



ECOSYSTEMS

Unveiling the unknown diversity of planktonic green algae (Chlorophyta) in urban ponds in the semiarid region of Northeastern Brazil

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Abstract: This study examined the taxonomic composition and ecological aspects of planktonic green algae (Chlorophyta) in four urban ponds (Parque da Lagoa, Lagoa Grande, Laguneville, and Pindoba) in Feira de Santana, Bahia State, Brazil. We analyzed 96 samples collected bimonthly in 2022 and identified 54 taxa, with the majority (42) classified as uncommon or sporadic. The most common species were *Monoraphidium circinale* and *Lemmermannia komarekii*, found in 100% and 95.8% of samples, respectively. Parque da Lagoa had the highest number of taxa (43), followed by Lagoa Grande (40), Laguneville (31), and Pindoba (30). Most taxa were found in water with high levels of oxygenation (5.8-12.3 mg L⁻¹) and conductivity (400-1000 µS cm⁻¹), neutral to slightly alkaline conditions (pH 7-8), and moderate water temperature (26-27 °C). Significant differences in the composition of planktonic green algae and limnological variables were observed among ponds. These studies underscore the importance of implementing actions aimed at the restoration and conservation of urban ponds in Feira de Santana to avoid biodiversity loss and eutrophication while ensuring the provision of critical ecosystem services, such as local climate regulation.

Key words: Chlorophyceae, freshwater algae, eutrophication, phytoplankton, Trebouxiophyceae.

INTRODUCTION

Green algae (Chlorophyta) are notable for their phylogenetic diversity and morphological, physiological, and ecological variability and can be found in a wide range of habitats, including marine, freshwater, and terrestrial environments (Komárek & Fott 1983, Coesel & Krienitz 2008, Fang et al. 2017, Leliaert 2019, Fučíková et al. 2019). These algae, specifically planktonic algae, respond to environmental factors such as nutrient concentrations, light intensity, and temperature variations, which influence their occurrence, distribution, and abundance, rendering them useful environmental bioindicators (Bellinger &

Sigee 2010, Alencar et al. 2019). It is abundant in Brazilian continental waters, particularly in tropical, shallow, and eutrophic systems (Rodrigues et al. 2010, Domingues & Torgan 2012, Nogueira et al. 2008).

Eutrophication is characterized by high primary productivity due to excessive nutrient accumulation, particularly phosphorus and nitrogen, in aquatic environments, resulting in the uncontrolled growth of macrophytes, microalgae, and cyanobacteria (Wang & Wang 2009, Huszar et al. 2000, Borduqui & Ferragut 2012, Adam et al. 2017).

This process triggers responses that compromise the water quality and aquatic biota.

The loss of biodiversity is the most significant, as it represents the loss of submerged plants, replacement of algal species, the occurrence of toxic cyanobacterial blooms, and increases in biomass and microbial productivity (Qin et al. 2013, Santana et al. 2017). This issue has gained global attention, particularly in urban lakes, which are important areas of recreation and local climate regulation (Mao et al. 2019) but are undergoing biodiversity loss and reduced resilience due to environmental degradation (Dunalska et al. 2015, Roy & Pal 2015).

At the end of the 20th century, studies of phytoplankton in urban lakes gained prominence in Brazil, with particular emphasis on the works of Giani & Pinto-Coelho (1986), Chamixaes (1990), Eterovick & Giani (1997), Menezes (1999), Nogueira & Leandro-Rodrigues (1999), Silva (1999), Ferreira & Menezes (2000), Tucci et al. (2006), Nogueira et al. (2008), Gentil et al. (2008), Domingues & Torgan (2012), Riediger et al. (2014), Góes et al. (2016), D'Alessandro & Nogueira (2017), Alencar et al. (2019), Werner et al. (2020) and Vieira et al. (2021), which include several representatives of phytoplankton, especially green algae.

In the state of Bahia, the majority of phytoplankton studies that report the presence of planktonic chlorophytes originate from preserved areas such as rivers (Fuentes et al. 2010, Ramos et al. 2021, Aboim 2018), floodplains (Ramos et al. 2012, 2014, 2015a, b, c, d, 2016), and reservoirs (Carraro 2009, Cordeiro-Araújo et al. 2010, Ramos et al. 2018). To date, studies on ponds in urban areas are limited, focusing on the work of Martins et al. (1991) in Salvador, where 44 taxa (28 Chlorophyceae) were recorded for the Dique do Tororó.

The present study investigated the species composition and environmental conditions in four shallow ponds located in the urban area of the municipality of Feira de Santana, Bahia, Brazil, considering the standing of planktonic green

algae (Chlorophyceae and Trebouxiophyceae) as important components of aquatic ecosystem biodiversity.

MATERIALS AND METHODS

We conducted the study in the municipality of Feira de Santana, Bahia, Brazil (12°16'S, 38°57'W), the headquarters of the Metropolitan Region, which now includes six municipalities with a population of over 600.000 (IBGE 2022). It is located in the transition between the Atlantic Forest and Caatinga biomes (Fig. 1), has a tropical climate (AW), and has an average annual temperature and rainfall of 24 °C and 800 mm, respectively (Brandão et al. 2009).

Six collections were conducted (April, May, June, September, October, and November/2022) in four ponds, belonging to two hydrographic basins: three of these are located in the Pojuca River basin: José da Costa Falcão Park (Lagoa Grande, 12°14'59"S, 38°56'17"W), Lagoa da Pindoba (12°11'29"S, 38°58'12"W), and Laguneville (12°12'11"S, 38°56'26"W), while one, Parque da Lagoa (Erivaldo Cerqueira Municipal Park, 12°14'12"S, 38°57'50"W) is situated in the Jacuípe River basin. (Fig. 2). We used the Hanna portable probe (model HI98130) to measure temperature (°C), pH, conductivity (EC) ($\mu\text{S cm}^{-1}$) and total dissolved solids (TDS) (ppt), while the Instrutherm portable probe (model MO-910) was used to measure dissolved oxygen (DO) (mg L^{-1}). A Secchi disk was used to measure water transparency (TRANSP) (m).

A light microscope (LEICA DM-2500) equipped with an attached digital camera (LEICA MC170 HD) was used to examine the live or fixed samples in Transeau's solution (Bicudo & Menezes 2017). Taxonomic identification was based on morphological characteristics from the specialized literature (Komárek & Fott 1983, Comas 1996, Ramos et al. 2012, 2015a, d, 2016,

