Composition and occurrence of testate amoebae in the Curuá-Una Reservoir (State of Pará, Brazil)

Composição e ocorrência de tecamebas na área de influência do reservatório de Curuá-Una (Estado do Pará, Brasil)

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Abstract: This study investigated the composition and occurrence of testate amoebae community in the Curuá-Una Reservoir (State of Pará), as well as, described and illustrated some species registered in this reservoir. This is the first study about testate amoebae with identification at specific level in Brazilian North Region, thus, contributing for the knowledge of geographical distribution of these organisms. Samples were obtained at various sampling stations in the Curuá-Una Reservoir, and in the main channel and in two tributaries, Muju River and Mojuí dos Campos River. Samplings were accomplished from November 1977 to September 1978 period. Samples were obtained from vertical and horizontal hauls, in the main channel of the rivers, using a plankton net (55 μm). Fifty-one infra-generic testate amoebae taxa were identified, belonging to 7 families. The most specious families were Difflugiidae (19 taxa), Arcellidae (15 taxa) and Centropyxidae (9 taxa). The sampling stations located in the main body of the reservoir presented higher species richness than those situated in the tributaries. Among registered taxa, 26 taxa, representing different families, were described and illustrated. For these species, the values of limnological variables pH, dissolved oxygen (DO), electric conductivity and water temperature were measured.

Keywords: testate amoebae, zooplankton, reservoir, Brazilian North region, taxonomy.

Resumo: O presente trabalho tem o objetivo de investigar a composição e ocorrência da comunidade de tecamebas no reservatório de Curuá-Una (Estado do Pará), bem como descrever e ilustrar algumas espécies encontradas neste reservatório. Este é o primeiro trabalho de tecamebas com identificação ao nível de espécies na região Norte do país, contribuindo, dessa forma, para o conhecimento da distribuição geográfica desses organismos. As amostras de plâncton foram obtidas em diferentes estações da área de influência do reservatório de Curuá-Una, incluindo o corpo principal do reservatório e dois tributários, rio Muju e rio Mojuí dos Campos. As amostragens foram realizadas durante o período de novembro de 1977 a setembro de 1978. As amostras foram obtidas através de arrastos verticais e horizontais no canal principal dos rios, utilizando uma rede de plâncton de 55 μm. Foram identificados 51 táxons infragenéricos de tecamebas, pertencentes a sete famílias. As famílias mais especiosas foram Difflugiidae (19 táxons), Arcellidae (15 táxons) e Centropyxidae (9 táxons). As estações localizadas no corpo principal do reservatório apresentaram as maiores riquezas de espécies do que aquelas situadas nos tributários. Entre os táxons registrados, 26 deles, representantes das diferentes famílias, foram descritos e ilustrados. Para esses táxons, os valores das variáveis limnológicas (pH, oxigênio dissolvido, condutividade elétrica e temperatura) foram indicados.

Palavras-chave: tecamebas, zooplâncton, reservatório, região Norte, taxonomia.

1. Introduction

The term testate amoebae include a heterogeneous assemblage of amoebae with a shell or test (Bonnet, 1974). These organisms are found in a wide range of freshwater and most habitats (Ogden and Hedley, 1980; Lansac-Tôha et al., 1997).

This protozoan group presents several advantages which become them interesting to ecological surveys, since they are abundant in most continental aquatic ecosystems, presenting high biomass production, moreover, their size and generation time allow investigating the demographic processes, both in spatial and temporal scales, representing an important component in energy flow and nutrient cycling (Hardoim, 1997).

In continental aquatic environments, testate amoebae have been considered as principally associated to littoral aquatic vegetation and to sediment from lentic and lotic environments (Green, 1975; Lena and Zaidenwerg, 1975). These authors also defended the hypothesis that the presence of these organisms in plankton is due to stochastic processes and that the sporadic occurrence, with low abundances and species richness, would suggest a low ecological importance in plankton community.

Nevertheless, several current studies have shown that testate amoebae can be found at high densities and frequencies in plankton samples (Lansac-Tôha et al., 1997; 2004). In this way, some studies have suggested that, although testate amoebae are not typically planktonic, they are frequent in plankton samples and their occurrence should not be considered accidental (Green, 1994; Velho et al., 1999; 2004).

In Brazil, in spite of some informations reveal that these organisms are available in different habitats (sediment, plankton, fauna associated to aquatic macrophytes and mosses/*Sphagnum*), the studies are limited to Center-West, South and Southeast regions (Lansac-Tôha et al., 2007).

In the Amazon, there is an important study about this group from samples obtained in litter from black-water streams (Walker, 1982). Albeit the author had not identified testate amoebae to species level, the number of recorded morphotypes, 119, indicates a high species richness of these organisms, at least in streams in the Amazon forest.

Thus, the knowledge of occurrence and distribution of several organisms, including testate amoebae, are limited to some Brazilian regions, although faunistic and floristic inventories as well as the knowledge of geographical distribution of organisms are the basis to the development of studies on some ecological approaches and to the conservation of biodiversity. In this way, the aim of this study was realize the first survey on the occurrence of testate amoebae at the specific level to the North region of Brazil.

2. Material and Methods

2.1. Study area

The dam of Curuá-Una hydroelectric power plant was built to provide electric power for the Santarém (State of Pará) city and its outskirts and it was inaugurated in the first semester of 1997. It is located at 54°18' 55" W and 02° 48' 38" S, at 68 m above sea level. It presents 56 km of maximum length and 3.8 km of maximum width. It has a shallow dam, and mean depth is 5.2 m, and the maximum depth can reach 18 m. Its area is 102 km^2 and the volume, measured at 68 m of quota, is 530.56 Hm^3 (Robertson, 1980).

Samples were obtained at different sampling stations in the Curuá-Una Reservoir, including the main channel (C-Una 20, C-Una 32, C-Una 45 and C-Una 80) and some tributaries, Muju River (Mu 5, Mu 25, Mu 40 and Mu 70) and Mojuí dos Campos River (MoC 10). Muju River flows into Curuá-Uma River about 40 km from the dam and the Mojuí dos Campos River joins the Muju River about 10 km above the confluence of Muju with Curuá-Una River (Figure 1).

C-Una 80, Mu 40 and Mu 70 sampling stations are located at larger distances from the dam, and they present high current flow. Aquatic macrophytes stands were only observed at C-Una 20, C-Una 32, C-Una 45 sampling stations.

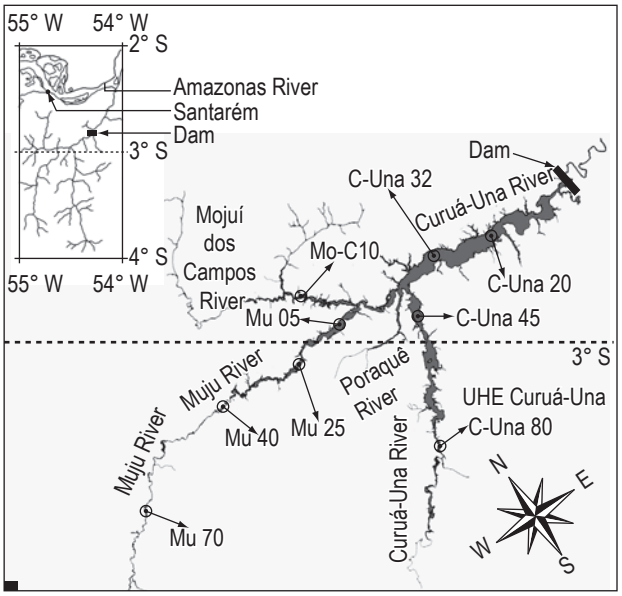

Figure 1. Study area and sampling sites in the Curuá-Una Reservoir. C-Una 20 = Curuá-Una River, Km 20; C-Una 32 = Curuá-Una River, Km 32; C-Una 45 = Curuá-Una River, Km 45; C-Una 80 = Curuá-Una River, Km 80; Mu 5 = Muju River, Km 5; Mu 25 = Muju River, Km 25; Mu 40 = Muju River, Km 40; MoC 10 = Mojuí dos Campos River, Km 10.

2.2. Sampling

Zooplankton samplings were done from November 1977 to September 1978 period. Samples were obtained from vertical and horizontal hauls, in the main channel of the rivers, using a plankton net (55 μm) and the samples were preserved in formaldehyde solution (6%). Simultaniously, limnological variables were measured in the study area and results are presented in Darwich (1980).

2.3. Laboratory analysis

Analyses were performed using Sedgewick-Rafter chambers with an optical microscope. Exemplars were removed from samples and set up in slides with glycerin for posterior identification. Although the samples have been collected many years before the analysis, they were carefully stored and the fixative solution replaced periodically. In this way, the shells were well preserved including their protoplasms. The taxonomic classification used was based on the one proposed by Loeblich and Tappan (1964).

Figures from different species presented were elaborated from images taken by digital camera (CoolSnap Pro) and image capture system (ImagePro express) coupled to an optical microscope (Olympus BX51).

The studied material is stored in a collection of the Zooplankton Laboratory of Núcleo de Pesquisas em Limnologia, Ictiologia and Aquicultura (Nupélia) of Universidade Estadual de Maringá, State of Paraná.

3. Results and Discussion

Fifty-one infra-generic testate amoebae taxa were identified, belonging to 7 families. The most specious families were Difflugiidae (19 taxa), Arcellidae (15 taxa) and Centropyxidae (9 taxa). These families have been frequently registered as the most specious in several Brazilian continental aquatic ecosystems (Green, 1975; Dabés, 1995; Lansac-Tôha et al., 1997; 2004; 2007; Landa and Mourguês-Schurter, 2000; Velho et al., 2000; 2001, among others). From the 51 recorded taxa, 46 were found in the reservoir (with 22 exclusive taxa) and 29 in the tributaries (with 5 exclusive taxa) (Table 1).

Considering only the reservoir, the highest species richness was verified at C80 station (40 taxa), 80 km distant from the dam, with lotic and shallow water characteristics. This fact can be related to intense flow, which promotes sediment washout, where these organisms are preferentially associated, carrying them to the water column.

The other sampling stations in Curuá-Una River under dam effects also presented expressive species richness, ranging from 16 to 25 taxa. These sampling stations had their banks colonized by aquatic macrophytes (Robertson, 1980), which also constitute a favorable habitat for testate amoebae.

