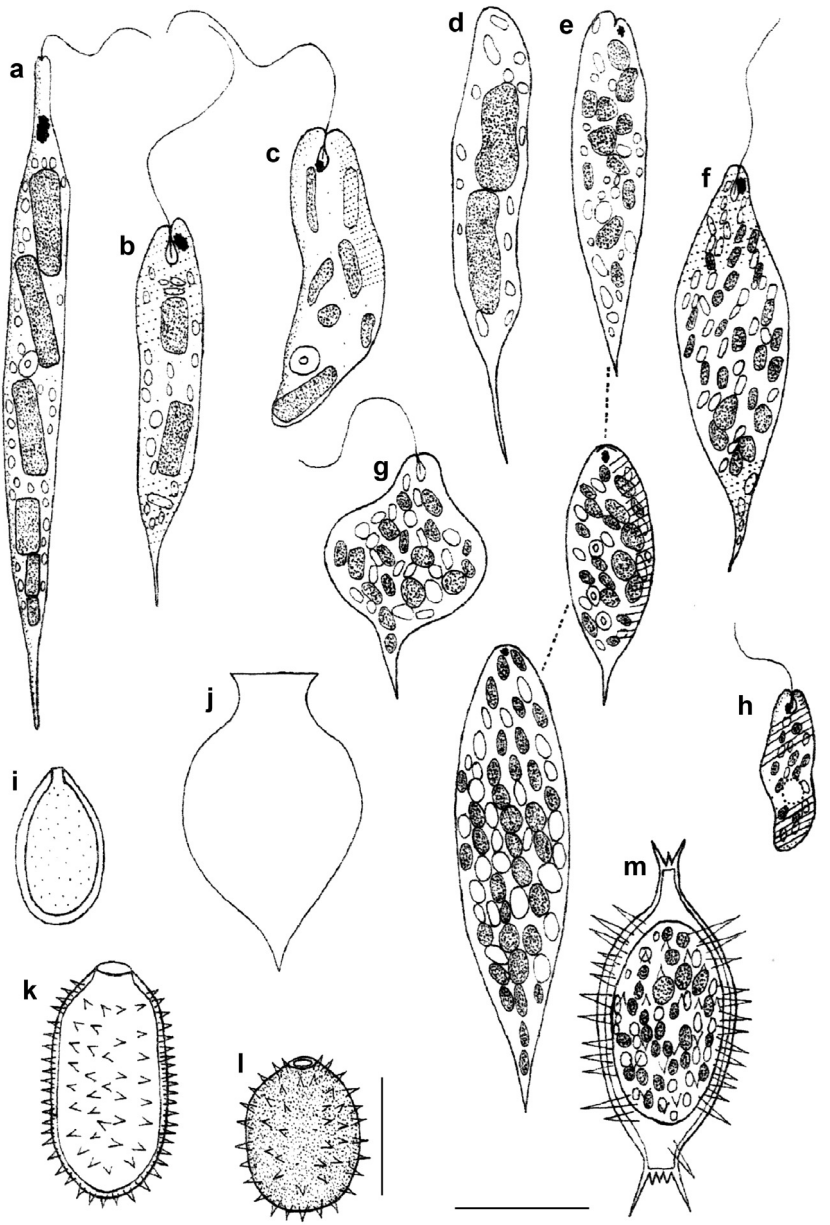

Fig. 2. **a.** *Euglena acus*. **b, d.** *E. gasterosteus*. **c.** *E. gaumei*. **e.** *E. proxima*. **f, g.** *E. spathirhyncha*. **h.** *E. rustica*. **i.** *Trachelomonas ovalis*. **j.** *Strombomonas napiformis*. **k.** *T. piscatoris* var. *sparsespinosa*. **l.** *T. superba*. **m.** *T. acanthophora* var. *speciosa*. Scale = 20 µm.

with sharp hyaline processes at the posterior end. Pellicle normally is longitudinal only sometimes is striated in spiral form. Chloroplasts numerous, cylindrical, discoid or irregular margin. Paramylon grains two, cylindrical. Flagellum larger than cell length.
Locality: LARIC (December 1999, pH 6.58), RSI (June 1998, pH 5.91), LCH (March 1998, pH 6.41), LPR (August 1998, pH 6.43).
General distribution: Europe (Starmach & Siemińska 1983), America (Tell & Conforti 1986).
Habitats: Planktonic, lakes and tributaries.

