



## Pigmented Euglenophyceae of a lentic environment at the Upper Paraná River Floodplain, Brazil

Euglenophyceae pigmentadas de ambiente lêntico da Planície de Inundação do alto rio Paraná, Brasil

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**Abstract: Aim:** Contributing to taxonomic knowledge on Pigmented Euglenophyceae at the Upper Paraná River Floodplain by enlarging the biodiversity survey in this ecosystem, in addition to contributing to the knowledge on the geographical distribution of this group in Brazil. **Methods:** Quarterly samplings in the limnetic region of a floodplain lake between February 2000 and March 2009, numbering 30 samples obtained from both vertical and horizontal trawls using plankton net of a 15 µm-mesh aperture and subjected to Transeau-solution preservation. We prepared temporary slides and analyzed in order to have the organisms identified, measured and photographed through digital camera, directly using an Olympus binocular optical microscope with a 400x/1000x magnification. The analysis included the calculation of Constancy (C) for the sample of each species. **Results:** 36 taxa were identified. Genus *Trachelomonas* Ehr. emend. Defl. had the best representation, with 20 taxa. Among the taxa surveyed, 53% (19 taxa) constituted new records of occurrence for the Upper Paraná River Floodplain. The taxa recorded as frequent (33.3%) are considered cosmopolitan and present wide geographical distribution throughout Brazil; however, most of the taxa surveyed (67%) was classified as sporadic or rare, which is probably related to the high environmental variability observed along the study period. **Conclusion:** Among the surveyed 19 taxa constituted new records of occurrence for the upper Paraná River floodplain and extended the geographical distribution of Euglenophyceae in Brazil.

**Keywords:** taxonomy; floodplain lake; flagellated algae; Euglenophyceae.

**Resumo: Objetivo:** Contribuir para o conhecimento taxonômico das Euglenophyceae pigmentadas da planície de inundação do alto rio Paraná, ampliando o levantamento da biodiversidade neste ecossistema, além de contribuir para o conhecimento da distribuição geográfica do grupo no Brasil. **Métodos:** Foram realizadas amostragens trimestrais na região limnética de uma lagoa de várzea entre fevereiro de 2000 e março de 2009, totalizando 30 amostras. Estas foram obtidas a partir de arrastos verticais e horizontais com rede de plâncton com 15 µm de abertura de malha e preservadas em solução de Transeau. Foram preparadas e analisadas lâminas temporárias, nas quais os organismos foram identificados, medidos e fotografados em câmara digital, diretamente no microscópio óptico binocular Olympus em aumento de 400x e 1000x. Foi calculada a constância (C) de cada espécie nas amostras analisadas. **Resultados:** Foram identificados 36 táxons. O gênero *Trachelomonas* Ehr. emend. Defl. foi



o melhor representado com 20 táxons. Dentre os táxons inventariados 53% (19 táxons) constituem novos registros de ocorrência para a Planície de inundação do alto rio Paraná. Os táxons registrados como frequentes (33,3%) são considerados cosmopolitas e apresentam ampla distribuição geográfica no Brasil, no entanto, a maioria dos táxons inventariados (67%) foi classificada como esporádica ou rara, o que provavelmente está relacionado à grande variabilidade ambiental observada durante o período de estudo. **Conclusão:** Entre os táxons descritos, 19 táxons constituíram novos registros de ocorrência para a Planície de Inundação do Alto Rio Paraná e ampliam a distribuição geográfica das Euglenophyceae para o Brasil.

**Palavras-chave:** taxonomia; lagoa de várzea; alga flagelada; Euglenofíceas.

## 1. Introduction

Floodplains are river systems with high heterogeneity of habitats and great functional and structural complexity (Thomaz et al., 2004). In these systems, the hydro sedimentological regime (Neiff, 1990) acts directly on the degree of connectivity among their many environments, providing an efficient route of dispersion and recruitment of species as well as ensuring the maintenance of high biodiversity (Train & Rodrigues, 2004; Borges & Train, 2009). The Upper Paraná River Floodplain is considered a relevant region for the conservation of biodiversity in Brazil and its environments have been studied since 2000 through a Long-term Ecological Project (PELD-site 6/ CNPq), which has constituted an important opportunity to build a survey of phytoplankton in this environment.

Phytoplanktonic communities of river-floodplain systems present high diversity of species distributed in many taxonomic algae classes, including the Euglenophyceae, a group especially favored in floodplain lakes rich in organic matter and with the occurrence of high species richness (Jati & Train, 1994; Train & Rodrigues, 2004).

Even though the ecology of the phytoplanktonic community in these environments has been widely investigated, studies involving its taxonomic approach are still rare (Jati & Train, 1994; Oliveira et al., 1994; Bovo-Scomparin et al., 2005; Paula et al., 2014; Jati et al., 2014; Moresco et al., 2015). In this context, the papers by Jati & Train (1993, 1994) and Biolo & Rodrigues (2010) represent the only records of Euglenophyceae taxonomy for such environments.

Therefore, the objective of this study is to contribute to the taxonomic knowledge on Pigmented Euglenophyceae at the Upper Paraná River Floodplain as well as to expand the biodiversity survey in this ecosystem, in addition to contributing to the knowledge on the geographical distribution of this group in Brazil.

## 2. Material and Methods

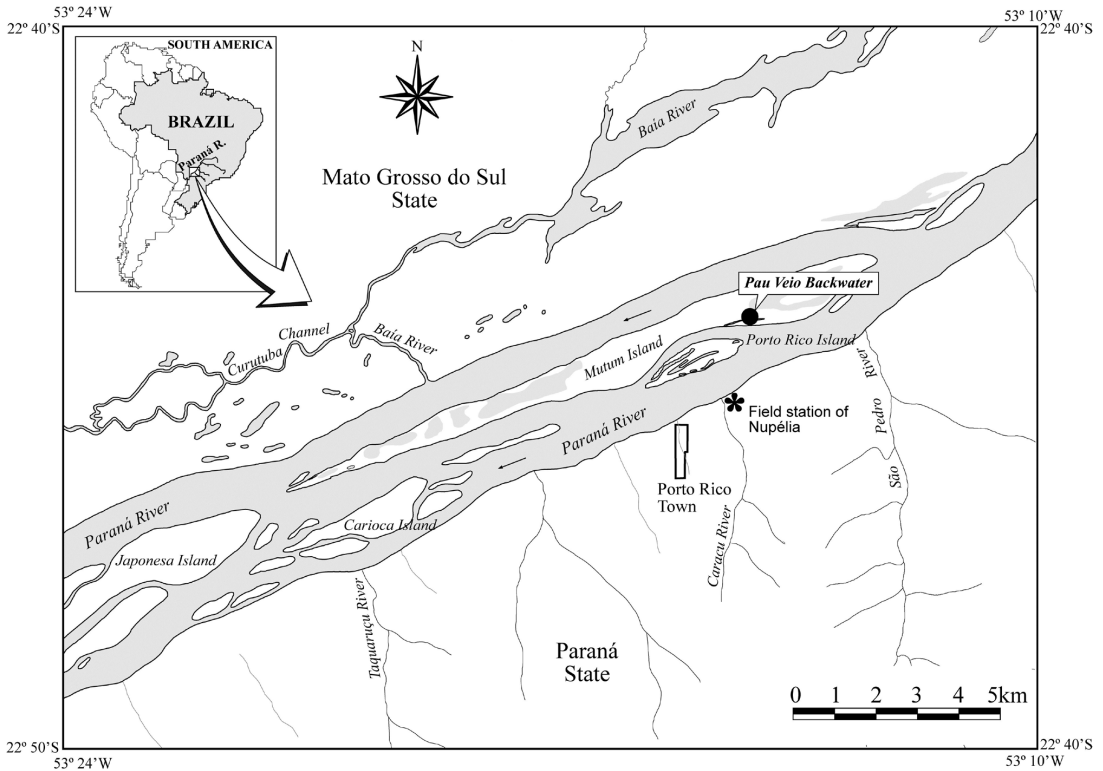
The Upper Paraná River Floodplain is located in the Central-South region of Brazil, encompassing the area between Porto Primavera (Primavera/SP) and Itaipu hydroelectric plants (Guaíra/PR). With 230 km of extension, it is the last dam-free stretch of Paraná River, whose major channel presents numerous islands, marginal lakes and channels (Souza Filho, 2009).