During high flow periods, there is a carrying of testate amoebae species to plankton compartment, probably due to the aquatic macrophytes washout. Robertson (1980) observed this same process for cladocerans, with the emergence of occasional non-planktonic species, in the main channel of Curuá-Una Reservoir, in this same period, as consequence of rain, waves and fetch, transporting the organisms to pelagic region.

The sampling stations located in the tributaries presented lower species richness, varying from 7 to 13 taxa (Figure 2). Although they are lotic environments, the low richness can be related to the absence of aquatic vegetations, depth increase and low pH values (ranging from 3.9 to 6.2) (Darwich, 1980).

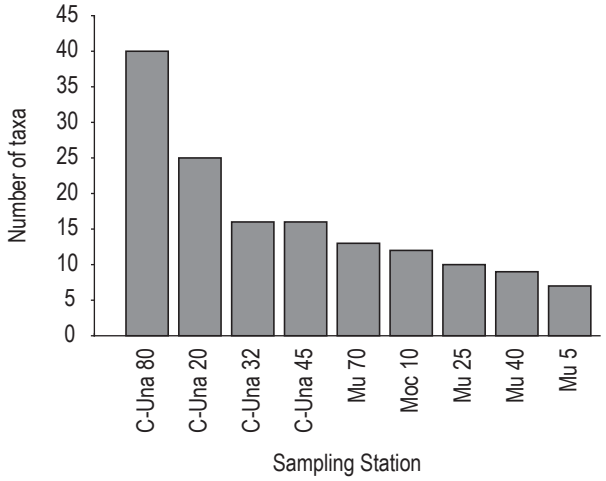

Figure 2. Number of testate amoeba taxa registered by sampling station.

Although the studied tributaries did not present aquatic macrophytes, Robertson (1980) registered several non-planktonic species of Chydoridae and Macrothricidae families (Cladocera), in M25 and MO8 stations, suggesting that they might be associated to algae blooms observed between trunks and branches of flooded trees. According to Gliwicz and Rybak (1976), the algae concentrations can favor the development of species living typically associated to aquatic macrophytes. This fact can explain the occurrence of testate amoebae in the tributaries, especially in M25 and MO8 sampling stations.

Among the 51 reccorded taxa, the 26 more frequent species, representing all registered families, were described and illustrated. For these species, were presented the range of values of some limnological variables (pH, dissolved oxygen, electric conductivity and water temperature) of the sampling sites where they were recorded (according to Darwich, 1980).

ARCELLIDAE Ehrenberg, 1830

Arcella brasiliensis Cunha, 1913 (Plate I, figure 1)

Cunha, 1913: 108-109, pl. IX, figs. 1a-b; Deflandre, 1928: 242-243, figs. 263-265; Velho et al., 1996: 39, pl. I, fig. 4; Gomes e Souza, 2008: 71, figs. a-b.

Description: Laterally, the dorsal face is rounded, with an expansion at the oral face represented by a brim. The apical profile of the shell is circular, with two concentric internal circles. The inner circle represents the aperture and the outermost circle corresponds to the beginning of the brim formed by rays separated by smooth areas and with areolas. The circular aperture does not present a bucal tube. The shell is yellow colored (Table 2).

Comments: All examined individuals had inferior dimensions than those observed in the literature. In Brazil, this species was recorded only in plankton samples in the Southeastern and Center-West regions and in plankton and aquatic macrophytes in South region (Lansac-Tôha et al., 2000; 2007 and references therein).

pH: 5.2-7.4; DO ($mg.L^{-1}$): 1.54-6.53; Conductivity ($\mu s.cm^{-1}$): 14.85-30.42; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Arcella conica (Playfair, 1917) (Plate I, figure 2)

Playfair, 1917: 640, figs. 16-17; Deflandre, 1928: 238-240, figs. 244-255; Grospietsch, 1972: 7; Vucetich, 1972: 273-274, pl. I, fig. 2; 1973: 293, pl. I, fig. 8; Ogden and Hedley, 1980: 32, pl. V, figs. a-c; Velho et al., 1996: 40, pl. I, fig. 8; Hardoim, 1997: 171, fig. 49; Alekperov and Snegovaya, 2000: 138, fig. 1, d-f; Gomes e Souza, 2008: 72, figs. a-b.

Description: In lateral view, the shell is composed by facets forming a pyramid. At apical view, the shell is

Table 1. Occurrence of testate amoebae taxa recorded at each sampling station.

Sampling stations	Reservoir				Tributaries				
	C-Una 20	C-Una 32	C-Una 45	C-Una 80	Mu 05	Mu 25	Mu 40	Mu 70	MoC 10
ARCELLIDAE									
Arcella brasiliensis Cunha, 1913	X	-	X	X	-	-	-	-	-
A. conica (Playfair, 1917)	X	-	X	X	-	-	-	-	X
A. costata Ehrenberg, 1847	X	X	X	X	X	-	-	-	-
A. crenulata Deflandre, 1928	-	-	-	X	-	-	X	X	-
A. dentata Ehrenberg, 1838	X	-	-	X	-	-	-	-	-
A. discoides Ehrenberg, 1843	X	-	X	X	X	-	X	X	X
A. gibbosa Pénard, 1890	-	X	-	X	-	-	-	X	X
A. hemisphaerica Perty, 1852	X	X	X	X	X	-	-	-	X
A. megastoma Pénard, 1902	X	-	X	X	-	X	X	-	X
A. mitrata Leidy, 1879	-	-	X	X	-	X	-	-	-
A. mitrata var. *spectabilis* Deflandre, 1928	-	-	X	X	-	-	-	-	-
A. nordestina Vucetich, 1973	-	-	-	X	-	-	-	-	-
A. artocrea Leidy, 1876	-	-	-	-	-	-	X	-	-
A. vulgaris Ehrenberg, 1830	X	X	-	X	X	-	X	-	X
A. vulgaris f. *undulata* Deflandre, 1928	-	X	X	X	-	-	-	-	X
CENTROPYXIDAE									
Centropyxis aculeata (Ehrenberg, 1838)	X	X	X	X	X	X	X	X	X
C. aerophila Deflandre, 1929	-	-	-	-	-	-	X	-	-
C. cassis (Wallich, 1864)	-	-	-	X	-	-	-	-	-
C. constricta (Ehrenberg, 1841)	-	-	-	X	-	-	-	X	-
C. discoides (Pénard, 1890)	X	-	-	X	-	-	-	-	-
C. ecornis (Ehrenberg, 1841)	-	-	X		-	-	-	-	-
C. hirsuta Deflandre, 1929	X	X	-	X	-	X	-	-	-
C. marsupiformis (Wallich, 1864)	-	-	-	X	-	-	-	X	-
C. spinosa (Cash, 1905)	-	-	-	X	-	-	-	X	-
TRIGONOPYXIDAE									
Cyclopyxis kahli (Deflandre, 1929)	-	X	-	X	-	X	X	X	X
DIFFLUGIIDAE									
Cucurbitella dentata f. *quinquilobata*, G-L and Thomas, 1958	-	-	-	X	-	-	-	-	-
Difflugia acuminata Ehrenberg, 1838	-	-	-	X	-	-	-	-	-
D. cf. *bryophila* (Pénnard, 1902)	-	-	-	-	-	-	-	X	-
D. corona Wallich, 1854	X	X	-	X	-	-	-	-	-
D. corona f. *tuberculata* Vucetich, 1973	X		-	X	-	-	-	-	-
D. elegans Pénard, 1899	-	X	-	X	-	-	-	-	-
D. gramem Pénard, 1902	X	-	-	X	-	-	-	-	X
D. helvetica var. *multilobata* G-L and Thomas ,1958	X	-	-	-	-	-	-	-	-
D. lithophila Pénard, 1902	-	-	-	-	X	-	-	-	-
D. lobostoma Leidy, 1879	X	X	-	X	-	-	-	-	X
D. lobostoma var. *cornuta* G-L and Thomas ,1958	X		-	-	-	-	-	-	-
D. lobostoma var. *multilobata* G-L and Thomas, 1958	X	X	-	-	-	-	-	-	-
D. muriculata G-L and Thomas, 1958	-	X	-	-	-	-	-	-	-
D. muriformis G-L and Thomas, 1958	X	X	X	-	-	X	-	-	X
D. muriformis f. *crucilobata* G-L and Thomas, 1958	X	-	-	X	-	X	-	-	-
D. oblonga Ehrenberg, 1838	X	-	-	X	-	-	-	X	-
D. pseudogramem G-L and Thomas, 1960	-	-	X	X	-	-	-	-	-
Pontigulasia compressa (Carter, 1864)	-	-	-	X	-	-	-	-	-
Protocucurbitella coroniformis G-L and Thomas, 1960	-	-	-	X	-	-	-	-	-
LESQUEREUSIIDAE									
Lesquereusia mimetica Rhumbler, 1896	-	-	-	X	-	-	-	-	-
L. modesta G-L and Thomas, 1959	X	-	-	X	-	X	-	X	-
L. spiralis (Ehrenberg, 1840)	X	X	X	X	-	X	-	X	-
Netzelia oviformis (Cash, 1909)	X	-	X	X	-	-	-	-	-
EUGLYPHIDAE									
Euglypha acanthophora (Ehrenberg, 1841)	X	X	X	X	X	X	-	-	-
HYALOSPHENIIDAE									
Nebela carinata (Archer, 1867)	-	-	-	-	-	-	X	X	-
Heleopera sp.	-	-	-	X	-	-	-	-	-

Table 2. Measurements (μm) of *Arcella brasiliensis*.

Authors	Shell diameter	Shell height	Pseudostome diameter
Deflandre (1928)	80	40	20
Velho et al. (1996)	81	49	22
Gomes e Souza (2008)	70	-	18
Present study (4 shells)	65-72	35-37	15-17

approximately circular with a polygon of eight or nine concave sides and rounded edges. The aperture is circular with or without a bucal tube. Shell color is yellow to brown (Table 3).