Euglena proxima Dangeard (Fig. 2e)
Cells 38.3-72.7 µm long, 11.4-16.8 µm wide.
Locality: CNAP (March 1998. pH 7.23), LNAP (July 1998, pH 6.12; September 1998, pH 5.93; October 1998, pH 6.14; November 1998, pH 5.84; February 1999, pH 5.93), LBRA (June 1998, pH 6.05), RM (February 1998, pH 7.14), LLG (June 1998. pH 5.79), LCA (November 1998, pH 6.13); LARIC (May 1999, pH 6.65), LCHI (March 1999, pH 6.28).
Distribution in Venezuela: Zulia State (Yacubson 1980).
General distribution: Cosmopolitan.
Habitats: Small water bodies, puddles, edge peat bogs, slowly flowing rivers and village ponds (Wołowski 1998).

Euglena spathirhyncha Skuja (Fig. 2f, g)
Cells 29.6-59.6 µm long, 8.6-16.4 µm wide.
Locality: CNAP (March 1998, pH 7.23), LNAP (July 1998, pH 6.12; February 1999, pH 5.93), LLG (June 1998, pH 5.79), LCA (November 1998, pH 6.13), LARIC (May 1999, pH 6.65), LCHI (March 1999, pH 6.28), RSI (June 1998, pH 5.91).
Distribution in Venezuela: Zulia State (Yacubson 1980-1981).
General distribution: Europe (Skuja 1948; Péterfi 1962; Iordan 1966; Popova 1966; Asaul 1975; Uherkovich 1977), Asia (Popova 1966; Naidu 1966; Vetrova 1993); South America (Tell & Conforti 1986).
Habitats: Planktonic, lakes, small rivers, ditches, rice-fields, and village ponds (Wołowski 1998).

***Euglena rustica** Schiller (Fig. 2h)
Cells 23.4-35.8 µm long, 6.2-11.8 µm wide, fusiform-obovoid, sac like, each cell elongated at the anterior end and rounded at the posterior end. Pellicle thin faintly striated. Flagellum shorter than cell length. Paramylon grains small (Wołowski 1998).
Locality: LBRA (January 1999, pH 6.61).
General distribution: Europe (Huber-Pestalozzi 1955).
Habitats: Village ponds (Wołowski 1998).

Strombonas Deflandre 1930

***Strombomonas napiformi**s* (Playfair) Deflandre (Fig. 2j)
Lorica 28.41-43.23 µm long, 18.53-27.18 µm wide, broadly ellipsoid with right collar. Caudal appendix short, right.
Locality: LBRA (January 1999, pH 6.61; February 1999, pH 6.53).
General distribution: Europa (Starmach & Siemińska 1983).
Habitats: Planktonic, lakes.

Trachelomonas Ehrenberg 1833

***Trachelomonas ovalis** (Daday) Lemmermann (Fig. 2i)
Lorica 22.2 µm long, 12.3 µm wide, broadly elliptical, pore without collar.
Locality: LBRA (July 1998, pH 5.92), LLG (March 1999, pH 6.21).
General distribution: Asia, Africa and Europe (Starmach & Siemińska 1983).
Habitats: Planktonic, lakes.

***Trachelomonas piscatoris** (Fisher) Stokes var. **sparsespinosa** Huber-Pestalozzi (Fig. 2k)
Lorica 34.6 µm long, 17.1 µm wide, elliptical to semi-elongated with conic spines.
Locality: LNAP (February 1999, pH 5.93; March 1999, pH 6.03), LCH (December 1999, pH 6.93), LCA (March 1999, pH 6.32).
General distribution: Europe (Starmach & Siemińska 1983)
Habitats: Planktonic, lakes.

Trachelomonas superba Swirenko (Fig. 2l)
Lorica 25.8-27.2 µm long, 18.7-20.4 µm wide.
Locality: LARIC (October 1999, pH 6.35), LCHI (June 1998, pH 5.81).
Distribution in Venezuela: Guárico State (Deflandre 1926), Zulia State (Yacubson 1980)
General distribution: Cosmopolitan.
Habitats: Lakes, puddles, swamps, village and fishponds, rivers (Wołowski 1998).

***Trachelomonas acanthophora** Stokes var. **speciosa** (Deflandre) Balech (Fig. 2m)
Lorica 47.2-52.8 µm long, 19.9-23.5 µm wide, elliptical-elongated, covered by strong spines, collar long and cylindrical.
Locality: LCE (November 1998, pH 5.95), LCHI (November 1998, pH 6.12).
General distribution: South America (Huber-Pestalozzi 1955)
Habitats: Planktonic, lakes (Wołowski 1998).

