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Subfossil and periphytic diatoms from the upper Paraná river, Brazil: last ~1000 years of a transition period[1]

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ABSTRACT - (Subfossil and periphytic diatoms from the upper Paraná river, Brazil: last ~1000 years of a transition period). Considering the lack of knowledge regarding the paleolimnology and the diatom flora from the sediment in Brazilian aquatic environments, this study aimed to provide information about diatom biodiversity and autoecology in an environment located in the upper Paraná river floodplain. Sediment and periphytic samples were collected from a swamp located in an island of the upper Paraná river floodplain. Sediment samples were obtained by collecting a core of ~2 m with a calibrated date of 726 to 903 cal yr BP near the base. The core was sliced into layers of 2.5 cm, totaling 41 samples. Periphytic diatom samples were obtained by scraping macrophytes' petioles, totaling two samples. The community was represented by 31 species belonging to 15 genera. All of the taxa were found in the sediment record, and 15 were present in the periphyton. The three new records (*Eunotia longicamelus*, *Planothidium bagualensis* and *Luticola hustedtii*) reinforce the importance of paleolimnological and periphytic studies to increase information about the aquatic biodiversity.
Keywords: bioindicators, floodplain, freshwater, paleolimnology

RESUMO - (Diatomáceas subfósseis e perifíticas do alto rio Paraná, Brasil: últimos ~1000 anos de um período de transição). Considerando a falta de conhecimento paleolimnológico e da flora de diatomáceas do sedimento nos ambientes aquáticos brasileiros, este estudo teve como objetivo fornecer informações sobre biodiversidade e autoecologia de diatomáceas de um ambiente localizado na planície de inundação do alto rio Paraná. Amostras de sedimento e perifíton foram coletadas em um pântano localizado em uma ilha fluvial na planície de inundação do alto rio Paraná. As amostras de sedimento foram obtidas através da coleta de um testemunho de ~2 m, com uma data calibrada perto da base de 726 a 903 cal anos PB. O testemunho foi dividido em fatias de 2,5 cm, totalizando 41 amostras. As amostras perifíticas foram obtidas através da raspagem de pecíolos de macrófitas, totalizando duas amostras. A comunidade foi representada por 31 espécies pertencentes a 15 gêneros. Todos os táxons foram encontrados no registro de sedimentos, e 15 estavam presentes no perifíton. Os três novos registros para a região (*Eunotia longicamelus*, *Planothidium bagualensis* e *Luticola hustedtii*) mostram a importância dos estudos paleolimnológicos e da comunidade perifítica para aumentar a informação sobre a biodiversidade aquática.
Palavras-chave: água doce, bioindicadores, paleolimnologia, planície de inundação,

Introduction

Taxonomic diversity is one of the most important characteristics of biological communities that reflect evolutionary and ecological processes (Komulaynen 2009). Species richness is a basic and fundamental measurement of community and regional diversity (Magurran 1988). Several factors affect small-scale species richness. According to reviews, alteration, and loss of habitat, hydrological modification, pollution, and invasion have been identified as the main drivers of species reduction (Stendera *et al.* 2012).

Palaeolimnological studies are a tool to evaluate changes in the environments over time and access the ancient biodiversity. Past communities are very often the only available tool to provide information on natural biodiversity before human impacts (Smucker & Vis 2010). Therefore, the data from these studies become an important appliance for conservation actions in freshwater environments (Smol 1992, Saulnier-Talbot 2016).

Diatoms are widely used on paleolimnological studies (Gabito *et al.* 2013), these organisms precipitate and are incorporated in the sediment

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due to their biogenic structures constituted of silica (Sierra-Arango *et al.* 2014). Diatoms respond sensibly (directly and indirectly) to a wide range of aquatic environmental stimuli, including physical and chemical changes (Douglas & Smol 1999, Stevenson & Pan 1999). The information provided by the diatoms enables us to understand the degree of changes that have was found in the habitat, for example, variation in water level and influence of erosion, or even introduction of species and extinctions (Smol 1992, Battarbee 1999).

Regardless of the importance of these studies on biodiversity changes, these applications have been scarce in tropical environments (Rühland *et al.* 2015). Palaeolimnological studies addressing taxonomy and richness of diatoms are even rarer, and for Brazil there are only a few studies (Fontana & Bicudo 2009, 2012, Almeida & Bicudo 2014, Silva & Bicudo 2014, Wengrat *et al.* 2015, Almeida *et al.* 2015, Faustino *et al.* 2016), which concentrate focus on surface sediments of reservoirs from São Paulo State. However, there is still rare taxonomic work addressing Brazilian subfossil diatoms with sediments of more than 100 years and also from the floodplain.

Therefore, considering the lack of palaeolimnological studies concerning diatom flora from the sediment of the Brazilian aquatic environments and given, the current transformations in the global and regional environments, this study aimed to provide information about the diatom biodiversity and autoecology from a tropical floodplain.

Materials and methods

The study area is located on a swamp on an island in the Paraná River, in the upper Paraná river floodplain, in the reach between the reservoirs of Porto Primavera and Itaipu Lake. The Mutum Island presented 15 km long, with variable width (high and low waters) between 0.5 and 1.20 km and height of 5.0 m above the average level of the River. The sampling site is located in the central region of the swamp (22°45'31.98''S and 53°17'52.60''W) (figure 1) with depth less than one meter.

A sediment core with a length of two meters was removed with a vibrocore. The sediment was analyzed according to granulometry, structure, composition, and coloration. With this analysis, it was possible to identify 5 geomorphological zones matching the geomorphological process of the fluvial islands approached in the studies of Fernandez *et al.*