Comments: This species was formerly recorded in different habitats in Brazilian South, Southeastern and Center-West regions (Lansac-Tôha et al., 2000, 2007 and references therein).

pH: 4.4-7.4; DO (mg.L^{-1}): 1.54-6.53; Conductivity (μs.cm^{-1}): 9.29-30.42; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Arcella costata Ehrenberg, 1847 (Plate I, figure 3)

Deflandre, 1928: 240-241, figs. 257-258; Chardez, 1967, pl. I, fig. 45; Vucetich, 1973: 293, pl. I, fig. 9; Velho et al., 1996: 40, pl. I, fig. 7; Gomes e Souza, 2008: 73, figs a-c.

Description: The shell is formed by an incomplete pyramid of five to seven facets. The apical profile of the shell is approximately circular and presents a star with five to seven points formed by the pyramid facets. The oral face is wider than the apical face. The aperture is circular with a bucal tube. The color of the shell is yellow to brown (Table 4).

Comments: In Brazil, this species was recorded in plankton samples in South and Southeastern regions and plankton and aquatic macrophytes in Center-West region (Lansac-Tôha et al., 2000; 2007 and references therein).

pH: 4.4-7.4; DO (mg.L^{-1}): 1.54-7.46; Conductivity (μs.cm^{-1}): 10.06-30.42; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Arcella dentata Ehrenberg, 1838 (Plate I, figure 4)

Ehrenberg, 1838, pl. IX, fig. 7a; Pénard, 1902: 411; Deflandre, 1928: 252, fig. 307, 310-314; Hoogenraad and Groot, 1937, fig. 31; Chardez, 1967, pl. I, fig. 42; Grospietsch, 1972: 7, fig. 7; Vucetich, 1973: 295, fig. 13; Velho et al., 1996: 40, pl. I, fig. 9; Gomes e Souza, 2008: 71, fig. a-b.

Description: Laterally, the shell presents a rounded dorsal face. Apically, the outline of the shell is approximately circular, ornamented by a variable number of denticles. The circular aperture does not present a bucal tube. The color of the shell is yellow to brown (Table 5).

Comments: This species was formerly cited in different habitats from Brazilian South, Southeastern, Center-West and Northeast regions (Lansac-Tôha et al., 2000; 2007 and references therein).

Table 3. Measurements (μm) of *Arcella conica*.

Authors	Shell Diameter	Shell height	Pseudostome diameter	Bucal depth
Deflandre (1928)	69-80	31-48	20-22	12-13
Vucetich (1973)	80-100	48-60	20-25	12-14
Ogden and Hedley (1980)	68-76	63-66	23-33	-
Velho et al. (1996)	75-121	54-102	19-35	12-21
Alekperov and Snegovaya (2000)	50-70	30-40	12-18	-
Present study (7 shells)	55-97	50-62	20-30	7-15

Table 4. Measurements (μm) of *Arcella costata*.

Authors	Shell diameter	Shell height	Pseudostome diameter	Bucal depth
Deflandre (1928)	64	44	17	-
Vucetich (1973)	60-65	42-46	23-33	-
Velho et al. (1996)	87-116	54-81	24-40	14-24
Gomes e Souza (2008)	80-100	36-45	24-30	
Present study (7 shells)	87-117	50-65	25-37	15-17

Table 5. Measurements (μm) of *Arcella dentata*.

Authors	Shell diameter	Shell height	Pseudostome diameter	Bucal depth
Deflandre (1928)	123-168	38-40	32-40	17-22
Vucetich (1973)	132-143	30-60	34-40	-
Velho et al. (1996)	113-138	32-43	35-49	13-21
Gomes e Souza (2008)	60-70	33-39	12-21	-
Present study (4 shells)	112-125	32-52	30-38	-

pH: 5.2-6.2; DO (mg.L^{-1}): 2.60-6.53; Conductivity (μs.cm^{-1}): 14.85-28.94; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Arcella hemisphaerica Perty, 1852 (Plate I, figure 5)

Pénard, 1890, pl. V, figs. 93-95; Deflandre, 1928: 212-214, figs. 107-121; Chardez, 1967, pl. I, fig. 35; Grospietsch, 1972: 8; fig. 6; Vucetich, 1972: 272, pl. I, fig. 8; 1973: 289, pl. I, fig. 1; Lena and Zaidenwerg, 1975, pl. II, fig. 14 a-b; Ogden and Hedley, 1980: 40, pl. IX, figs. a-c; Hardoim, 1997: 180, fig. 54; Andrei and Mazei, 2007: 367, fig. 5f; Gomes e Souza, 2008: 76, figs. a-c.

Description: At lateral view, the dorsal face of the shell is hemispherical. The oral face is circular. The circular aperture is slightly invaginated, with bucal tube. The shell is yellow or brown (Table 6).

Comments: Shell dimensions found in the present study were larger than those observed in the literature. In Brazil, this species was registered in plankton and aquatic macrophytes samples in the Center-West region and plankton samples in Southeastern region (Lansac-Tôha et al., 2000; 2007 and references therein).

Table 6. Measurements (μm) of *Arcella hemisphaerica.*

Authors	Shell diameter	Shell height	Pseudostome diameter	Bucal depth
Deflandre (1928)	45-56	36-42	13-18	-
Vucetich (1973)	48-52	36-40	12-13	-
Ogden and Hedley (1980)	55-63	23-35	11-14	
Andrei and Mazei (2007)	38-68	23-37	10-20	6-9
Gomes e Souza (2008)	30-48	27-30	9-24	-
Present study (8 shells)	65-75	42-50	10-15	5-7

Table 7. Measurements (μm) of *Arcella megastoma.*

Authors	Shell diameter	Shell height	Pseudostome diameter	Bucal depth
Deflandre (1928)	180-268	36-55	68-131	-
Vucetich (1973)	140-305	35-45	70-140	-
Velho et al. (1996)	183-402	35-97	70-216	18-48
Gomes e Souza (2008)	84-120	51-81	27-33	-
Present study (5 shells)	175-250	35-62	57-132	-

Table 8. Measurements (μm) of *Arcella vulgaris.*

Authors	Shell diameter	Shell height	Pseudostome diameter	Bucal depth
Deflandre (1928)	100-145	52-73	30-47	14-24
Vucetich (1973)	100-140	51-70	30-40	-
Ogden and Hedley (1980)	104-136	46-56	22-32	-
Velho et al. (1996)	115-127	92-99	39-51	15-24
Present study (6 shells)	95-137	47-60	25-32	12-20

pH: 4.4-7.4; DO (mg.L^{-1}): 1.54-7.46; Conductivity (μs.cm^{-1}): 9.29-30.42; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Arcella megastoma Pénard, 1902 (Plate I, figure 6)

Pénard, 1902: 409; Wailes, 1913: 204-205, pl. XV, figs. 1-2; Deflandre, 1928: 267-268, figs. 363-372; Chardez, 1967, pl. I, fig. 22; Dioni, 1967: 121; 1970: 204, pl. I, fig. 3; Vucetich, 1972: 274; 1973: 298, pl. II, fig. 18; Velho et al., 1996: 43, pl. II, fig. 14; Gomes e Souza, 2008: 75.

Description: Apically, the shell contour is circular. It presents a circular pseudostome proportionally large and rounded by fine pores. The oral face is little invaginated without bucal tube. The shell is flattened laterally. Shell color is yellow to dark brown (Table 7).

Comments: Records of this species were obtained from samples of mosses, plankton and aquatic macrophytes collected in South, Southeastern and Center-West regions of Brazil (Lansac-Tôha et al., 2000; 2007 and references therein).

pH: 3.9-7.4; DO (mg.L^{-1}): 1.54-6.53; Conductivity (μs.cm^{-1}):10.36-30.42; Temperature (°C): 26.5-33.2. (Darwich, 1980).

Arcella vulgaris Ehrenberg, 1830 (Plate I, figure 7)

Pénard, 1902: 398, fig. 1-2; Wailes, 1913, pl. XV, fig. 5; Deflandre, 1928: 219-221, fig. 156-164; Chardez, 1967, pl. I, fig. 8; Dioni, 1967: 121; 1970: 295, pl. I fig. 7; Grospietsch, 1972: 9, fig. 9; Vucetich, 1972: 274; 1973: 292, pl. I, fig. 6; Lena and Cachi, 1972: 378, pl. I, fig. 28-32; Ogden and Hedley, 1980: 44, pl. II, figs. a-d; Velho et al., 1996: 37, pl. I, fig. 1.

Description: In lateral view, the shell is rounded with an expansion in the oral part. From the apical view, the shell is circular and presents two concentric circles; the inner circle represents the pseudostome and the outermost circle corresponds to the expansion in the oral part. The circular pseudostome presents a bucal tube. Shell color is dark brown or yellow (Table 8).

Comments: The records of this species were made previously in the Brazilian South, Southeastern, Center-West and Northeast regions, mainly in plankton samples, but the species was also registered in aquatic macrophytes and sediment samples (Lansac-Tôha et al., 2000; 2007 and references therein).

pH: 4.4-6.5 ; DO (mg.L^{-1}): 1.78-7.46; Conductivity (μs.cm^{-1}): 9.29-28.94; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Arcella vulgaris f. undulata Deflandre, 1928 (Plate I, figure 8)

Deflandre, 1928: 221, figs. 165-170; Chardez, 1967, pl. I, fig. 9; Vucetich, 1970: 43, figs. 1-2; 1973: 292, pl. I, fig. 7; Velho et al., 1996: 37, pl. I, fig. 2.

Description: It differs from the typical form by the well-developed marginal ondulation and fossettes on the shell. The pseudostome is circular with a bucal tube. The color of the shell is yellow (Table 9).

Comments: It was recorded in Brazil only in plankton samples from the South and Center-West regions (Lansac-Tôha et al., 2000; 2007 and references therein).

pH: 4.4-7.4; DO (mg.L^{-1}):1.54-6.53; Conductivity (μs.cm^{-1}): 9.29-30.42; Temperature (°C): 26.8-33.2 (Darwich, 1980).