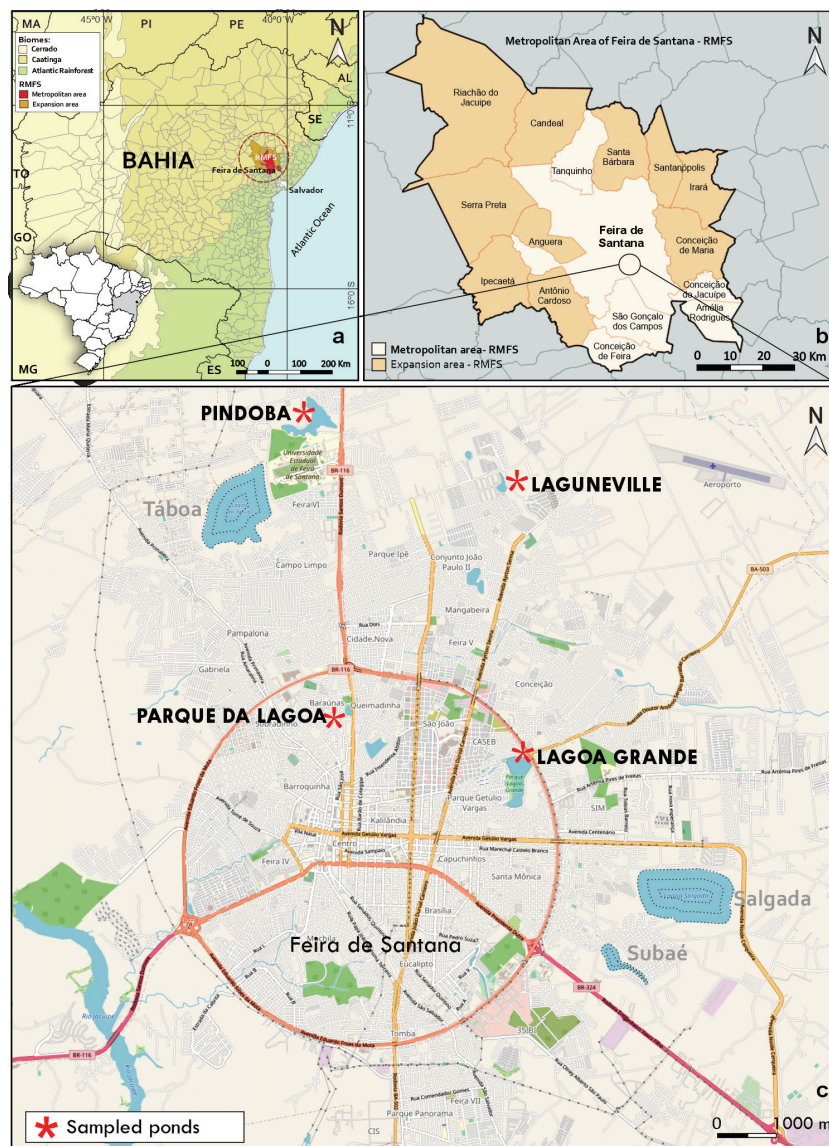


Figure 1. a) Metropolitan Region of Feira de Santana (RMFS) in the state of Bahia, with the transition between the Caatinga biome and Atlantic Forest highlighted. b) Feira de Santana Municipality in the RMFS. c) The location of the investigated ponds in the urban area.

Riediger et al. 2014, Rosini & Tucci 2020). The classification system proposed by Krienitz & Bock (2012) was used. The scanning electron microscopy analysis was conducted using the JEOL-6390 LV microscope, following the protocols described by Moura et al. (2021).

A Venn diagram was generated to demonstrate the diversity of taxa present in

the four ponds using software available on the Bioinformatics and Evolutionary Genomics website (<https://bioinformatics.psb.ugent.be/webtools/Venn/>).

We calculated the frequency of occurrence for each taxon using the formula: $F = n \cdot 100 / N$, where “n” is the number of samples in which a taxon was recorded and “N” is the total number

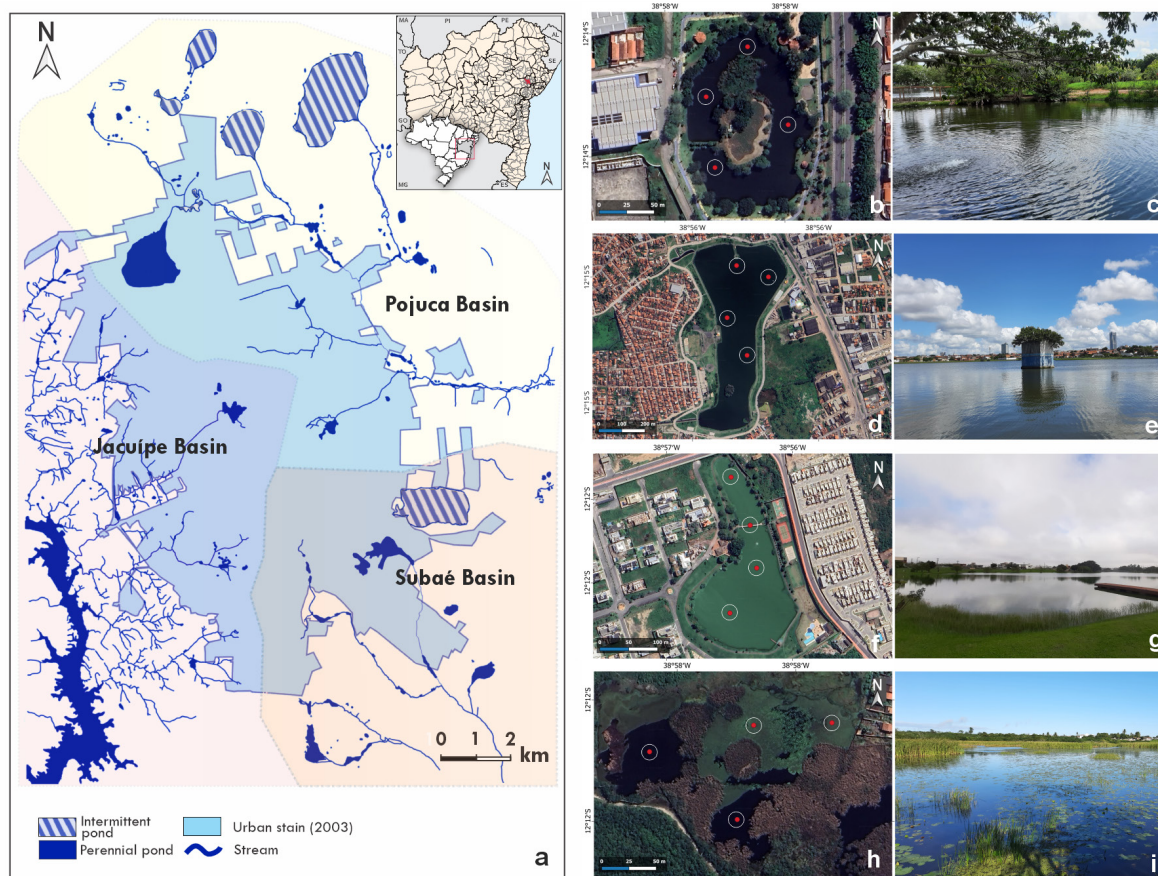


Figure 2. a. Pojuca, Subaé and Jacuípe River Basins in the Municipality of Feira de Santana (adapted from Santo 2012), and an aerial view and detail of the water slide, respectively, of Parque da Lagoa (b-c), Lagoa Grande (d-e), Laguneville (f-g), and Pindoba (h-i); the collection points are highlighted in white circles.

of samples analyzed, being classified as follows by Matteucci & Colma (1982): > 70% - Very frequent (VF); 70% and > 40% - Frequent (F); 40% and > 10% - Uncommon (U); 10% - Sporadic or Rare (S).

Non-metric Multidimensional Scaling Analysis (NMDS) is useful for visualizing the differences in community composition among sampling sites (Clarke 1993). To investigate the differences in species composition among the four ponds, we used an NMDS based on the Jaccard distance, which considers the presence and absence of species. Multivariate Permutational Analysis of Variance (PERMANOVA) with 999 permutations was used to determine the statistical significance of the NMDS results.

After verifying the data normality assumptions, we used the Kruskal-Wallis test to detect significant differences ($\alpha = 0.05$) in the abiotic variables between the studied ponds (Shapiro-Wilk test).

A Principal Component Analysis (PCA) was used to simplify and reduce the dimensionality of the measured abiotic data. Except for the pH, the abiotic data matrix was logarithmically transformed ($[\log_{10}(x + 1)]$). We excluded variables with a Variance Inflation Factor (VIF) exceeding 10, selected those with the highest correlation with the axes, and best characterized the environmental gradient between ponds. The resulting predictor matrix included TDS, pH, and TRANSP. All statistical analyses were performed

using R software (R Development Core Team 2023).

RESULTS

Taxonomic composition

The taxonomic diversity in the four ponds studied was represented by 54 taxa classified into two classes: Trebouxiophyceae (nine taxa) and Chlorophyceae (45) (Table I). Scenedesmaceae was the most abundant of the seven families studied, accounting for 45% of the total richness (24 taxa), followed by Selenastraceae at 23% (12 taxa). In contrast, the lowest richness was found in Schroederiaceae (two taxa) and Neochloridaceae (one taxon) (Table I, Fig. 3). *Desmodesmus* and *Monoraphidium* were the most represented genera, each comprising ten taxa, followed by *Scenedesmus* (four), *Tetrademus* and *Tetradron* (three each) (Table I).

Parque da Lagoa had the highest richness (43 taxa) and the most exclusive taxa (four), followed by Lagoa Grande (40 taxa, two exclusive), Laguneville (31 taxa, three exclusive), and Pindoba (30 taxa, two exclusive). Fifteen taxa were shared between the four ponds (Fig. 4).

The most frequent taxa were found in Parque da Lagoa, followed by the Lagoa Grande, Pindoba, and Laguneville ponds. The latter contained the most sporadic and unusual taxa (Table II).

Some taxa stood out for their high frequency, such as *Monoraphidium circinale*, which was found in 100% of the samples from Parque da Lagoa, Lagoa Grande, and Pindoba. *Lemmermannia komarekii* was also classified as very frequent in the same ponds, exhibiting a 100% frequency of occurrence, except for Parque da Lagoa, where it was found in 95.8% of the samples (Table II).