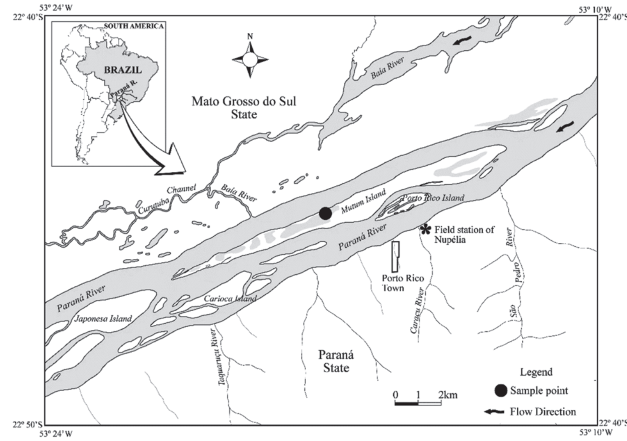
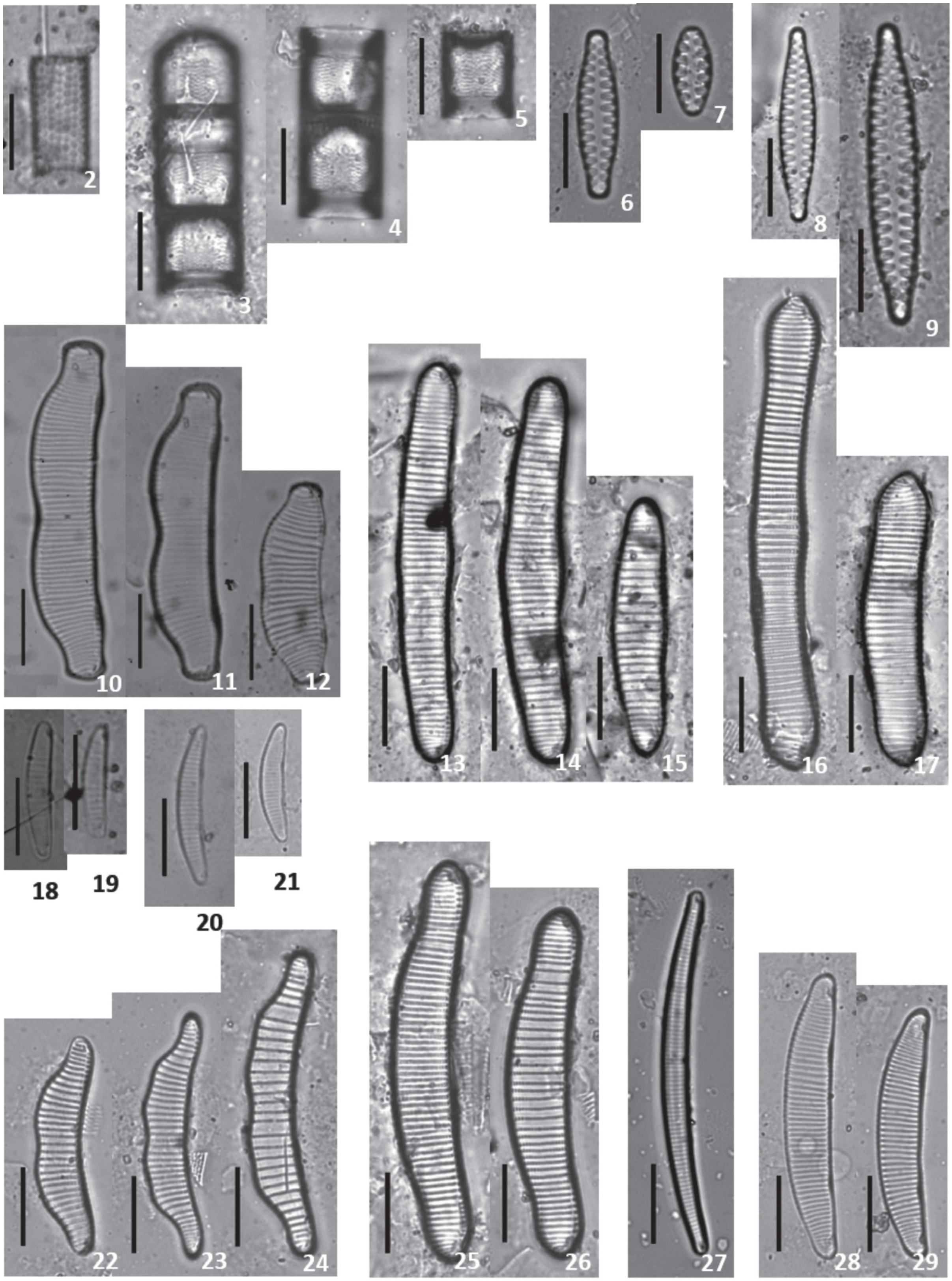


Figure 1. Sampling point in the Mutum, island upper Paraná river floodplain, Brazil.

(1993) and Steauvx (1994). According to Fernandez *et al.* (1993) and Steauvx (1994), the fluvial islands in the upper Paraná river floodplain are formed by coalescence processes of bars to the islands. This process begins with the formation of the original island through a deposition of sediment. After its permanent establishment, there is the formation of a lateral bar of sediment on the side of the original island. The original island and the sidebar will be separated by a channel, which due to the sediment flow will become a connected lake or backwater, consequently, in a lake, transition period and, at the end of the process will be a swamp (see figure 2 in Ruwer & Rodrigues 2018).

With small amounts of sediment from the depths 0.78 m, 1.40 m and 1.90 m, data were analyzed with radiocarbon analysis. The analyses were performed by the Center for Applied Isotope Studies - CAIS (University of Georgia, USA) and the Nuclear Energy Center in Agriculture - CENA (São Paulo University). Radiocarbon ages were calibrated (cal yr BP and cal yr AD) by CALIB7.0.4 using the SHCal13 calibration curve for the Southern Hemisphere (Stuiver and Reimer 1993, Hogg *et al*. 2013). The absolute dating with the isotope of ^{14}C in the samples of depths: 78 cm, 140 cm, and 190 cm, indicated modern age, 760 ± 65 yr BP (569 to 721 cal yr BP) and 920 ± 60 ^{14}C yr BP (726 to 903 cal yr BP), respectively. In addition, the record was separated into 2.5 cm slices with 5 cm of intervals and disregarding the first 5 cm (from the top of the core). From each 2.5 cm slice, 0.01 g of sediment was removed for the preparation of permanent slides for subsequent quantitative and qualitative analysis under a microscope. The methodology for the preparation of slides was based on Battarbee *et al.* (2001). Diatom analysis was carried out on 32 out of 41 samples.



Figures 2-29. Diatom species from Mutum Island in the upper Paraná river floodplain, Brazil (LM). 2. *Aulacoseira granulata*. 3-5. *Aulacoseira italica*. 6-7. *Staurosirella crassa* mf. I. 8-9. *Staurosirella crassa*. 10-12. *Eunotia bidens*. 13-15. *Eunotia* cf. *deformis*. 16-17. *Eunotia formica*. 18-19. *Eunotia* cf. *intermedia*. 20-21. *Eunotia subarcuatoides*. 22-24. *Eunotia longicamelus*. 25-26. *Eunotia major*. 27. *Eunotia naegelli*. 28-29. *Eunotia pseudosudetica*. (Scale bar: 10 µm).

Nine samples were not found a sufficient number of diatoms for analysis (78307UPCB to 78310UPCB, 78318UPCB to 78322UPCB).

Given the high dominance of diatoms in periphytic samples (Biolo & Rodrigues 2013, Bichoff *et al.* 2016), the periphytic community was sampled in order to identify diatom communities from the current environment. The sampling of the periphytic diatom community was made in April 2016 after a period of flooding. The following abiotic parameters were measured *in situ* with a multi-parameter probe: dissolved oxygen (percentage saturation and g/L), pH, water temperature (°C), electric conductivity (µS/cm), turbidity (NTU), total solids (g/L) and salinity (ppt) (Mackareth *et al.* 1978, Wetzel & Likens 1981).

Periphytic diatom community was obtained by scraping mature petioles of an aquatic macrophyte. Two petioles were collected in the sampling site, placed in 150 ml Wheaton bottles and kept cool until further removal of the periphytic biofilm, which was performed using a stainless-steel blade wrapped in aluminum foil and jets of distilled water. After removal, periphyton was fixed and preserved in Transeau solution (Bicudo & Menezes 2017). The periphytic material was oxidized and cleaned using the Simonsen (1974) method, modified by Moreira-Filho & Valente-Moreira (1981) and prepared on permanent slides with Naphrax resin. We analyzed the samples of non-oxidized periphyton under the optical microscope, to observe the forms of arrangement and fixation of the species.

The quantitative analysis was performed according to the method of Battarbee *et al.* (1986) with the count of at least 500 valves in an optical microscope. The slides were analyzed qualitatively under an optical microscope (under 1000× magnification) and scanning electron microscopy (Ferrario *et al.* 1995). The samples were deposited in the herbarium of Botanic Department of Universidade Federal do Paraná (78280UPCB to 78322UPCB). We recorded 329 taxa in the study, and we presented here only the taxa that occurred with a relative abundance of ≥ 20%, which contributed 74% of the relative abundance of all samples. Has been adopted the Round *et al.* (1990) classification system.

Results and Discussion

The swamp in the current period was characterized by relatively high temperature, slightly acidic pH, low conductivity, low dissolved oxygen concentration and high turbidity (table 1).

In the total 329 taxa found in the 34 samples, 31 species had a high abundance. The community was represented by 15 genera, among which the most representative were *Eunotia* Ehrenberg (10), *Gomphonema* Ehrenberg (three) and *Luticola* D.G. Mann (three).