CENTROPYXIDAE Deflandre, 1953

Centropyxis aculeata (Ehrenberg, 1838) (Plate II, figure 9)

Ehrenberg, 1838: 133, pl. IX, fig. 6; Pénard, 1902: 303, fig. 1; Deflandre, 1929: 344-348, fig. 80-92; Schönborn, 1966, figs.3a-d; Chardez, 1967, pl. II, fig. 26; Dioni, 1970: 206, fig. 8; 1971: fig. 2; Vucetich, 1970: 47; 1973: 322, pl. VIII fig. 66; Grospietsch, 1972: 11, fig. 15; Laminger, 1972, fig. 12.3h-i; Lena and Cachi, 1972: pl. I, fig. 23-25; Boltovskoy and Lena, 1974, pl. V, fig. 10; Ogden and Hedley, 1980: 46, pl. XII, figs. a-d; Velho et al., 1996: 44, pl. III, fig. 16; Gomes e Souza, 2008: 81, figs. a-c.

Table 9. Measurements (μm) of *Arcella vulgaris f. undulata*.

Authors	Shell diameter	Shell height	Pseudostome diameter	Bucal depth
Vucetich (1973)	105-140	55-70	32-40	-
Velho et al. (1996)	98-151	63-98	24-43	19-27
Present study (4 shells)	115-140	57-60	25-37	17-20

Description: From the frontal view, the shell is ovoid or approximately circular, and it was registered individuals presenting a breadth larger than length. The posterior part of the shell is ornamented by a variable number of spines which, laterally, are positioned at same heights. The pseudostome is irregular and eccentric. The shell revetment is formed by a variable number of sand particles or diatom frustules. The colour varing from yellow to dark brown in specimens with a few number of exogenous particles, and gray in specimens with many exogenous particles (Table 10).

Comments: The analyzed individuals presented the length of the shell smaller or larger than those registered in the literature. It is the species with the greatest number of records in Brazil, registered in plankton, moss/*Sphagnum*, sediment and aquatic macrophytes in South, Southeastern, Center-West and Northeast regions (Velho et al., 2000; Lansac-Tôha et al., 2007 and references therein).

pH: 4.4-7.4; DO (mg.L^{-1}): 1.54-7.46; Conductivity (μs.cm^{-1}): 9.29-30.42; Temperature (°C): 26.5-33.2 (Darwich, 1980).

Centropyxis constricta (Ehrenberg, 1841) (Plate II, figure 10)

Ehrenberg, 1841: 410, pl. IV, fig. 35, pl. V, fig. 1; Leidy, 1879, pl. XVIII, figs. 29-30; Pénard, 1902: 299, figs. 1-2; Deflandre, 1929: 340-341, figs. 60-67; Closs and Madeira, 1962: 14-15, pl. Vii, fig. 3; 1967, pl. I, fig. 9; Schönborn, 1965, fig. 3g; Boltovskoy and Lena, 1966: 58, pl. I, figs. 15-16; 1974, pl. III, fig. 11; Brant-Ribeiro, 1970: 12-13, pl. I, figs. 8a-c; Grospietsch, 1972: 11, fig. 19; Laminger, 1972, fig. 12.3r; 1973, fig. 29q; Green, 1975: 547, fig. 4; Ogden and Hedley, 1980: 52, pl. XV, figs. A-E; Medioli and Scott, 1983: 41, pl. VII, figs. 1-9; 1985: 30, figs. 7; Hardoim, 1997: 210, fig. 67, Rhoden and Pitoni, 1999: 96, fig. 5; Oliveira, 1999, pl. VI, figs. 1-6; Gomes e Souza, 2008: 84, figs. a-b.

Description: In ventral view, elongated shell with elliptic or ovoid contour. In lateral view, the aboral region is spherical but slightly flattened towards the pseudostome. The shell is usually smooth on the apertural surface and rough at the aboral region. The aperture is invaginated, circular or oval, sub-terminal and has a semi-circular apertural rim. The shell is yellow or brown (Table 11).

Comments: This species was recorded in Brazilian South, Southeastern and Center-West regions, especially in sediment samples (Velho et al., 2000; Lansac-Tôha et al., 2007 and references therein).

Table 10. Measurements (μm) of *Centropyxis aculeata.*

Authors	Shell length	Shell breadth	Shell height	Pseudostome length	Spines length
Deflandre (1929)	120-150	48-60	31-60	-	-
Vucetich (1973)	110-145	30-40	15-20	-	-
Ogden and Hedley (1980)	92-178	77-137	40-72	35-70	-
Velho et al. (1996)	86-132	86-138	32-43	29-63	16-29
Present study (11 shells)	65-202	60-187	25-75	25-62	15-37

Table 11. Measurements (μm) *Centropyxis constricta.*

Authors	Shell length	Shell breadth	Shell height	Pseudostome length
Deflandre (1929)	120-150	75-100	-	-
Green (1975)	90-120	60-78	-	30-35
Ogden and Hedley (1980)	141-181	132-148	82-102	62-85
Hardoim (1997)	120	80	-	32
Gomes e Souza (2008)	75-120	45-69	21-45	-
Present study (8 shells)	95-117	57-75	47-55	25-42

pH: 5.4-6.2; DO (mg.L^{-1}): 4.58-6.53; Conductivity (μs.cm^{-1}): 20.42-28.94; Temperature (°C): 26.8-27.5 (Darwich, 1980).

Centropyxis discoides (Pénard, 1890) (Plate II, figure 11)

Pénard, 1902: 306, figs. 1-7; Deflandre, 1926: 517, figs. 2-3; 1929: 351-353, figs. 104-107; Chardez, 1967, pl. II, fig. 44; Dioni, 1970: 297-298, pl. II, fig. 11; Grospietsch, 1972: 12, fig. 21; Vucetich, 1972: 278-279, pl. II, fig. 6; 1973: 317-318, pl. VII, fig. 57; Green, 1975: 548, fig. 1; Ogden and Hedley, 1980: 54, pl. XVI, figs. a-e.; Velho et al., 1996: 46, pl. III, fig. 19; Gomes e Souza, 2008: 85.

Description: In frontal view, the shell is approximately circular. The pseudostome is circular and approximately central. Laterally, C. discoides is strongly compressed without clear thickness difference between the anterior and posterior part. The posterior part of the shell is ornamented with spines of variable number, distributed at same heights. The shell revetment is compounded by sand particles.The shell colour is dark brown (Table 12).

Comments: All examined individuals had dimensions smaller than those observed in the literature. This species was registered especially in plankton and aquatic macrophyte samples from the South, Southeastern and Center-West regions of Brazil (Velho et al., 2000; Lansac-Tôha et al., 2007 and references therein).

pH: 5.2-6.2; DO (mg.L^{-1}): 2.60-6.53; Conductivity (μs.cm^{-1}): 14.85-28.94; Temperature (°C): 26.8-33.2 (Darwich, 1980).

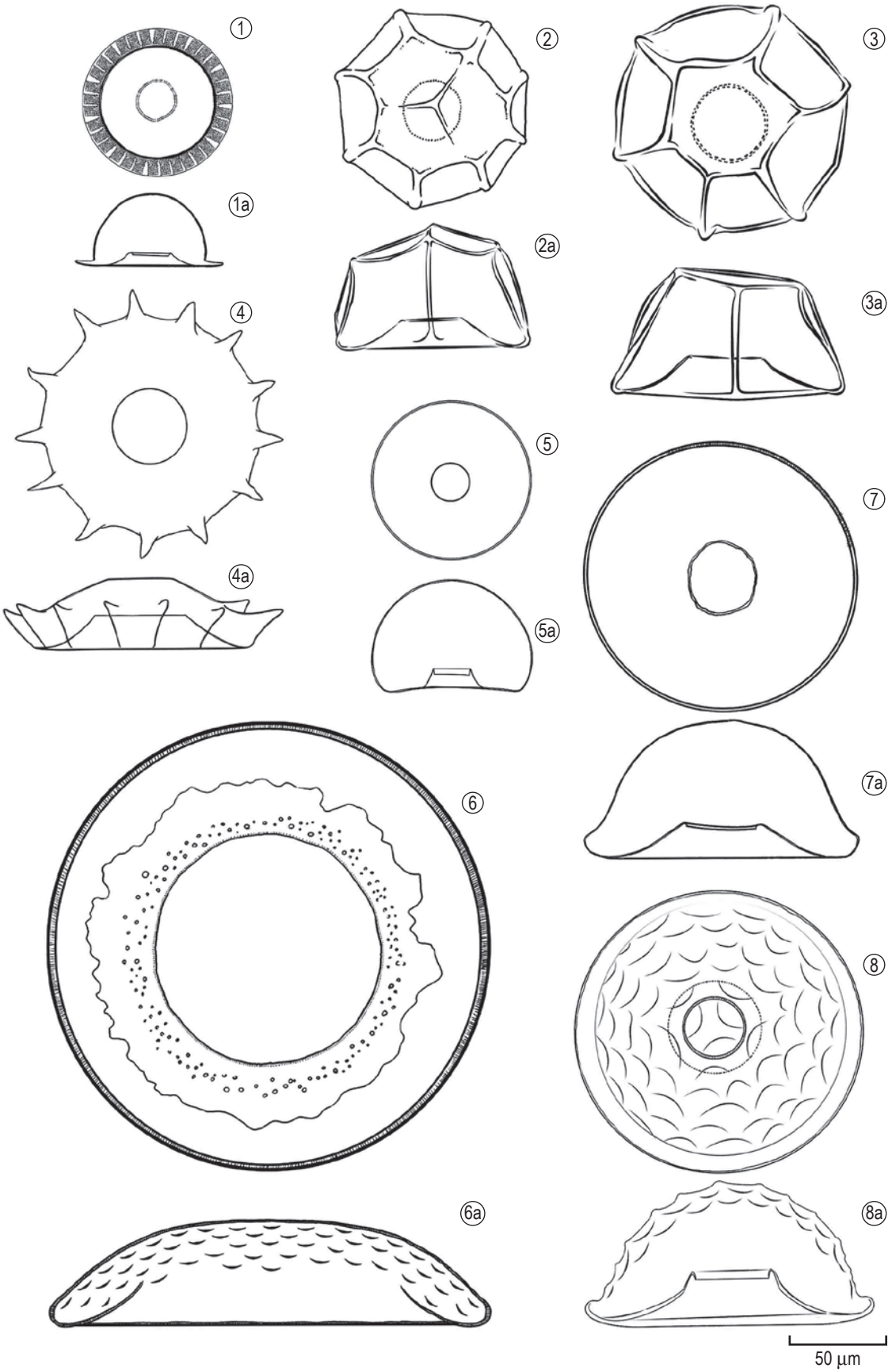

Plate I. 1) *Arcella brasiliensis*, apical view; 1a) lateral view; 2) *A. conica*, apical view; 2a) lateral view; 3) *A. costata*, apical view; 3a) lateral view; 4) *Arcella dentata*, apical view; 4a) lateral view; 5) *Arcella hemisphaerica*, apical view; 5a) lateral view; 6) *Arcella megastoma*, apical view; 6a) lateral view; 7) *Arcella vulgaris*, apical view; 7a) lateral view; 8) *Arcella vulgaris f. undulata*, apical view; 8a) lateral view.