Six taxa with a high global occurrence frequency (*Desmodesmus communis*,

Lemmermannia komarekii, *Monoraphidium circinale*, *Tetrademus lagerheimii*, *Tetraëdron minimum* and *Chlorella* sp.) were classified as very common, having been found in all four ponds studied. While *Desmodesmus armatus* var. *bicaudatus*, *Lemmermannia tetrapedia*, *Monoraphidium contortum*, *M. nanum*, *Scenedesmus ecoris* and *Willea crucifera* were classified as frequent. Most of the taxa studied belonged to the unusual, sporadic, or rare categories, with 21 taxa in each.

Non-metric Multidimensional Scaling (NMDS) analysis revealed significant differences (PERMANOVA, $F = 18.553$, $p < 0.001$), with greater variability in the samples from Laguneville pond compared to the others, which had a more aggregated distribution (Fig. 5).

Quality-dependent habitat conditions

Except for water temperature ($p = 0.797$), all abiotic variables analyzed differed significantly between ponds ($p < 0.005$) (Table III). Laguneville had the highest mean pH and DO, 8.93 and 9.05 (mg L^{-1}), respectively. On the other hand, Pindoba had the highest mean values of TDS and EC, with 1.51 (ppt) and 3000 ($\mu\text{S cm}^{-1}$), respectively. Regarding TRANSP, Parque da Lagoa and Pindoba had the highest averages at 0.4 m.

The PCA analysis of the physicochemical variables among the ponds (Table III) revealed that they had distinct environmental gradients, with the first two axes explaining 88.6% of the data variability (Fig. 6). On the positive side of axis 1, Pindoba and Parque da Lagoa were related to high TDS and TRANSP, respectively, whereas Lagoa Grande and Laguneville were associated with high pH. TRANSP ($R=0.88$, $p<0.05$) and TDS ($R=0.75$, $p<0.05$) had the highest positive correlation with axis 1, whereas pH had the highest negative correlation ($R=-0.84$, $p<0.05$). No variables showed a significant correlation with axis 2.

Table I. Planktonic green algae (Chlorophyta) were identified in the ponds of the Parque da Lagoa, Lagoa Grande, Pindoba and Laguneville, in the months of April, May, June, September, and November/2022, in the urban region of Feira de Santana, Bahia, Brazil, (First record for Bahia).**

Class/Family/Taxa	Cells dimensions	Figures	References for Bahia
CHLOROPHYCEAE			
SCENEDESMACEAE			
<i>Coelastrum sphaericum</i> Nägeli	Coenobium 25.2 µm diam, cells 5.7 µm long x 6 µm wide	Fig. 7a	**
<i>Comasiella arcuata</i> var. <i>platydisca</i> (G.M.Smith) E.Hegewald & M.Wolf	Coenobium 16.8-22.8 µm diam, cells 6.2-7.8 µm long x 2.8-3.7 µm wide	Figs. 7b, 10a	Ramos et al. (2015d)
<i>Desmodesmus armatus</i> var. <i>bicaudatus</i> (Guglielmetti) E.H.Hegewald	Coenobium 9.7-22.3 µm diam, cells 5.8-13.4 µm long x 2.4-6.3 µm wide, spines 6.2-16.5 µm long	Figs. 7c, 10c	Ramos et al. (2015d)
<i>D. communis</i> (E.Hegewald) E.Hegewald	Coenobium 12.1-18.9 µm diam, cells 6.5-12.8 µm long x 1.9-3.7 µm wide, spines 5.5-11.7 µm long	Fig. 7d	Fuentes et al. (2010) as <i>Scenedesmus quadricauda</i> (Turpin) Brébisson; Ramos et al. (2015d)
<i>D. denticulatus</i> (Lagerheim) S.S.An, T.Friedl & E.Hegewald	Coenobium 23.9-34.8 µm diam, cells 12.6-18.4 µm long x 5.8-10.7 µm wide, spines 1.4-2.8 µm long	Fig. 7e	Martins et al. (1991) as <i>Scenedesmus denticulatus</i> Lagerheim
<i>D. dispar</i> (Brébisson) E. Hegewald	Coenobium 20.4-35.4 µm diam, cells 13.2-20.7 µm long x 6.8-8.8 µm wide, spines 1.3-4.9 µm long	Figs. 7f, 10d	Martins et al. (1991) as <i>Scenedesmus dispar</i> Brébisson
<i>D. granulatus</i> (West & G.S.West) P.M.Tsarenko	Coenobium 9.7-12.3 µm diam, cells 5.4-9 µm long x 1.6-2.6 µm wide, spines 0.7-1 µm long	Fig. 7g	Ramos et al. (2015d)
<i>D. lunatus</i> (West & G.S.West) E.Hegewald	Coenobium 19.6-19.9 µm diam, cells 15.9-17.9 µm long x 4.4-5 µm wide, spines 2.2-3.0 µm long	Fig. 7h	**
<i>D. maximus</i> (West & G.S.West) Hegewald	Coenobium 23.2-37.1 µm diam, cells 16-27.7 µm long x 4-10 µm wide, spines 16.5-25.8 µm long	Figs. 7i, 10b	Martins et al. (1991) as <i>Scenedesmus quadricauda</i> var. <i>westii</i> G.M.Smith
<i>D. opoliensis</i> var. <i>mononensis</i> (Chodat) E. Hegewald	Coenobium 14-24.5 µm diam, cells 7.5-19 µm long x 2.3-6.7 µm wide, spines 6.7-20.5 µm long	Fig. 7j	Ramos et al. (2015d)
<i>D. spinosus</i> (Chodat) E. Hegewald	Coenobium 5.3-11.5 µm diam, cells 5.4-8 µm long x 1.8-3.4 µm wide, spines 1.8-7 µm long	Fig. 7l, 10f	**
<i>D. spinulatus</i> (Biswas) E.Hegewald	Coenobium 24.7-29.6 µm diam, cells 16-20.9 µm long x 5.7-6.6 µm wide, spines 2.1-3.7 µm long	Fig. 7k, 10e	**
<i>Hariotina reticulata</i> P.A.Dangeard	Coenobium 43.7-60.7 µm diam, cells 3.5-4.9 µm diam	Figs. 7m, 11a	Carraro (2009); Fuentes et al. (2010) as <i>Coelastrum reticulatum</i> (P.A.Dangeard) Senn
<i>Scenedesmus baculiformis</i> Chodat	Coenobium 13.2-21.21 µm diam, cells 11.9-14.7 µm long x 3.7-4.8 µm wide	Figs. 7n, 11b	**
<i>Scenedesmus ecornis</i> (Ehrenberg) Chodat	Coenobium 13.2-21.1 µm diam, cells 11.9-14.7 µm long x 3.7-4.8 µm wide	Fig. 7o	Aboim (2018), Cordeiro-Araújo et al. (2010), Fuentes et al. (2010), Ramos et al. (2015d, 2018)

Table I. Continuation.