Bacillariophyta
Coscinodiscophyceae
Aulacoseirales
Aulacoseiraceae

Aulacoseira granulata (Ehrenberg) Simonsen, Bacillaria, 2: 58, 1979 ≡ *Gaillonella granulata* Ehrenberg *in* Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin 1841: 127, 1843. *Melosira granulata* Ralfs in Pritchard, Hist. Infus. 4: 820, 1861.
Figure 2

Diameter: 8-17 µm; height: 14-30 µm; striae: 9-14/10 µm.

Material examined: Brazil. Paraná: Porto Rico, Ilha Mutum, sediment, 27/II/2012, Ruwer *et al.* (78282UPCB - 78285UPCB, 78287UPCB - 78296UPCB, 78300UPCB, 78305UPCB, 78312UPCB, 78315UPCB).

Ecological information: this species generally has a planktonic habitat, but can be also found in the periphytic community. Dominant in shallow lakes, it occurs in mesotrophic to eutrophic waters but is commonly found in eutrophic waters. This species occurs in alkaline waters and tolerate temperatures

Table 1. Abiotic variables of the swamp located in the Mutum island in the upper Paraná river floodplain, Brazil, in April 2016 (OD - dissolved oxygen; TDS – total dissolved solids).

Variables	Values
Temperature (°C)	27.92
pH	6.19
Conductivity (mS/cm)	0.112
Turbidity (NTU)	10.8
DO (g/L)	0.0023
DO (%)	30
TDS (g/L)	0.073
Salinity (ppt)	0.1

of 15 to over 30°C (Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Taylor *et al.* 2007, Zalat & Vildary 2007, Kiss *et al.* 2012, Estepp & Reavie 2015, Bicudo *et al.* 2016, Faustino *et al.* 2016). According to some works, this species is associated with water column mixing, high flood conditions and depth variations, and physical alterations as erosion events, turbulence, and deforestation (Zalat & Vildary 2007, Dong *et al.* 2008, Costa-Böddeker *et al.* 2012, Fontana *et al.* 2014). This species was found in 52% of the samples, presenting greater abundance in the transition and swamp periods, with the highest abundance between these two periods.

Aulacoseira italica (Ehrenberg) Simonsen, Bacillaria, 2: 60, 1979 ≡ *Gaillonella italica* Ehrenberg *in* Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin 1836: 53. 1836. *Melosira italica* (Ehrenberg) Kützing *in* Bacillarien 55, 1844.
Figures 3-5, 64

Diameter: 9-20 µm; height: 12-24 µm; inconspicuous striae.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78288UPCB, 78290UPCB - 78311UPCB, 78313UPCB - 78315UPCB, 78317UPCB).

Ecological information: species generally of planktonic habitat, but also found in the periphytic community. Dominant in shallow lakes, occurring in oligotrophic to eutrophic waters, tolerate temperatures of 0 to 30 °C (Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Estepp & Reavie 2015). Species of *Aulacoseira* genus has heavy silicified cells with a high sinking rate (characteristic clearly observed in the *Aulacoseira italica* of this study), therefore, this species requires turbulence to maintain its presence in the water column (Bradbury 1975). This species was found in 85% of the samples. With greater abundance in the transition and swamp periods, with the highest abundance between the transition and lake periods.

Bacillariophyceae
Fragilariales
Fragilariaceae

Staurosirella crassa (Metzeltin & Lange-Bertalot) Ribeiro & Torgan *in* Ribeiro *et al.*, Revista Brasileira de Paleontologia, 13(1): 24, 2010 ≡ *Fragilaria crassa* Metzeltin & Lange-Bertalot *in* Iconographia Diatomologica, 5: 89, fig. 1: 20-23, fig. 2:1, 1998.
Figures 6-7, 65

Length: 36-87.8 µm; breadth: 10-10.1 µm; striae: 5-6/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78296UPCB, 78299UPCB - 78302UPCB, 78304UPCB, 78306UPCB - 78317UPCB).

Ecological information: episamic species (Ribeiro *et al.* 2008), was found in 82% of the samples with higher values of abundance during the swamp and connected lake periods. In Brazil, it was recorded by Dunck *et al.* (2012) in a lentic, oligotrophic to mesotrophic environments and by Ribeiro *et al.* (2010) for sediment samples from a coastal zone.

Staurosirella crassa morpho. I (Metzeltin & Lange-Bertalot) Ribeiro & Torgan *in* Ribeiro *et al.*, Revista Brasileira de Paleontologia 13(1): 24, 2010 ≡ *Fragilaria crassa* Metzeltin & Lange-Bertalot *in* Iconographia Diatomologica, 5: 89, fig. 1: 20-23, fig. 2:1, 1998.
Figures 8-9

Length: 14.1-58 µm; breadth: 4.8-9 µm; striae: 5-8/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27/II/2012, Ruwer *et al.* (78282UPCB - 78296UPCB, 78298UPCB - 78317UPCB).

Ecological information: these specimens differ from *S. crassa* in this study because they have rostrate to rostrate-rounded ends than just rounded ends. This species was recorded in 91% of the samples with higher values of abundance during the swamp and connected lake.

Eunotiales
Eunotiaceae

Eunotia bidens Ehrenberg, Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 413. 1843.
Figures 22-24

Length: 20-72 µm; breadth: 7-11 µm; striae: 9-14/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78294UPCB, 78298UPCB - 78313UPCB, 78315UPCB - 78317UPCB).

Ecological information: periphytic species of lentic environments, occurring in acid waters, from oligotrophic to mesotrophic environments, and high temperature tolerant (Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Lange-Bertalot *et al.* 2011, Faustino *et al.* 2016), associated with bryophytes in marsh environments (Furey *et al.* 2011). This species was registered in 76% of the samples, during the periods of lake and transition, but its abundance was greater during the swamp and lake.

Eunotia cf. ***deformis*** Metzeltin & Lange-Bertalot *in* Lange-Bertalot, Iconographia Diatomologica, 5: 57, pl. 16: figs. 9-11, 1998.
Figures 13-15, 70-71

Length: 19-62 µm; breadth: 7-9 µm; striae: 9-12/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78285UPCB, 78287UPCB - 78288UPCB, 78291UPCB - 78292UPCB, 78297UPCB - 78302UPCB, 78305UPCB - 78306UPCB).

Ecological information: taxon registered for sediment of Brazilian environments (Metzeltin & Lange-Bertalot 1998). The description of *Eunotia deformis* type in Metzeltin & Lange-Bertalot (1998) presents a length variation compare to the population we were found, thus this taxon was maintained as *Eunotia* cf. *deformis*. This species was found in 47% of the samples, with higher abundances during the lake period.

Eunotia formica Ehrenberg, Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1841: 414. 1843.
Figures 16-17, 69

Length: 30-110µm; breadth: 7-11µm; striae: 10-12/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78284UPCB, 78286UPCB - 78293UPCB, 78295UPCB - 78306UPCB).

Ecological information: species with broad geographical distribution, intolerant of pollution (Bere & Mangadze 2014), of benthic habitat, present in lentic, humid environments or slow-flowing waters, occurring in oligotrophic to mesotrophic, acidic waters, tolerate to temperatures of 15 to 30 °C (Patrick & Reimer 1966, Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Ortiz-Lerín & Cambra 2007, Taylor *et al.* 2007). This species was found in 64% of the samples, during the swamp and transition period, but with greater abundances during the lake period.

