Expanding the Green Algal Flora of Brazil: New Records of Chlorophyta from Paraná Streams

Ionara De Souza Neis
ionaradesouzaneis@gmail.com

Universidade Estadual do Oeste do Paraná: Universidade Estadual do Oeste do Parana
https://orcid.org/0000-0002-4036-0225

Patrícia Iatskiu
Universidade Estadual do Oeste do Parana

Norma Catarina Bueno
UNIOESTE: Universidade Estadual do Oeste do Parana

Research Article

Keywords: Chlorophyceae, Microalgae, Streams, Taxonomy, Trebouxiophyceae

Posted Date: July 29th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10058189/v1

Expanding the Green Algal Flora of Brazil: New Records of Chlorophyta from Paraná Streams[1]

Ionara de Souza Neis [2, 3] (0000-0002-4036-0225), Patrícia Iatskiu [2] (0000-0003-0988-6517) & Norma Catarina Bueno[2] (0000-0001-6939-9222).

1. Part of the dissertation of the first author

2. State University of Western Paraná, Rua Universitária, 1619, Universitário, 85819-110 Cascavel, PR, Brazil

3. Corresponding author: ionaradesouzaneis@gmail.com

ABSTRACT(Expanding the Green Algal Flora of Brazil: New Records of Chlorophyta from Paraná Streams). This study conducted a taxonomic survey of microalgae from the class Chlorophyta in nine streams in western Paraná, Brazil. Sampling points were chosen across three watersheds (Paraná 3, Piquiri, and Baixo Iguaçu) and classified according to the stage of riparian forest regeneration: reference, intermediary, and young. Collections occurred during the dry (May/June) and rainy (September/October) seasons using surface trawling with a 20-micrometer plankton net. A total of 93 taxa were recorded, distributed across two classes, six orders, and seven families, with 32 new records, including 23 for the state of Paraná and 9 new records for Brazil, namely: *Pediastrum duplex* var. *asperum* (A. Braun) Hansgirg, *Pediastrum duplex* var. *intermedium* Vodenicharov, *Sorastrum pediastriforme* M. Jena & C. Bock, *Radiococcus signiensis* (P. A. Broady) I. Kostikov, T. Darienko, A. Lukesová, and L. Hoffmann, *Coelastrum triangulare* Jao & Z. Y. Hu, *Desmodesmus communis* var. *polisicus* Tsarenko & E. Hegewald, *Scenedesmus smithii* Chodat, *Pleurastrum diplobionticum* (Herndon) Sciuto, M.A. Wolf, Mistri & Mori, and *Hegewaldia parvula* (Woronichin) Pröschold, C. Bock, W. Luo & L. Krienitz. These results significantly expand the floristic knowledge of the region and highlight the importance of taxonomic studies in areas that have been little covered.

Keywords: Chlorophyceae; Microalgae; Streams; Taxonomy; Trebouxiophyceae.

Introduction

The phytoplankton community is significant for continental ecosystem studies, in addition to its high production of organic matter and role in the food chain. As they are suspended in the water column, their response to stress and environmental change is rapid, they are considered bioindicators of environmental quality, given their ability to assess the environment in which they live by absorbing organic and inorganic pollutants, heavy metals, and radioactive substances. (Tanaka et al. 2016, Vélez-Azañero, Lozano & Cáceres-Torres 2016, González et al. 2023, Marques & Américo-Pinheiro 2017).

The state of Paraná stands out for its numerous aquatic ecosystems, including 16 river basins, among them the Iguaçu, Piquiri, and Paraná 3 basins, as well as large rivers such as the Iguaçu and Paraná (IAT 2014) and numerous streams that have yet to be studied in depth. These habitats are home to a vast flora of microalgae, but there are still few studies on the floristic composition and ecological assessment of these environments as a whole (Menezes et al. 2011). Floristic studies contribute to the geographical distribution of species and to taxonomic knowledge of species. Despite this relevance, it is estimated that the number of algae species described is still substantially lower than the actual number (Guiry 2024, Bellinger & Sigee 2015, Wehr et al. 2015).

A concise bibliographic survey revealed that, by 2025, 12 taxonomic studies had been conducted, presenting descriptions and illustrations of algae in the western region of the state of Paraná, for the phylum Chlorophyta: Bittencourt-Oliveira (1997) with 84 taxa recorded in the study, Moresco et al. (2007) with 21 taxa, Biolo et al. (2009) with 21 taxa, Bortolini et al. (2010) with 28 taxa, Menezes et al. (2011) with 17 taxa, Riedger et al. (2014) with 28 taxa, Aquino et al. (2014) with 30 taxa, Medeiros et al. (2021) with 26 taxa, Silva et al. (2022) with 55 taxa, Pilatti et al. (2023) with 36 taxa, and the most recent one Neis et al. (2026) with 77 taxa. In this context, the present study aims to inventory the phytoplankton community of the Chlorophyceae and Trebouxiophyceae taxa present in the Lower Iguaçu, Piquiri, and Paraná 3 river basins. In addition to providing images and morphometric data, as well as contributing new specimen records to the country's diversity, this study thereby contributes to knowledge of the floristic composition and serves as a bibliographic resource for future studies involving local biodiversity.

Material and Methods

Study area and sampling sites - the selected points were classified according to the riparian forest present in their surroundings, relating them to the stage of vegetation formation. They are thus distributed according to the level of regeneration in reference, young and intermediate, following the MapBiomas platform, totaling nine streams, classified from first to fourth order, in three watersheds in western Paraná: Piquiri, Paraná 3, and Baixo Iguaçu.

The Paraná 3 basin is located in the western mesoregion of the state, covering 28 municipalities with a total area of approximately 8.000 km². According to the Köppen classification (Aparecido et al. 2016), the region's climate is defined as type Cfa, which corresponds to a subtropical climate with hot summers, temperatures above 22°C in the summer, and rainfall of more than 30 mm in the driest month (IAT 2014).

The Piquiri basin is bordered to the north by the Ivaí basin and to the south by the Iguaçu basin, it covers a total area of approximately 24,171 km² and spans around 68 municipalities. According to the Köppen climate classification, the climate is defined as Cfa, a subtropical climate with hot summers, and Cfb, a temperate climate with mild summers, no dry season, and evenly distributed rainfall. In the hottest month, average temperatures do not exceed 22°C, frosts are frequent, and precipitation varies from 1.100 to 2.000 mm (SOMA 2008).

The Iguaçu basin crosses the state of Paraná and is subdivided into three hydrographic units, Upper, Middle, and Lower Iguaçu, with a total area of approximately 55.000 km². The climate is humid subtropical (mesothermal – Cfa), with no defined dry season (SEMA 2013).

In spatial terms, the sampling area comprised nine streams (Figure 1), two located in the Piquiri basin, two in the Paraná 3 basin, and five in the Lower Iguaçu basin, four collections were made in May, June, September, and October 2024, during the rainy (September and October) and dry (May and June) seasons (Table I). Qualitative samples were collected at each point, one sample per point corresponding to 36 samples (N:36), which were deposited in the Herbarium of the State University of Western Paraná – UNOPA and linked to the Brazilian Herbarium Network, and the computerized data made available on *speciesLink* (www.splink.cria.org.br).

Sample collection and analysis – For qualitative phytoplankton collections, the material was obtained using a plankton net with a 20-micrometer mesh opening by means of surface trawling and was subsequently fixed with Transeau solution in a 1:1 ratio, according to Bicudo & Menezes (2017).

For taxonomic identification, temporary slides were prepared, averaging 15 slides per sample or until no new taxa per sample occurred, adopting the following for systematic and taxonomic classification: Bicudo & Menezes (2017) for all groups, being reviewed and verified with Algaebase (Guiry & Guiry, 2026).

All images and dimensions were obtained using an Olympus BX43 infinity-corrected optical microscope and CellSens software to record images and dimensions; all observations were made using a 400X objective, and metric data were recorded in micrometer (µm). Metric data are therefore represented in the text as follows: Cel. l. – Cell length; Cel. w. – Cell width; Ce. l.: Coenobial length; Coe. w.: – Coenobial width; S – Spike; Int. – internal; ext. – External; D – Diameter; Cel. d.: – Cell diameter; Coe. d. – Coenobial diameter; Co. l. – Colonial length; Co. w. – Colonial width; Syn. – SynCoenobium. Information for each taxon, such as updated geographic distribution in Brazil, biomes, and watershed, follows the Algaebase platform (Guiry & Guiry 2026) and IAT (2007), considering only taxonomic published papers, meaning those that include descriptions, illustrations or photographs for geographic distribution.

Data on water temperature, dissolved oxygen, pH, electrical conductivity, and turbidity were measured using the Horiba U-5000 multiparameter probe, depth data were collected using a ruler, measuring tape, and a floating object, with flow rate calculated in situ by multiplying the average velocity resulting from the object's displacement by the cross-sectional area at that location. Estimates of nitrate, nitrite, ammonia nitrogen, total dissolved phosphorus, orthophosphate, and chlorophyll-α concentrations were performed following the methods standardized in Standard Methods (APHA 2017).

Results

This taxonomic survey allowed the identification of 93 taxa of the phyla Chorophyta in the Baixo Iguaçu, Piquiri, and Paraná 3 basins (Figures 2-94) The taxa were distributed in two classes, six orders, and seven families. Thirty-two new citations were recorded, among them, 9 new citations qualify as new citations for the country. Taxonomic remark were provided for the new records in Brazil, while information on species that were found and had already been recorded—such as illustrations, dimensions, and river basins—was organized in table format (Table II). In addition to representing new citations, these records expand knowledge about the biodiversity of the continental flora of Paraná.