This study was developed in a floodplain lake (Pau Véio, 22°44'S; 53°15'W) permanently connected to the Paraná River, located at Mutum Island (Figure 1) and presenting approximately 1.2 km of length and 50 m of width; with an area of 3.0 ha and an average depth of 1.8 m. The lake is surrounded by arboreous vegetation and its margins are occupied with aquatic macrophytes, especially *Eichhornia azurea* Kunth.

We carried out quarterly samplings at the limnetic region of the lake between February 2000 and March 2009, totaling 30 samples obtained from vertical and horizontal trawls using plankton net with a 15-µm-mesh aperture and subjected to Transeau solution preservation (Bicudo & Menezes, 2006).

We prepared and analyzed temporary slides until new taxa stopped occurring. The organisms were identified, measured and photographed through digital camera directly using an Olympus binocular optical microscope with a 400x/1000x magnification. The taxonomic framework followed Bicudo & Menezes (2016). Species and infraspecific taxa were identified according to basic works such as Deflandre (1926), Huber-Pestalozzi (1955), and Tell & Conforti (1986). Several recent floristic works as Alves-da-Silva & Klein (2015), Alves-da-Silva et al. (2013, 2016), Araujo & Bicudo (2017), Araujo et al. (2012), Kufner & Giani (2017) were also used, in addition to molecular biology studies such as Bennett & Triemer (2012), Kim et al. (2013) and Marin et al. (2003).

In order to estimate the constancy (C) of each species in the samples analyzed, we used the suggestion by Dajoz (2005):  $C = (p \times 100)/P$ ,



**Figure 1.** Map and location da sampling station.

according to which:  $C \geq 70$  represents the constant species;  $70 \geq C \geq 30$  the frequent species;  $30 \geq C \geq 10$  the sporadic species, and  $C < 10$  represents the rare species. The character “p” is the amount of samples containing the species and “P” is the total amount of samples analyzed.

The samples are stored at the Herbário da Universidade Estadual de Maringá (HUEM – Herbarium of the State University of Maringá).

Concomitantly to phytoplankton samplings, we also sampled physical and chemical water parameters to verify the variation of the environmental conditions along the study period. Water temperature (WT, °C), pH, electrical conductivity (Cond,  $\mu\text{Scm}^{-1}$ ), and dissolved oxygen (DO,  $\text{mgL}^{-1}$ ) were obtained *in situ* using Digimed portable digital potentiometers. Water transparency (m) was obtained using a Secchi disk. Concentrations of total phosphorus (TP,  $\mu\text{gL}^{-1}$ ), reactive soluble phosphorus ( $\text{PO}_4$ ,  $\mu\text{gL}^{-1}$ ; Golterman et al., 1978), total nitrogen Kjeldahl (TN,  $\mu\text{gL}^{-1}$ ; Mackereth et al., 1978) nitrate ( $\text{NO}_3\text{-N}$ ,  $\mu\text{gL}^{-1}$ ; Giné et al., 1980), and ammonium ( $\text{NH}_4\text{-N}$ ,  $\mu\text{gL}^{-1}$ ; Koroleff, 1978) were also obtained.

### 3. Results and Discussion

The environmental variables sampled simultaneously with the phytoplankton samples evidence high environmental variability during the

study period. Table 1 presents the temporal variation of the mean values of the main environmental variables along with their respective standard deviations. The environmental variation caused by the hydrometric pulse seasonality and the range of variation of this event between the sampling years (Figure 2) are probably the main factors responsible for the high variability observed for the period. Such a high environmental variability may have benefited the great amount of both rare and sporadic species surveyed as well as the fact that the species classified as frequent are pointed out as cosmopolitan in the literature (Alves-da-Silva & Bridi, 2004).

The taxonomic framework considered in this study followed Bicudo & Menezes (2016).

#### Division Euglenophyta

#### Class Euglenophyceae

#### Ordem Euglenales

#### Family Phacaceae Kim *et al.* 2010

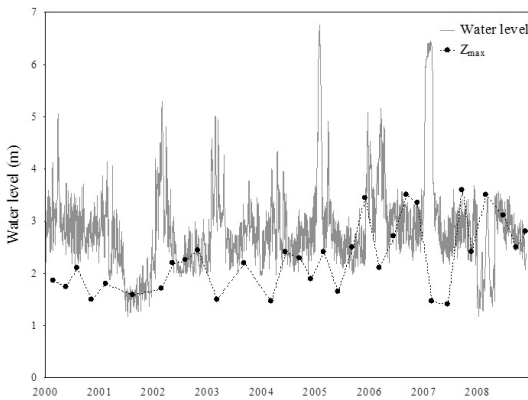
#### Genus *Lepocinclis* Perty emend. Marin & Melkonian 2003

#### *Phacus* Dujardin emend. Linton & Karnkowska 2010

#### Family Euglenaceae Stein 1878

Genus *Monomorphina* Mereschkowsky  
1877 emend. Kosmala & Zakrýs 2007  
*Strombomonas* Deflandre 1930  
*Trachelomonas* Ehrenberg 1835

We identified 36 taxa belonging to the families Phacaceae (12) and Euglenaceae (24) (Figure 3-38). The genus *Trachelomonas* had the best representation, with twenty (20) taxa, followed by *Lepocinclis* and *Phacus*, both with six (6) taxa, *Strombomonas* with three (3) and *Monomorphina* with one (1) taxon.



**Figure 2.** Hydrometric levels of the Paraná River (lines) and Zmax of the floodplain lake (points) from February 2000 to March 2009. Points also indicate the sampling days.

Among the surveyed taxa, 55.5% (19 taxa) constituted new records of occurrence for the Upper Paraná River Floodplain, which are the following: *Lepocinclis fusca*, *Monomorphina pyrum*, *Phacus contortus*, *P. longicauda* var. *major*, *P. rodriguesiae*, *Strombomonas fluviatilis* var. *levis*, *S. triquetra*, *Trachelomonas abrupta* var. *obesa*, *T. acanthophora*, *T. amphoriformis* var. *spinosa*, *T. armata* var. *longispina*, *T. decora*, *T. hispida* var. *coronata*, *T. megalacantha*, *T. molesta*, *T. obtusa*, *T. similis* var. *similis*, *T. volvocina* var. *volvocina* and *T. woycickii* var. *pusilla*.