Eunotia cf. ***intermedia*** (Krasske *ex* Hustedt) Nörpel & Lange-Bertalot *in* Lange-Bertalot, Bibliotheca Diatomologica, 27: 32, 1993 ≡ *Eunotia pectinalis* f. *intermedia* Krasske *ex* Hustedt *in* Rabenhorst's Kryptogamen Flora von Deutschland, Österreich und der Schweiz, 298, fig. 763 l-o, 1932.
Figures 18-19, 72-73

Length: 10-18.5 µm; breadth: 2.2-2.4 µm; striae: 12-18/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78288UPCB, 78292UPCB - 78294UPCB, 78297UPCB - 78298UPCB, 78300UPCB - 78312UPCB).

Ecological information: in the present study a population presents a variation of length smaller than the description of the species in other studies (Metzeltin & Lange-Bertalot 1998), therefore, identified the specimens as *E.* cf. *intermedia*. Species found in oligotrophic and acid environments (Van Dam *et al.* 1994, Ortiz-Lerín & Cambra 2007), was registered in 44% of the samples with greater abundance in the lake period.

Eunotia longicamelus Costa, Bicudo & Wetzel, Bibliotheca Diatomologica, 64: 32, pl. 73: figs. 1-17; pl. 74: figs. 108; pl. 75: 105; pl. 76: 1-4. 2017.
Figures 22-24, 66-68

Length: 17.5-85 µm; breadth: 4-7 µm; striae: 8-12/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78311UPCB, 78313UPCB - 78315UPCB).

Ecological information: species erroneously identified as *Eunotia camelus* Ehrenberg in taxonomic and ecological studies (Costa *et al.* 2017). Planktonic species of lentic and lotic acid environments, but can be found in alkaline environments. They tolerate oligotrophic to mesotrophic conditions and temperatures of 15 to more than 30 °C (Moro & Fürstenberger 1997, Ortiz-Lerín & Cambra 2007, Faustino *et al.* 2016). This species was found in 91% of samples, was found in all periods, with greater abundance during the lake period.

Eunotia major (Smith) Rabenhorst. Flora europaea algarum aquae dulcis et submarinae, 1: 72, 1864 ≡ *Himantidium majus* Smith *in* A synopsis of the British Diatomaceae, 14, pl. XXXIII [33]: fig. 286, 1856.
Figures 25-26, 77-79

Length: 42-107 µm; breadth: 7.8-9 µm; striae: 8-11/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78301UPCB, 78303UPCB - 78312UPCB, 78315UPCB - 78317UPCB).

Ecological information: periphytic species of oligotrophic and acid waters, found in lentic and lotic environments (Moreira-Filho *et al.* 1973). Taxon with 85% frequency, with higher values of abundance in the lake period.

Eunotia naegelii Migula, Kryptogamen-Flora von Deutschland, Deutsch-Österreich und der Schweiz, 203. 1905.
Figure 27

Length: 20-85 µm; breadth: 2.7-4.2 µm; striae: 20/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78289UPCB, 78294UPCB, 78296UPCB - 78298UPCB, 78300UPCB, 78305UPCB).

Ecological information: benthic species, adhered by mucilage foot, occurring in lentic, oligotrophic and acidic waters (Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Montoya-Moreno & Aguirre-Ramírez 2013). This species was found in 26% of the samples, with greater abundance for the current period.

Eunotia pseudosudetica Metzeltin, Lange-Bertalot, & García-Rodríguez, Iconographia Diatomologica, 15: 57, pl. 24: figs. 15-18, 2005.
Figures 28-29, 74-76

Length: 15.8-45 µm; breadth: 4-6.5 µm; striae: 11-16/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78316UPCB).

Ecological information: species registered in the Bicca *et al.* (2011) study, where the periphytic community was collected in environments which are characterized by slightly acidic and temperature variation of 14 to 29.8 °C. The taxon was reported by Faustino *et al.* (2016) in samples ranging from meso to supereutrophic conditions. *E. pseudosudetica* was registered in 97% of the samples, in all periods, but with greater abundance in the lake period.

Eunotia rabenhorstiana var. ***elongata*** (Patrick) Metzeltin & Lange-Bertalot, Iconographia Diatomologica, 5: 76, pl. 64: figs. 1-13; pl. 65: figs. 17-19, 1998 ≡ *Desmogonium rabenhorstianum* var. *elongatum* Patrick *in* Notulae Naturae, 3, fig. 1-3, 1940.
Figure 30

Length: 77-125 µm; breadth: 5-7 µm; striae: 16-18/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB, 78285UPCB, 78287UPCB - 78301UPCB, 78303UPCB, 78305UPCB).

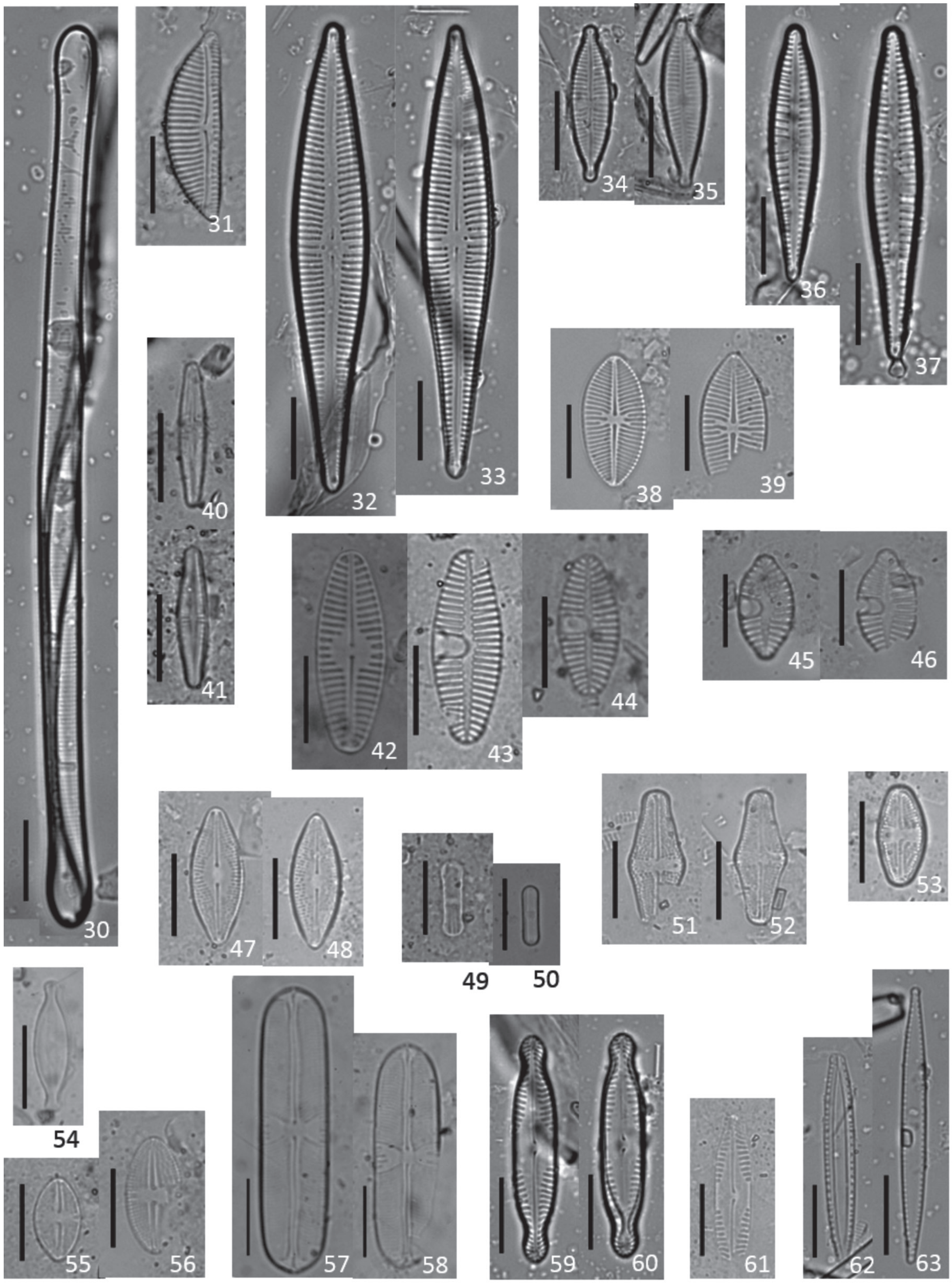
Ecological information: we observe through the periphytic samples that the specimens form chains, this species was found in 61% of the samples, with higher values of abundance in the transition period.