PHYLUM CHLOROPHYTA

CLASS CHLOROPHYCEAE

ORDER SPHAEROPLEALES

FAMILY HYDRODICTYACEAE

Pediastrum duplex* var. *asperum (A.Braun) Hansgirg, *in* Archiv für die naturwissenschaftliche Landesdurchforschung von Böhmen 6(5): [1]-288, 1855.

Figure: 6-6a

Circular coenobium formed by 8-16-32-64 cells with smooth cell walls and small perforations; internal cells square to angular and in contact in the central part of the side wall, external cells with two short, truncated processes. Single, parietal chloroplast, one pyrenoid per cell.

Dimensions: Int. cel. l.: 10.0–12.5 µm; Int. cel. w.: 10.0–12.5 µm; Ext. cel. l..: 12.5–20.0 µm; Ext. cel. w.: 10.0–12.5 µm; Coe. d.: 55.0–92.5 µm.

Occurrence in samples:UNOPA 7826, 7835, 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: This variety differs from the typical species in terms of the small perforations in the smooth cell wall, which are not easily visible, as well as the size and thickening of the cell processes, as described by Braun (1855) and Hansgirg (1888). McManus & Lewis (2005) conducted a molecular phylogenetic study of the family Hydrodictytaceae, demonstrating that most isolates associated with the typical species maintain a stable morphological pattern, and that the variety belongs to an isolate that distinguishes it from the others, not only morphologically but also molecularly.

Pediastrum duplex* var. *intermedium Vodenicharov, Ukrainian Botanical Journal 17(2): 89–94, 1960.

Figure: 7

Flat, rounded coenobia formed by 32-64 cells arranged concentrically with regular elliptical to triangular intercellular spaces, internal cells more or less rectangular, external cells H-shaped, apices truncated with two short cylindrical processes. Single, parietal chloroplast, one pyrenoid per cell.

Dimensions: Int. cel. l.: 5.0–10.0 µm; Int. cel. w.: 5.0–10.0 µm; Ext. cel. l.: 7.5–12.5 µm; Ext. cel. w.: 5.0–10.0 µm; Coe. l.: 40.0–62.5 µm; Coe. w.: 37.5–62.5 µm.

Occurrence in samples:UNOPA 7833, 7821, 7826, 7835.

Watershed: Paraná 3, Baixo Iguaçu.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: This variety differs from the typical species in the presence of well-defined, large, ellipsoidal to triangular intercellular spaces relative to cell size. Also noted by Vodenicharov (1960) is a thickening of the cell membrane at the junctions between cells; the outer cells have a clear, colorless membrane, similar to *P. duplex*, but extends in a defined, less detailed, and thicker manner.

Sorastrum pediastriforme M.Jena & C.Bock, Fottea 14(1): 63-76, 8 fig., 3 tables, 2014.

Figure: 10

Circular or rounded flat coenobium formed by 8-16-32 cells arranged concentrically with regular intercellular spaces, internal cells polygonal with straight sides; external cells bilobed, cell wall smooth or granular. Parietal chloroplast, one pyrenoid per cell.

Dimensions: Int. cel. l.: 10–12.5 µm; Int. cel. w.: 12.5–15.0 µm; Ext. cel. l.: 15.0–20.0 µm; Ext. cel. w.: 12.5–15.0 µm; Coe. l.: 52.5–85.0 µm; Coe. w.: 50.0–85.0 µm.

Occurrence in samples:7826, 7844, 7835, 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: This species is characterized by its resemblance to the genus *Pediastrum*; its specific epithet is derived from this, since the genus *Sorastrum* is typically defined by its three-dimensional cenobiums, whereas this species exhibits a flat cenobium. Jena et al. (2014), through the combination of morphology and molecular phylogenetics, identified *Sorastrum pediastriforme* as a new species, visually distinguished by the irregular appearance at the cell apex and by differences in the nucleotide sequences of SSU and ITS rRNA in the genetic sequence when compared to the other individuals analyzed.

FAMILY RADIOCOCCACEAE

Coenochloris aquatica I.Kostikov, T.Darienko, A.Lukesová, & L.Hoffmann, Archiv für Hydrobiologie Supplement 104: 23-58, 5 figures, 2 tables, 2002.

Figure: 13

Irregular colonies formed by groups of 4-8 round to ovoid cells arranged irregularly in 1-2 planes. Single, parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. l.: 5.0 µm; Cel. w.: 10.0 µm; Coe. l.: 17.5 µm; Coe. w.: 20.0 µm; Co. l.: 47.5 µm; Co. w.: 57.5 µm.

Occurrence in samples:UNOPA 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: São Paulo (Tucci et al. 2019), Paraná first record.

Coenocystis planctonica Korshikov, Viznachnik prisnovodnihk vodorostey Ukrainsykoi RSR Vol. 5 pp. 439, 421 figures,1953.

Figure: 15

Spherical colony of 4-8 spherical cells arranged irregularly in the center of an inconspicuous mucilage sheath. Single, parietal chloroplast, one pyrenoid per cell.

Dimensions: Cel. d.: 12.5 µm; Co. d.: 70.0 µm.

Occurrence in samples:UNOPA 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: São Paulo (Tucci et al. 2019), Paraná first record.

Eutetramorus globosus Walton, Ohio Journal of Science 18: 126-128, 1918.

Figure: 16

Colonies formed by 4-8 or 16 spherical cells, arranged at a certain distance from each other and surrounded by a spherical, colorless and homogeneous mucilaginous envelope. Cup-shaped chloroplast, one pyrenoid per cell.

Dimensions: Cel. d.: 10.0 µm; Co. l.: 52.5 µm; Co. w.: 47.5 µm.

Occurrence in samples:UNOPA 7833.

Watershed: Paraná 3.

Biome: Cerrado, Atlantic Forest.

Geographical distribution in Brazil: Goiás (Alves et al. 2014), Paraná first record.

Eutetramorus tapasteanus (J.Komárek) I.Kostikov, T.Darienko, A.Lukesová, & L.Hoffmann, Archiv für Hydrobiologie Supplement 104: 23-58, 5 figures, 2 tables, 2002.

Figure: 17

Spherical to ellipsoidal colonies formed by 4-8 spherical or slightly asymmetrical cells arranged irregularly in colorless, irregular mucilage. Poculiform chloroplast, one pyrenoid per cell.

Dimensions: Co. d.: 15.0–25.0 µm.

Occurrence in samples:UNOPA 7833.

Watershed: Paraná 3.

Biome: Cerrado, Atlantic Forest.

Geographical distribution in Brazil: Goiás (Alves et al. 2014), Paraná first record.

Palmococcus hercynicus (H.Heynig) I.Kostikov, T.Darienko, A.Lukesová, & L.Hoffmann, Archiv für Hydrobiologie Supplement 104: 23-58, 5 figures, 2 tables, 2002.

Figure: 19

Rounded colony consisting of 8 elliptical to ovoid cells arranged in two distinct planes, located at the center of an inconspicuous mucilage sheath. Parietal chloroplast; pyrenoid not observed.

Dimensions: Cel. d.: 7.5 µm; Co. l.: 17.5 µm; Co. w.: 22.5 µm.

Occurrence in samples: UNOPA 7826.

Watershed: Paraná 3.

Biome: Caatinga, Atlantic Forest.

Geographical distribution in Brazil: Bahia (Ramos et al. 2015), Paraná first record.

Radiococcus nimbatus (De Wildeman) Schmidle, Allgemeine botanische Zeitschrift für Systematik, Floristik, Pflanzengeographie 8: 41-42, 1902.

Figure: 20

Rounded colony consisting of 4–8–16 spherical cells surrounded by a mucilaginous envelope and arranged in a radial pattern. Parietal chloroplasts, one pyrenoid per cell.

Dimensions: Cel. d.: 7.5 µm; Coe. d.: 15.0 µm; Co. d.: 32.5–50.0 µm.

Occurrence in samples:UNOPA 7835, 7844.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: Rio de Janeiro (Menezes 2010), Paraná first record.

Radiococcus planktonicus J.W.G.Lund, Journal of the Linnean Society of London, Botany 55: 593-613, 1956.

Figure: 21

Rounded colony formed by groups of 4 spherical cells arranged tetrahedrally within a hyaline mucilage sheath, usually with striations at the edge. Single, cup-shaped chloroplast, pyrenoid not observed.

Dimensions: Cel. d: 7.5 µm; Coe. d.: 17.5–20.0 µm; Co. l.: 72.5 µm; Co. w.: 77.5 µm.

Occurrence in samples: UNOPA 7835, 7833.

Watershed: Paraná 3.

Biome: Caatinga, Amazon Rainforest, Cerrado, Atlantic Forest.

Geographical distribution in Brazil: Rio de Janeiro (Menezes 2010), São Paulo (Bicudo et al. 2022) Bahia (Ramos et al. 2015), Paraná first record.

Radiococcus signiensis (P.A.Broady) I.Kostikov, T.Darienko, A.Lukesová, & L.Hoffmann, Archiv für Hydrobiologie Supplement 104: 23-58, 5 figures, 2 tables, 2002.

Figure: 23

Colony with 2-4(-)8 spherical to ellipsoid cells, irregularly scattered in a thick mucilaginous envelope, smooth cell wall. Parietal chloroplast, which may be lobed, one pyrenoid per cell.

Dimensions: Cel. d.: 17.5 µm; Coe. l.: 52.5 µm; Coe. w.: 67.5 µm.

Occurrence in samples:UNOPA 7835.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: The species is characterized by the presence of highly spherical, very dark green cells, scattered without a fixed pattern in irregular gelatinous mucilage, which distinguishes it from other species of the same genus, as well as by the presence of a lobed chloroplast, as described by Broady (1976), Андреева (1998) also observed that, with the lobed chloroplast, the single pyrenoid is located in its basal area, which makes it quite difficult to observe.