Frequent taxa included: *Lepocinclis acus* var. *acus* (45%), *L. oxyuris* var. *oxyuris* (41%), *L. ovum* var. *ovum* (42%), *L. salina* var. *salina* (45%), *L. spinosa* (54%), *Phacus orbicularis* (45%), *P. longicauda* var. *major* (33%), *Trachelomonas armata* var. *steini* (42%), *T. hispida* var. *crenulatocollis* (33%), *T. rugulosa* var. *rugulosa* fa. *paralela* (30%), *T. sculpta* var. *sculpta* (51%), and *T. volvocinopsis* var. *volvocinopsis* (67%). Most of the taxa surveyed (67%) was classified as sporadic or rare.

***Lepocinclis acus*** (O.F. Müller) Marin & Melkonian var. ***acus***, Protist 154: 104. 2003: 104.

**Figure 3**

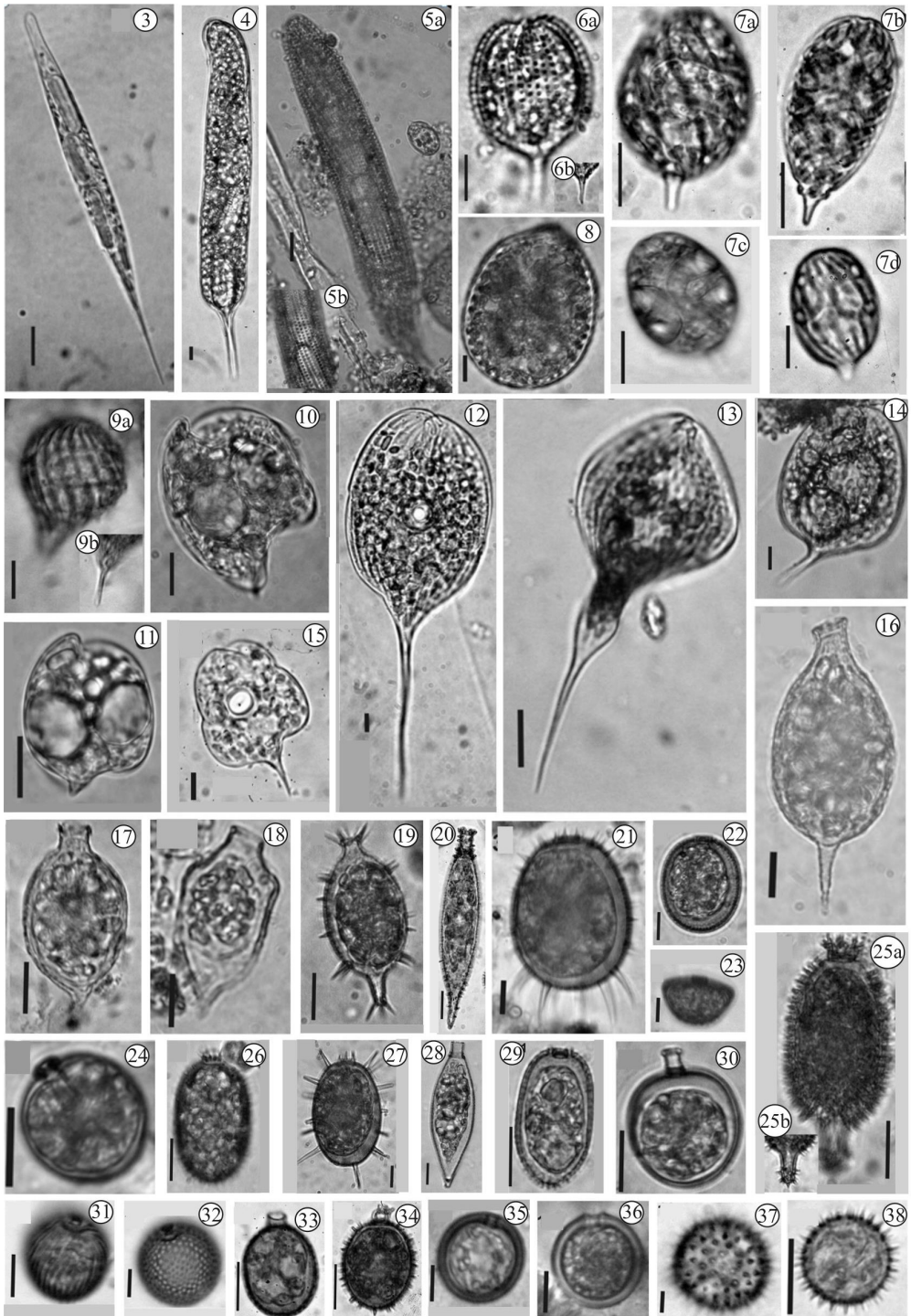
Fusiform cells; long and thin caudal process; helicoidal striation hardly discernible; rod-shaped paramylon granules; numerous peripheral discoid

**Table 1.** Mean values and coefficient of variation (% in parentheses) of the abiotic variables sampled in the Pau Vêio lake between March 2000 and March 2009.