Class/Family/Taxa	Cells dimensions	Figures	References for Bahia
<i>S. indicus</i> Philipose ex Hegewald, Engelberg & Paschma	Coenobium 21.2-32.6 µm diam, cells 12.3-17 µm long x 4.5-9 µm wide	Fig. 7p	**
<i>S. obtusus</i> Meyen	Coenobium 7.8-12 µm diam, cells 4.1-7 µm long x 2-3.3 µm wide	Figs. 7q, 11c	Ramos et al. (2015d, 2018)
<i>Tetradodesmus dimorphus</i> (Turpin) M.J.Wynne	Coenobium 38.3-45 µm diam, cells 17.7-34.2 µm long x 6-8.4 µm wide	Fig. 7t, 11d	Ramos et al. (2015d) as <i>Acutodesmus dimorphus</i> (Turpin) PM.Tsarenko
<i>T. lagerheimii</i> M.J.Wynne & Guiry	Coenobium 14.6-31.6 µm diam, cells 11.1-24.1 µm long x 2.4-4 µm wide	Figs. 7s, 11e	Aboim 2018, Fuentes et al. (2010) and Martins et al. (1991) as <i>Scenedesmus acuminatus</i> (Lagerheim) Chodat; Ramos et al. (2015d) as <i>Acutodesmus acuminatus</i> (Lagerheim) PM.Tsarenko
<i>T. obliquus</i> (Turpin) M.J.Wynne	Coenobium 8.7-18.8 µm diam, cells 19.8-21.3 µm long x 3.3-3.8 µm wide	Figs. 7t, 11f	Ramos et al. (2015d) as <i>Acutodesmus obliquus</i> (Turpin) Hegewald & Hanagata; Martins et al. (1991) as <i>Scenedesmus acutus</i> var. <i>acutus</i> f. <i>alternans</i> Hortobagyi
<i>Tetrastrum heteracanthum</i> (Nordstedt) Chodat	Coenobium 8.8-16.3 µm diam, cells 6.9-7.9 µm diam, spines 5.9-9.7 µm long	Figs. 8a, 12a	**
<i>T. staurogeniiforme</i> (Schröder) Lemmermann	Coenobium 8.9-10.8 µm diam, cells 3.9-5 µm diam, spines 1.3-1.9 µm long	Figs. 8b, 12b	**
<i>Verrucodesmus verrucosus</i> (V.V.Roll) E.Hegewald	Coenobium 10.1-23.2 µm diam, cells 6.3-9 µm compr x 3.6-4. 5 µm wide	Fig. 8c	Ramos et al. (2015d)
SELENASTRACEAE			
<i>Ankistrodesmus arcuatus</i> Korshikov	Cells 24.2 µm long x 1 µm wide	Fig. 8d	Fuentes et al. (2010), Ramos et al. (2012b) as <i>Monoraphidium arcuatum</i> (Korshikov) Hindák
<i>Kirchneriella diana</i> (Bohlin) Comas	Cells 6.8 µm long x 2.4 µm wide	Fig. 8e	Ramos et al. (2015a)
<i>Monoraphidium caribeum</i> Hindák	Cells 26.7-34.3 µm long x 3.1-3.7 µm wide	Fig. 8f	Ramos et al. (2012, 2018)
<i>M. circinale</i> (Nygaard) Nygaard	Cells 6.2-9.5 (14.3) µm long x 1.1-2 µm wide	Figs. 8g, 12d	Ramos et al. (2012)
<i>M. contortum</i> (Thuret) Komárková-Legnerová	Cells 9.2-16.9 µm long x 1.3-1.9 µm wide	Fig. 8h	Aboim (2018), Carraro (2009), Fuentes et al. (2010), Ramos et al. (2012, 2018)
<i>M. griffithii</i> (Berkeley) Komárková-Legnerová	Cells (33.8) 43.1-47.3 µm long x 2.2-3.3 µm wide	Figs. 8i, 12b	Carraro (2009), Fuentes et al. (2010), Ramos et al. (2012, 2018)
<i>M. irregularare</i> (G.M.Smith) Komárková-Legnerová	Cells 15.2-36.1 µm long x 1-1.4 µm wide	Fig. 8j	Aboim (2018), Ramos et al. (2012)
<i>M. komarkovae</i> Nygaard	Cells 43.2-116.4 µm long x 1-2.6 µm wide	Fig. 8k	Fuentes et al. (2010), Ramos et al. (2012, 2018).
<i>M. nanum</i> (Ettl) Hindák	Cells 5.3-7 µm long x 2.4-3.4 µm wide	Figs. 8l, 12e-f	Ramos et al. (2012)

Table I. Continuation.

Class/Family/Taxa	Cells dimensions	Figures	References for Bahia
<i>M. pusillum</i> (Printz) Komárková-Legnarová	Cells 23.8-29 µm long x 5.4-66.4 µm wide	Fig. 8m	Aboim (2018), Ramos et al. (2012)
<i>M. subclavatum</i> Nygaard	Cells 10.3-17.3 µm long x 3.6-4.5 µm wide	Fig. 8n	Ramos et al. (2014, 2018)
<i>M. tortile</i> (West & G.S.West) Komárková-Legnarová	Cells 33-44.5 µm long x 1.3-1.5 µm wide	Fig. 8o	Ramos et al. (2012)
HYDRODICTYACEAE			
<i>Monactinus simplex</i> (Meyen) Corda var. <i>echinulatum</i> (Wittrock) Pérez, Maidana & Comas	Coenobium 39.1-62.6 µm diam, external cells 8.1-9.3 µm long x 4.5-5.9 µm wide, internal cells (9.81) 15.9-25.5 µm long x 6.6-14.6 µm wide	Figs. 8p, 12g	**
<i>Pediastrum angulosum</i> Ehrenberg ex Meneghini	Coenobium 92.2 µm diam, external cells 13.6 µm long x 17.5 µm wide, internal cells 15.2 µm long x 12.2 µm wide	Fig. 8q	Ramos et al. (2016)
<i>P. duplex</i> Meyen	Coenobium 27.6-60.4 µm diam, external cells 7.4-12.5 (17) µm long x 4.5-10.8 (15.8) µm wide, internal cells 4.1-9.4 (15.2) µm long x 2.9-8 (17.3) µm wide	Figs. 8r, 12h	Cordeiro-Araújo et al. (2010)
<i>Stauridium tetras</i> (Ehrenberg) E. Hegewald	Coenobium 22-59.2 µm diam, external cells 5.4-14.3 µm long x 4.3-10.5 µm wide, internal cells 4.2-11.6 µm long x 4.1-13.1 µm wide	Figs. 9a, 13a	Aboim (2018) and Martins et al. (1991) as <i>Pediastrum tetras</i> (Ehrenberg) Ralfs; Ramos et al. (2016)
<i>Tetraëdron minimum</i> (A.Braun) Hansgirg	Cells 5.3-12.9 µm diam	Figs. 9b, 13b	Ramos et al. (2016)
<i>T. triangulare</i> Korshikov	Cells 11.5 µm diam	Fig. 9c	Ramos et al. (2016)
<i>T. tumidulum</i> (Reinsch) Hansgirg	Cells 11.1-20.2 µm diam	Figs. 9d, 13c	**
NEOCHLORIDACEAE			
<i>Golenkinia radiata</i> Chodat	Cells 11-23.4 µm diam, setae 8.5-18.3 µm long	Fig. 9h	Carraro (2009), Cordeiro-Araújo et al. (2010), Fuentes et al. (2010)
SCHROEDERIAEAE			
<i>Schroederia indica</i> Philipose	Cells including the ends 34.9-50.5 µm long x 3-4.3 µm wide	Fig. 9i	Aboim (2018)
<i>S. spiralis</i> (Printz) Korshikov	Cells including the ends 47.2 µm long x 4.3 µm wide	Fig. 9j	**

Table 1. Continuation.

Class/Family/Taxa	Cells dimensions	Figures	References for Bahia
TREBOUXIOPHYCEAE			
OOCYSTACEAE			
<i>Nephrochlamys allanthoidea</i> Korshikov	Cells 9.8-12.5 µm long x 2.7-5.6 µm wide	Fig. 9k	**
<i>Oocystis marssonii</i> Lemmermann	Cells 7.8-13.4 µm long x 5.6-9.4 µm wide	Fig. 9l	Martins et al. (1991)
<i>Willea apiculata</i> (Lemmermann) D.M.John, M.J.Wynne & P.M.Tsarenko	Cells 3.6-7 µm compr x 2.3-4 µm wide	Fig. 9m	**
<i>W. crucifera</i> (Wolle) D.M.John, M.J.Wynne & P.M.Tsarenko	Cells 5.4-7.4 µm long x 3-7.2 µm wide	Figs. 9n, 13e	Ramos et al. (2015b)
CHLORELLACEAE			
<i>Chlorella</i> sp.	Cells 8.3-8.8 diam	Figs. 9e, 13d	
<i>Dictyosphaerium ehrenbergianum</i> Nägeli	Cells 3.6-6.3 µm long x 2.5-6.5 µm wide	Figs. 9f, 13f	Ramos et al. (2015b)
<i>Mucidosphaerium pulchellum</i> (H.C.Wood) C.Bock, Proschold & Krienitz	Cells 4.5-7.8 µm long x 3.8-7.1 µm wide	Fig. 9g	Aboim (2018), Carraro (2009), Cordeiro-Araújo et al. (2010), Fuentes et al. (2010) and Martins et al. (1991) as <i>Dictyosphaerium pulchellum</i> H.C.Wood; Ramos et al. (2015b)
Incertae sedis			
<i>Lemmermannia komarekii</i> (Hindák) C.Bock & Krienitz	Cells 3-5.9 µm diam	Fig. 9o	Ramos et al. (2015a)
<i>L. tetrapedia</i> (Kirchner) Lemmermann	Cells 6.4-8.4 µm diam	Fig. 9p	**