Phacus Dujardin 1841

***Phacus margaritatus** Pochmann (Fig. 3a)

Cells 24.1-26.7 µm long, 11.1-13.7 µm wide, ovate, each cell depressed at the anterior end and sharp at the posterior end, with two paramylon grains.
Locality: LNAP (November 1998, pH 5.84; May 1999, pH 6.25), LLG (June 1998, pH 5.79).
General distribution: Europa (Starmach & Siemińska 1983).
Habitats: Planktonic, lakes.

***Phacus acuminatus** Stokes var. **discifera** (Pochmann) Huber-Pestalozzi (Fig. 3b)

Cells 21.6 µm long, 16.4 µm wide, ovate, each cell depressed at the anterior end and sharp at the posterior end, with two paramylon grains.
Locality: RSI (March 1999, pH 6.37), RM (February 1998, pH 7.14), LNAP (November 1998, pH 5.84; January 1999, pH 5.95), LARIC (February 2000, pH 6.91).
General distribution: Europe (Huber-Pestalozzi 1955), South America (Conforti 1994).
Habitats: Planktonic, rivers, lakes and tributaries.

***Phacus rodriguesiae** Conforti (Fig. 3c)

Cell 32.9 µm long, 22.6 µm wide, trapezoidal, asymmetrical. Anterior end broadly rounded, strongly overlapped, with a short apical furrow. Lateral margins, one entire and the other with a notch or both with a slight central concavity. Posterior end tapered with a straight and acute cauda. Periplast longitudinally striated (Conforti 1994).
Locality: LNAP (October 1998, pH 6.14; January 1999, pH 5.95; May 1999, pH 6.25; June 1999, pH 6.10).
General distribution: South America (Conforti 1994).
Habitats: Lakes.

***Phacus horridus** Pochmann (Fig. 3d-e)

Cells 37.7-39.0 µm long, 13.0-23.3 µm wide, ovate, symmetrical, moderately flattened, each cell obtuse at the anterior end with a prominent, papillate collar surrounding the flagellar pore and broadly rounded at the posterior end with a well-developed, straight bluntly-pointed cauda. Pellicle longitudinally striate.
Locality: LCE (November 1998, pH 5.95), CBRA (July 1999, pH 6.16), LNAP (May 1999, pH 6.25), LCH (March 1998, pH 6.41).
General distribution: Europe (Starmach & Siemińska 1983, Conforti 1994), South America (Conforti 1994).
Habitats: Planktonic, lakes.