Eunotia subarcuatoides Alles, Nörpel, & Lange-Bertalot, Nova Hedwigia, 53: 188, pl. 4: figs. 1-36, 1991.
Figures 20-21

Length: 13-22 µm, breadth: 3-5 µm; striae: 16-20/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78283UPCB - 78285UPCB, 78287UPCB, 78289UPCB - 78298UPCB, 78300UPCB - 78303UPCB, 78305UPCB).

Ecological information: epiphytic species, occurring in acidic and oligotrophic environments (Van Dam *et al.* 1994, Ortiz-Lerín & Cambra 2007). This species was found in 58% of the samples with greater abundance during the transition period.



Figures 30-63. Diatom species from Mutum Island in in the upper Paraná river floodplain, Brazil (LM). 30. *Eunotia rabenhorstiana* var. *elongata*. 31. *Encyonema silesiacum*. 32-33. *Gomphonema gracile*. 34-35. *Gomphonema lagenula*. 36-37. *Gomphonema* sp. 1. 38-39. *Placoneis ovillus*. 40-41. *Achnanthidium minutissimum*. 42-44. *Planothidium bagualensis*. 45-46. *Planothidium* aff. *rostratum*. 47-48. *Diadesmis confervacea*. 49-50. *Humidophila contenta*. 51-52. *Luticola hustedtii*. 53. *Luticola* cf. *simplex*. 54. *Nupela* cf. *bicapitata*. 55-56. *Luticola muticoides*. 57-58. *Sellaphora fusticulus*. 59-60. *Pinnularia brauniana*. 61. *Pinnularia* sp. 1. 62-63. *Nitzschia palea* var. *debilis*. (Scale bar: 10 µm).

Cymbellales
Gomphonemataceae

Encyonema silesiacum (Bleisch) Mann *in* Round, Crawford, & Mann, Diatoms, 667, 1990 ≡ *Cymbella silesiaca* Bleisch *in* Algen Europa's, 1802, 1864.
Figures 31, 80

Length: 28-45 µm; breadth: 7.8-10 µm; striae: 9-12/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78303UPCB, 78305UPCB, 78314UPCB).

Ecological information: *E. silesiacum* presented periphytic habitat, but also can be found in plankton community, is an indicator of oligotrophic water, but can be found in eutrophic waters. It occurs in lentic and lotic waters, with acidic to alkaline pH and temperature ranging from 15 to more than 30 ºC (Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Marquardt & Bicudo 2014). The taxon was reported by Faustino *et al.* (2016) and Almeida & Bicudo (2014), studies of paleolimnological approach in Brazil, and was related with mesotrophic to supereutrophic conditions. This species was registered in 76% of the samples, with greater abundance in the transitional period.

Gomphonema gracile Ehrenberg, Die Infusionsthierchen als vollkommene Organismen, 217, pl. 18: fig. 3, 1938.
Figures 32-33, 81

Length: 24-64.3 µm; breadth: 5.7-10.4 µm; striae: 12-17/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78283UPCB - 78284UPCB, 78287UPCB - 78298UPCB, 78303UPCB - 78304UPCB, 78313UPCB - 78314UPCB, 78316UPCB).

Ecological information: periphytic species from lentic environments, from oligotrophic to mesotrophic, neutral to alkaline waters, and tolerate temperatures from 15 to 30 ºC (Valente-Moreira 1975, Contin & Oliveira 1993, Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Marquardt & Bicudo 2014, Faustino *et al.* 2016). This species was found in 61% of the samples with greater abundance in the current and transition periods.

Gomphonema lagenula Kützing, Die Kieselschaligen Bacillarien oder Diatomeen, 85, pl. 30: fig. 60, 1844.
Figures 34-35, 82

Length: 19-21 µm; breadth: 5-6 µm; striae: 17-18/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78306UPCB).

Ecological information: this periphytic species was related to mesotrophic and eutrophic conditions in the study of Dunck *et al.* (2013) and Faustino *et al.* (2016), and related to urban and polluted environments by Moresco & Rodrigues (2014). We have recorded the species in 79% of samples, it was absent only in the connected lake period, with higher values of abundance in the transition and current periods.

***Gomphonema* sp. 1**
Figures 36-37, 83

Length: 22.5-44.9 µm; breadth: 5.9-7.4 µm; striae: 13-16/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78283UPCB, 78287UPCB, 78291UPCB, 78295UPCB - 78298UPCB, 78300UPCB - 78302UPCB, 78304UPCB, 78314UPCB).

Ecological information: we observe through the periphytic samples that the specimens presenting stalks for fixation. It was found in the current environment that presented a temperature of 27.9 ºC, acidic to neutral pH and low oxygen value. Occurred in 41% of the samples, more abundant in the current period.

Placoneis ovillus Metzeltin, Lange-Bertalot & García-Rodríguez, Iconographia Diatomologica, 15: 187, pl. 74: figs. 20-26, 2005.
Figures 38-39

Length: 14-24 µm; breadth: 7-10 µm; striae: 14-18/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27/II/2012, Ruwer *et al.* (78283UPCB, 78285UPCB - 78286UPCB, 78289UPCB, 78291UPCB - 78293UPCB, 78298UPCB - 78304UPCB, 78306UPCB - 78317UPCB).

Ecological information: this species was in 64% of the samples, with greater abundance in the period of the backwater.

Cocconeidales
Achnanthidiaceae

Achnanthidium minutissimum (Kützing) Czarnecki *in* Kockiolek, Proceedings of the 11th International Diatom Symposium, 17: 157, 1994 ≡ *Achnanthes minutissima* Kützing *in* Synopsis diatomearum oder Versuch einer systematischen Zusammenstellung der Diatomeen, 578, fig. 54, 1833.
Figures 40-41

Length: 12.5-21 µm, breadth: 2.8-4 µm; inconspicuous striae.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB); sediment, 27-II-2012, Ruwer *et al.* (78284UPCB -78289UPCB, 78291UPCB - 78293UPCB, 78295UPCB, 78299UPCB - 78301UPCB, 78304UPCB, 78313UPCB - 78315UPCB).

Ecological information: the *Achnanthidium minutissimum* species complex is considered cosmopolitan and inhabits all freshwater habitats, mainly in lentic waters. *Achnanthidium* had a much wider tolerance range to various environmental factors. The *Achnanthidium minutissimum* is tolerant to a wide range of organic and inorganic pollution varying from oligotrophic to eutrophic conditions, although in some studies it is associated with low nutrients. It is tolerant at high temperatures (Moro & Fürstenberger 1997, Ponader & Potapova 2007, Potapova & HaMilton 2007, Faustino *et al.* 2016). This species was in 52% of the samples, with higher values of abundance in the transition and backwater period.