|       | Depth         | T              | DO             | pH            | Cond.          | Secchi         | Turb.           | Alc.            | TN              | NO <sub>3</sub> -N | NH <sub>4</sub> -N | TP             | PO <sub>4</sub> -P |
|-------|---------------|----------------|----------------|---------------|----------------|----------------|-----------------|-----------------|-----------------|--------------------|--------------------|----------------|--------------------|
| 2000  | 1.8<br>(71.7) | 24.6<br>(1.0)  | 6.1<br>(77.5)  | 6.6<br>(23.5) | 52.8<br>(0.5)  | 1.0<br>(463.9) | 7.7<br>(4.2)    | 314.3<br>(0.6)  | 273.9<br>(0.4)  | 44<br>(146.0)      | 6.2<br>(852.2)     | 15<br>(40.5)   | 0.7<br>(713.8)     |
| 2001  | 1.7<br>(8.3)  | 27<br>(18.8)   | 6.9<br>(8.4)   | 6.62<br>(1.9) | 54.0<br>(8.5)  | 1.1<br>(0)     | 53.5<br>(127.8) | 270.4<br>(32.5) | 464.4<br>(32.1) | 146.3<br>(16.2)    | 10.45<br>(106.2)   | 19.6<br>(33.1) | 4.8<br>(58.9)      |
| 2002  | 2.1<br>(14.8) | 25.1<br>(14.8) | 5.3<br>(42.4)  | 6.5<br>(5.6)  | 58.0<br>(14.5) | 1.8<br>(23.1)  | 2.2<br>(13.2)   | 351<br>(47.3)   | 193.3<br>(19.6) | 62.9<br>(67.5)     | 17.7<br>(118.9)    | 16.2<br>(11.9) | 3.5<br>(14.5)      |
| 2003  | 1.8<br>(26.7) | 25.8<br>(30.1) | 5.73<br>(16.2) | 6.6<br>(4.4)  | 61.4<br>(13.1) | 1.4<br>(69.5)  | 1.7<br>(103.9)  | 322.5<br>(0.6)  | 224.1<br>(12.9) | 36.7<br>(25.9)     | 4.7<br>(38.1)      | 36.0<br>(50.1) | 7.7<br>(94.0)      |
| 2004  | 2.0<br>(21.5) | 25.1<br>(20.4) | 4.7<br>(41.4)  | 6.2<br>(4.9)  | 56.7<br>(9.7)  | 2.0<br>(21.5)  | 3.5<br>(86.3)   | 344.4<br>(11.0) | 197.4<br>(26.8) | 68.4<br>(93.8)     | 18.0<br>(13.7)     | 14.3<br>(49.3) | 3.1<br>(65.2)      |
| 2005  | 2.5<br>(29.5) | 24.1<br>(16.0) | 4.2<br>(33.4)  | 6.3<br>(3.5)  | 58.1<br>(6.8)  | 2.1<br>(53.6)  | 4.3<br>(89.0)   | 399<br>(12.8)   | 484.4<br>(54.6) | 75.3<br>(65.2)     | 11.8<br>(36.9)     | 16.8<br>(62.7) | 3.4<br>(40.3)      |
| 2006  | 2.9<br>(22.0) | 24.8<br>(14.9) | 5.3<br>(27.5)  | 6.4<br>(7.0)  | 55.1<br>(10.3) | 2.9<br>(22.0)  | 3.2<br>(101.7)  | 351.3<br>(8.9)  | 398.3<br>(96.2) | 59.9<br>(41.7)     | 5.7<br>(80.5)      | 13.7<br>(46.7) | 6.8<br>(60.9)      |
| 2007  | 2.2<br>(46.6) | 25.4<br>(14.7) | 5.4<br>(47.8)  | 6.8<br>(6.7)  | 56.5<br>(7.8)  | 2.0<br>(39.0)  | 6.5<br>(124.8)  | 414.2<br>(9.5)  | 381.1<br>(18.1) | 97.6<br>(71.8)     | 16.2<br>(85.3)     | 17.7<br>(24.7) | 7.4<br>(83.3)      |
| 2008  | 2.9<br>(14.3) | 23.6<br>(17.0) | 4.1<br>(37.4)  | 6.6<br>(1.8)  | 58.5<br>(11.5) | 2.3<br>(20.4)  | 2.7<br>(82.0)   | 420.9<br>(11.6) | 409.0<br>(15.8) | 88.3<br>(43.1)     | 16.9<br>(104.3)    | 16<br>(26.8)   | 7.8<br>(58.2)      |
| 2009* | 2.8           | 28.5           | 5.22           | 58.8          | 2.25           | 0.96           | 2.8             | 410.4           | 999.0           | 120.6              | 7.2                | 20.6           | 5.5                |

Depth (m); T, Water temperature (°C); DO, dissolved oxygen (mg L<sup>-1</sup>); Cond., electrical conductivity (µS cm<sup>-1</sup>); Secchi disk (m); Turb., Turbidity (NTU); Alc., Alkalinity (mg L<sup>-1</sup>); Clo, Chlorophyll-a (µg L<sup>-1</sup>); TN, Total nitrogen (µg L<sup>-1</sup>); NO<sub>3</sub>, Nitrate (µg L<sup>-1</sup>); NH<sub>4</sub>, Ammonium (µg L<sup>-1</sup>); TP, total phosphorus (µg L<sup>-1</sup>); PO<sub>4</sub>, Phosphate (µg L<sup>-1</sup>); \*Data referent to only one sampling in the year of 2009.





**Figures 3-38.** 3. *Lepocinclis acus* var. *acus*, 4. *L. oxyuris* var. *oxyuris*, 5a. *L. fusca*, 5b. Detail pellicular strips, 6a. *Lepocinclis spinosa*, 6b. Detail of the caudal process, 7 a-d. *L. ovum* var. *ovum*, 8. *L. salina* var. *salina*, 9a. *Monomorphina pyrum*, 9b. Detail of the caudal process, 10. *Phacus contortus* var. *contortus*, 11. *P. curvicauda* var. *curvicauda*, 12. *P. longicauda* var. *major*, 13. *P. tortus*, 14. *P. orbicularis*, 15. *P. rodriguesiae* var. *rodriguesiae*, 16. *Strombomonas fluviatilis* var. *levis*, 17. *S. fluviatilis* var. *fluviatilis*, 18. *S. triquetra* var. *torta*, 19. *Trachelomonas acanthophora* var. *acanthophora*, 20. *T. amphoriformis* var. *spinosa*, 21. *T. armata* var. *longispina*, 22. *T. abrupta* var. *obesa*, 23. *T. cupula*, 24. *T. cervicula* var. *cervicula*, 25a. *T. decora* var. *decora*, 25b. Detail of the caudal process, 26. *T. hispida* var. *coronata*, 27. *T. megalacantha* var. *megalacantha*, 28. *T. molesta* var. *molesta*, 29. *T. obtusa* var. *obtusa*, 30. *T. parvicollis* var. *parvicollis*, 31. *T. rugulosa* var. *rugulosa* fa. *paralela*, 32. *T. sculpta* var. *sculpta*, 33. *T. similis* var. *similis*, 34. *T. similis* var. *spinosa*, 35. *T. volvocina* var. *volvocina*, 36. *T. volvocinopsis* var. *volvocinopsis*, 37. *T. woycickii* var. *woycickii*, 38. *T. woycickii* var. *pusilla*. Scale bar = 10µm.

chloroplasts, several long. Length 97-170 µm, width 7.3-15.6 µm.

Occurrence frequency: Frequent.

Examined material: Brazil, Paraná, Porto Rico, 09.II.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16753); 03.VIII.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 09.XII.05, *S. Jati w/n<sup>o</sup>* (HUEM 16769); 10.III.06, *S. Jati w/n<sup>o</sup>* (HUEM 16770); 23.VI.06, *S. Jati w/n<sup>o</sup>* (HUEM 16771); 01.XII.06, *S. Jati w/n<sup>o</sup>* (HUEM 16772); 29.II.08, *S. Jati w/n<sup>o</sup>* (HUEM 16778); 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Lepocinclis oxyuris*** Schmarða Marin & Melkonian var. *oxyuris*, Protist 154: 104. 2003.

Figure 4

Cylindrical cell; circular apical view; striated periplast in spiral; twisted anterior pole; posterior pole with tapered long caudal process; two bastoniform paramylons, one anterior and another posterior to the core; several discoid chloroplasts all over the cell. Length 133-254 µm, width 27-36.3 µm, caudal process 26.1 µm, paramylons length 39.6 µm, width 13.2 µm.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16754); 20.VIII.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16755); 03.VIII.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 23.VI.06, *S. Jati w/n<sup>o</sup>* (HUEM 16771); 01.XII.06, *S. Jati w/n<sup>o</sup>* (HUEM 16772); 15.IX.06, *S. Jati w/n<sup>o</sup>* (HUEM 16773); 29.II.08, *S. Jati w/n<sup>o</sup>* (HUEM 16778); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Lepocinclis fusca*** (Klebs) Kosmala & Zakryś, Journal of Phycology 41: 1264. 2005.