Table 12. Measurements (μm) of *Centropyxis discoides*.

Authors	Shell length	Shell height	Pseudostome length	Spines length
Vucetich (1973)	145-150	20-28	50-60	20-35
Ogden and Hedley (1980)	202-240	63-65	69-71	
Velho et al. (1996)	260	62	81	35-38
Gomes e Souza (2008)	111-282	-	36-108	-
Present study (3 shells)	125-145	37-42	67-72	15-17

Centropyxis hirsuta Deflandre, 1929 (Plate II, figure 12)

Deflandre, 1929: 354-355, figs. 112-115; Schönborn, 1965, fig. 4d-e; Chardez, 1967, pl. II, fig. 25; Dioni, 1970: 208, pl. II, fig. 12; Vucetich, 1970: 47; 1972: 279, pl. I, fig. 1; 1973: 317, pl. VII, fig. 56; Laminger, 1972, fig. 12.3f-g; Green, 1975: 548, fig. 6; Ogden and Hedley, 1980: 58, pl. XVIII, figs. a-c. Velho et al., 1996: 44, pl. III, fig. 18.

Description: In frontal view, the profile of the shell is approximately circular. The pseudostome is approximately circular and eccentric. Laterally, the shell is high and narrowing towards the anterior region. The shell has spines in variable numbers which are distributed over the whole surface of the shell at different heights. The revetment of the shell has sand particles with variable sizes. The colour varies from brown to dark gray depending on the amout of exogenous particles (Table 13).

Comments: Some analyzed individuals presented dimensions larger than those observed in the literature. It was found previously in Brazil only in plankton samples of the regions South and Southeastern regions and in plankton and aquatic macrophytes in the Center-West region (Velho et al., 2000; Lansac-Tôha et al., 2007 and references therein).

pH: 3.9-6.5; DO ($mg.L^{-1}$): 1.78-6.53; Conductivity ($\mu s.cm^{-1}$):10.36-28.94; Temperature (°C): 26.5-33.2 (Darwich, 1980).

Centropyxis spinosa (Cash, 1905) (Plate II, figure 13)

Deflandre, 1929: 353-354, figs. 108-111; Chardez, 1967. pl. II, fig. 9; Grospietsch, 1972: 12, fig. 13; Lena and Zaidenwerg, 1975, pl. I, fig. 1; Ogden and Hedley, 1980: 62, pl. XX, fig. a-d; Lena, 1983, pl. 2, fig. 13-16; Fenchel, 1987, fig. 9. 4a; Hardoim, 1997: 222, fig. 72.; Alekperov and Snegovaya, 2000: 140, fig. 10; Mitchel, 2003: 1-2; Alves et al., 2007: 180: pl. 2, fig. 6; Gomes e Souza, 2008: 85, figs a-b.

Description: In frontal view, the profile of the shell is ovoid or circular. The shell is composed of exogenous particles, although part of the shell may be constituted only by organic material. Laterally, *C. spinosa* is low, narrowing towards the anterior region. The posterior part of the shell is ornamented with spines of variable length and number, and distributed at different heights. The pseudostome is approximately circular and eccentric. The colour varies from brown to dark gray depending on the amount of exogenous particles (Table 14).

Table 13. Measurements (μm) of *Centropyxis hirsuta*.

Authors	Shell length	Shell breadth	Shell height	Pseudostome length	Spines Length
Deflandre (1929)	72-88	-	42-54	-	-
Vucetich (1973)	71-90	-	42-54	30-40	25-30
Ogden and Hedley (1980)	72-85	81-82	44-51	33-50	-
Velho et al. (1996)	87	84	40	38	35
Present study (5 shells)	75-130	65-118	37-50	35-57	20-37

Table 14. Measurements (μm) of *Centropyxis spinosa*.

Authors	Shell length	Shell breadth	Shell height	Pseudostome length	Spines Length
Deflandre (1929)	120-140	30-40	-	-	-
Ogden and Hedley (1980)	105-141	84-137	-	27-51	-
Alves et al. (2007)	73-133	70-128	26-51	30-56	20-46
Gomes e Souza (2008)	90-114	-	-	30-45	-
Present study (4 shells)	72-105	65-95	25-42	27-37	17-25

Comments: In Brazil, this species was registered in aquatic macrophyte samples from the South and Southeastern regions and in plankton and aquatic macrophyte samples of the Center-West region (Velho et al., 2000; Lansac-Tôha et al., 2007 and references therein).

pH: 5.4-6.2; DO ($mg.L^{-1}$): 4.58-6.53; Conductivity ($\mu s.cm^{-1}$): 20.42-28.94; Temperature (°C): 26.8-27.5 (Darwich, 1980).

TRIGONOPYXIDAE Loeblich and Tappan, 1964.

Cyclopyxis kahli (Deflandre, 1929) (Plate II, figure 14)

Deflandre, 1929: 370, figs. 164-167; Vucetich, 1973: 320, pl. VIII, fig. 63; Green, 1975, fig. 5; Ogden and Hedley, 1980; 70, pl. XXIV, figs a-e; Foissner and Korganova, 1995: 14, figs. 17-21, 23-29, 47-60; Velho et al., 1996: 47, pl. IV, fig. 23; Fulone et al., 2005: pl. II, figs. 2a-b; Gomes e Souza, 2008: 90, fig. a-c.

Description: In ventral view, the shell outline is circular. The dorsal face is semi-circular and slightly flattened in lateral view. The pseudostome is circular, small and central, and their surface is slightly invaginated and circular. The color of the shell is brown to yellow (Table 15).

Comments: It was formerly found only in plankton samples in the South, Southeastern and Center-West regions of Brazil (Velho et al., 2000; Lansac-Tôha et al., 2007 and references therein).

pH: 4.4-6.5; DO ($mg.L^{-1}$): 1.78-6.53; Conductivity ($\mu s.cm^{-1}$): 9.29-28.94; Temperature (°C): 26.5-32.8 (Darwich, 1980).

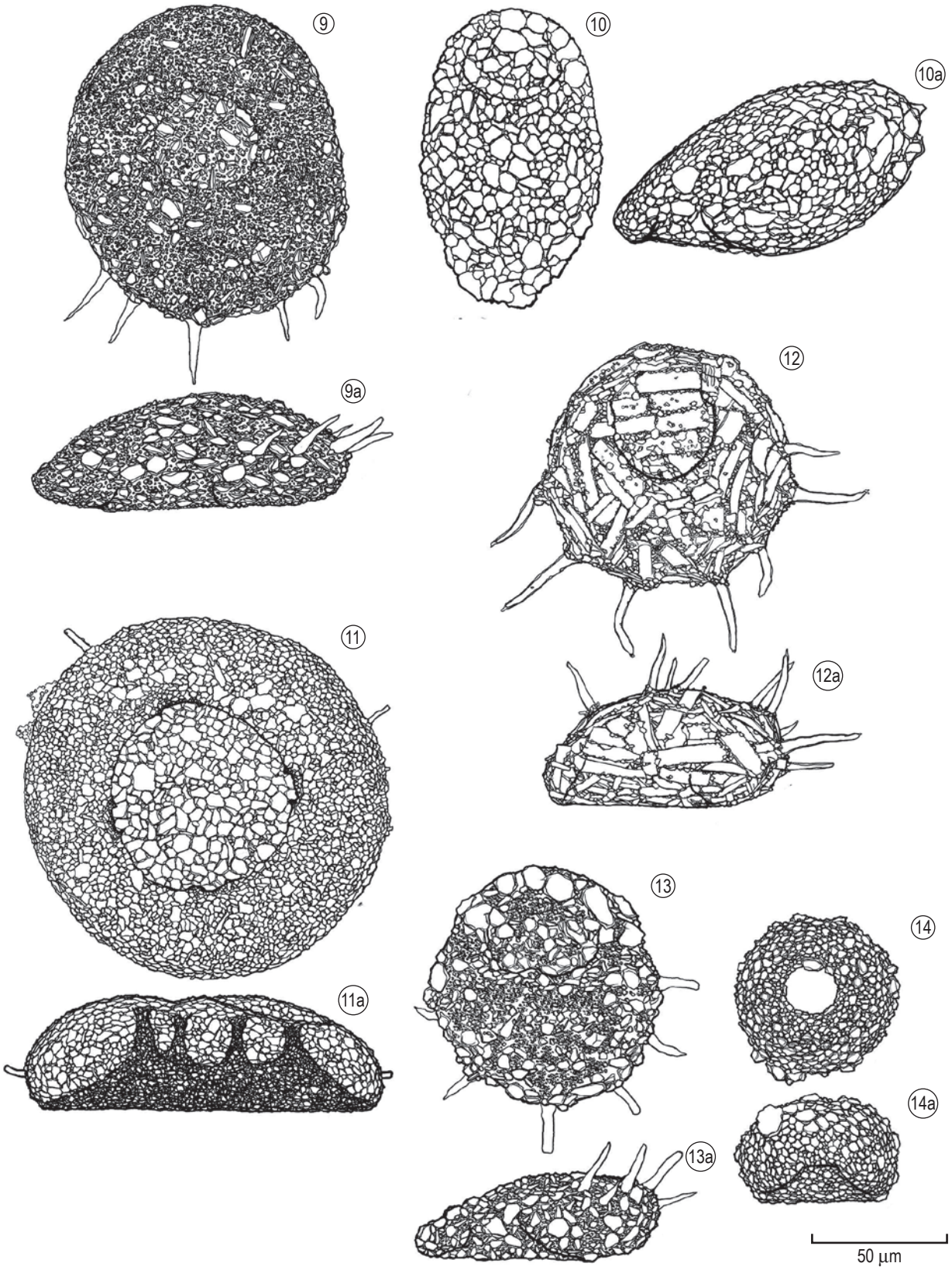

Plate II. 9) *Centropyxis aculeata*, ventral view; 9a) lateral view; 10) *C. constricta*, ventral view; 10a) lateral view; 11) *C. discoides*, ventral view; 11a) lateral view; 12) *C. hirsuta*, ventral view; 12a) lateral view; 13) *C. spinosa*, ventral view; 13a) lateral view; 14) *Cyclopyxis kahli*, ventral view; 14a) lateral view.