Planothidium bagualensis Wetzel & Ector, Phytotaxa, 156 (4): 201-210. 2014.
Figures 42-44, 84

Length: 12.9-30.8 µm; breadth: 6-9 µm; striae: 10-16/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78284UPCB, 78286UPCB - 78288UPCB, 78290UPCB, 78292UPCB, 78297UPCB - 78317UPCB).

Ecological information: species erroneously identified as *Planothidium lanceolatum* (Brébisson *ex* Kützing) H. Lange-Bertalot in Brazilian studies, found in the periphytic and phytoplanktonic community, mainly in lotic environments. Species with an optimum at mesotrophic waters, tolerating a large range of temperature (Burliga *et al.* 2005, Bes *et al.* 2012, Fontana & Bicudo, 2012, Bartozek *et al.* 2013, Wetzel & Ector 2014). This species was recorded in 73% of the samples, with greater abundance in the lake phase.

Planothidium* aff. *rostratum (Østrup) Lange-Bertalot *in* Lange-Bertalot, Iconographia Diatomologica, 6: 279, 1999 ≡ *Achnanthes rostrata* Østrup *in* Botanisk Tidsskrift 25: 35, pl. I: fig. 11, 1903.
Figures 45-46, 85

Length: 12-16 µm; breadth: 6-8 µm; striae: 12-16/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78283UPCB, 78292UPCB - 78293UPCB, 78295UPCB, 78297UPCB - 78317UPCB).

Ecological information: reported in studies by the synonym *Achnanthes rostrata* Østrup or by basionym *Achnanthes lanceolata* var. *rostrata* (Østrup) Lange-Bertalot. Species mainly found in the periphytic community, prostate, in lotic environments (Moro & Fürstenberger 1997, Bartozek *et al.* 2013), also found in sedimentary samples in Brazil (Fontana & Bicudo 2012). This species was found in 64% of the samples, with higher values of abundance during the lake and backwater periods.

Naviculales
Diadesmidaceae

Diadesmis confervacea Kützing, Die Kieselschaligen Bacillarien oder Diatomeen, 109, pl. 30: fig. 8, 1844.
Figures 47-48, 86-87

Length: 12-22 µm; breadth: 5-8 µm; striae: 12-14/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78306UPCB, 78313UPCB, 78317UPCB).

Ecological information: benthic species that form long chains (observed in the periphytic samples), present in shallow water, wet and marshy environments. Occurs in eutrophic environments with high temperatures, acidic to alkaline waters (Cholnocky 1958, Hustedt 1966, Patrick & Reimer 1966, Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Taylor *et al.* 2007, Torgan & Santos 2008). This species had a broader distribution in a Brazilian study with sediment samples (Faustino *et al.* 2016) and was related to mesotrophic to supereutrophic conditions. This species was found in 85% of samples, showed greater abundance during the transition period.

Humidophila contenta (Grunow) Lowe, Kociolek, Johansen, Van de Vijver, Lange-Bertalot & Kopalová, Diatom Research, 29: 357, 2014 ≡ *Navicula contenta* Grunow *in* Synopsis des Diatomées de Belgique, 109, 1885.
Figures 49-50, 88-89

Length: 7-15 µm; breadth: 2.2-3 µm; inconspicuous striae.

Material examined: Brazil. Paraná: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78311UPCB, 78313UPCB - 78317UPCB).

Ecological information: recently transferred of the *Diadesmis* to *Humidophila* genus (Lowe *et al.* 2014). Reported in paleolimnological studies in Brazilian environments (Costa-Böddeker *et al.* 2012, Fontana & Bicudo 2012), related to aerophilic habit and low-nutrient. Benthic species, such as *D. confervaceae*, occur in shallow waters and wet environments. It tolerates low luminosity and temperatures from 15 to 30 °C, indicate mesotrophic to eutrophic environments and acid to alkaline waters (Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Lobo *et al.* 2004, Taylor *et al.* 2007). Frequently in 91% of the samples with higher values of abundance during the transition period.

Luticola hustedtii Levkov, Metzeltin & Pavlov, Diatoms of Europe, 7: 131, pl. 24: fig. 49; pl. 166: figs. 24-37; pl. 168: figs. 7-26; pl. 170: figs. 1-7, 2013.
Figures 51-52, 90

Length: 10.5-25 µm; breadth: 5.8-8 µm; inconspicuous striae.

Material examined: Brazil. Paraná: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78296UPCB, 78300UPCB - 78306UPCB, 78313UPCB, 78315UPCB, 78317UPCB).

Ecological information: species of the genus *Luticola* are common in moist and swampy soils (Van de Vijver *et al.* 2002, Lowe *et al.* 2007). *Luticola hustedtii* was reported in Faustino *et al.* (2016) in sediment samples and was related to past oligotrophic conditions. This taxon was found in the epiphyton of slightly acidic waters in Straube *et al.* (2017). This species was found in 76% of samples, was abundant in the swamp and transition periods.

Luticola muticoides (Hustedt) Mann in Round, Crawford, & Mann, Diatoms, 671, 1990 ≡ *Navicula muticoides* Hustedt *in* Süsswasser-Diatomeen, 82, pl. 4: figs 33-36, 1949.
Figures 55-56, 91

Length: 10-23 µm; breadth: 6-9.5 µm; inconspicuous striae.

Material examined: Brazil. Paraná: Porto Rico, Ilha Mutum, sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78298UPCB, 78300UPCB - 78302UPCB, 78304UPCB - 78305UPCB, 78313UPCB, 78315UPCB).

Ecological information: occurring lotic and lentic environments, in acidic to alkaline waters (Moro & Fürstenberger 1997). It was found in 70% of the samples with higher values of abundance during the transition.

Luticola* cf. *simplex Metzeltin, Lange-Bertalot & García-Rodríguez, Iconographia Diatomologica, 15: 116, pl. 87: figs 1-9, 2005.
Figures 53, 92

Length: 11-16 µm; breadth: 5.2-6 µm; inconspicuous striae.

Material examined: Brazil. Paraná: Porto Rico, Ilha Mutum, sedimento, 27-II-2012, Ruwer *et al.* (78282UPCB - 78317UPCB).

Ecological information: this species was found in sediment samples of Faustino *et al.* (2016), where this taxon had a broad distribution range, related with oligotrophic and eutrophic conditions. Taxon occurring in 94% of samples with higher values of abundance during a transition and swamp periods.

Brachysiraceae

Nupela* cf. *bicapitata (Hustedt) Tremarin & Ludwig, Fottea, 15(1): 78, 2015 ≡ *Achnanthes bicapitata* Hustedt *in* Botaniska Notiser, 386, figs. 68-71, 1952.
Figures 54, 93

Length: 18-20 µm; breadth: 5-6 µm; striae: 50/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78283UPCB - 78284UPCB, 78286UPCB - 78287UPCB, 78291UPCB - 78299UPCB, 78305UPCB, 78314UPCB).

Ecological information: taxon registered for the first time in Brazil by Tremarin *et al.* (2015), however, we consider our specimens as *Nupela* cf. *bicapitata* due to the smaller population length. This species was found in all periods, however, presented higher values of abundance in the period of the backwater.

Sellaphoraceae

Sellaphora fusticulus (Østrup) Lange-Bertalot, Iconographia Diatomologica, 9: 216, 2000 ≡ *Navicula fusticulus* Østrup *in* Danske Diatoméer, 36; pl. 1, fig. 19, 1910.
Figures 57-58

Length: 32-46 µm; breadth: 8-9 µm; inconspicuous striae.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78283UPCB, 78286UPCB - 78303UPCB, 78313UPCB - 78314UPCB).

Ecological information: present in 70% of the samples with higher values of abundance during the transition period.