FAMILY SCENEDESMACEAE

Coelastrum cambricum var. intermedium (Bohlin) G.S.West, Journal of the Linnean Society of London, Botany 38: 81-197, 1907.

Figure: 27

Spherical coenobium formed by 8-16(-128) spherical to hemispherical cells, surrounded by a gelatinous sheath and joined to each other by short extensions, with wavy margins. Parietal chloroplast, pyrenoid not observed.

Dimensions: Coe. d.: 40.0–50.0 µm.

Occurrence in samples:UNOPA 7835.

Watershed: Paraná 3.

Biome: Atlantic Forest, Pampa.

Geographical distribution in Brazil: Rio Grande do Sul (Bicudo & Martau 1974), Paraná first record.

Coelastrum sphaericum Nägeli, Schweizerischen Gesellschaft für die Gesammten Naturwissenschaften 10(7): i-viii, 1-139, pls I-VIII, 1849.

Figure: 33

Spherical coenobios formed by 4-8-16-32 spherical, ellipsoidal to cubic cells, irregular and wide intercellular spaces, rounded to spherical apical projection at the poles. Parietal chloroplast, pyrenoid not observed.

Dimensions: Coe. d.: 20.0 µm.

Occurrence in samples:UNOPA 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest, Pampa, Cerrado.

General Environment: freshwater species.

Geographical distribution in Brazil: Rio Grande do Sul (Bicudo & Martau 1974), Rio de Janeiro (Menezes 2010), Bahia (Pereira et al. 2024), Paraná first record.

Coelastrum triangulare C.C.Jao & Z. Y. Hu, Acta Phytotaxonomica Sinica 32: 193-196, 1994.

Figure: 34

Coenobium formed by 4-8 pyramidal to subquadrate cells, simple or interdigitated, triangular at the top, ellipsoidal at the sides, margins slightly convex, corners more or less projected. Single parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. d.: 5.0 µm; Coe. d.: 10.0 µm.

Occurrence in samples:UNOPA 7815.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: The specimen identified here is slightly smaller dimensions than those described by Hu (1994), but still exhibits the defining characteristics of the species, namely the presence of pyramidal cells; in other species of the genus Coelastrum, these cells tend to be spherical, as in *C. reticulatum*, or hexagonal, as in *C. proboscideum*; this species has triangular cells when viewed from a top view and elliptical cells when viewed from a side view; furthermore, when compared to other species of the genus, the appearance of the cenobium is generally spherical, which is not observed in this species.

Crucigenia mucronata (G.M. Smith) Komárek, Archiv für Protistenkunde 116: 25, fig. 31. 1974.

Figure: 36

Flat, quadrangular coenobia formed by 4 oval to trapezoidal cells, quadrangular central space, cell wall with wart-like thickening at the angles where the cells connect, convex or slightly concave outer margin. Single, parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. l.: 7.5–10.0 µm; Cel. w.: 10.0–12.5 µm; Coe. l.: 20.0–25.0 µm; Coe. w.: 22.5 µm.

Occurrence in samples:UNOPA 7833, 7835.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: São Paulo (Godinho et al. 2010), Mato Grosso do Sul (Bortolini et al. 2010b), Paraná first record.

Desmodesmus communis* var. *polisicus Tsarenko & E.Hegewald, Arch. Hydrobiol. Suppl. 1 160 (Algol. Stud. 118): 1-45, 142 figs., 3 tables, 2005.

Figure: 41

Straight and flat coenobium, formed by 4-8 oblong to trapezoidal cells joined together and arranged linearly, rounded poles with the presence of reduced cylindrical rosettes that may or may not be visible, the ultrastructure of the cell wall is similar to a network, external cells with a slightly convex margin and with 1 long, curved spine at each pole. Single parietal chloroplast, one pyrenoid per cell.

Dimensions: Cel. l.: 20.0–30.0 µm; Cel. w.: 5.0–10.0 µm; Coe. l.: 57.5–72.5 µm; Coe. w.: 52.5–65.0 µm; S: 20.0–25.0 µm.

Occurrence in samples:UNOPA 7835, 7833.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: This variety differs from the typical species in that it has small rosettes at the base of its spines, which may be elongated or very reduced, making visualization difficult. Tsarenko et al. (2005) also suggest that the variety represents an intermediate form between *D. communis* and *D. maximus*, due to the structure of the cell wall and the small mutations in the ITS-2 sequence that are likely to accumulate over time.

Desmodesmus lunatus (W. & G. S. West) Hegewald, Algological Studies 96: 1-18, 2000.

Figure: 44-44a

Flat coenobia formed by 2-4 ellipsoid to reniform cells arranged linearly, with 1-3 teeth at each cell pole. Single, parietal chloroplast, one pyrenoid per cell.

Dimensions: Cel. l.: 17.5 µm; Cel. w.: 7.5 µm; Coe. l.: 35.0–45.0 µm; Coe. w.: 35.0–57.5 µm; S.: 2.5 µm.

Occurrence in samples:UNOPA 7833.

Watershed: Paraná 3.

Biome: Atlantic Forest, Pampa, Cerrado.

Geographical distribution in Brazil: Rio Grande do Sul (Hentschke & Torgan 2010), Bahia (Pereira et al. 2024), São Paulo (Tucci et al. 2019), Paraná first record.

Desmodesmus spinosus (Chodat) E.Hegewald, Algological Studies 96: 1-18, 2000.

Figure: 52-52a

Flat coenobia, formed by 2-4 cells arranged linearly; external cells oblong, external face convex with 1-2 spines, rounded poles with 1 spine each, without polar spines or with 1 spine on one of the poles, arranged diagonally, or with 1 spine on each pole. Single parietal chloroplast with one pyrenoid.

Dimensions: Cel. l.: 7.5 µm; Cel. w.: 2.5 µm; Coe. l.: 15.0 µm; Coe. w.: 12.5 µm; Pri. s.: 5.0 µm; Sec. s.: 2.5 µm.

Occurrence in samples:UNOPA 7826.

Watershed: Paraná 3.

Biome: Atlantic Forest, Pampa, Cerrado.

Geographical distribution in Brazil: Rio Grande do Sul (Bicudo & Martau 1974), Rio de Janeiro (Menezes 2010), Bahia (Pereira et al. 2024), São Paulo (Tucci et al. 2019, Ferragut et al. 2005), Paraná first record.

Hariotina reticulata P.A.Dangeard, Le Botaniste 1: 127-174, 1889.

Figure: 53

Spherical coenobia, formed by 8-16-32 spherical cells with long, cylindrical processes in apical view connecting neighboring cells, presence of intercellular spaces. Single, parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. d.: 5.0 µm; Coe. d.: 12.5–20.0 µm; Co. l.: 45.0–90.0 µm; Co. w.: 35.0–105.0 µm.

Occurrence in samples:UNOPA 7844, 7842, 7848, 7849, 7833, 7835.

Watershed: Paraná 3, Baixo Iguaçu.

Biome: Atlantic Forest, Cerrado, Caatinga.

Geographical distribution in Brazil: Rio de Janeiro (Menezes 2010), Bahia (Pereira et al. 2024), São Paulo (Bicudo et al. 1999, Tucci et al. 2019, Ferragut et al. 2005), Paraná first record.

Scenedesmus obtusus* f. *disciformis (Chodat) Compère, Bulletin du Jardin Botanique National de Belgique 47(1): 264-265,1977.

Figure: 57

Flat coenobium with 8 oblong to ellipsoid cells arranged in two overlapping series, compressed by mutual pressure. Single chloroplast and parietal, pyrenoid not observed.

Dimensions: Cel. l.: 7.5 µm; Cel. w.: 10.0 µm; Coe. l.: 30.0 µm; Coe. w.: 20.0 µm.

Occurrence in samples: UNOPA 7835.

Watershed: Paraná 3.

Biome: Atlantic Forest, Cerrado.

Geographical distribution in Brazil: São Paulo (Tucci et al. 2019), Paraná first record.

Scenedesmus smithii Chodat, Schweizerische Zeitschrift für Hydrologie 3: 71-258, 1926.

Figure: 59-59b

Coenobium formed by 2-4 oval to oblong cells arranged alternately, with 2-3 teeth at the apical poles arranged parallel to the longitudinal axis of the cenobium or oblique. Single, parietal chloroplast, one pyrenoid per cell.

Dimensions: Cel. l.: 10.0–15.0 µm; Cel. w.: 5.0–10.0 µm; Coe. l.: 22.5–35.0 µm; Coe. w.: 20.0–45.0 µm; S.: 5.0–7.5 µm.

Occurrence in samples: UNOPA 7824, 7833, 7835, 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: A specie that is morphologically very similar to *Desmodesmus lunatus*, differing only in cell shape—being more oblong and ovoid, with 2 to 3 longer, curved spines at the apical poles (Chodat 1926) whereas *D. lunatus* has ellipsoid to reniform cells with 1 to 3 short, slightly curved, almost straight spines (Hentschke & Torgan 2010). Hegewald & Braband (2017) also compared the species to *D. retangularis* based on its morphology and size, but confirmed that they are very distinct species.

Tetrastrum staurogeniiforme (Schröder) Lemmermann, Berichte der deutsche botanischen Gesellschaft 18: 90-98, 1900.

Figure: 62

Flat coenobium formed by 4 triangular to ovoid cells, arranged in a cross pattern, with 4-6 spines on the outer margin. Parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. d.: 5.0 µm; Coe. d.:15.0 µm; S.:1.0 µm.

Occurrence in samples:UNOPA 7844.

Watershed: Paraná 3.

Biome: Atlantic Forest, Cerrado, Caatinga.

Geographical distribution in Brazil: Rio de Janeiro (Menezes 2010), Bahia (Pereira et al. 2024), Paraná first record.