Figure 5a and 5b

Cylindrical cell; rounded anterior and posterior pole with long caudal process; striated periplast in spiral in which polygonal warts are arranged on the striae; two bastoniform paramylon granules, one anterior and another posterior to the core, several

discoid chloroplasts. Length 137.8-190.5 µm, width 23.5-24.6 µm, caudal process of 26.1 µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 09.II.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16753); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 01.XII.06, *S. Jati w/n<sup>o</sup>* (HUEM 16772); 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779).

*Lepocinclis ovum* (Ehrenberg) Minkevich var. *ovum*, Trudy Imperatorskago S. Peterburgskavo Obshchestra Estestvoispytatelei. Vypusk 29: 241. 1899.

Figure 7a, 7b, 7c and 7d

Ovoid organisms; levogyre striae; rounded anterior pole and posterior pole ending in a conical caudal process; two lateral, horseshoe-shaped paramylon granules; several discoid chloroplasts. Length 28.7-31.3 µm, width 15.6-23.5 µm., length of caudal process 5.2-9.9 µm.

Comment: According to Tell & Conforti (1986), the thickening of the caudal process is a characteristic that distinguishes the typical variety of *Lepocinclis ovum* var. *bütschlii*; however, according to Menezes (1987), within a single population such feature represents a morphological expression of the cellular development. The observed specimens presented high morphological variation, such as observed by Jati & Train (1994) for the examined material at Porto Rico Island.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16754); 20.VIII.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16755); 03.VIII.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 16.IX.05, *S. Jati w/n<sup>o</sup>* (HUEM 16768); 09.XII.05, *S. Jati w/n<sup>o</sup>* (HUEM 16769); 10.III.06, *S. Jati w/n<sup>o</sup>* (HUEM 16770); 15.IX.06, *S. Jati w/n<sup>o</sup>* (HUEM 16773); 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Lepocinclis salina*** Fritsch var. *salina*, New Phytologist. 13: 351 fig.3 a, b, e. 1940

Figure 8

Ovoid cell; circular apical view; dextrogyre striae; rigid periplast; neatly asymmetric anterior pole with subapical flagella aperture; rounded

posterior pole; large grain, discoid or elliptical, never bastoniform paramylon granules; several discoid chloroplasts. Length 33.9-54.1 µm, width 26.1-49.2 µm.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16754); 09.II.01, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16753); 20.VIII.01, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16755); 03.VIII.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16758); 03.IX.03, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16761); 02.XII.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16765); 03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766); 10.VI.05, *S. Jati w/n*<sup>o</sup> (HUEM 16767); 16.IX.05, *S. Jati w/n*<sup>o</sup> (HUEM 16768); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770); 23.VI.06, *S. Jati w/n*<sup>o</sup> (HUEM 16771); 27.XI.08, *S. Jati w/n*<sup>o</sup> (HUEM 16779); 13.III.09, *S. Jati w/n*<sup>o</sup> (HUEM 16782).

***Lepocinclis spinosa*** Bennett & Triemer, Journal of Phycology 48(3): 837. 2012.

Figure 6a and 6b

Napiform cells, spines curved on the striae towards the posterior pole; anterior pole with median papilla emerging; conical caudal process; numerous discoid chloroplasts. Length 29.7-39.6 µm, width 26.4-36.3 µm, length caudal process. 6.6-10,0 µm.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16754); 20.VIII.01, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16755); 28.II.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16756); 03.VIII.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16758); 08.III.03, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16763); 18.VI.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16764); 24.IX.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16765); 03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766); 10.VI.05, *S. Jati w/n*<sup>o</sup> (HUEM 16767); 09.XII.05, *S. Jati w/n*<sup>o</sup> (HUEM 16769); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770); 23.VI.06, *S. Jati w/n*<sup>o</sup> (HUEM 16771); 15.IX.06, *S. Jati w/n*<sup>o</sup> (HUEM 16773); 29.II.08, *S. Jati w/n*<sup>o</sup> (HUEM 16778); 27.XI.08, *S. Jati w/n*<sup>o</sup> (HUEM 16779); 13.III.09, *S. Jati w/n*<sup>o</sup> (HUEM 16782).

***Monomorphina pyrum*** (Ehrenberg) Mereschkowsky emend Kim, Triemer & Shin, Journal of Phycology 49:88. 2013.

Figure 9a and 9b

Obpyriform cell; levogyre striae forming conspicuous hyaline keels; rounded anterior

pole; posterior pole ending in a pointed caudal process; two flat ring-shaped paramylon granules located between the pellicle and the single perforated parietal chloroplast, looking like several smaller discoid chloroplasts. Length 52.2 µm, width 32.5 µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 01.XII.06, *S. Jati w/n*<sup>o</sup> (HUEM 16772); 13.III.09, *S. Jati w/n*<sup>o</sup> (HUEM 16782).

***Phacus contortus*** Bourrelly var. ***contortus***, Algues d'eau douce de la Guadeloupe et dependances 177, pl. 22, fig. 271-277 1952.

Figure 10

Ovoid cells, composed of two asymmetrical and twisted alliform parts, separated between each other by large, deep grooves, cuneiform apical view, short and curved caudal process; two discoid paramylon granules arranged side by side, other smaller, bastoniform dispersed by the cytoplasm, numerous discoid chloroplasts. Length 40.8-44.3 µm, width 32.6-34.4 µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766); 29.II.08, *S. Jati w/n*<sup>o</sup> (HUEM 16778).

***Phacus curvicauda*** Swirenko var. ***curvicauda***, Archiv für Hydrobiologie und Planktonkunde 10: 333, pl. 2, fig. 13-16. 1915.

Figure 11

Ovoid cells; sigmoid apical view; short and curved caudal process; two discoid paramylon granules in the arranged side by side, other smaller discoid or bastoniform ones. Length 19.7-29.6 µm, width 17.2-24.5 µm, length caudal process 5 µm.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766); 16.IX.05, *S. Jati w/n*<sup>o</sup> (HUEM 16768); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770); 23.VI.06, *S. Jati w/n*<sup>o</sup> (HUEM 16771); 15.IX.06, *S. Jati w/n*<sup>o</sup> (HUEM 16773); 29.II.08, *S. Jati w/n*<sup>o</sup> (HUEM 16778); 27.XI.08, *S. Jati w/n*<sup>o</sup> (HUEM 16779).

***Phacus longicauda*** (Ehrenberg) Dujardin var. ***major*** (Ehrenberg) Dujardin, Histoire Naturelle des Zoophytes, 337, pl.5, fig. 6. 1841.

Figure 12

Obovoid cells, long, straight caudal process; two concentric and central discs of paramylon,



numerous discoid chloroplasts. Length 198 µm, width 70-75 µm, length caudal process 39.4 µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 09.XII.05, *S. Jati w/n<sup>o</sup>* (HUEM 16769); 23.VI.06, *S. Jati w/n<sup>o</sup>* (HUEM 16771); 15.IX.06, *S. Jati w/n<sup>o</sup>* (HUEM 16773); 29.II.08, *S. Jati w/n<sup>o</sup>* (HUEM 16778); 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Phacus orbicularis*** Hübner emend Zakryś & Kosmala, Journal of Phycology 43: 1077, fig.1, f-n, p, r, s, u. 2007.