Pinnulariaceae

Pinnularia brauniana (Grunow) Studnicka *in* Wein, Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft, 38: 737, 1888 ≡ *Navicula brauniana* Grunow *in* Atlas der Diatomaceen-kunde, pl. 45: figs 77-78, 1876
Figures 59-60, 94

Length: 28.1-50 µm; breadth: 5.6-8.3 µm; striae: 11-15/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78282UPCB - 78283UPCB, 78285UPCB - 78298UPCB, 78300UPCB - 78301UPCB, 78316UPCB).

Ecological information: *P. brauniana* was in 61% of the samples with greater abundance in the current and transition periods.

Pinnularia sp. 1
Figures 61, 95

Length: 19-23 µm; breadth: 4.8-5 µm; striae: 14-16/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, sedimento, 27-II-2012, Ruwer *et al.* (78288UPCB - 78298UPCB, 78300UPCB, 78302UPCB).

Ecological information: the species was found in 38% of the samples, with greater abundance during the transition period.

Bacillariales
Bacillariaceae

Nitzschia palea* var. *debilis (Kützing) Grunow, Kongliga Svenska Vetenskaps-Akademiens Handligar, 17(2): 96, 1880 ≡ *Synedra debilis* Kützing *in* Die Kieselschaligen Bacillarien oder Diatomeen, 65, pl. 3: fig. XLV, 1844.
Figures 62-63

Length: 23-49.3 µm; breadth: 3.1-5.2 µm; fibulae: 11-13/10 µm.

Material examined: Brazil. PARANÁ: Porto Rico, Ilha Mutum, periphyton, 12-IV-2016, Ruwer *et al.* (78280UPCB - 78281UPCB); sediment, 27-II-2012, Ruwer *et al.* (78285UPCB, 78291UPCB, 78295UPCB, 78297UPCB, 78301UPCB, 78314UPCB).

Ecological information: found in periphytic and plankton community. Occurring in lentic, oligotrophic and eutrophic environments, but prefer clean or only slightly polluted waters (Tomas & Sabater 1985, Gasse 1987, Vyverman 1991, Van Dam *et al.* 1994, Moro & Fürstenberger 1997, Potapova & Charles 2007, Trobajo *et al.* 2009). A frequency of 23% with greater abundance in the current period.

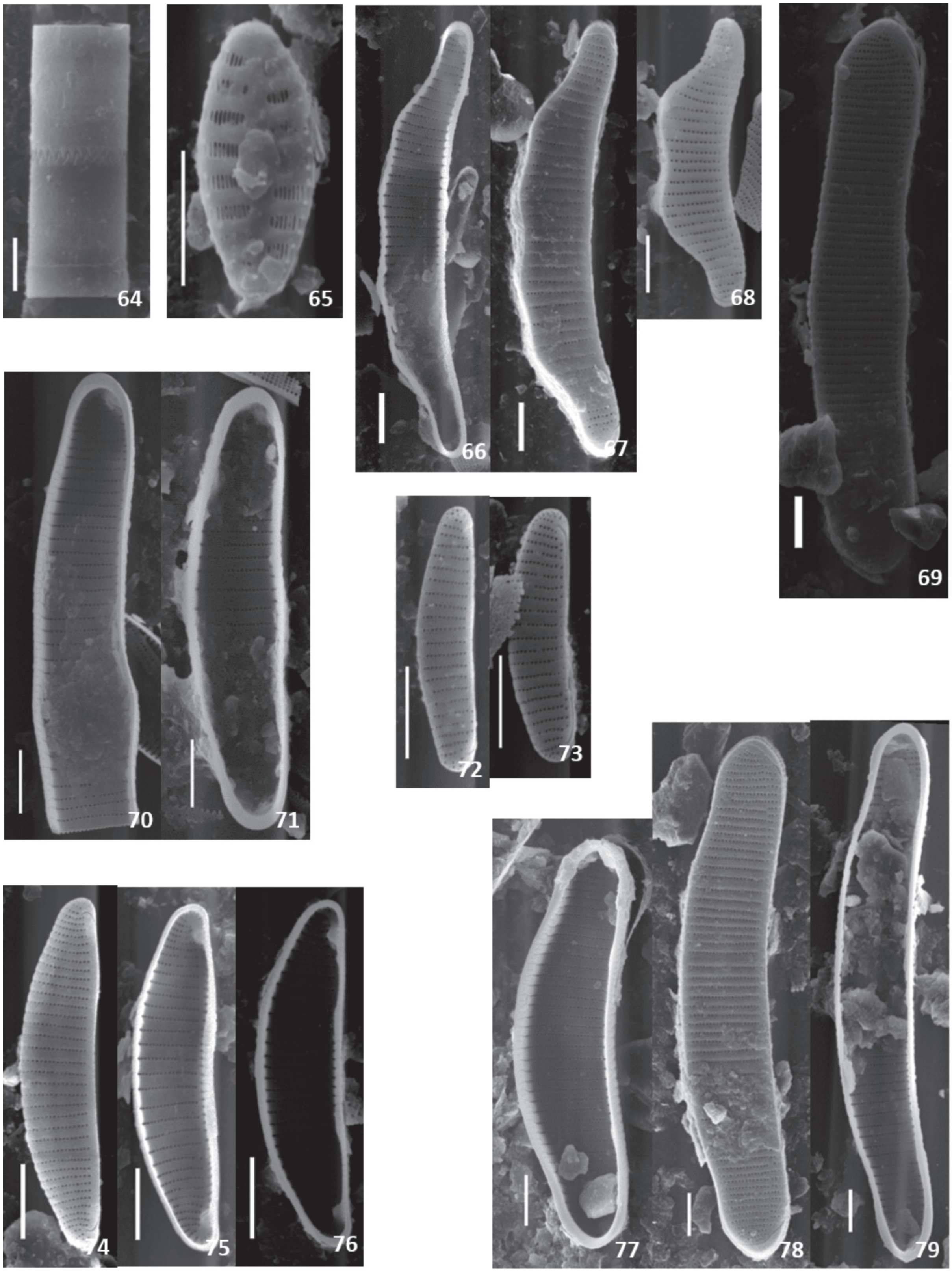
Among the 31 taxa addressed, all were found in the sediment samples and 15 were present in the periphyton community, 16 were exclusive in the sediment (table 2). It is important to highlight the great exclusive diversity of diatoms that can be found in sediments. Along the temporal variation, there are consequently physical and chemical, biological and geomorphological changes in the environment. In temporal ecology, these factors and the habitat control

Table 2. Distribution and abundance of diatom species in the studied periods, Mutum island in in the upper Paraná river floodplain, Brazil (hatched area according to range of abundance values; dark gray - 30% to 100%, gray - 20% to 30%, light gray - 5% to 20%, white - 0%) * New records for the State of Paraná according to Tremarin *et al.* 2009, Bertolli *et al.* 2010, Faria *et al.* 2010, Silva *et al.* 2010, Santos *et al.* 2011, Moresco *et al.* 2011, Bartozek *et al.* 2013 - Table organized according to Round *et al.* 1990.