FAMILY SELENASTRACEAE

Monoraphidium fontinale Hindák, Biologicke Práce 26 (incl. 73 plates): 1-195, 1980.

Figure: 71

Isolated cells fusiform-oblong to sigmoidal, apices slightly tapered and curved. Single, parietal chloroplast, without pyrenoid.

Dimensions: Cel. l.: 50.0 µm; Cel. w.: 5.0 µm.

Occurrence in samples:UNOPA 7835.

Watershed: Paraná 3.

Biome: Atlantic Forest, Caatinga.

Geographical distribution in Brazil: Bahia (Ramos et al. 2014), Paraná first record.

Monoraphidium indicum Hindák, Biologicke Práce 23: 1-192, 1977.

Figure: 73-73a

Isolated, fusiform cells, strongly arched in a precise curvature with gradually tapering apices. Single, parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. l.: 70.0-95.0µm; Cel. w.: 2.5-5.0 µm.

Occurrence in samples: UNOPA 7821, 7848, 7849, 7841, 7833, 7832, 7831.

Watershed: Paraná 3, Baixo Iguaçu.

Biome: Atlantic Forest, Caatinga.

Geographical distribution in Brazil: Bahia (Ramos et al. 2014), Paraná first record.

Monoraphidium subclavatum Nygaard, Biologiske Skrifter 21(1): 1-107, 86 figs, 1977

Figure: 74

Solitary, isolated cell, lunate to arched, tapering gradually toward the apical ends, which are pointed to sharp. Single, parietal chloroplast, without pyrenoid.

Dimensions: Cel. l.: 25.0-27.5 µm; Cel. w.: 2.5-5.0 µm.

Occurrence in samples:UNOPA 7842, 7844.

Watershed: Paraná 3.

Biome: Atlantic Forest, Caatinga.

Geographical distribution in Brazil: Bahia (Ramos et al. 2014, Pereira et al. 2024), Paraná first record.

ORDER VOLVOCALES

FAMILY PLEURASTRACEAE

Pleurastrum diplobionticum (Herndon) Sciuto, M.A.Wolf, Mistri & Mori, Diversity 16(650): 1-31, 14 figs, 2 tables, 2023.

Figure: 79

Single cells, spherical to ovoid, covered by a thin to very thick mucilaginous envelope, spherical, ellipsoidal, or irregular. Single, parietal chloroplast with one to multiple pyrenoids.

Dimensions: Cel. d.:15.0-20.0 µm.

Occurrence in samples:UNOPA 7833.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: This species is characterized by deep green cells and thickening of the cell membrane as they mature; the multiple pyrenoids give the chloroplast the appearance of an opening, and they begin to resemble acinetes when there is thickening, according to Herndon (1958), the author also points out that the species is well defined and described based on its life cycle and reproduction, which result from the union of gametes and are apparently diploid.

CLASS TREBOUXIOPHYCEAE

ORDER CHLORELLALES

FAMILY CHLORELLACEAE

Hegewaldia parvula (Woronichin) Pröschold, C.Bock, W.Luo & L Krienitz, Phycological Research 58(1): 1-8, 2010.

Figure: 83

Isolated, spherical cell, covered by a very thin mucilaginous envelope, with 6–20(–25) short and long spines that taper toward the apex. Single, cyaciform chloroplast, one pyrenoid.

Dimensions: Cel. d.:15.0-17.5 µm; S.: 22.5-40.0 µm

Occurrence in samples:UNOPA 7833, 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: First record.

Taxonomic remarks: This species was initially described as part of the genus Golenkinia, as it shares very similar morphological characteristics with that genus; it is a solitary, single-celled, spherical species that may or may not have spines. However, in 2010, Pröschold and collaborators conducted a phylogenetic study based on spine formation in different genera of the family Chlorellaceae, identifying the genus Hegewaldia, which differs from the others based on the ordering of SSU and ITS rDNA sequences. When compared to the genus Golenkinia, Hegewaldia parvula has a smaller number of spines, which are thicker and more pronounced, and vary in size within the same individual.

Willea crucifera (Wolle) D.M.John, M.J.Wynne & P.M.Tsarenko, Phytotaxa 167(2): 212-214, 2014.

Figure: 87-87b

Flat, approximately hexagonal coenobium, formed by 4 irregular oblong to slightly reniform cells with a losangular to quadratic central space, outer margin of the cell almost straight or slightly concave. Parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. l.: 5.0-12.5 µm; Cel. w.: 7.5-12.5 µm; Coe. l.: 17.5-30.0 µm; Coe. w.: 17.5-30.0 µm.

Occurrence in samples:UNOPA 7826, 7842, 7825, 7833, 7834

Watershed: Paraná 3, Piquiri.

Biome: Atlantic Forest, Caatinga, Cerrado.

Geographical distribution in Brazil: Bahia (Ramos et al. 2015, Pereira et al. 2024), São Paulo (Tucci et al. 2019), Paraná first record.

FAMILY OOCYSTACEAE

Nephrochlamys subsolitaria (G.S.West) Korshikov, Viznachnik prisnovodnihk vodorostey Ukrainsykoi RSR. Vol. 5 pp. 439, 421 figures,1953.

Figure: 88

Lunate colonies formed by 4 reniform cells arranged irregularly in conspicuous mucilage. Parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. l.: 1.,5 µm; Cel. w.: 10.0 µm; Coe. l.: 30.0 µm; Coe. w.: 27.5 µm.

Occurrence in samples:UNOPA 7835.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: Rio de Janeiro (Menezes 2010), Paraná first record.

Pachycladella komarekii (Fott & Kovácik) Reymond, Candollea 35: 37-70, 1980.

Figure: 91

Free-standing, isolated cell, tetrahedral or spherical in shape, smooth cell wall, hyaline and distinct from processes; 4 straight, pointed, hyaline processes. Single, parietal chloroplast, one pyrenoid.

Dimensions: Cel. l.: 145.0 µm; Cel. w.: 150.0 µm; S.:82.5 µm.

Occurrence in samples:UNOPA 7826.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: Goiás (D'Alessandro & Nogueira 2017), Paraná first record.

ORDER TREBOUXIALES

FAMILY BOTRYOCOCCACEAE

Dichotomococcus curvatus Korshikov, Zapiski Gorkovskogo Universiteta 9: 101-128, 1939.

Figure: 92

Irregular colonies, formed by groups of 2 lanceolate cells, slightly curved, elongated and rounded at the base, joined by inconspicuous dichotomous mucilaginous peduncles; hyaline colonial mucilage. Single, parietal chloroplast, without pyrenoid.

Dimensions: Cel. l.: 5.0 µm; Cel. w.: 2.5 µm; Coe. l.: 37.5 µm; Coe. w.: 40.0 µm.

Occurrence in samples:UNOPA 7842.

Watershed: Paraná 3.

Biome: Atlantic Forest.

Geographical distribution in Brazil: Rio de Janeiro (Menezes 2010), Paraná first record.

ORDER TREBOUXIOPHYCEAE ORDO INCERTAE SEDIS

FAMILY TREBOUXIOPHYCEAE INCERTAE SEDIS

Lemmermannia komarekii (Hindák) C.Bock & Krienitz 2013: 337, Journal of Phycology 49(2): 329-339.

Figure: 93

Flat coenobium, 4 cells, cells arranged in a cruciform pattern, small intercellular space, with or without mucilaginous envelope; subtriangular cells, slightly convex outer margins, rounded. Parietal chloroplast, pyrenoid not observed.

Dimensions: Cel. d.:3.5 µm; Coe. d.:10.0 µm.

Occurrence in samples:UNOPA 7815.

Watershed: Paraná 3.

Biome: Atlantic Forest, Caatinga.

Geographical distribution in Brazil: Rio de Janeiro (Menezes 2010), Bahia (Ramos et al. 2015, Pereira et al. 2024), Paraná first record.

This survey revealed that, among the 93 recorded taxa, the genera *Coelastrum* and *Desmodesmus* stand out for having the largest number of species. Among the new records, the following are noteworthy: *Pediastrum duplex* var. *asperum* (A. Braun) Hansgirg, *Pediastrum duplex* var. *intermedium* Vodenicharov, *Sorastrum pediastriforme* M.Jena & C.Bock, *Radiococcus signiensis* (P.A.Broady) I.Kostikov, T.Darienko, A.Lukesová, & L.Hoffmann, *Coelastrum triangulare* Jao & Z. Y. Hu, *Desmodesmus communis* var. *polisicus* Tsarenko & E. Hegewald, *Scenedesmus smithii* Chodat, *Pleurastrum diplobionticum* (Herndon) Sciuto, M.A. Wolf, Mistri & Mori, *Hegewaldia parvula* (Woronichin) Pröschold, C. Bock, W. Luo & L. Krienitz, and *Pachycladella komarekii* (Fott & Kovácik) Reymond, are the first records for the country, representing a considerable number of species; also noteworthy are the 25 new records for the state of Paraná, which expand knowledge of the Baixo Iguaçu, Piquiri, and Paraná 3 basins.

The greatest diversity of taxa associated with streams and collection sites was found in Adão Eliana, followed by Correntoso; both streams are located in areas of young vegetation, which are also found within the Paraná 3 basin, where a majority of the taxa identified were found.

Regarding the vegetative formation around the streams (Figure 95), the intermediary and reference areas did not have species exclusive to them, but they share species with the young formation, which had 83 exclusive species; seven species appeared in both the young and reference areas, and two species were common to both the young and intermediary areas. Only the species *Ankistrodesmus arcuatus* Korshikov was present in all areas, regardless of vegetation formation.

Although most of the sampling sites are located within the same watershed and have the same surrounding vegetation, species richness is still higher in less well-preserved areas; it is important to note that the sites with the highest number of species are located in areas susceptible to anthropogenic impacts, in this case agriculture and fish farming, which may or may not cause interference in the phytoplankton community at these sites; when combined with the physical and chemical parameters (Table 3), this may provide further insights into the ecology of these environments.