Figure 14

Cell broadly ovoid to circular; triangular apical view; periplast with transverse striae between longitudinal striae; long and curved caudal process; two central, overlapping paramylon discs of different sizes, numerous discoid chloroplasts. Length 39.8-83.5 µm, width 27.5-59.4 µm, length caudal process 13.2-23.1 µm.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16754); 09.II.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16753); 20.VIII.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16755); 03.VIII.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 10.III.06, *S. Jati w/n<sup>o</sup>* (HUEM 16770); 23.VI.06, *S. Jati w/n<sup>o</sup>* (HUEM 16771); 01.XII.06, *S. Jati w/n<sup>o</sup>* (HUEM 16772); 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Phacus rodriguessiae*** Conforti var. *rodriguessiae*, Revue Hydrobiologique Tropicale, v.27, p.15, pl.IV, figs. 5 a-c, 1994.

Figure 15

Ovoid cell; rounded anterior pole; marginal notches located in the middle of the cell; median groove encompassing 1/3 of the length; hyaline, straight, conical caudal process; two paramylon discs, a larger central one and another smaller, lateral

one. Length 23.5-36.9 µm, width 21.4-24.6 µm, length caudal process 7.4-8.2 µm.

Comment: This taxon is rarely mentioned in the specialized Brazilian literature; it has been mentioned by Alves-da-Silva et al. (1991) for Rio Grande do Sul as *Phacus acuminatus* Stokes var. *acuticauda* Pochm. The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Phacus tortus*** (Lemmermann) Skvortzov, Berichte der Deutschen Botanischen Gesellschaft, 46(2):110, pl.2, fig. 9-10. 1928.

Figure 13

Ovoid cell; median groove encompassing 1/3 of the length; rounded anterior pole; long, twist on the caudal process; two concentric and central discs of paramylon, numerous discoid chloroplasts. Length 67.7-198 µm, width 31.3-70.5 µm, caudal process 39.4-97.5 µm.

Comment: Tell & Conforti (1986) considered the degree of cell torsion as a basic characteristic for the differentiation of *Phacus tortus* (one turn of torsion), *Phacus sesquitortus* (one and ½ turn of torsion) and *Phacus helicoides* (many turns of torsion). However, Alves-da-Silva & Bicudo (2009) consider this a not very consistent morphological feature. In the same way, Alves-da-Silva & Klein (2015) raised to species the taxa similar to *Phacus longicauda* (Ehrenberg) Dujardin var. *tortus* Lemmerman. We agree with this last author and identify our specimens as *P. tortus*.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 20.VIII.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16755); 03.VIII.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 09.XII.05, *S. Jati w/n<sup>o</sup>* (HUEM 16769); 15.IX.06, *S. Jati w/n<sup>o</sup>* (HUEM 16773); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Strombomonas fluviatilis*** (Lemmermann) Deflandre var. *levis* (Lemmermann) Skvortzov, Archiv für Protistenkunde 69 (3): 551-614, 1930.

Figure 16

Fusiform lorica, circular apical view; smooth wall; anterior pole projected on a curved smooth collar; posterior pole ending in a straight caudal process. Length 65.3-66.5 µm, width 27.0-28.3 µm, length caudal process 12.0-13.2 µm.



Comment: It is distinguished from the typical variety due to its larger dimensions. The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 18.VI.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16764); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 16.IX.05, *S. Jati w/n<sup>o</sup>* (HUEM 16768); 10.III.06, *S. Jati w/n<sup>o</sup>* (HUEM 16770).

***Strombomonas fluviatilis*** (Lemmermann) Deflandre var. ***fluviatilis***, Archiv für Protistenkunde 69 (3): 580, fig. 52, 53, 1930.

Figure 17

Ellipsoid lorica; circular apical view; smooth wall; short and straight collar; short and curved caudal process. Length 20.9-39.4 µm, width 13.0-24.6 µm, length collar 2.6 µm, length caudal process 2.6 µm

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 20.VIII.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16755); 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766).

***Strombomonas triquetra*** (Playfair) Deflandre var. ***torta*** Rino, Revista de Ciências Biológicas, 5: 169, pl. 9, fig. 7-10. 1972.

Figure 18

Rectangular lorica, nearly parallel in the 2/3 anterior and triangular at the distal portion; smooth walls; triangular in apical view, short and large collar; short and conical caudal process, 2.6 µm. Length 36.5 µm, width 18.3 µm, length collar 2.6 µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779).

***Trachelomonas acanthophora*** Stokes var. ***acanthophora***, Proceedings of the American Philosophical Society 33: 340, pl. XXI, fig.6, 1894.

Figure 19

Lageniform lorica; wall ornamented with spines; developed collar decorated with six conical spines; long and cylindrical caudal process with three acute, divergent spines, implanted in its distal pole. Length 39.1-51.4 µm, width 18.3-23.1 µm, spines 5.2 µm, length collar 5.2 µm, length caudal process 7.8 µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Trachelomonas amphoriformis*** Osorio-Taffal var. ***spinosa*** Conforti, Rea. Hydrobiol. trop. 26 (1): 8, fig. 15, 1993.

Figure 20

Fusiform lorica; wall with granulations distributed irregularly; anterior pole with a tall collar, with granulations; posterior pole ending in an acute caudal process with granulations. Length 64 - 70.5 µm, width 12.3-18.3 µm, length collar 6.1-7.4 µm.

Comment: Conforti (1993) acknowledges the presence of spines in the wall. The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Trachelomonas armata*** (Ehrenberg) Stein var. ***longispina*** Playfair emend. Deflandre, Nemours, v. 88, pl. 6, fig. 330. 1926.

Figure 21

Oval-expanded lorica; wall ornamented with short spines distributed all over the lorica and bigger spines at the posterior pole; short collar surrounded by spines. Length 36.9-54.6 µm, width 23.1-39.6 µm.

Comment: This taxon is different from the typical variety as it presents an oval-expanded lorica and larger length, spines in the anterior pole and considerably larger spines in the posterior pole (Deflandre, 1926, Araujo et al., 2012). The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 09.II.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16753); 20.VIII.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16755); 02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 03.IX.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16761); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 18.VI.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16764); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765);

03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766); 10.VI.05, *S. Jati w/n*<sup>o</sup> (HUEM 16767); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770); 23.VI.06, *S. Jati w/n*<sup>o</sup> (HUEM 16771); 29.II.08, *S. Jati w/n*<sup>o</sup> (HUEM 16778); 27.XI.08, *S. Jati w/n*<sup>o</sup> (HUEM 16779).

***Trachelomonas abrupta*** Swirenko emend. Deflandre var. ***obesa*** (Playfair) Deflandre, Nemours, p. 93, fig. 353, 362, 363. 1926.

Figure 22

Ellipsoid to obovoid lorica; strong and irregularly punctate wall, usually scrobiculate; no spines; ring thickening. Length 24.5 µm, width 19.4 µm.

Comment: This taxon is different from the typical variety for presenting larger width. The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 09.II.01, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16753); 24.IX.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16765); 03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766).