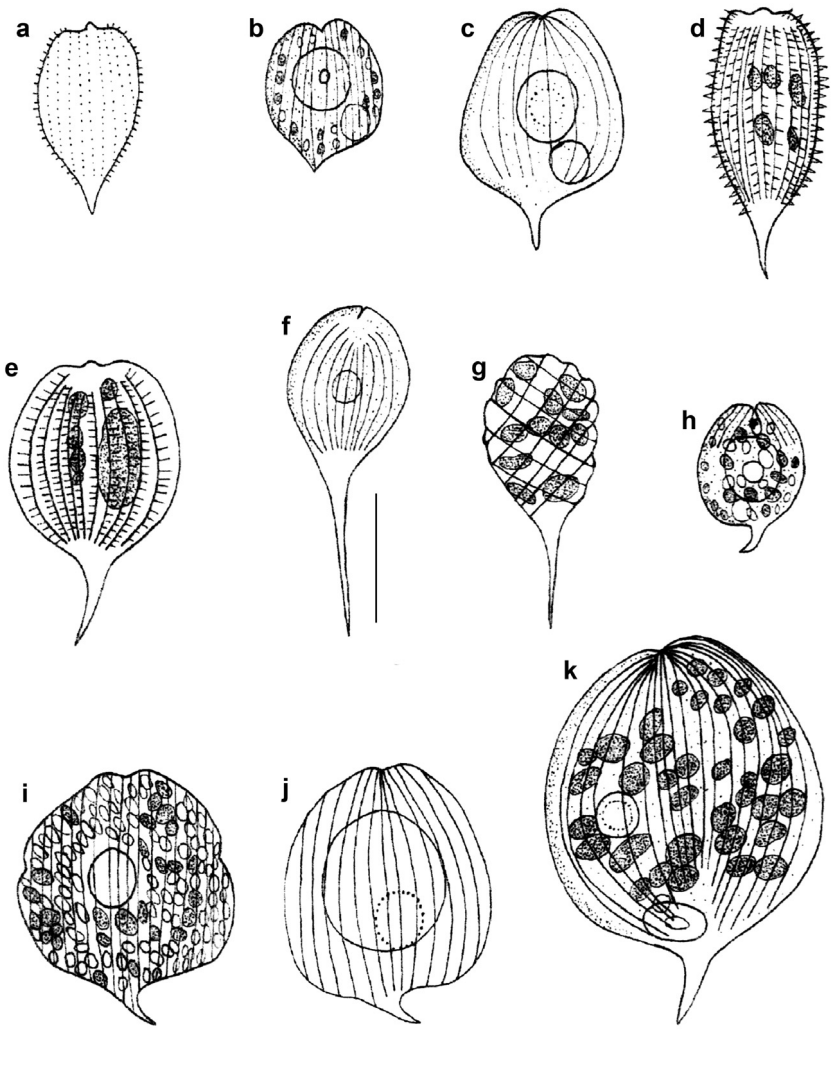

Fig. 3. **a.** *Phacus margaritatus*. **b.** *Phacus acuminatus* var *discifera*. **c.** *P. rodriguesiae*. **d-e.** *P. horridus*. **f.** *P. longicauda*. **g.** *P. pyrum*. **h.** *P. curvicauda*. **i.** *P. onyx*. **j.** *P. orbicularis* f. *communis*. **k.** *P. pleuronectes*. Scale = 20 µm.

Phacus longicauda (Ehrenberg) Dujardin (Fig. 3f)
Cells 51.5-61.2 µm long, 18.3-22.4 µm wide.
Locality: LNAP (November 1998, pH. 5.84; June 1998, pH 6.13), LCH (July 1998, pH. 6.16), LCHI (November 1998, pH 6.12).
General distribution: South America (Conforti 1994)
Habitats: Planktonic, lakes and tributaries.

Phacus pyrum (Ehrenberg) Stein (Fig. 3g)
Cells 29.4-37.7 µm long, 12-3-15.7 µm wide.
Locality: LARIC (January 2000, pH 6.31).
Distribution in Venezuela: Zulia State (Yacubson 1984-85).
General distribution: Cosmopolitan.
Habitats: Swamps, ditches, planktonic in lakes and ponds (Wołowski 1998).

Phacus curvicauda Swirenko (Fig. 3h)
Cells 20.5-34.2 µm long, 14.4-20.4 µm wide.
Locality: LLG (June 1998, pH 5.79).
Distribution in Venezuela: Apure State (Deflandre 1928), Zulia State (Yacubson 1984-85; Yacubson & Bravo 1986-1988).
General distribution: Cosmopolitan.
Habitats: Stagnant water bodies, ponds, reservoirs, ditches, puddles and lakes (Wołowski 1998).

***Phacus onyx** Pochmann (Fig. 3i)
Cells 35.6 µm long, 29.4 µm wide, oval, each cell slightly corrugated at the rim, depressed at the anterior end and with strong cauda curved at the posterior end. Each cell have two cracks at the rims. Pellicle longitudinally striate, with one paramylon grain situated at the centre.
Locality: LARIC (January 2000, pH 6.31; February 2000, pH 6.91), LCH (June 1998, pH 6.29).
General distribution: Europe and South America (Conforti 1994)
Habitats: Planktonic, lakes and ponds.

***Phacus orbicularis** f. **communis** Popova (Fig. 3j)
Cells 35.6-54.4 µm long, 28.1-45.7 µm wide, each cell broadly oval with short cauda at the posterior end.
Locality: LNAP (June 1998, pH 6.13), LBRA (September 1999, pH 5.70), LCE (November 1998, pH 5,95).
General distribution: Cosmopolitan.
Habitats: Ponds, reservoirs, ditches, puddles and lakes (Wołowski 1998).

Phacus pleuronectes (Ehrenberg) Dujardin (Fig. 3k)
Cells 45.6-51.4 µm long, 30.1-38.7 µm wide.

Locality: LNAP (June 1998, pH 6.13; September 1998, pH 5.93), LBRA (November 1998, pH 6.65), LLG (November 1998, pH 6.13).
Distribution in Venezuela: Zulia State (Yacubson & Bravo 1986-1988).
General distribution: Cosmopolitan.
Habitats: Planktonic, lakes, ponds and swamps.

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