Table 15. Measurements (μm) of *Cyclopyxis kahli*.

Authors	Shell diameter	Shell height	Pseudostome diameter
Deflandre (1929)	80-85	55-60	24-25
Vucetich (1973)	75-85	50-60	15-25
Ogden and Hedley (1980)	77-105	43-61	24-36
Velho et al. (1996)	81-95	57-62	24-28
Gomes e Souza (2008)	68-84	39-51	18-30
Present study (7 shells)	50-87	35-50	17-22

Table 16. Measurements (μm) of *Difflugia corona* f. *tuberculata*.

Authors	Shell height	Shell diameter	Pseudostome diameter	Collar height	Spines Length
Vucetich (1973)	120-160	100-140	50-68	-	-
Velho and Lansac-Tôha (1996)	125-212	120-202	67-103	-	-
Present study (4 shells)	87-100	87-107	40-50	7-10	17-25

DIFFLUGIIDAE Awerintzew, 1906

Difflugia corona f. *tuberculata* Vucetich, 1973 (Plate III, figure 15)

Vucetich, 1973: 302, pl. III, fig. 24; Velho and Lansac-Tôha, 1996: 181, pl. I, figs. 2; Fulone et al., 2005: pl. II, figs 4a-b.

Description: In lateral view, the shell has a spherical or subspherical contour, with variable number of more or less divergent horns at its base. The large pseudostome has numerous teeth. The shell revetment is composed by sand particles of variable size. It differs from *D. corona* by rounded, regular expansions along the whole surface of the shell (Table 16).

Comments: All examined individuals presented dimensions smaller than those observed in literature. This species was only registered in plankton samples from the regions South, Southeastern and Center-West of Brazil (Lansac-Tôha et al., 2001a; 2007 and references therein).

pH: 5.2-6.2; DO (mg.L^{-1}): 2.60-6.53; Conductivity (μs.cm^{-1}): 14.85-28.94; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Difflugia elegans Pénard, 1890 (Plate III, figure 16)

Pénard, 1890: 140, pl. 4, figs. 4-11; 1902: 236, figs. 1-13; Deflandre, 1926: 521-522, figs. 9 and 11; Gauthier-Lièvre and Thomas, 1958: 333, figs. 49a-c; Schönborn, 1966: figs. 5q-v; Chardez, 1967: pl. IV, fig. 25; Grospietsch, 1972: 13, fig. 38; Laminger, 1972: fig. 12.4c; Vucetich, 1973: 306, pl. III, fig. 33; Boltovskoy and Lena, 1974: pl. I, figs. 4a–b; Lena and Zaidenwerg, 1975: pl. II, fig. 6; Green, 1975: 550, fig. 9: Ogden, 1979: 146, fig. 5; Ogden and Hedley, 1980: 132, pl. LV, figs. A-C; Torres and Jebram, 1994: 72, fig. 4A; Velho and Lansac-Tôha, 1996: 187, pl. II, fig. 17; Gomes e Souza, 2008: 98, figs. a-b.

Description: Laterally, the shell is approximately fusiform, ending in a narrow spine and slightly curved, and there is a distinct constriction posterior to the circular pseudostome. Shell revetment with angular sand particles and diatom frustules (Table 17).

Comments: In Brazil, this species was registered in plankton, aquatic macrophytes and sediment samples in South region, in plankton and aquatic macrophyte samples from the Southeastern region and only plankton samples from the Center-West region (Lansac-Tôha et al., 2001a; 2007 and references therein).

Table 17. Measurements (μm) of *Difflugia elegans*.

Authors	Shell height	Shell diameter	Pseudostome Diameter
Gauthier-Lièvre and Thomas (1958)	80-150	36-65	25-40
Vucetich (1973)	100-110	45-60	30-40
Ogden (1979)	113-151	75-95	25-48
Ogden and Hedley (1980)	117-158	69-99	39-55
Velho and Lansac-Tôha (1996)	121-138	64-70	41-43
Gomes e Souza (2008)	74-114	36-54	18-51
Present study (4 shells)	97-112	50-52	25-35

pH: 5.0-6.5; DO (mg.L^{-1}): 1.78-6.53; Conductivity (μs.cm^{-1}): 11.93-28.94; Temperature (°C): 26.8-32.8 (Darwich, 1980).

Difflugia helvetica var. *multilobata* Gauthier-Lièvre and Thomas, 1958 (Plate III, figure 17)

Gauthier-Lièvre and Thomas, 1958: 260-261, fig. 4; Alves et al., 2007: 185, pl. III, fig. 13.

Description: In lateral view, globular and transparent shell with discreet collar. Shell revetment is very specific represented by disks approximately ovoids. Apically, the aperture presents eight irregulars and few deep lobes. It differs from the typical form by present eight lobes in the aperture while the typical form present three irregular lobes (Table 18).

Comments: It is the second record from Brazil, the first one was made by Alves et al. (2007) in plankton samples from the Upper Paraná River floodplain, State of Mato Grosso do Sul.

pH: 5.2-5.6; DO (mg.L^{-1}): 2.6-4.19; Conductivity (μs.cm^{-1}): 14.85-18.29; Temperature (°C): 30.0-33.2 (Darwich, 1980).

Difflugia lobostoma var. *cornuta* Gauthier-Lièvre and Thomas, 1958 (Plate III, figure 18)

Gauthier-Lièvre and Thomas, 1958: 267, pl. IX, fig. H; Fulone et al., 2005, fig. 3. Alves et al., 2007: 188, pl. IV, fig. 14.

Description: In lateral view, the shell has an ovoid outline. Shell revetment with sand particles of variable size, more or less angular. Apically, the pseudostome has three lobes and present a few evident collar. The base of the shell exhibits two or three empty, short horns (Table 19).

Table 18. Measurements (μm) of *Difflugia helvetica* var. *multilobata*.

Authors	Shell height	Shell diameter	Pseudostome Diameter
Gauthier-Lièvre and Thomas (1958)	68-120	60-87	15-30
Alves et al. (2007)	90-92	90-92	28-38
Present study (6 shells)	92-97	87-92	35-40

Table 19. Measurements (μm) of *Difflugia lobostoma* var. *cornuta*.

Authors	Shell height (without spine)	Spine length	Shell diameter	Pseudostome diameter
Gauthier-Lièvre and Thomas (1958)	95-120	10-12	72-90	25-40
Fulone et al. (2005)	81	-	60	-
Alves et al. (2007)	80-95	8-12	60-69	15-20
Present study (2 shells)	92-95	12	62-70	22

Comments: In Brazil, this species had been found in plankton samples, in Southeastern and Center-West regions (Lansac-Tôha et al., 2001a; 2007 and references therein).

pH: 5.2-5.6; DO (mg.L^{-1}): 2.6-4.19; Conductivity (μs.cm^{-1}): 14.85-18.29; Temperature (°C): 30.0-33.2 (Darwich, 1980).

Difflugia lobostoma var. *multilobata* Gauthier- Lièvre and Thomas, 1958 (Plate III, figure 19)

Gauthier-Lièvre and Thomas, 1958: 266, pl. IX, figs. D-F; Chardez, 1967: pl. IV, fig. 45; Vucetich, 1972: 277, pl. II, fig. 3; 1973: 301, pl. III, fig. 22; Boltovskoy and Lena, 1974: pl. VI, fig. 8-9; Velho and Lansac-Tôha , 1996: 182, pl. I fig. 4; Gomes e Souza, 2008: 106, figs. a-c.

Description: Laterally, the shell is approximately circular with a distinct collar. In apical view, the pseudostome presents five to seven rounded lobes. Shell revetment with sand particles of variable size, and diatom frustules. The collar presents smaller particles (Table 20).

Comments: The specimens analyzed in the this study present much larger dimensions than those observed by Gauthier-Lièvre and Thomas (1958) and Vucetich (1973), but similar to those verified by Velho and Lansac-Tôha (1996). Gauthier- Lièvre and Thomas (1958) found specimens with five or six lobes in the aperture, whereas Vucetich (1973) observed apertures with six to eight lobes. Our specimens presented five to seven lobes, and the specimen drawed was that with 5 lobes. In Brazil, this species was recorded only in plankton samples from the South and Center-West regions (Lansac-Tôha et al., 2001a; 2007 and references therein).

pH: 5.0-6.5; DO (mg.L^{-1}): 1.78-5.77; Conductivity (μs.cm^{-1}): 11.93-24.95; Temperature (°C): 28.4-33.2 (Darwich, 1980).

Table 20. Measurements (μm) of *Difflugia lobostoma* var. *multilobata.*

Authors	Shell height	Shell diameter	Pseudostome Diameter
Gauthier-Lièvre and Thomas (1958)	95–120	65–100	25–40
Vucetich (1973)	105–135	90–120	35–45
Velho and Lansac-Tôha (1996)	151–161	135–148	39–46
Gomes e Souza (2008)	90-168	105-138	30-45
Present study (3 shells)	150-151	132-135	47-50

Difflugia muriformis f. *crucilobata* Gauthier-Lièvre and Thomas, 1958 (Plate III, figure 20)

Gauthier-Lièvre and Thomas, 1958: 272, pl. X, figs. d-e; Alves et al., 2007: 188, pl. IV, fig. 17.

Description: In lateral view, the shell is nearly spherical with regular protuberances, similar to the typical form. Pseudostome contains four regular lobes. It has an evident collar with waves which indicate pseudostome lobes. The shell revetment comprises regular sand particles, which are smaller around the pseudostome (Table 21).