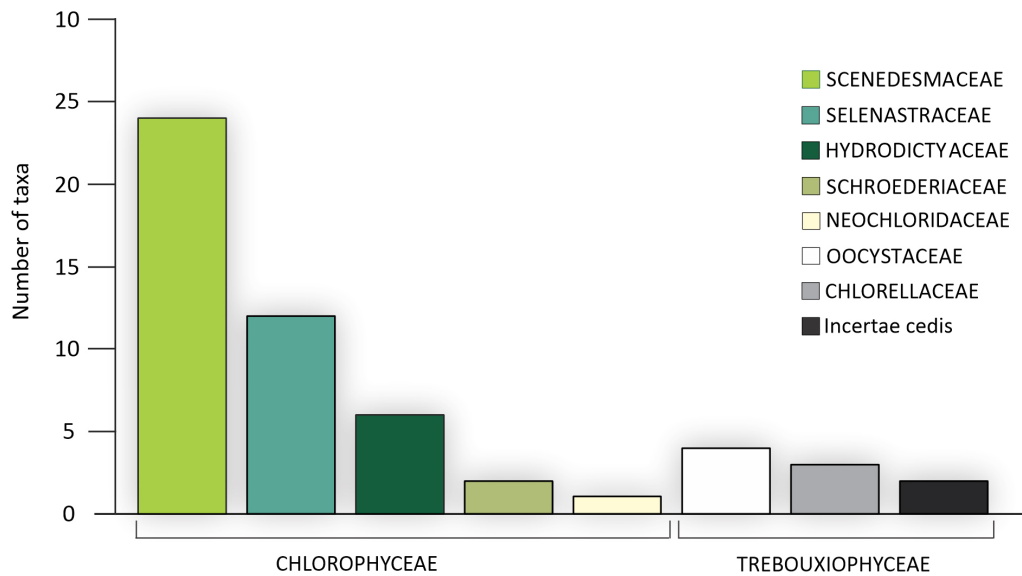


Figure 3. Number of Chlorophyta taxa inventoried by class/family in urban ponds of Feira de Santana, Bahia State, Brazil.

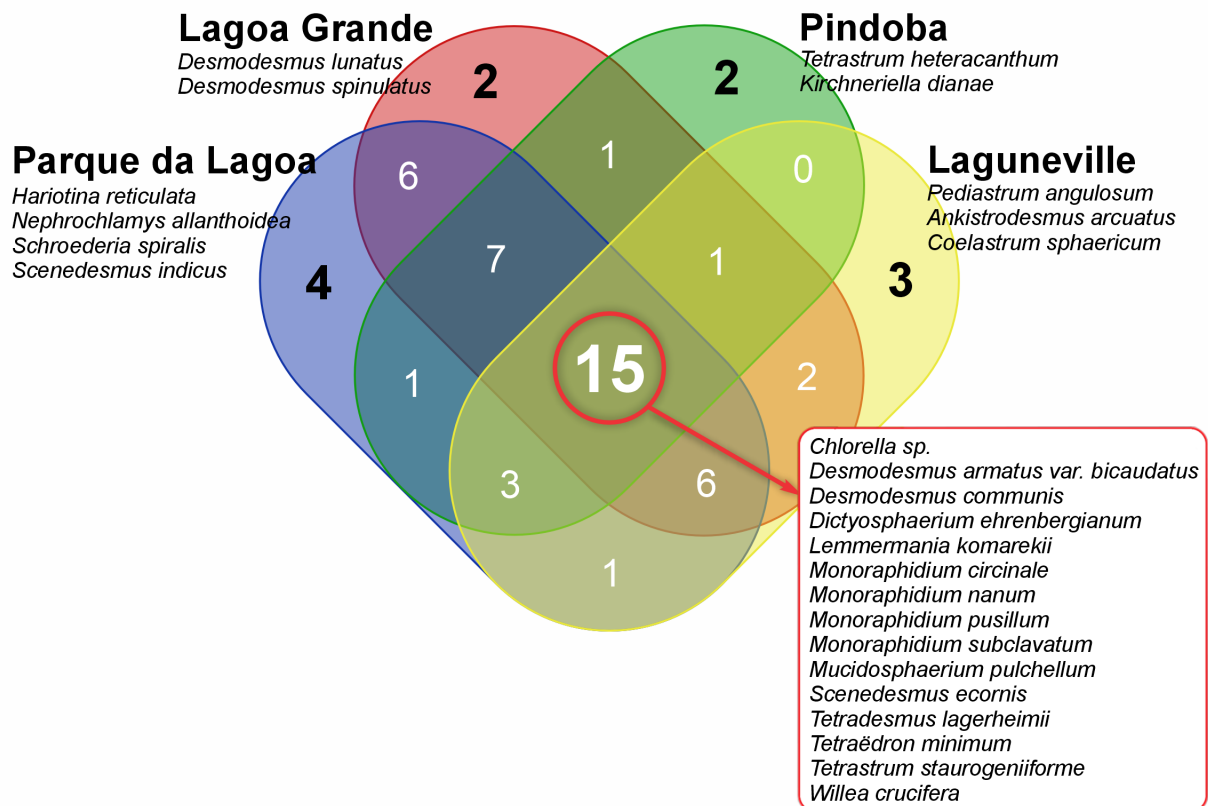


Figure 4. Venn diagram of the unique and shared Chlorophyta taxa in the ponds of Feira de Santana, Bahia, Brazil's Parque da Lagoa, Lagoa Grande, Pindoba, and Laguneville.

Table II. Water abiotic variables (mean and standard deviation) and frequency of occurrence (VF = very frequent, F = frequent, U = uncommon, S = sporadic) of planktonic green algae taxa (Chlorophyta) recorded in ponds of the Parque da Lagoa (PL), Lagoa Grande (LG), Pindoba (LP), and Laguneville (LV) in April, May, June, September, and November/2022, in Feira de Santana, Bahia. DO = dissolved oxygen, Cond = conductivity, T = water temperature, TDS = totals dissolved solids, Transp = water transparency.