***Trachelomonas cupula*** Deflandre. Revue Générale de Botanique 38: 584, pl.6, figs. 97-99, 1926.

Figure 23

Hemispheric lorica; finely punctuated wall; flattened anterior pole, developed ring thickening; triangular posterior pole. Length 12.3 -14.8 µm, width 15.6 -19.9.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 08.III.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16763); 18.VI.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16764); 10.VI.05, *S. Jati w/n*<sup>o</sup> (HUEM 16767); 29.II.08, *S. Jati w/n*<sup>o</sup> (HUEM 16778).

***Trachelomonas cervicula*** Stokes var. ***cervicula***, Proceedings of the American Philosophical Society 28:75, fig 11. 1890.

Figure 24

Spherical lorica; smooth wall; presence of ring thickening with cylindrical collar, inclined or not, oriented to the inside of the cell. Diameter 15.3-17.2 µm, length collar 7.4 µm.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16754); 02.XII.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16763); 24.IX.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16765); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 1770); 13.III.09, *S. Jati w/n*<sup>o</sup> (HUEM 16782).

***Trachelomonas decora*** Deflandre var. ***decora***, Monographie du genre ***Trachelomonas*** Ehr. 121, Pl.11, fig. 631. 1926.

Figure 25a and 25b

Elongated-cylindrical ellipsoid lorica; wall densely ornamented with short spines except in the area near the collar and caudal process; infundibuliform short collar, conical, cast spines, short at the distal edge forming a crown; sub-cylindrical caudal process, long and with spines only at the distal pole. Length 39.8 µm, width 18.4 µm.

Comment: *Trachelomonas decora* Deflandre var. ***decora*** constitutes the first citation of occurrence for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 24.IX.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16765).

***Trachelomonas hispida*** (Perty) Stein emend. Deflandre var. ***coronata*** Lemmermann, in Pascher, Süßwasserfl. Deutsch. 2 (2): 150. 1913.

Figure 26

Ellipsoid lorica; sides nearly parallel; punctuated wall ornamented with spines distributed all over the lorica; sharp ring thickening covered with a crown of spines. Length 22.9-31.5 µm, width 18.7-27 µm.

Comment: Differs from the typical variety for presenting collar covered with spines identical to those in the lorica. The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16754); 03.VIII.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16758); 02.XI.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16760); 03.IX.03, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16761); 02.XII.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16762); 24.IX.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16765); 03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766); 09.XII.05, *S. Jati w/n*<sup>o</sup> (HUEM 16769); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770); 23.VI.06, *S. Jati w/n*<sup>o</sup> (HUEM 16771).

***Trachelomonas megalacantha*** Cunha var. ***megalacantha***, Memórias do Instituto Oswaldo Cruz 6(3): 172, fig. 5. 1914.

Figure 27

Elliptic-elongated loric; wall punctuated and ornamented with long spines, distributed irregularly throughout the cell; flagellar pore with finite annular formed by the fusion of short conical spines. Length 46.9 µm, width 31.6 µm, length spines 11.2µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770).

***Trachelomonas molesta*** Deflandre var. *molesta*, Revue Algologique 3 (1-2): 223, fig. 74, 1928.

Figure 28

Fusiform lorica; densely punctuated wall; cylindrical tall collar with serrated distal pole, external ring thickening; hollow caudal process with a cross-section membrane separating it from the remaining of the lorica. Length 67.9 µm, width 20.9 µm, collar 7.8 µm.

Comment: *Trachelomonas molesta* and *Trachelomonas allorgei* are very similar and differ only regarding the presence of a membrane separating the caudal process from the remaining of the lorica in *Trachelomonas molesta*. For Tell & Conforti (1986), both taxa are independent. Menezes & Fernandes (1989) assumed *Trachelomonas allorgei* var. *molesta*. Dillard (2000), kept both taxa separated and referred to the caudal process of *Trachelomonas molesta* as a thorn. We agree with Tell & Conforti (1986) and Dillard (2000) and identified the observed specimens as *Trachelomonas molesta* Deflandre. The specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 08.III.03, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16760).

***Trachelomonas obtusa*** Palmer var. *obtusa*, Proceedings of the Academy of Natural Sciences of Philadelphia, 57: 673, pl. 41, fig. 3, 1905.

Figure 29

Cylindrical-conical lorica, nearly parallel sides; wall thickly covered by short conical spines; flagellar pore with short collar or without it; apical pole slightly convex; tapered posterior pole with slightly rounded sides. Length 19.7-23.5 µm, width 12.2- 15.7 µm, collar 2.6 µm.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 16.IX.05, *S. Jati w/n*<sup>o</sup> (HUEM 16768); 13.III.09, *S. Jati w/n*<sup>o</sup> (HUEM 16782).

***Trachelomonas parvicollis*** Deflandre var. *parvicollis*, Révue Générale de Botanique 38: 704. pl. 9, fig. 493, 1927.

Figure 30

Subspherical lorica; smooth wall; pore with a long, cylindrical collar projected towards the outside of the lorica; rounded anterior and posterior poles.

Length 18.9-25.5 µm, width 17.8-24 µm, collar 4.2- 6 µm.

Comment: Tell & Conforti (1986) found in the specimens studied a cellular wall finely punctuated and with much spacing. However, the specimens found at Pau Velho Backwater, as well as those observed by Deflandre (1926), present smooth cellular wall.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16754); 08.III.03, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16762); 18.VI.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16764); 24.IX.04, *S. Jati w/n*<sup>o</sup> (HUEM 16765); 03.III.06, *S. Jati w/n*<sup>o</sup> (HUEM); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770); 01.XII.06, *S. Jati w/n*<sup>o</sup> (HUEM 16772); 13.III.09, *S. Jati w/n*<sup>o</sup> (HUEM 16782).

***Trachelomonas rugulosa*** Stein emend. Deflandre. var. *rugulosa* fa. *paralela* Tell & Zalocar De Domitrovic, Nova Hedigia, 41: 353-391, 1985.

Figure 31

Subspherical lorica; wall ornamented with prominent striae, longitudinally slightly anastomosed; short collar. Length 15.7-26.4 µm, width 14.7-23.1 µm.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 28.II.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16756); 05.V.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16758); 02.XI.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16760); 02.XII.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16763); 03.III.05, *S. Jati w/n*<sup>o</sup> (HUEM 16766); 10.VI.05, *S. Jati w/n*<sup>o</sup> (HUEM 16767); 09.XII.05, *S. Jati w/n*<sup>o</sup> (HUEM 16769); 10.III.06, *S. Jati w/n*<sup>o</sup> (HUEM 16770).

***Trachelomonas sculpta*** Balech var. *sculpta*, Anales del Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", 41: 245, fig. 32, fig. 167. 1944.

Figure 32

Spherical lorica; wall ornamented with depressions approximately polygonal, isometric and regularly distributed, distributed all over the lorica, without spines; short collar. Diameter 18.3-20.9 µm.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16754); 09.II.01, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16753); 28.II.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16756); 05.V.02, *L. C. Rodrigues w/n*<sup>o</sup> (HUEM 16758);



02.XI.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16759); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 03.IX.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16761); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 18.VI.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16764); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 10.VI.05, *S. Jati w/n<sup>o</sup>* (HUEM 16767); 16.IX.05, *S. Jati w/n<sup>o</sup>* (HUEM 16768); 09.XII.05, *S. Jati w/n<sup>o</sup>* (HUEM 16769); 15.IX.06, *S. Jati w/n<sup>o</sup>* (HUEM 16773); 29.II.08, *S. Jati w/n<sup>o</sup>* (HUEM 16778).