Comments: The unique record of this species in Brazil was made by Alves et al. (2007) in the Upper Paraná River floodplain, State of Mato Grosso do Sul.

pH: 3.9-6.5; DO (mg.L^{-1}): 1.78-5.77; Conductivity (μs.cm^{-1}): 10.36-24.95; Temperature (°C): 26.5-33.2 (Darwich, 1980).

Difflugia pseudogramen Gauthier-Lièvre and Thomas 1960 (Plate III, figure 21)

Gauthier-Lièvre and Thomas, 1960: 592, figs. 12d-e; Vucetich, 1973: 313, pl. V, fig. 49; Velho and Lansac-Tôha, 1996: 182, pl. I, fig. 5; Gomes e Souza, 2008: 101, figs. a-c.

Description: Laterally, shell with an oval contour of a very slim wall. The pseudostome presents three well-defined lobes with well-differentiated collar without internal diaphragm. The shell is transparent and coated by small sand particles, which are smaller around the collar (Table 22).

Comments: This species was recorded in plankton samples in the Brazilian South and Center-West regions, and in aquatic macrophytes samples in the Southeastern region (Lansac-Tôha et al., 2001a; 2007 and references therein).

pH: 5.3-7.4; DO (mg.L^{-1}): 1.54-6.53; Conductivity (μs.cm^{-1}): 20.42-30.42; Temperature (°C): 26.8-33.0 (Darwich, 1980).

LESQUEREUSIIDAE Jung, 1942

Netzelia oviformis (Cash, 1909) (Plate IV, figure 22)

Oye, 1931: 59, fig. 4 (like *Difflugia oviformis*), Gauthier-Lièvre and Thomas, 1958: : 273, figs. 9a-e (like *D. oviformis*); Grospietsch, 1958: 319 (like *D. oviformis*); Chardez, 1967, pl. IV, fig. 46 (like *D. oviformis*); Vucetich, 1975: 110-111, fig.11 (like *D. oviformis*); Ogden, 1979: 206; Ogden and

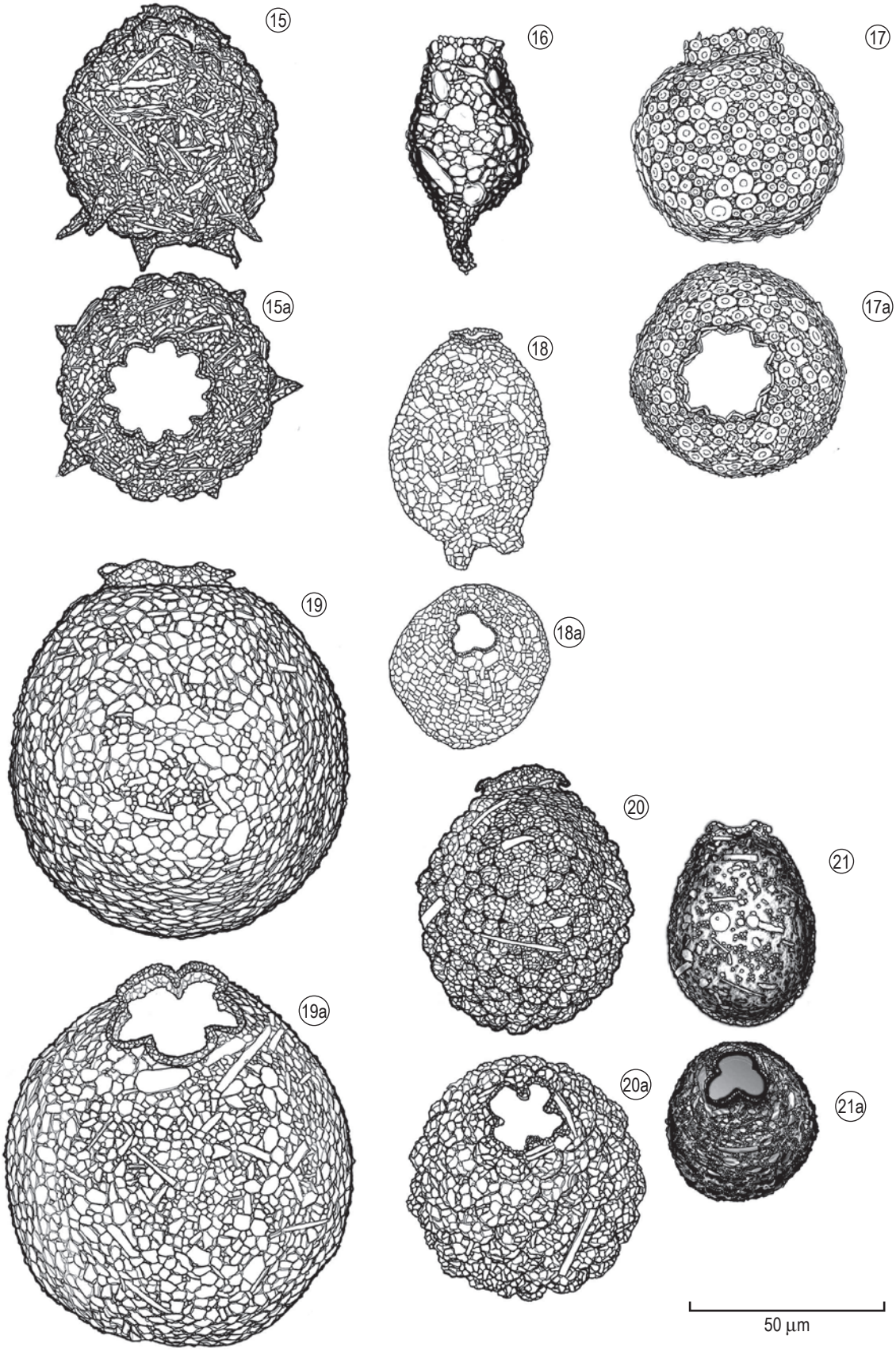

Plate III. 15) *Difflugia corona* f. *tuberculata*, lateral view; 15a) apical view; 16) *Difflugia elegans*; 15) *D. helvetica* var. *multilobata*, lateral view; 17a) apical view; 18) *D. lobostoma* var. *cornuta*, lateral view; 18a) apical view; 19) *Difflugia lobostoma* var.. *multilobata*, lateral view; 19a) apical view; 20) *Difflugia muriformis* f. *crucilobata*, lateral view; 20a) apical view; 21) *Difflugia pseudogramen*, lateral view; 21a) apical view.

Table 21. Measurements (μm) of *Difflugia muriformis* f. *crucilobata*.

Authors	Shell height	Shell diameter	Collar height	Pseudostome diameter
Gauthier-Lièvre and Thomas (1958)	119-149	100-150	3-10	43-50
Alves et al. (2007)	102	75	7	22
Present study (2 shells)	102-107	80-87	7-10	25-27

Table 22. Measurements (μm) of *Difflugia pseudogramen*.

Authors	Shell height	Shell diameter	Pseudostome Diameter
Gauthier-Lièvre and Thomas (1960)	85	58	18-20
Vucetich (1973)	85-90	65-78	-
Velho and Lansac-Tôha (1996)	83-92	60-70	21-24
Gomes e Souza (2008)	75-81	54-72	21-27
Present study (4 shells)	72-85	55-60	20-22

Table 23. Measurements (μm) of *Netzelia oviformis*.

Authors	Shell height	Shell diameter	Pseudostome diameter
Gauthier-Lièvre and Thomas (1958)	65-120	30-90	15-30
Ogden and Hedley (1980)	79-87	57-67	25-26
Hardoim (1997)	71-86	43-60	15-28
Alves et al. (2007)	192	174	61
Present study (9 shells)	172-202	157-197	52-60

Table 24. Measurements (μm) of *Lesquereusia modesta*.

Authors	Shell height	Shell diameter	Pseudostome diameter
Vucetich (1973)	105-185	50-80	15-48
Ogden and Hedley (1980)	109-174	100-159	25-43
Hardoim (1997)	102-150	78	30-32
Alekperov and Snegovaya (2000)	90-110	60-95	20-35
Present study (7 shells)	77-127	62-102	17-32

Hedley, 1980: 150, pl. LXIV, figs. A-D (like *D. oviformis*); Ogden and Meisterfeld, 1989: 123-126; Hardoim, 1997: 255, fig. 89; Missawa, 2000, pl. VI, fig. 64; Dabés and Velho, 2001: 303; Alves et al., 2007: 191, pl. V, figs. 22.

Description: In lateral view, the shell has an ovoid contour. The revetment of the shell is of endogenous nature, incorporating irregular plates in transparent cement. The pseudostome presents four lobes rounded by a thick brim of organic cement. Short collar. The color of the shell is yellow to brown (Table 23).

Comments: All analyzed individuals presented four lobes. In Brazil, this species was recorded in sediment samples from the South region, in aquatic macrophyte samples from the Southeastern region and in plankton, sediment and aquatic macrophytes samples from the Center-West region (Velho et al., 2001; Lansac-Tôha et al., 2007 and references therein).

pH: 5.2-7.4; DO (mg.L^{-1}): 1.54-6.53; Conductivity (μs.cm^{-1}): 14.85-30.42; Temperature (°C): 26.8-33.2 (Darwich, 1980).

Lesquereusia modesta Rhumber, 1896 (Plate IV, figure 23)

Rhumbler, 1896: 101, pl. IV, fig. 2; Thomas and Gauthier-Liévre, 1959: 52-53, fig. 10a-g and pl. II, fig. 6; Chardez, 1967, pl. VI, fig. 5; Boltovskoy and Lena, 1966: 62, pl. I, fig. 18; 1974: 28, pl. I, fig. 5 a 6; Grospietsch, 1972: 20-21, fig. 47; Laminger, 1973, fig. 32q; Vucetich, 1973: 324, fig. 70; Ogden and Hedley, 1980: 84, pl. XXXI, fig. A-D; Hardoim, 1997: 226, fig. 75; Torres, 1998: 548-549, fig. 9; Alekperov and Snegovaya, 2000: 5; fig. 1q.

Description: The shell is circular and slightly flattened laterally. It presents a short neck in oral part and asymmetrically expanded in lateral plane. The pseudostome is terminal, circular and bordered by small particles of quartz. Shell revetment is of mineral origin (Table 24).