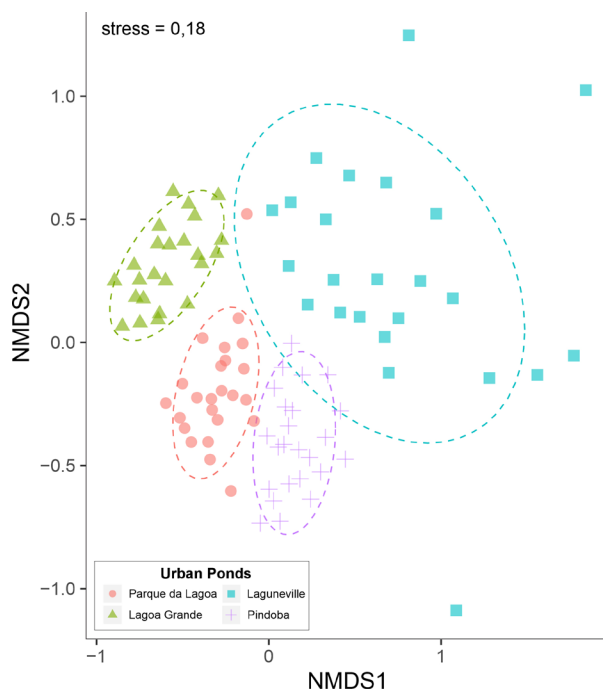
TAXA	Water abiotic variables							Frequency of occurrence							
	pH	DO (mg L ⁻¹)	Cond (µS cm ⁻¹)	TDS (ppt)	Transp (m)	T (°C)		PL		LG		LP		LV	
								FR%	C	FR%	C	FR%	C	FR%	C
<i>Ankistrodesmus arcuatus</i>	9.2	12.3	450	0.22	0.29	26.7		-	-	-	-	-	-	4.2	S
<i>Chlorella</i> sp.	8(± 0.7)	6.2 (± 2.8)	1359 (± 1093)	0.68 (± 0.55)	0.32 (± 0.12)	26.5 (± 1.8)		91.7	VF	95.8	VF	100	VF	66.7	F
<i>Coelastrum sphaericum</i>	9.4	12.4	450	0.22	0.19	27.2		-	-	-	-	-	-	4.2	S
<i>Comasiella arcuata</i> var. <i>platydisca</i>	7.1 (± 0.7)	4.4 (± 2.1)	642 (± 238)	0.31 (± 0.13)	0.41 (± 0.05)	27.3 (± 0.4)		29.2	U	4.2	S	4.2	S	-	-
<i>Desmodesmus armatus</i> var. <i>bicaudatus</i>	7.7 (± 0.8)	5.4 (± 1.9)	705 (± 172)	0.35 (± 0.09)	0.29 (± 0.13)	27.2 (± 1.5)		79.2	VF	100	VF	8.3	S	16.7	U
<i>D. communis</i>	7.9 (± 0.6)	6.5 (± 2.1)	743 (± 144)	0.37 (± 0.07)	0.33 (± 0.11)	26.0 (± 1.7)		100	VF	91.7	VF	62.5	F	37.5	U
<i>D. denticulatus</i>	8.3 (± 1.1)	6.2 (± 1.1)	800	0.43 (± 1.1)	0.27 (± 1.1)	26.1 (± 1.1)		4.2	S	4.2	S	-	-	-	-
<i>D. dispar</i>	7.7 (± 0.6)	4.7 (± 1.3)	716 (± 109)	0.36 (± 0.05)	0.23 (± 0.04)	25.6 (± 2.4)		-	-	66.7	F	-	-	4.2	S
<i>D. granulatus</i>	7.6(± 0.6)	4.4 (± 1.7)	1894 (± 1009)	0.96(± 0.51)	0.31 (± 0.09)	24.8 (± 2.0)		-	-	8.3	S	12.5	U	-	-
<i>D. lunatus</i>	8.0 (± 0.5)	5.4 (± 1.9)	847 (± 31)	0.42 (± 0.02)	0.18 (± 0.01)	22.6 (± 0.0)		-	-	8.3	S	-	-	-	-
<i>D. maximus</i>	7.9 (± 0.8)	6.7 (± 2.7)	645 (± 184)	0.32 (± 0.10)	0.28 (± 0.12)	25.2 (± 2.4)		12.5	U	-	-	-	-	8.3	S
<i>D. opoliensis</i> var. <i>mononensis</i>	7.5 (± 0.8)	4.7 (± 1.7)	659 (± 172)	0.33 (± 0.09)	0.31 (± 0.12)	25.5 (± 2.2)		83.3	VF	54.2	F	-	-	16.7	U
<i>D. spinosus</i>	7.4 (± 0.6)	5.2 (± 1.9)	844 (± 576)	0.42 (± 0.29)	0.40 (± 0.07)	25.8 (± 1.5)		45.8	F	4.2	S	4.2	S	-	-
<i>D. spinulatus</i>	7.7 (± 0.6)	5.4 (± 1.6)	680 (± 103)	0.34 (± 0.04)	0.23 (± 0.03)	26.4 (± 1.6)		-	-	16.7	U	-	-	-	-
<i>Dictyosphaerium ehrenbergianum</i>	7.9 (± 0.8)	6.1 (± 2.4)	1133 (± 938)	0.57 (± 0.47)	0.32 (± 0.11)	26.7 (± 1.7)		70.8	VF	58.3	F	25	U	4.2	S
<i>Golenkinia radiata</i>	7.8 (± 1.3)	6.7 (± 5.1)	564 (± 144)	0.28 (± 0.08)	0.25 (± 0.10)	26.4 (± 0.8)		4.2	S	8.3	S	-	-	4.2	S
<i>Hariotina reticulata</i>	6.9 (± 0.6)	3.6 (± 2.2)	528 (± 105)	0.24 (± 0.08)	0.44 (± 0.05)	26.1 (± 1.6)		16.7	U	-	-	-	-	-	-
<i>Kirchneriella diana</i> e	7.2	3.2	2760	1.4	0.37	28.1		-	-	-	-	4.2	S	-	-
<i>Lemmermannia komarekii</i>	7.9 (± 0.7)	5.8 (± 2.6)	1381 (± 1097)	0.69 (± 0.55)	0.33 (± 0.12)	26.6 (± 1.8)		95.8	VF	100	VF	100	VF	45.8	F
<i>L. tetrapedia</i>	7.6 (± 0.5)	4.9 (± 2.2)	1890 (± 1203)	0.95 (± 0.61)	0.41 (± 0.08)	26.4 (± 1.6)		91.7	VF	4.2	S	95.8	VF	-	-
<i>Monactinus simplex</i> var. <i>echinulatum</i>	7.5 (± 0.7)	5.9 (± 2.3)	718 (± 162)	0.35 (± 0.09)	0.42 (± 0.07)	26.4 (± 1.6)		75	VF	4.2	S	-	-	-	-
<i>Monoraphidium caribeum</i>	8.0 (± 0.9)	6.3 (± 2.4)	887 (± 557)	0.44 (± 0.28)	0.26 (± 0.11)	27.7 (± 2.3)		12.5	U	33.3	U	4.2	S	-	-
<i>M. circinale</i>	8.0 (± 0.7)	6 (± 2.7)	1325 (± 1079)	0.66 (± 0.54)	0.32 (± 0.12)	26.5 (± 1.8)		100	VF	100	VF	100	VF	66.7	F
<i>M. contortum</i>	7.9 (± 0.7)	5.6 (± 2.4)	1611 (± 1197)	0.81 (± 0.60)	0.36 (± 0.11)	26.6 (± 1.5)		79.2	VF	-	-	95.8	VF	58.3	F

Table II. Continuation.