These findings regarding the distribution of taxa, their morphometric characteristics, and physical and chemical data are of paramount importance because, in addition to identifying species, they provide information on the habitat's biodiversity and open up opportunities for future studies that can conduct a comprehensive environmental assessment, as well as examine the potential influence of surrounding vegetation on the streams and the phytoplankton community.

Acknowledgements

Ionara de Souza Neis thanks the Araucária Foundation for granting a Technical Scholarship, category FA-ATNS, to Napi TaxonLine; Dr. Norma Catarina Bueno thanks the Neotropical Institute for Environmental Research/Fisheries Resources and Limnology Research Group/State University of Western Paraná for the physical and chemical analyses of the samples collected.

Authors' Contributions

Ionara de Souza Neis and Norma Bueno: contribution to the study concept and design, data analysis and interpretation; critical review and preparation of the manuscript, all adding intellectual content.

Conflicts of interest

There are no conflicts of interest.

References

ALVES, F.R.R., GAMA, W.A. & DE NOGUEIRA, I.S. (2014). Planktonic Radiococcaceae Fott ex Komárek of the Tigres Lake system, Britânia, Goiás State, Brazil. Braz. J. Bot 37, 519–530.

AMERICAN PUBLIC HEALTH ASSOCIATION (APHA). (2017). Standart Methods for the Examination of Water and Wastewater. 23 th Edition. Washington, D.C. 1796

APARECIDO, L.E.O. et al. (2016). Köppen, Thornthwaite and Camargo climate classifications for climatic zoning in the State of Paraná, Brazil. Ciência e Agrotecnologia, v. 40, n. 4, p. 405-417.

APRILE FM & MERA PAS. (2007). Fitoplâncton e fitoperifíton de um rio de águas pretas da Amazônia Periférica do Norte, Brasil. BJAST 11(2): 1-14.

AQUINO, C.A.N., BUENO, N.C. & MENEZES, V.C. (2014). Chlorococcales sensu latu (Chlorophyceae) de um ecossistema lótico subtropical, Estado do Paraná, Brasil. Hoehnea 41(3):431–451.

BELLINGER, E.G. & SIGEE, D.C. (2015). Freshwater algae.:identification, enumeration and use as bioindicators. John Wiley & Sons.

BICUDO, C. E. M., & MARTAU, L. (1974). Catálogo das algas de águas continentais do Estado de Rio Grande do Sul, Brasil: II-Charophyceae, Chlorophyceae, Chrysophyceae, Cyanophyceae, Rodophyceae e Xantophyceae. Iheringia, sér. Bot, 19, 31-48.

BICUDO, C. E. M.; SANT'ANNA, C. L.; FERNANDES, S. (2022). Flora Ficológica do Estado de São Paulo: v. 2, parte 1 – Chlorophyceae: Chlorococcales. São Carlos: RiMa Editora, 238 p.

BICUDO, C.E.M. & MENEZES, M. (2017). Gêneros de algas de águas continentais do Brasil: chave para identificação e descrições. RiMa, São Carlos.

BIOLO, S., SIQUEIRA, N.S. & BUENO, N.C. 2009. Chlorococcales (Chlorophyceae) de um tributário do Reservatório de Itaipu, Paraná, Brasil. Hoehnea 36:667–678.

BITTENCOURT-OLIVEIRA, M.C. (1997). Fitoplâncton do rio Tibagi, Estado do Paraná, Brasil: Nostocophyceae, Chlorophyceae, Euglenophyceae, Chrysophyceae e Tribophyceae. Hoehnea 24:1–20.

BORTOLINI, J.C., BIOLO, S., BUENO, N.C., GODINHO, L.R. & POTT ,V.J. (2010b). Chlorococcales sensu lato (Chlorophyceae) em tanques de depuração de efluente de origem bovina no Mato Grosso do Sul, Brasil. Iheringia 65: 63-74.

BORTOLINI, J.C., MEURER, T., GODINHO, L.R. & BUENO, N.C. (2010a). Chlorococcales planctônicas do rio São João, Parque Nacional do Iguaçu, Paraná, Brasil. Hoehnea 37:315–330.

BRAUN, A. (1855). Algarum unicellularium genera nova et minus cognita praemissis observationibus de algis unicellularibus in genere. pp. 114, 6 plates. Leipzig: W. Engelmann.

BROADY, P.A. (1976). Six new species of terrestrial algae from Signy island, South Orkney Islands, Antarctica. British Phycological Journal 11(4): 387-405, 7 figs, 5 tables.

CHAMIXAES, C. B. (1990). Ficoflórula do açude de Apipucos (Recife-PE). Rev. bras. biol, 45-60.

CHODAT, R. (1926). Scenedesmus. Étude de génétique de systématique expérimentale et d'hydrobiologie. Schweizerische Zeitschrift für Hydrologie 3: 71-258.

DA SILVA ALMEIDA, I. C., FERREIRA-CORREIA, M. M., DOS SANTOS DOURADO, E. C., & DE OLIVEIRA CARIDADE, E. (2005). Comunidade fitoplanctônica do lago Cajari, Baixada Maranhense, no período de cheia. Boletim do Laboratório de Hidrobiologia, 18(1).

D'ALESSANDRO, E. B., & NOGUEIRA, I. D. S. (2017). Algas planctônicas flageladas e cocoides verdes de um lago no Parque Beija-Flor, Goiânia, GO, Brasil. Hoehnea, 44(3), 415-430.

FERRAGUT, C., LOPES, M. R. M., BICUDO, D. D. C., BICUDO, C. D. M., & VERCELLINO, I. S. (2005). Ficoflórula perifítica e planctônica (exceto Bacillariophyceae) de um reservatório oligotrófico raso (Lago do IAG, São Paulo). Hoehnea, 32(2), 137-184.

FERREIRA, A. D. S., & MENEZES, M. (2000). Flora planctônica de um reservatório eutrófico, lagoa Guandu, município de Nova Iguaçu, RJ. Hoehnea, 27(1), 45-76.

FRANCESCHINI, I. M. (1992). Algues d'eau douce de Porto Alegre, Brésil-(les Diatomophycées exclues). Cryptogamic Studies 13(4): 273-280.

GODINHO, L. R., COMAS, A. & BICUDO, C.E.M. (2010). Criptógamos do Parque Estadual das Fontes do Ipiranga, São Paulo, SP. Algas, 30: Chlorophyceae (família Scenedesmaceae). Hoehnea 37: 513-553.

GONZÁLEZ, M.E., RENGIFO, A., PIÑEROS MARÍN, D.P., & BUITRAGO RAMÍREZ, L.M. (2023). Reconocimiento de algas, protozoos y metazoos como bioindicadores ambientales. FC Gómez Meneses, LM, Gómez Melo, D., Valencia Enríquez, S., Gómez Herrera, JM, López Moreno y Villota Paz, JM Sostenible, Avances y Desafíos En Las Ciencias y La Ingeniería, 207-220.

GUIRY, M.D. & Guiry, G.M. (2026). AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. https://www.algaebase.org.

GUIRY, M.D. (2024). How many species of algae are there? A reprise. Four kingdoms, 14 phyla, 63 classes and still growing. Journal of Phycology, 60(2), 214-228.

HANSGIRG, A. (1888). Prodromus der Algenflora von Böhmen. Erster theil enthaltend die Rhodophyceen, Phaeophyceen und einen Theil der Chlorophyceen. I. Heft. Archiv für die naturwissenschaftliche Landesdurchforschung von Böhmen 6(5): [1]-288.

HEGEWALD, E., & BRABAND, A. (2017). A taxonomic revision of Desmodesmus serie Desmodesmus (Sphaeropleales, Scenedesmaceae). Fottea, 17(2), 191-208.

HENTSCHKE, G. S., & TORGAN, L. C. (2010). Desmodesmus e Scenedesmus (Scenedesmaceae, Sphaeropleales, Chlorophyceae) em ambientes aquáticos na planície costeira do Rio Grande do Sul, Brasil. Rodriguésia, 61(4), 585-601.

HERNDON, W. (1958). Some new species of chlorococcacean algae. American Journal of Botany 45(4): 308-323, 118 figs.

HU ZHENG-YU. (1994). New chlorococcal algae from Hubei, China. Acta Phytotaxonomica Sinica 32: 193-196.

INSTITUTO ÁGUA E TERRA (IAT). (2014). Características Gerais da Bacia (Produto 1). Plano da Bacia Hidrográfica do Paraná 3, Comitê da Bacia Hidrográfica do Paraná 3.

JENA, M., BOCK, C., C.BEHERA, C., ADHIKARY, S.P. & KRIENITZ, L. (2014). Strain survey on three continents comfirms the polyphyly of the genus Pediastrum (Hydrodictyaceae, Chlorophyceae). Fottea 14(1): 63-76, 8 fig., 3 tables.

MARQUES, S.M. & AMÉRICO-PINHEIRO, J.H.P. (2017). Algas como bioindicadores da qualidade da água. Revista Científica ANAP Brasil, 10(19)

MCMANUS, H.A. & LEWIS, L.A. (2005). Molecular phylogenetics, morphological variation and colony-form evolution in the family Hydrodictyaceae (Sphaeropleales, Chlorophyta). Phycologia 44: 582-595.

MEDEIROS, Y., AQUINO, C.A.N., BORTOLINI, J.C., MEDEIROS, G., AMARAL, M.W., FAVARETTO, C.C.R. & BUENO, N.C. (2021). Plnktonic chlorophyceans of a Brazilian subtropical river: Taxonomy and ecological aspects. Rodriguésia 72:02192019

MENEZES, M. (2010). Chlorophyceae. In: Catálogo de plantas e fungos do Brasil. Vol. 1. (Forzza, R.C. Eds), pp. 335-352. Rio de Janeiro: Andrea Jakobsson Estúdio; Instituto de Pesquisas Jardim Botânico do Rio de Janeiro.