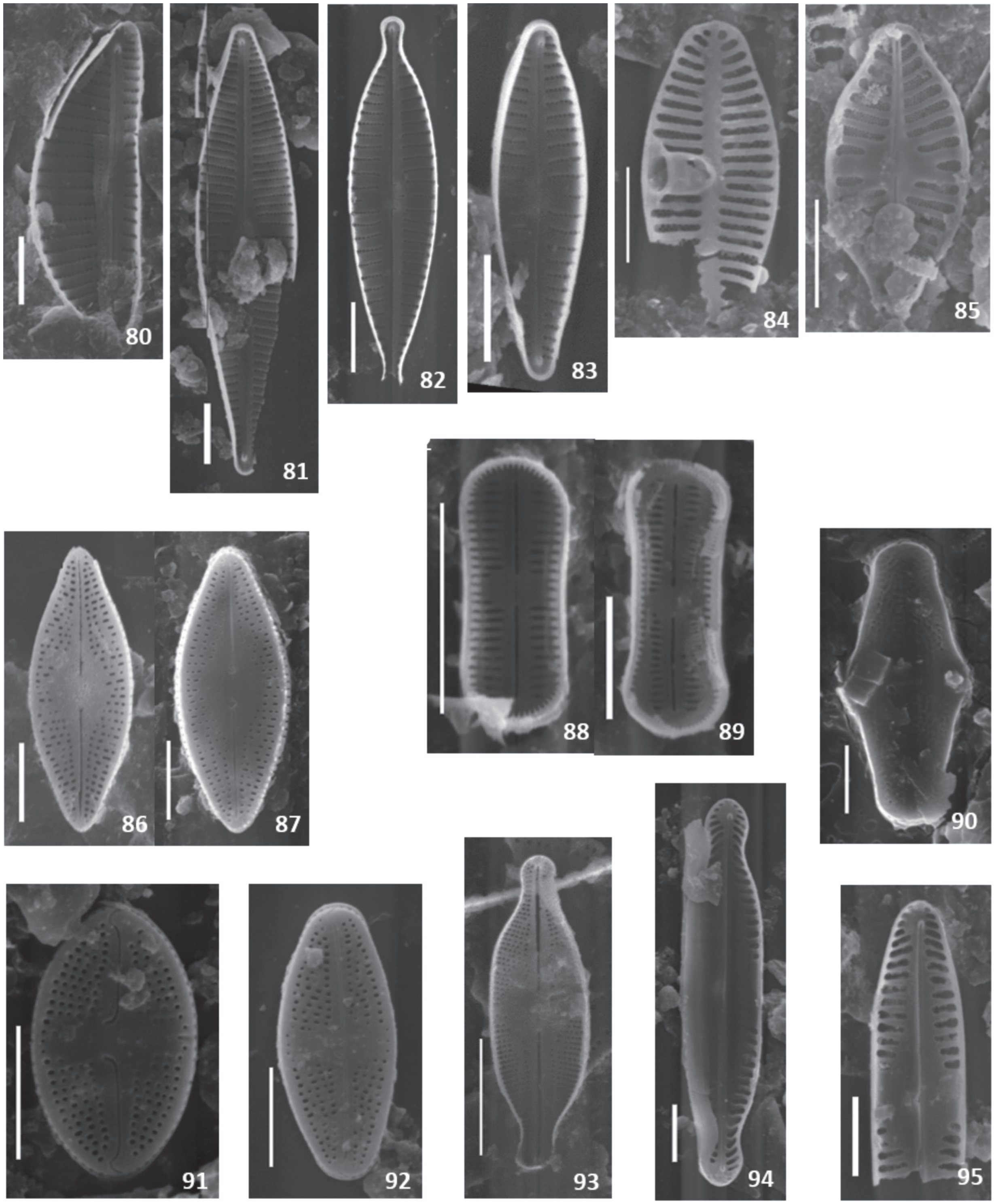
Taxa	Periphyton (2016)	Swamp	Transition (> 300 years)	Lake (> 760 years)	Backwater (> 920 years)
Aulacoseira italica					
Staurosirella crassa					
Staurosirella crassa mp. I					
Eunotia bidens					
Eunotia cf. *deformis*					
Eunotia formica					
Eunotia cf. *intermedia*					
Eunotia longicamelus *					
Eunotia major					
Eunotia naegelli					
Eunotia pseudosudetica					
Eunotia rabenhorstiana var. *elongata*					
Eunotia subarcuatoides					
Encyonema silesiacum					
Gomphonema gracile					
Gomphonema lagenula					
Gomphonema sp. 1					
Placoneis ovillus					
Achnanthidium minutissimum					
Planothidium bagualensis *					
Planothidium aff. *rostratum*					
Diadesmis confervaceae					
Humidophila contenta					
Luticola hustedtii *					
Luticola muticoides					
Luticola cf. *simplex*					
Nupela cf. *bicapitata*					
Sellaphora fusticulus					
Pinnularia brauniana					
Pinnularia sp. 1					
Nitzschia palea var. *debilis*					

the establishment and colonization of the species. The ability of populations to compete and persist in a habitat depends on how well species adapt to develop under specific environmental conditions (Patrick & Reimer 1966).

Each period was recognized in the record through the peculiar characteristics of each phase in the sedimentological material (Leli *et al.* 2017). In this research, some species presented greater abundance for each geomorphological period (backwater, lake, transition, and swamp). However, in the channel period (726-903 cal yr BP) was not found diatoms. The great dominance of periphytic species in swamp and transition periods could indicate the presence and abundance of macrophytes and vegetation located in the coastal region of the aquatic environment



Figures 64-79. Diatom **s**pecies from Mutum Island (SEM).island in in the upper Paraná river floodplain, Brazil (SEM). 64. *Aulacoseira italica*. 65. *Staurosirella crassa*. 66-68. *Eunotia longicamelus*. 69. *Eunotia formica.* 70-71. *Eunotia* cf. *deformis* (71 - internal valvar view). 72-73. *Eunotia* cf. *intermedia*. 74-76. *Eunotia pseudosudetica* (75 and 76 - internal valvar view). 77-79. *Eunotia major* (77 and 79 - internal valvar view). (Scale bar: 5 µm).



Figures 80-95. Diatom species from Mutum Island (SEM).island in in the upper Paraná river floodplain, Brazil (SEM). 80. *Encyonema silesiacum* (internal valvar view). 81. *Gomphonema gracile* (internal valvar view). 82. *Gomphonema lagenula* (internal valvar view). 83. *Gomphonema* sp. 1 (internal valvar view). 84. *Planothidium bagualensis* (internal valvar view). 85. *Planothidium* aff. *rostratum* (internal valvar view). 86-87. *Diadesmis confervaceae*. 88-89. *Humidophila contenta* (internal valvar view). 90. *Luticola hustedtii*. 91. *Luticola muticoides*. 92. *Luticola* cf. *simplex*. 93. *Nupela* cf. *bicapitata* (internal valvar view). 94. *Pinnularia brauniana* (internal valvar view). 95. *Pinnularia subcapitata* (internal valvar view). (Scale bar: 5 µm).

(Felisberto & Rodrigues 2010). The occurrence of some species as *Diadesmis confervacea*, *Humidophila contenta*, *Luticola muticoides*, *Luticola* cf. *simplex* in transition and swamp periods indicated shallow water environments, wet soils and marsh environments (Van de Vijver *et al.* 2002, Lowe *et al.* 2007, Torgan & Santos 2008). The great contribution of species of the order Naviculales in the transition period can be explained by these taxa being abundant in marshy environments as reported in the study of Vijayan & Ray (2016).

The lake period has a predominance of Eunotiaceae species (as *Eunotia longicamelus*, *Eunotia major*), which indicates a decrease of the pH, conductivity, and nutrients (Vélez *et al.* 2005). The occurrence of species belonging to the family Fragilariaceae (as *Staurosirella crassa*), in the backwater can be explained by the affinity of these taxa to unstable environments with continuous changes, characteristics that can be provided in a connected lake (Haworth 1976, Thomaz *et al.* 1997). Our results show a taxonomic contribution of diatoms to the region due to the three new registrations (*E. longicamelus, Planothidium bagualensis* and *Luticola hustedtii*). We showed the importance of palaeolimnological studies to increase information about aquatic biodiversity and also provided the first palaeolimnological research for a Brazilian floodplain.

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