***Trachelomonas similis*** Stokes var. *similis*, Proceedings of the American Philosophical Society, 28:76, fig. 12. 1890.

Figure 33

Ellipsoidal lorica; wall ornamented with punctuations; curved collar. Length 20.4 µm, width 16.3 µm, diameter collar 3.1 µm.

Comment: The specimens analyzed constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16754); 09.II.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16753); 28.II.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16756); 05.V.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 09.XII.05, *S. Jati w/n<sup>o</sup>* (HUEM 16769); 23.VI.06, *S. Jati w/n<sup>o</sup>* (HUEM 16771); 01.XII.06, *S. Jati w/n<sup>o</sup>* (HUEM 16772); 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Trachelomonas similis*** Stokes var. *spinosa* Huber-Pestalozzi, Phytoplankton des Süßwasser 16 (4): 342, pl. 73, fig. 722a, 1955.

Figure 34

Distinguished from the typical variety for having the wall ornamented with spines distributed all over the lorica and in the curved collar. Length 23.5-29.7 µm, width 18.3-23.1 µm, spines, 6.6 µm, collar diameter 2.6-4.2 µm.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Trachelomonas volvocina*** (Ehrenberg) Ehrenberg var. *volvocina*, Abhandlungen der königlichen Akademie der wissenschaften zu Berlin 1833:315, pl. 7, fig. 3, 1835.

Figure 35

Spherical lorica; smooth wall; short collar; two lateral chloroplasts with double pyrenoids. Diameter 17.2-19.7 µm.

Comment: The safe differentiation between *T. volvocinopsis* and *T. volvocina* is determined by observing the amount of chloroplasts, which are numerous and present no pyrenoids at the first and between two or three laterals with double pyrenoids at the second. The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Trachelomonas volvocinopsis*** Swirenko var. *volvocinopsis*, Archiv für Hydrobiologie und Planktonkunde 9: 633, pl. 19: fig. 1-2, 1914.

Figure 36

Spherical lorica; smooth wall; short collar; numerous discoid chloroplasts distributed all over the cytoplasm. Diameter 12.3-29.5 µm.

Occurrence frequency: Frequent.

Examined Material: Brazil, Paraná, Porto Rico, 11.V.00, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16754); 09.II.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16753); 20.VIII.01, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16755); 28.II.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16756); 05.V.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 03.VIII.02, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16758); 08.III.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16760); 03.IX.03, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16761); 02.XII.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16762); 08.III.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16763); 18.VI.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16764); 24.IX.04, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM 16765); 03.III.05, *S. Jati w/n<sup>o</sup>* (HUEM 16766); 10.VI.05, *S. Jati w/n<sup>o</sup>* (HUEM 16767); 16.IX.05, *S. Jati w/n<sup>o</sup>* (HUEM 16768); 09.XII.05, *S. Jati w/n<sup>o</sup>* (HUEM 16769); 10.III.06, *S. Jati w/n<sup>o</sup>* (HUEM 16770); 23.VI.06, *S. Jati w/n<sup>o</sup>* (HUEM 16771); 01.XII.06, *S. Jati w/n<sup>o</sup>* (HUEM 16772); 15.IX.06, *S. Jati w/n<sup>o</sup>* (HUEM 16773); 29.II.08, *S. Jati w/n<sup>o</sup>* (HUEM 16778); 27.XI.08, *S. Jati w/n<sup>o</sup>* (HUEM 16779); 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

***Trachelomonas woycickii*** Koczwara var. *woycickii*, Kosmos 40: 231-275. 1915.

Figure 37

Spherical lorica; wall ornamented with short, conical spines distributed all over the lorica; short collar. Diameter 16.5-22.0 µm.

Occurrence frequency: Sporadic.

Examined Material: Brazil, Paraná, Porto Rico, 24.IX.2004, *L. C. Rodrigues w/n<sup>o</sup>* (HUEM

16765); 10.VI.2005, *S. Jati w/n<sup>o</sup>* (HUEM 16767); 16.IX.2005, *S. Jati w/n<sup>o</sup>* (HUEM 16768); 10.III.2006, *S. Jati w/n<sup>o</sup>* (HUEM 16770); 29.II.2008, *S. Jati w/n<sup>o</sup>* (HUEM 16778); 27.XI.2008, *S. Jati w/n<sup>o</sup>* (HUEM 779).

*Trachelomonas woycickii* Koczwara var. *pusilla* Drezepolski, Kosmos, Warszawa, 50(1A): 265, fig. 15, 1925.

Figure 38

Distinguished from the typical variety for presenting smaller dimensions. Diameter 11.2-12.2 µm.

Comment: The material analyzed by Jati & Train (1994) for temporary lakes of Porto Rico Island revealed only organisms with small dimensions (7.9-10.5 µm). However, the authors decided to maintain them within the typical variety of the species. At Pau Velho Backwater, many organisms were found with dimensions equal to the typical variety (20,0-29,0 µm) and other much smaller ones (11.2-12.2 µm), categorized within the variety *pusilla*, which differs from the typical variety only due to their smaller cellular dimensions.

Comment: The observed specimens constitute a new record for the Upper Paraná River Floodplain.

Occurrence frequency: Rare.

Examined Material: Brazil, Paraná, Porto Rico, 13.III.09, *S. Jati w/n<sup>o</sup>* (HUEM 16782).

#### 4. Conclusion

This study has enabled the update of the nomenclature of Euglenophyceae registered in these habitats. Among the six (6) taxa described here as belonging to the genera *Lepocinclis*, three (3) were previously registered as *Euglena* Ehrenberg and one (1) as *Phacus* Dujardin. In studies of taxonomic review, Marin et al. (2003) and Kosmala et al. (2005) have transferred *Euglena acus* Ehrenberg, *E. oxyuris* Schmarida and *E. spirogyra* Ehrenberg to the genus *Lepocinclis*. Bennett & Triemer (2012), on the other hand, transferred *Phacus horridus* to *Lepocinclis spinosa*.

This study has increased the knowledge on the geographic distribution of pigmented Euglenophyceae in the upper Paraná River floodplain and in Brazil: *Lepocinclis fusca*, *Monomorphina pyrum*, *Phacus contortus*, *P. longicauda* var. *major*, *P. rodriguesiae*, *Strombomonas fluviatilis* var. *levis*, *S. triquetra*, *Trachelomonas abrupta* var. *obesa*, *T. acanthophora*, *T. amphoriformis* var. *spinosa*, *T. armata* var. *longispina*, *T. decora*, *T. hispida* var. *coronata*, *T. megalacantha*, *T. molesta*, *T. obtusa*, *T. similis* var. *similis*, *T. volvocina* var. *volvocina* and

*T. woycickii* var. *pusilla* consisted new occurrence records.

Furthermore, the high occurrence of taxa classified as sporadic and rare (67%) is probably related to the high environmental variability observed during the study period.

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