MENEZES, V.C., BUENO, N.C., BORTOLINI, J.C. & GODINHO, L.R. (2011). Chlorococcales sensu lato (Chlorophyceae) em um lago artificial urbano, Paraná, Brasil. Iheringia (Série Botânica) 66: 227- 240.

MORESCO, C. & BUENO, N.C. (2007). Scenedesmaceae (Chlorophyceae – Chlorococcales) de um lago artificial urbano: Desmodesmus e Scenedesmus. Acta Sci. Biol. Sci. 29:289–296

NEIS, I.S., ET. AL. (2026). Novos registros de Chlorophyceae e Trebouxiophyceae (Chlorophyta) em ambientes lóticos subtropicais na área de influência da Usina Hidrelétrica do Baixo Iguaçu, Estado do Paraná, Brasil. Hoehnea

PEREIRA, A.J.S., RAMOS, G.J.P., LIMA, M.A.S., BRITO, K.L.M., VILLA, PARK.M., TUCCI, A. & MOURA, C.W.N. (2024). Unveiling the unknown diversity of planktonic green algae (Chlorophyta) in urban ponds in the semiarid region of Northeastern Brazil. Anais da Academia Brasileira de Ciências 96(4 e20231398): 1–26, 13 figures, 2 tables.

PILATTI, M.C., SILVA, T.T., BORTOLINI, J.C., MEDEIROS, G., AMARAL, M.W.W., NARDELLI, M.S., BUENO, N.C. (2023). Taxonomic study and local environmental conditions of occurrence of Chlorophyceae (Chlorophyta) from subtropical lotic environments, Paraná, Brazil. Biota Neotropica 23(2): e20221419.

PROJETO MAPBIOMAS – Coleção 2025 da Série Anual de Mapas de Cobertura e Uso da Terra do Brasil, acessado em 09 abr. 2025.

PRÖSCHOLD, T., BOCK, C. LUO, W. & KRIENITZ, L. (2010). Polyphyletic distribution of bristle formation in Chlorellaceae: Micractinium, Diacanthos, Didymogenes and Hegewaldia gen. nov. (Trebouxiophyceae, Chlorophyta). Phycological Research 58(1): 1-8.

RAMOS, G.J.P., BICUDO, C.E. DE M., GÓES-NETO, A. & MOURA, C.W. DO N. (2014). New additions of coccoid green algae to the phycoflora of Brazil and the Neotropics. Acta Botanica Brasilica 28(1): 8-16.

RAMOS, G.P.R., BICUDO, C.E. DE M. & MOURA, C.W. DO N. (2015). Novos registros de algas verdes cocoides (Chlorophyceae, Chlorophyta) para o estado da Bahia e para o Brasil. Sitientibus Série Ciências Biológicas 15: 1-13.

RIEDIGER, W., BUENO, N.C., JATI, S. & SEBASTIEN, N.Y. (2014). Fitoplâncton de lagoas de estabilização da Estação de Tratamento de Esgoto (ETE) no oeste do Paraná, Brasil: classes Chlorophyceae e Euglenophyceae. Iheringia Sér. Bot. 69:329–340.

SECRETARIA DE ESTADO DO MEIO AMBIENTE E RECURSOS HÍDRICOS – SEMA. (2013). Revista Bacias Hidrográficas do Paraná – Série Histórica p. 1 – 140.

SERVIÇOS, ORGANIZAÇÃO E MEIO AMBIENTE (SOMA). (2008). Avaliação Ambiental Integrada da Bacia Hidrográfica do Rio Piquiri.

SILVA, L. H. S. D., HUSZAR, V. L. D. M., & ROLAND, F. (2009). Algas planctônicas em reservatórios de hidrelétricas brasileiras: Atlas. In Algas planctônicas em reservatórios de hidrelétricas brasileiras: atlas (pp. 155-155).

SILVA, M.J.L., PILATTI, M.C., BORTOLINI, J.C., BAUMGARTNER, G. & BUENO, N.C. (2022). Chlorophyceae e Trebouxiophyceae (Chlorophyta) em rios da área de influência da Usina Hidrelétrica do Baixo Iguaçu, Estado do Paraná, Brasil. Hoehnea 50: e472022.

SOARES, M. C. S., SOPHIA, M. D. G., & HUSZAR, V. L. D. M. (2007). Phytoplankton flora of two rivers in Southeast Brazil: Paraibuna and Pomba Rivers, Minas Gerais. Brazilian Journal of Botany, 30(3), 433-450.

SOPHIA MG, DIAS ICA & ARAÚJO AM. (2005). Chlorophyceae and Zygnematophyceae from the Turvo State Forest Park, state of Rio Grande do Sul, Brazil. Iheringia, Série Botânica 60: 25-47.

TANAKA, M.O., SOUZA, A.L.T., MOSCHINI, L.E., OLIVEIRA, A.K. (2016). Influence of watershed land use and riparian characteristics on biological indicators of stream water quality in southeastern Brazil. Agriculture, Ecosystems & Environment, v. 216, p. 333–339.

TSARENKO, P.M., HEGEWALD, E. & BRABAND, A. (2006). Scenedesmus-like algae of Ukraine. 1. Diversity of taxa from water bodies of Volyn Polissia. Arch. Hydrobiol. Suppl. 1 160 (Algol. Stud. 118): 1-45, 142 figs., 3 tables.

TUCCI, A. ET AL. (2019). Atlas de Cianobactérias e Microalgas de Águas Continentais Brasileiras. Publicação eletrônica, Instituto de Botânica, Núcleo de Pesquisa em Ficologia.

VÉLEZ-AZAÑERO, A., LOZANO, S. & CÁCERES-TORRES, K. (2016). Phytoplankton diversity as an indicator of water quality in the lower basin of the Lurín River, Lima, Perú.

VODENICHAROV, D.G. (1960). Novi zeleni vodorosti [New green algae]. Ukrainian Botanical Journal 17(2): 89–94, 16 figures, 1 table.

WEHR, J.D., SHEATH, R.G. & KOCIOLEK, J.P. (Eds.). (2015). Freshwater algae of North America: ecology and classification. Elsevier.

АНДРЕЕВА, В. М. 1998. Почвенные и аэрофильные зеленые водоросли (Chlorophyta: Tetrasporales, Clorococcales, Chlorosarcinales), pp. [1]–351, 108 plates.

Figure 1*:* Sampling area in the Piquiri, Paraná 3, and Iguaçu river basins for phytoplankton collection during the months of May, June, September, and October 2024. P1. Tributário Gonçalves Dias; P2. Tributário Manoel Gomes; P3. Manoel Gomes; P4. Gonçalves Dias; P5. São Salvador; P6. Lajeado Clarito; P7. Correntoso; P8; Claudicir; P9. Adão Eliana.

Figures 2-23: 2. *Pandorina morum*; **3-3a.***Volvox globator*; **4-4a.** *Lacunastrum gracillimum*; **5-5a**. *Pediastrum duplex*; **6-6a.** *P. duplex var. asperum*; **7.** *P. duplex var. intermedium*; **8-8a**. *Pseudopediastrum boryanum var. longicorne*; **9-9a.** *P. subgranulatum*; **10-10a.** *Sorastrum pediastriforme*; **11.** *Stauridium tetras*; **12**. *Coenochloris pyrenoidosa*; **13.** *C. aquática*; **14.** *Coenococcus planctonicus*; **15.** *Coenocystis planctonica*; **16.** *Eutetramorus globosus*; **17.** *E. tapasteanus*; **18.** *E. tetrasporus*; **19**. *Palmococcus hercynicus*; **20.** *Radiococcus nimbatus*; **21.** *R. planktonicus*; **22.** *R. polycoccus*; **23.** *R. signiensis*; **Scales: 2, 4-23 (10 µm); 3 (50 µm); 3a (200 µm);**

Figures 24-48: 24. *R. skujae*; **25.** *Coelastrum astroideum*; **26.** *C. cambricum*; **27.** *C. cambricum var. intermedium*; **28.** *C. indicum*; **29.** *C. microporum*; **30-30a.** *C. proboscideum*; **31.** *C. pseudomicroporum*; **32.** *C. reticulatum var. cubanum*; **33.** *C. sphaericum*; **34.** *C. triangulare*; **35.** *Comasiella arcuata var. platydisca*; **36.** *Crucigenia mucronata*; **37.** *Desmodesmus armatus var. bicaudatus*; **38.** *D. bicaudatus*; **39.** *D. brasiliensis;* **40.** *D. communis*; **41.** *D. communis var. polisicus*; **42.** *D. denticulatus*; **43.** *D. intermedius var. acutispinus*; **44-44a.** *D. lunatus*; **45.** *D. magnus*; **46.** *D. maximus*; **47.** *D. microspina*; **48.** *D. opoliensis*; **Scale: 10 µm.**

Figure 49-94a: 49. *D. opoliensis var. mononensis*; **50.** *D. protuberans*; **51.** *D. pseudodenticulatus*; **52-52a.** *D. spinosus*; **52a.** *in reproduction;* **53.** *Hariotina reticulata*; **54.** *Scenedesmus ecornis*; **55.** *S. indicus*; **56.** *S. obtusus;* **57.** *S. obtusus f. disciformis*; **58.** *S. pseudoquadricauda*; **59-59b.** *S. smithii*; **60.** *Tetradesmus bernardii*; **61.** *T. dimorphus*; **62.** *Tetrastrum staurogeniiforme*; **63.** *Westella botryoides*; **64.** *Ankistrodesmus arcuatus*; **65.** *A. densus*; **66.** *A. fusiformis*; **67.** *Kirchneriella dianae*; **68.** *K. lunares*; **69.** *Monoraphidium capricornutum*; **70-70a.** *M. contortum*; **71.** *M. fontinale*; **72.** *M. griffithii*; **73-73a.** *M. indicum*; **74.** *M. subclavatum*; **75.** *Quadrigula closterioides*; **76.** *Raphidocelis danubiana*; **77.** *Selenastrum bibraianum*; **78-78a.** *S. rinoi*; **79.** *Pleurastrum diplobionticum*; **80.** *Actinastrum hantzschii*; **81.** *Golenkinia radiata*; **82.** *Golenkiniopsis solitária;* **83.** *Hegewaldia parvula*; **84.** *Micractinium quadrisetum*; **85.** *M. pusillum*; **86.** *Mucidosphaerium pulchellum*; **87-87b.** *Willea crucífera*; **87.** *in reproduction*; **88.** *Nephrochlamys subsolitaria*; **89-89a.** *Oocystis borgei*; **89.** *in reproduction*; **90.** *O. irregularis*; **91.** *Pachycladella komarekii*; **92.** *Dichotomococcus curvatus*; **93.** *Lemmermannia komarekii*; **94-94a**. *L. tetrapedia;* **Scale: 50 µm.**

Figure 95*:* Numbers of species found in phytoplankton sampling for each vegetative formation in streams in western Paraná.