TAXA		Water abiotic variables							Frequency of occurrence							
									PL		LG		LP		LV	
		pH	DO (mg L ⁻¹)	Cond (µS cm ⁻¹)	TDS (ppt)	Transp (m)	T (°C)	FR%	C	FR%	C	FR%	C	FR%	C	
<i>M. griffithii</i>	7.5 (± 0.4)	4.5 (± 1.9)	2204 (± 1178)	1.11 (± 0.59)	0.40 (± 0.08)	26.4 (± 1.6)	50	F	4.2	S	91.7	VF	-	-		
<i>M. irregulare</i>	8.1 (± 0.9)	6.4 (± 3.6)	1593 (± 1112)	0.80 (± 0.57)	0.31 (± 0.12)	26.6 (± 1.8)	-	-	4.2	S	33.3	U	29.2	U		
<i>M. komarkovae</i>	7.7 (± 0.7)	4.8 (± 3.0)	2319 (± 1238)	1.16 (± 0.63)	0.35 (± 0.08)	26.3 (± 1.8)	4.2	S	-	-	58.3	F	12.5	U		
<i>M. nanum</i>	8.0 (± 0.8)	5.8 (± 2.6)	1269 (± 1069)	0.64 (± 0.54)	0.31 (± 0.13)	26.6 (± 1.8)	50	F	79.2	VF	45.8	F	25	U		
<i>M. pusillum</i>	8.1 (± 0.9)	6.7 (± 3.1)	881 (± 823)	0.44 (± 0.41)	0.30 (± 0.13)	25.7 (± 1.6)	25	U	20.8	U	4.2	S	12.5	U		
<i>M. subclavatum</i>	7.7 (± 0.6)	6.0 (± 2.3)	1249 (± 972)	0.63 (± 0.49)	0.37 (± 0.12)	27.0 (± 1.8)	70.8	VF	41.7	F	33.3	U	4.2	S		
<i>M. tortile</i>	7.6 (± 0.8)	5.7 (± 2.8)	1422 (± 1088)	0.71 (± 0.55)	0.38 (± 0.10)	26.3 (± 1.4)	62.5	F	4.2	S	54.2	F	-	-		
<i>Mucidosphaerium pulchellum</i>	8.1 (± 0.8)	6.8 (± 2.5)	891 (± 668)	0.45 (± 0.33)	0.29 (± 0.13)	26.7 (± 1.5)	25	U	33.3	U	4.2	S	8.3	S		
<i>Nephrochlamys allantoidea</i>	7.7 (± 0.4)	6.9(± 1.8)	835	0.42 (± 0.01)	0.47 (± 0.07)	27.3(± 0.1)	4.1	S	-	-	-	-	-	-		
<i>Oocystis marssonii</i>	8.3 (± 0.6)	7.1 (± 2.3)	767 (± 100)	0.39 (± 0.05)	0.30 (± 0.12)	26.1 (± 2.1)	16.7	U	20.8	U	-	-	-	-		
<i>Pediastrum duplex</i>	7.9 (± 0.8)	5.9 (± 2.1)	740 (± 153)	0.37 (± 0.08)	0.26 (± 0.10)	26.8 (± 1.8)	25	U	79.2	VF	-	-	-	-		
<i>P. angulosum</i>	9.1	11	450	0.22	0.29	26.1	-	-	-	-	-	-	4.2	S		
<i>Scenedesmus baculiformis</i>	7.8 (± 0.5)	7.6 (± 0.8)	662 (± 224)	0.31 (± 0.12)	0.21 (± 0.04)	26.5 (± 3.4)	-	-	8.3	S	-	-	4.2	S		
<i>S. ecornis</i>	7.6 (± 0.6)	5.1 (± 2.3)	1428 (± 1045)	0.71 (± 0.53)	0.35 (± 0.11)	26.6 (± 1.1)	70.8	VF	45.8	F	62.5	F	4.2	S		
<i>S. indicus</i>	8.0 (± 0.4)	7.7 (± 1.7)	845 (± 60)	0.43 (± 0.03)	0.43 (± 0.06)	27.4 (± 1.1)	66.7	F	-	-	-	-	-	-		
<i>S. obtusus</i>	7.3 (± 0.5)	4.2 (± 1.7)	1985 (± 1008)	1.00 (± 0.52)	0.36 (± 0.12)	26.5 (± 1.9)	33.3	U	33.3	U	83.3	VF	-	-		
<i>Schroederia indica</i>	7.5 (± 0.7)	5.1 (± 3.3)	1140 (± 966)	0.56 (± 0.49)	0.46 (± 0.07)	26 (± 1.3)	3.1	S	-	-	4.2	S	-	-		
<i>S. spiralis</i>	8.3	9.1	880	0.44	0.39	28.4	4.2	S	-	-	-	-	-	-		
<i>Stauridium tetras</i>	8.1 (± 0.6)	6.5 (± 2.0)	764 (± 125)	0.38 (± 0.06)	0.26 (± 0.11)	27.3 (± 1.7)	29.2	U	79.2	VF	-	-	-	-		
<i>Tetradesmus dimorphus</i>	7.5 (± 0.8)	4.7 (± 1.8)	682 (± 162)	0.34 (± 0.09)	0.26 (± 0.11)	25.8 (± 2.6)	20.8	U	62.5	F	-	-	-	-		
<i>T. lagerheimii</i>	7.9 (± 0.8)	5.9 (± 2.7)	993 (± 800)	0.50 (± 0.41)	0.31 (± 0.11)	26.2 (± 1.6)	95.8	VF	95.8	VF	62.5	F	70.8	VF		
<i>T. obliquus</i>	7.6 (± 0.7)	5.8 (± 2.0)	698 (± 159)	0.34 (± 0.09)	0.37 (± 0.09)	26.3 (± 1.6)	58.3	F	12.5	U	-	-	-	-		
<i>Tetraëdron minimum</i>	8.1 (± 0.8)	6.5 (± 2.7)	1218 (± 1046)	0.61 (± 0.53)	0.32 (± 0.12)	26.7 (± 1.5)	95.8	VF	37.5	U	75	VF	95.8	VF		
<i>T. triangulare</i>	7.7 (± 0.7)	5.8 (± 1.4)	668 (± 124)	0.34 (± 0.05)	0.27 (± 0.08)	25.9 (± 1.6)	4.2	S	16.7	U	-	-	-	-		
<i>T. tumidulum</i>	7.2 (± 0.9)	4.8 (± 3.2)	571 (± 129)	0.27 (± 0.08)	0.32 (± 0.12)	26.7 (± 1.2)	4.2	S	16.7	U	-	-	-	-		
<i>Tetrastrum heteracanthum</i>	7.2 (± 0.6)	5.6 (± 1.5)	2977 (± 445)	1.52 (± 0.20)	0.42 (± 0.08)	28.0 (± 0.7)	-	-	-	-	12.5	U	-	-		
<i>T. staurogeniiforme</i>	7.8 (± 0.5)	5.6 (± 1.9)	1419 (± 1327)	0.71 (± 0.67)	0.33 (± 0.15)	27.6 (± 0.9)	4.2	S	4.2	S	8.3	S	8.3	S		
<i>Verrucodesmus verrucosus</i>	7.9 (± 0.9)	6.2 (± 3.6)	1181 (± 980)	0.58 (± 0.50)	0.36 (± 0.14)	26.4 (± 2.0)	16.7	U	-	-	8.3	S	8.3	S		
<i>Willea apiculata</i>	7.9 (± 0.8)	5.5 (± 1.4)	754 (± 161)	0.38 (± 0.09)	0.29 (± 0.12)	26.8 (± 1.2)	16.7	U	29.2	U	-	-	4.2	S		
<i>W. crucifera</i>	7.9 (± 0.7)	6.4 (± 2.7)	1061 (± 856)	0.53 (± 0.43)	0.34 (± 0.12)	26.8 (± 1.8)	79.2	VF	5-	F	25	U	16.7	U		

Table III. Mean values, standard deviation, and Kruskal-Wallis test of abiotic variables measured in the ponds of the Parque da Lagoa (PL), Lagoa Grande (LG), Laguneville (LV), and Pindoba (LP) in Feira de Santana, Bahia.

Variables	Ponds				Kruskal-wallis test		
	PL	LG	LV	LP	X ²	df	p
pH	7.6 ± 0.6	8.2 ± 0.7	8.9 ± 0.3	7.5 ± 0.3	54.89	3	< 0.001
Dissolved oxygen (mg L ⁻¹)	6.4 ± 2.2	5.9 ± 2	9.1 ± 2.1	3.6 ± 1.1	50.86	3	< 0.001
Electrical conductivity (µS cm ⁻¹)	800 ± 200	800 ± 100	500 ± 100	3000 ± 500	74.38	3	< 0.001
Total dissolved solids (ppt)	0.4 ± 0.1	0.4 ± 0.1	0.2	1.5 ± 0.2	72.95	3	< 0.001
Water temperature (°C)	26.5 ± 1.6	26.5 ± 2.4	26.9 ± 1.2	26.4 ± 1.6	1.02	3	0.797
Water transparency (m)	0.4	0.2	0.2	0.4 ± 0.1	70.92	3	< 0.001

**Figure 5.** Non-metric Multidimensional Scaling Analysis (NMDS) based on the presence/absence matrix of taxa inventoried in the ponds of Feira de Santana, Bahia, Brazil's Parque da Lagoa, Lagoa Grande, Laguneville, and Pindoba.

DISCUSSION

We found significant diversity in planktonic green algae (54 taxa), with a focus on the class Chlorophyceae (45 taxa), which supports previous research that found this to be one of the dominant classes in freshwater ecosystems

(Dunck et al. 2018, Rosini & Tucci 2020, Fernandes et al. 2022). This dominance can be attributed to its global distribution, which includes diverse aquatic habitats ranging from tropical to Arctic regions (Leliaert 2019).

In the present study, the geographical distribution of the nine taxa extends to the northeastern region of Brazil: *Desmodesmus lunatus*, *Scenedesmus baculiformis*, *S. indicus*, *Tetrastrum heteracanthum*, *T. staurogeniiforme*, *Monactinus simplex* var. *echinulatum*, *Tetraëdron tumidulum*, *Nephrochlamys allanthoidea*, and *Schroederia spiralis*. In addition, the following taxa were newly recorded from the state of Bahia *Coelastrum sphaericum*, *Desmodesmus spinosus*, *Lemmermannia tetrapedia* and *Willea apiculata*. Thus, our knowledge of the diversity and distribution of phytoplankton green algae in the shallow, lentic, and eutrophic environments of Brazil's semiarid regions is expanding.