Comments: Some individuals presented lower height compared to those reported in the literature. In Brazil, it was registered previously in plankton samples from the Southeastern and Center-West regions and plankton and aquatic macrophytes in the South region (Velho et al., 2001; Lansac-Tôha et al., 2007 and references therein).

pH: 3.9-6.2; DO (mg.L^{-1}): 2.16-6.53; Conductivity (μs.cm^{-1}): 10.36-28.94; Temperature (°C): 26.5-33.2 (Darwich, 1980).

Lesquereusia spiralis (Ehrenberg, 1840) (Plate IV, figure 24)

Oye, 1931: 62, fig. 6; Thomas and Gauthier-Liévre, 1959: 65-67, figs. 14-15, pl. I, figs. 1 and pl. II, figs. 7-9; Chardez, 1967, pl. VI, figs. 1; Grospietsch, 1972: 21, figs. 47; Vucetich, 1973: 324-325, pl. IX, figs. 71; Lena and Zaidenwerg, 1975, pl. I, figs. 16; Ogden and Hedley, 1980: 86, pl. XXXII, figs. a-e; Patterson et al., 1985, pl. II, figs. 9-10; Vucetich and Lopretto, 1995, fig. 12; Hardoim, 1997: 228, fig. 76; Rhoden and Pitoni, 1999: 98, fig. 10.

Description: The shell is circular or ovoid and slightly flattened laterally. It presents a short neck in the oral part and asymmetrically expanded in lateral plane. It is composed by numerous and siliceous curved rods interposed with a meshwork of organic cement. The pseudostome is terminal, circular and bordered by siliceous rods (Table 25).

Comments: It was formerly registered in different habitats in South, Southeastern, Center-West and Northeast regions of Brazil (Velho et al., 2001; Lansac-Tôha et al., 2007 and references therein).

pH: 3.9-7.4; DO (mg.L^{-1}): 1.54-6.53; Conductivity (μs.cm^{-1}): 10.36-30.42; Temperature (°C): 26.5-33.2 (Darwich, 1980).

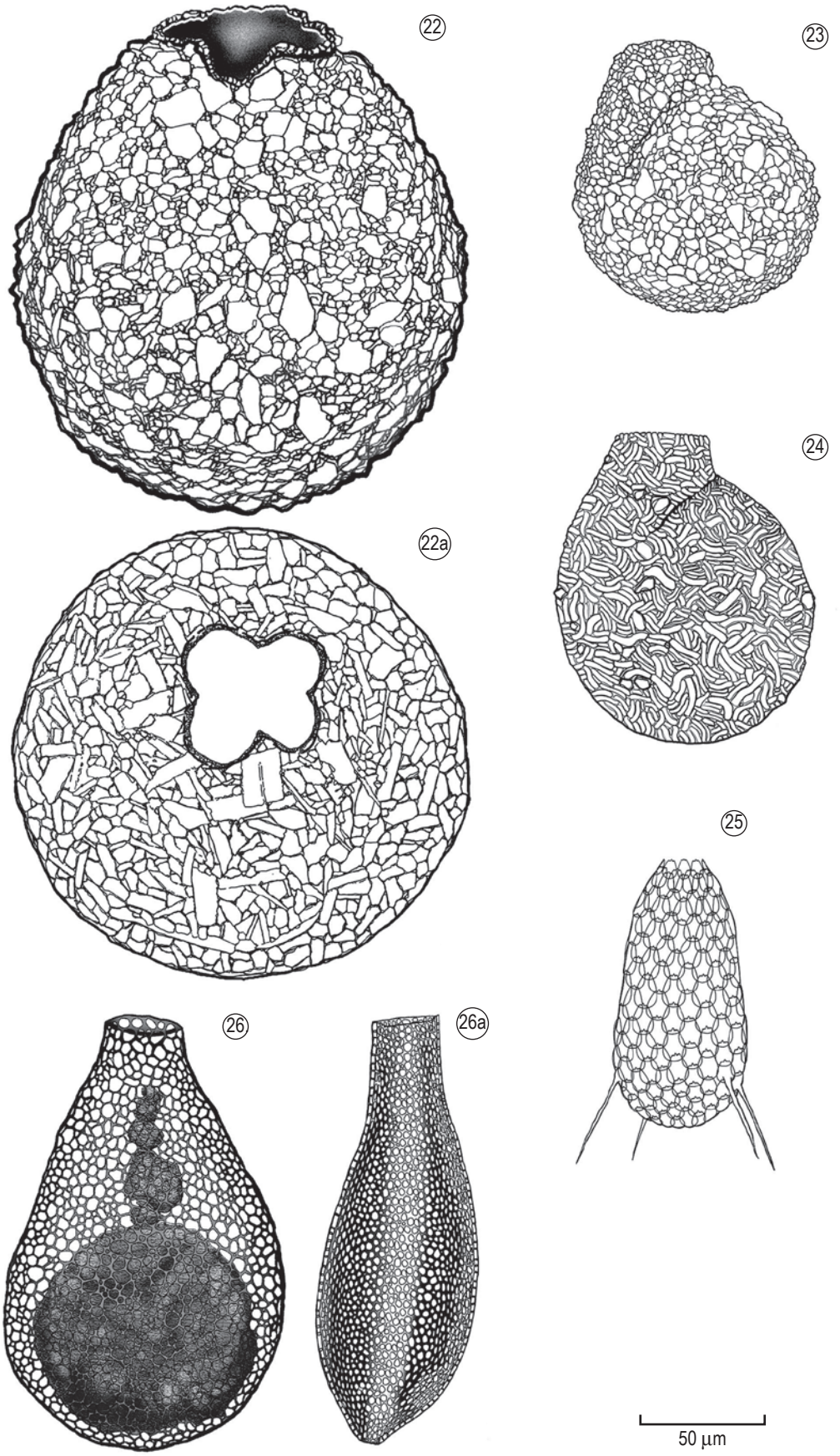

Plate IV. 22) *Netzelia oviformis*, lateral view; 22a) apical view; 23) *Lesquereusia modesta*, lateral view; 24) *L. spiralis*, lateral view; 25) *Euglypha acanthophora*, lateral view; 26. *Nebela carinata*, apical view; 26a) lateral view.

Table 25. Measurements (μm) of *Lesquereusia spiralis.*

Authors	Shell height	Shell diameter	Pseudostome diameter
Vucetich (1973)	125-150	110-125	35-40
Ogden and Hedley (1980)	89-117	86-109	23-31
Hardoim (1997)	75-176	89-132	32-64
Present study (6 shells)	90-132	65-115	27-47

EUGLYPHIDAE Wailes, 1919

Euglypha acanthophora (Ehrenberg, 1841) (Plate IV, figure 25)

Pénard, 1890: 177-178, pl. IX, figs. 26-40 (as. *E. alveolata*); Wailes, 1912: 145 (as. *E. alveolata*); Deflandre, 1926, fig. 23; Chardez, 1967, pl. VII, fig. 20; Dioni, 1971, fig. 6b; Grospietsch, 1972: 21, fig. 39; Vucetich, 1973: 326-327, pl. X, fig. 76; Ogden and Hedley, 1980: 176, pl. XXVII, figs. a-d; Hardoim, 1997: 264, fig. 93. Alekperov and Snegovaya, 2000: 11, fig. 3j-l; Gomes e Souza, 2008: 113, figs. a-b.

Description: The shell is ovoid, circular in transverse section. The pseudostome is circular and surrounded by evenly spaced apertural-plates. Each apertural-plate is roughly circular and carries a large median tooth with smaller lateral teeth at each side (Table 26).

Comments: *E. acanthophora* individuals were very transparent; therefore it was not possible to measure the pseudostome length. This species was previously recorded in different habitats in South, Southeastern, Center-West and Northeast regions of Brazil (Lansac-Tôha et al., 2001b; 2007 and references therein).

pH: 3.9-7.4; DO (mg.L^{-1}): 1.54-7.46; Conductivity (μs.cm^{-1}): 10.06-30.42; Temperature (°C): 26.5-33.2 (Darwich, 1980).

HYALOSPHENIIDAE Schulze, 1877

Nebela carinata (Archer, 1867) (Plate IV, figure 26)

Leidy, 1879, pl. XXIV, figs. 1-5 and 9-10; Pénard, 1890: 160-161, pl. VI, figs. 69-77; Deflandre, 1936: 274, figs. 122-127 and pl. XXV, figs. 12-15; Gauthier-Lièvre, 1953: 357: Hoogenrad and Groot, 1979, fig. 1c; Ogden and Hedley, 1980: 92, pl. XXXV, figs. a-d.

Description: In lateral view, the shell is oval and compressed with a lateral ridge that begins just posterior to the pseudostome. The shell presents a small lateral pore at each side. It is mainly compounded by oval or circular shell plates, often interspersed with small beads of organic cement. The pseudostome is oval and surrounded by a thin collar of organic cement (Table 27).

Comments: This species was registered previously only in bottom samples from the State of São Paulo (Oliveira, 1999).

Table 26. Measurements (μm) of *Euglypha acanthophora.*

Authors	Shell height	Shell diameter	Pseudostome length
Ogden and Hedley (1980)	53-84	28-40	14-20
Hardoim (1997)	94-100	50-60	28-40
Alekperov and Snegovaya (2000)	50-75	25-40	15-22
Gomes e Souza (2008)	75-117	30-54	18-30
Present study (7 shells)	92-112	47-55	-

Table 27. Measurements (μm)of *Nebela carinata*.

Authors	Shell height	Shell diameter	Pseudostome length
Deflandre (1936)	140-180	110-130	28-36
Ogden and Hedley (1980)	155-202	110-152	27-43
Present study (2 shells)	170-177	105-112	25-27

pH: 3,9 - 5,8; DO (mg.L^{-1}): 2,16 - 3,19; Conductivity (μs.cm^{-1}): 10,36-12,75; Temperature (°C): 26,5-29,0 (Darwich, 1980).

4. Final Considerations

The high number of species recorded in a few number of samples in Curuá-Una Reservoir suggests that North Region presents a high diversity of testate amoebae in aquatic environments. This result corroborated the survey of Walker (1982) who found a great number of morphotypes in "igarapés" of the State of Amazonas. Thus, these studies evidence the need to increase surveys on these organisms in the North Region, especially in floodplain system known by its high biodiversity.

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