Table I: Characterization of points and geographic coordinates of streams in western Paraná for phytoplankton collection during the months of May, June, September, and October 2024.

Sampling point	Stream	Vegetative formation	Sample number	Geographic coordinates
P1	Tributário Gonçalves Dias	Reference	7823, 7832, 7841, 7850	25°05'41"S 53°38'04"O
P2	Tributário Manoel Gomes	Reference	7822, 7831, 7840, 7849	25°09'30"S 53°50'11"O
P3	Manoel Gomes	Reference	7821, 7830, 7839, 7848	25°09'38"S 53°49'47"O
P4	Gonçalves Dias	Intermediary	7820, 7829, 7838, 7847	25°04'17"S 53°36'47"O
P5	São Salvador	Intermediary	7819, 7828, 7837, 7846	25°01'49"S 53°23'09"O
P6	Lajeado Clarito	Intermediary	7818, 7827, 7836, 7845	24°54'01"S 53°23'46"O

Table I - continues

P7	Correntoso	Young	7817, 7826, 7835, 7844	24°51'50"S 53°45'34"O
P8	Claudicir	Young	7816, 7825, 7834, 7843	24°50'26"S 53°30'39"O
P9	Adão Eliana	Young	7815, 7824, 7833, 7842	24°50'17"S 53°44'02"O

Table II: Species description, figure numbering, dimensions and watershed, for phytoplankton collection during the months of May, June, September, and October 2024.

SPECIES	FIGURE	DIMENSIONS	WATERSHED
Pandorina morum (O.F.Müller) Bory	2	Cel. d.:7.5-12.5 µm; Ce. l.: 50.0-80.0 µm; Ce. w.: 55.0-75.0 µm.	Paraná 3
Volvox globator Linnaeus	3-3a	Subsidiary cells: Cel. d.:50.0 µm; Cel. l.: 722.5 µm; Cel. w.: 732.5 µm	Paraná 3
Lacunastrum gracillimum (West & G.S.West) H.A.Mcmanus	4-4a	Cel. l. Int.: 7.5-12.5 µm; Cel. w. Int.: 7.5-12.5 µm; Cel. l. Ext.: 12.5-17.5 µm; Cel. w. Ext.: 10.0-12.5 µm; Ce. l.: 60.0-95.0 µm; Ce. w.: 60.0-90.0 µm.	Paraná 3
Pediastrum duplex Meyen	5-5a	Cel. l. Int.: 7.5-10.0 µm; Cel. w. Int.: 7.5-12.5 µm; Cel. l. Ext.: 10.0-15.0 µm; Cel. w. Ext.: 7.5-12.5 µm; Ce. l.: 57.5-80.0 µm; Ce. w.: 55.0-82.5 µm.	Paraná 3
Pseudopediastrum boryanum var. *longicorne* (Reinsch) Tsarenko	8	Cel. l. Int.: 5.0-10.0 µm; Cel. w. Int.: 5.0-12.5 µm; Cel. l. Ext.: 7.5-17.5 µm; Cel. w. Ext.: 5.0-12.5 µm; Ce. l.: 20.0-77.5 µm; Ce. w.: 22.5-65.0 µm.	Paraná 3
Pseudopediastrum subgranulatum (Raciborski) Lenarczyk	9	Cel. l. Int.: 10.0-17.5 µm; Cel. w. Int: 12.5-20.0 µm; Cel. l. Ext.: 12.5-25.0 µm; Cel. w. Ext.: 12.5-20.0 µm; Ce. l.: 72.5-142.5 µm; Ce. w.: 72.5-135.0 µm.	Paraná 3
Stauridium tetras (Ehrenberg) E. Hegewald	11	Cel. l. Int.: 7.5-12.5 µm; Cel. w. Int.: 7.5-12.5 µm; Cel. l. Ext.: 10.0-15.0 µm; Cel. w. Ext.: 7.5-12.5 µm; Ce. l.: 30.0-40.0 µm; Ce. w.: 30.0-42.5 µm.	Paraná 3
Coenochloris pyrenoidosa Korshikov	12	Cel. d.:10.0 µm; Ce. d.:17.5-22.5 µm.	Paraná 3
Coenococcus planctonicus Korshikov	14	Cel. d.:10.0 µm; Ce. d.:30.0 µm; Co. w.l.: 262.5; Co. w.:l.: 267.5 µm.	Paraná 3
Eutetramorus tetrasporus Komárek	18	Cel. d.:5.0 µm; Ce. d.:12.5-15.0 µm; Co. w.l.: 32.5-52.5 µm; Co. w.:l.: 37.5-72.5 µm.	Piquiri, Baixo Iuaçu
Radiococcus polycoccus (Korshikov) Kostikov, Darienko, Lukešová & Hoffmann	22	Cel. d.:10.0 µm; Ce. l.: 30.0-35.0 µm; Ce. w.: 25.0-35.0 µm.	Paraná 3, Piquiri
Radiococcus skujae I.Kostikov, T.Darienko, A.Lukešová & L.Hoffmann	24	Cel. d.:5.0 µm; Ce. d.:15.0 µm.	Paraná 3
Coelastrum astroideum De Notaris	25	Ce. l.: 22.5-25.0 µm; Ce. w.: 22.5 µm.	Paraná 3
Coelastrum cambricum W.Archer	26	Cel. d.:10.0 µm; Ce. d.:40.0 µm	Paraná 3
Coelastrum indicum W.B.Turner	28	Ce. d.:20.0 µm.	Paraná 3
Coelastrum microporum Nägeli	29	Cel. d.:12.5 µm; Ce. d.:30.0-35.0 µm.	Paraná 3
Coelastrum proboscideum Bohlin	30-30a	Cel. d.:5.0 µm; Ce. d.:12.5-30.0 µm.	Paraná 3
Coelastrum pseudomicroporum Korshikov	31	Cel. d.:2.5 µm; Ce. d.:27.5 µm.	Paraná 3
Coelastrum reticulatum var. *cubanum* Komárek	32	Ce. d.:22.5-32.5 µm.	Paraná 3
Comasiella arcuata var. *platydisca* (G.M.Smith) E.Hegewald & M.Wolf	35	Ce. l.: 15.0-17.5 µm; Ce. w.: 17.5-22.5 µm.	Paraná 3, Piquiri
Desmodesmus armatus var. *bicaudatus* (Guglielmetti) E.H.Hegewald	37	Cel. l.: 12.5-15.0 µm; Cel. w.: 5.0 µm; Ce. l.: 15.0-27.5 µm; Ce. w.: 35.0-37.5 µm; S.:12.5 µm.	Paraná 3, Piquiri

Table II - continues

Desmodesmus bicaudatus (Dedusenko) P.M.Tsarenko	38	Cel. l.: 12.5 µm; Cel. w.: 5.0 µm.; Ce. l.: 15.0 µm; Ce. w.: 15.0 µm; S.:7.5 µm.	Paraná 3
Desmodesmus brasiliensis (Bohlin) E.Hegewald	39	Cel. l.: 12.5-15.0 µm; Cel. w.: 5.0-7.5 µm; Ce. l.: 15.0-20.0 µm; Ce. w.: 22.5-25.0 µm	Paraná 3
Desmodesmus communis (Hegewald) Hegewald	40-40a	C. cel: 7.5-10.0 µm; L. cel: 2.5 µm; Ce. l.: 12.5-30.0 µm; Ce. w.: 25.0-57.5 µm; E:7.5-15.0.	Paraná 3, Baixo Iguaçu
Desmodesmus denticulatus (Lagerheim) S.S.An, T.Friedl & E.Hegewald	42	Cel. l.: 15.0-20.0 µm; Cel. w.: 7.5-10.0 µm; Ce. l.: 25.0-27.5 µm; Ce. w.: 25.0-30.0 µm; S.:2.5 µm.	Paraná 3
Desmodesmus intermedius var. *acutispinus* (Y.V.Roll) E.Hegewald	43	Cel. l.: 7.5-10.0 µm; Cel. w.: 2.5-5.0 µm; Ce. l.: 20.0-27.5 µm; Ce. w.: 12.5-20.0 µm; S.:7.5-10.0 µm.	Paraná 3, Piquiri
Desmodesmus magnus (Meyen) P.M.Tsarenko	45	Cel. l.: 22.5-27.5 µm; Cel. w.: 7.5-10.0 µm; Ce. l.: 62.5-67.5 µm; Ce. w.: 47.5-60.0 µm. E. pri.: 20.0 µm; E. sec.: 17.5 µm.	Paraná 3
Desmodesmus maximus (West & West) Hegewald	46	Cel. l.: 12.5-15.0 µm; Cel. w.: 5.0 µm; Ce. l.: 22.5-30.0 µm; Ce. w.: 40.0-42.5 µm; S.:10.0-15 µm.	Paraná 3, Baixo Iguaçu
Desmodesmus microspina (Chod.) P. M. Tsarenko	47	Cel. l.: 10.0-15.0 µm; Cel. w.: 2.5-5.0 µm; Ce. l.: 17.5-25.0 µm; Ce. w.: 25.0-32.5 µm; S.:7.5-10.0 µm.	Paraná 3
Desmodesmus opoliensis (P. Richter) Hegewald	48	Cel. l.: 20.0 µm; Cel. w.: 5.0 µm; Ce. l.: 57.5 µm; Ce. w.: 52.5 µm; S.:22.5 µm.	Paraná 3
Desmodesmus opoliensis var. mononensis (Chodat) E.Hegewald	49	Cel. l.: 15.0-22.5 µm; Cel. w.: 5.0-7.5 µm; Ce. l.: 40.0-60.0 µm; Ce. w.: 37.5-62.5 µm; S.:15.0-22.5 µm	Paraná 3
Desmodesmus protuberans (Fritsch & Rich) Hegewald	50	Cel. l.: 10.0-15.0 µm; Cel. w.: 5.0-7.5 µm; Ce. l.: 22.5-45.0 µm; Ce. w.: 37.5-47.5 µm; S.:12.5-17.5 µm.	Paraná 3
Desmodesmus pseudodenticulatus (E.Hegewald) E.Hegewald	51	Ce. l.: 10.0-12.5 µm; Ce. w.: 15.0-17.5 µm	Paraná 3, Piquiri
Scenedesmus ecornis (Ehrenberg ex Ralfs) Chodat	54	Cel. l.: 17.5-20.0 µm; Cel. w.: 20.0 µm.	Paraná 3
Scenedesmus indicus Philipose ex Hegewald, Engelberg & Paschma	55	Cel. l.: 15.0 µm; Cel. w.: 7.5 µm; Ce. l.: 25.0 µm; Ce. w.: 27.5 µm.	Paraná 3
Scenedesmus obtusus Meyen	56	Cel. l.: 5.0 µm; Cel. w.: 2.5 µm; Ce. l.: 7.5 µm; Ce. w.: 12.5 µm.	Paraná 3
Scenedesmus pseudoquadricauda Hortobágyi	58	Cel. l.: 20.0-25.0 µm; Cel. w.: 7.5-10.0 µm; Ce. l.: 40.0-50.0 µm; Ce. w.: 40.0-57.5 µm; S.:12.5 µm.	Paraná 3
Tetradesmus bernardii (G.M.Smith) M.J.Wynne	60	Cel. l.: 12.5-17.5 µm; Cel. w.: 2.5-5.0 µm; Ce. l.: 25.0-30.0 µm; Ce. w.: 37.5-45.0 µm.	Paraná 3, Baixo Iguaçu
Tetradesmus dimorphus (Turpin) M.J.Wynne	61	Cel. l.: 27.5-42.5 µm; Cel. w.: 2.5-5.0 µm; Ce. l.: 37.5-47.5 µm; Ce. w.: 65.0-80.0 µm.	Paraná 3
Westella botryoides (W. West) De Wildeman	63	Cel. d.:5.0-7.5 µm; Ce. l.: 15.0-20.0 µm; Ce. w.: 15.0-17.5 µm; C. sin.: 32.5-35.0 µm; L. sin.: 32.5-45.0 µm; Mother cell.:Cel. d.:12.5 µm.	Paraná 3, Piquiri
Ankistrodesmus arcuatus Korshikov	64	Cel. l.: 40.0-100.0 µm; Cel. w.: 2.5-5.0 µm.	Piquiri, Baixo Iguaçu
Ankistrodesmus densus Korshikov	65	Ce. l.: 32.5 µm; Ce. w.: 70.0 µm.	Paraná 3
Ankistrodesmus fusiformis Corda	66	Cel. l.: 50.0-52.5 µm; Cel. w.: 2.5 µm.	Paraná 3
Kirchneriella dianae (Bohlin) Comas	67	Cel. l.: 5.0-10.0 µm; Cel. w.: 5.0-7.5 µm; Ce. l.: 15.0-20.0 µm; Ce. w.: 15.0-20.0 µm; Co. w.l.: 50.0-62.5 µm; Co. w.:l.: 42.5-67.5 µm.	Paraná 3
Kirchneriella lunaris (Kirchner) Möbius	68	Cel. d.:5.0-10.0 µm; Ce. d.:15.0-20.0 µm; Co. w.l.: 70.0-92.5 µm; Co. w.:l.: 62.5-80.0 µm	Paraná 3, Piquiri, Baixo Iguaçu
Monoraphidium capricornutum (Printz) Nygaard	69	Cel. l.: 15.0 µm; Cel. w.: 2.5 µm.	Paraná 3
Monoraphidium contortum (Thuret) Komárková-Legnerová	70-70a	Cel. l.: 15.0-32.5 µm; Cel. w.: 2.5 µm.	Paraná 3

Table II - continues

Monoraphidium griffithii (Berkeley) Komárková-Legnerová	72	C. cel: 45.0 µm; L. cel: 5.0 µm; C: 72.5 µm; L: 10.0 µm.	Paraná 3
Quadrigula closterioides (Bohlin) Printz	75	Cel. l.: 2.5 µm; Cel. w.: 15.0 µm; Ce. l.: 7.5 µm; Cel. w.: 20.0 µm; Co. w.l.: 42.5 µm; Co. w.:l.: 102.5 µm.	Paraná 3
Raphidocelis danubiana (Hindák) Marvan, Komárek & Comas	76	C. cel: 7.5 µm; L. cel: 2.5 µm; C: 25.0 µm; L: 32.5 µm.	Paraná 3
Selenastrum bibraianum Reinsch	77	Cel. l.: 15.0 µm; Cel. w.: 2.5 µm; Ce. d.:15.0-22.5 µm; Co. w.l.: 115.0 µm; Co. w.:l.: 147.5 µm.	Paraná 3
Selenastrum rinoi Komárek & Comas	78-78a	Cel. l.: 7.5-12.5 µm; Cel. w.: 2.5 µm; Ce. l.: 12.5-25.0 µm; Ce. w.: 15-22.5 µm.	Paraná 3
Actinastrum hantzschii Lagerheim	80	Cel. l.: 17.5 µm; Cel. w.: 2.5 µm.	Paraná 3
Golenkinia radiata Chodat	81	Cel. d.:15.0-25.0 µm; S.:17.5-25.0 µm	Paraná 3
Golenkiniopsis solitaria (Korshikov) Korshikov	82	Cel. d.:7.5 µm; S.:12.5 µm.	Paraná 3
Micractinium pusillum Fresenius	85	Ce. l.: 67.5 µm; Ce. w.: 70.0 µm; S.:20.0 µm	Paraná 3
Micractinium quadrisetum (Lemmermann) G.M.Smith	84	Cel. d.:2.5 µm; Ce. d.:40.0 µm; S.:10.0 µm.	Paraná 3
Mucidosphaerium pulchellum (H.C.Wood) C.Bock, Proschold & Krienitz	86	Cel. d.:2.5-5.0 µm; Ce. d.:7.5-10.0 µm; Co. w.l.: 20.0-40.0µm; Co. w.:l.: 20.0-42.5 µm.	Paraná 3, Piquiri
Oocystis borgei J.W.Snow	89-89a	Cel. l.: 15.0 µm; Cel. w.: 10.0 µm; Ce. d.:20.0-30.0 µm; Co. w.l.: 42.5 µm; Co. w.:l.: 40.0 µm.	Paraná 3
Oocystis irregularis (Petkoff) Printz	90	Cel. l.: 25.0 µm; Cel. w.: 30.0 µm.	Paraná 3
Lemmermannia tetrapedia (Kirchner) Lemmermann	94-9a	Cel. d.:5.0-7.5 µm; Ce. l.: 15.0 µm; Ce. w.: 12.5.0-20.0 µm	Paraná 3, Piquiri

Table III - Average of physical and chemical parameters for phytoplankton collection during the months of May, June, September, and October 2024.

Parameters	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**
Chlorophyl-α (µg/L)	172.30	249.56	1046.94	115.07	80.95	88.22	386.41	104.68	167.53
Total Dissolved Phosphorus (mg/L)	0.29	0.35	0.25	0.38	0.35	0.32	0.33	0.32	0.44
Nitrate (mg/L)	1.92	1.46	1.69	2.48	1.72	3.49	2.74	3.66	3.17
Ammoniacal nitrogen (mg/L)	0.03	0.04	0.03	0.02	0.04	0.07	0.02	0.05	0.11
Orthophosphate (mg/L)	0.01	0.02	0.01	0.01	0.004	0.004	0.006	0.004	0.01
Water Temperature (°C)	19.88	19.6	18.06	20.28	20.32	19.54	21.41	20.67	22.16
pH	7.55	7.13	7.25	6.86	7.56	6.63	6.41	6.88	6.64
Turbidity (NTU)	4.56	3.39	3.51	20.95	9.51	3.13	16.67	38.52	20.67
Dissolved Oxygen (mg/L)	8.46	8.16	8.67	8.92	8.86	7.83	7.41	8.41	8.23
Electrical conductivity (µS/cm)	0.02	0.05	0.05	0.02	0.02	0.06	0.02	0.01	0.03
Depth (cm)	17.37	7.87	16.87	33.25	44.00	41.75	40.62	21.50	15.6