Martins et al. (1991) cataloged 44 taxa from the Dique do Tororó, a eutrophic urban spring (Silva et al. 2021) in the municipality of Salvador, of which 28 belong to the class Chlorophyceae, with a predominance of 53% of Scenedesmaceae (15 taxa). This family also stood out in the current study, accounting for 63% of the taxa identified. The Scenedesmaceae family contains several species that occur in various environmental conditions (Rosini et al. 2013, Ramos et al. 2018,

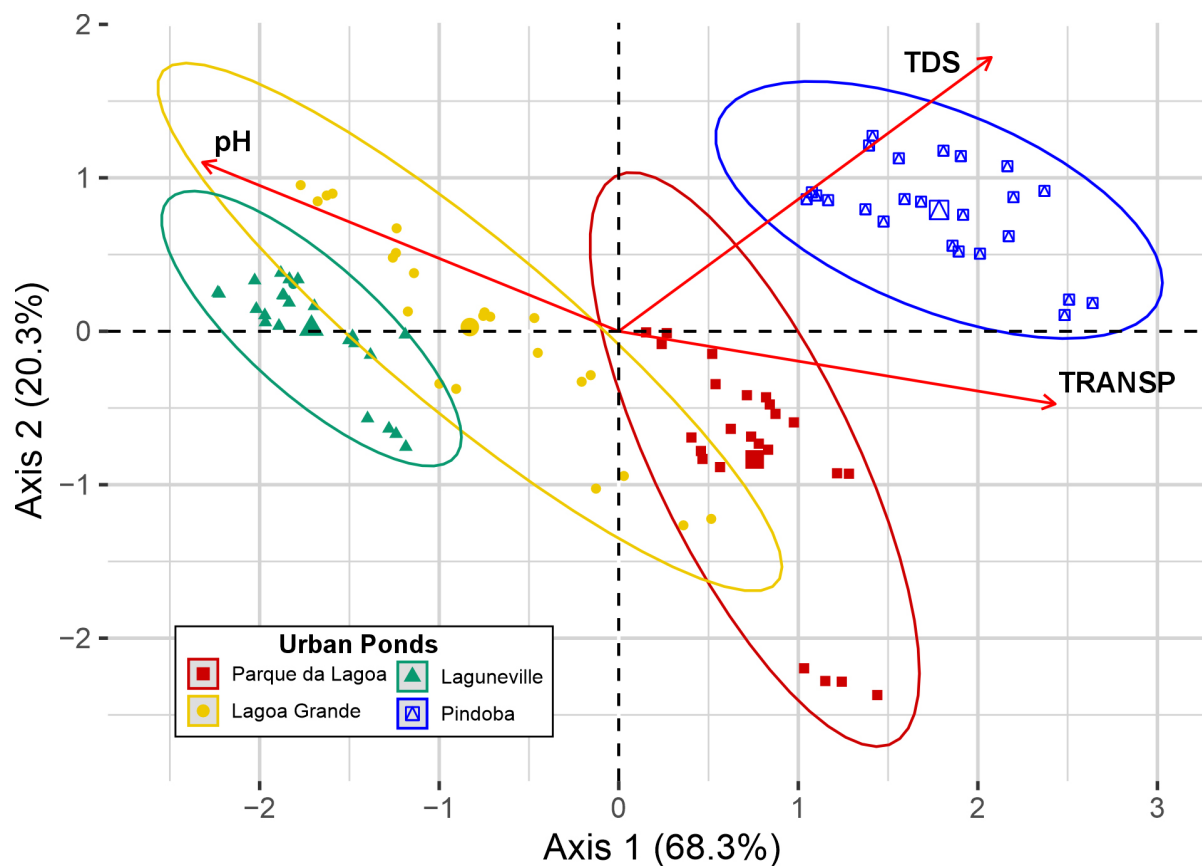


Figure 6. Graphical representation of the Principal Component Analysis of abiotic variables measured in the ponds of Pindoba, Lagoa Grande, Parque da Lagoa, and Laguneville in Feira de Santana, Bahia. TDS = Total dissolved solids, pH = pH, TRANSP = Water transparency.

Pilatti et al. 2023), particularly in eutrophic environments, where they typically dominate the algal community (Tucci et al. 2006, Domingues & Torgan 2012, D'Alessandro & Nogueira 2017).

The investigated ponds showed significant differences in most evaluated environmental variables (Table III), indicating a limnological distinction, particularly in relation to pH, conductivity, and water transparency, as illustrated by the PCA diagram (Fig. 6). Despite their proximity (maximum distance of 6.8 km between Pindoba and Lagoa Grande, and minimum distance of 2.9 km between Parque da Lagoa and Lagoa Grande) and urban location, these ponds displayed distinct limnological characteristics, which may have been influenced by their different uses and occupation histories.

The urbanization that began in the 1950s in Feira de Santana, in the Pojuca and Subaé river basins, significantly changed the city's configuration, directly influencing ponds in the area. Urban expansion has caused a gradual increase in anthropogenic pressure on ponds, significantly reducing their original areas (Santo 2012). Parque da Lagoa and Lagoa Grande, located in densely populated areas, recovered their water depths and were converted into municipal parks. The Pindoba, on the other hand, had its water depth partially grounded due to urban expansion in the Novo Horizonte neighborhood, whereas Laguneville was integrated into a private condominium.

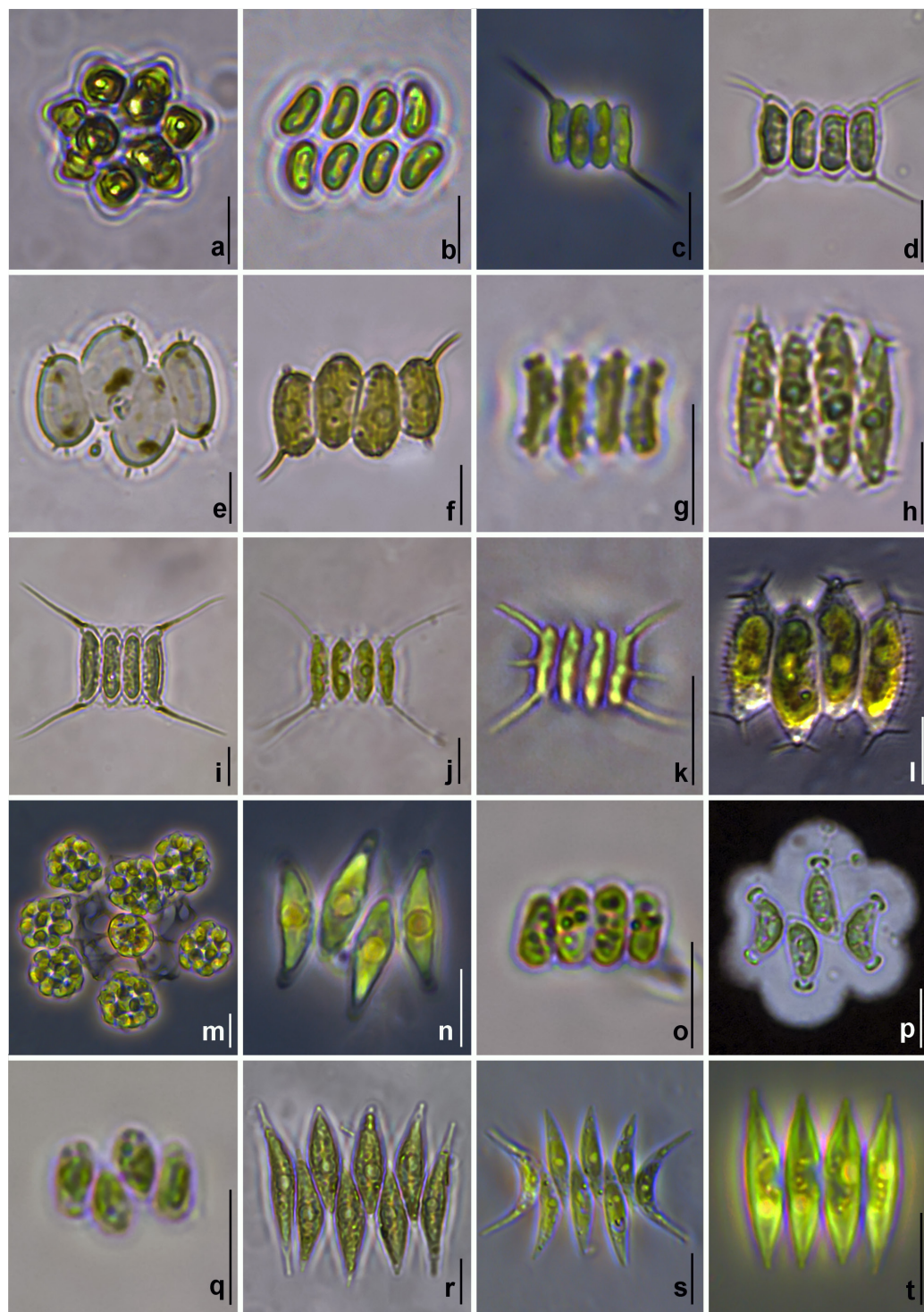


Figure 7. Chlorophyta taxa. a) *Coelastrum sphaericum*, b) *Comasiella arcuata* var. *platydisca*, c) *Desmodesmus armatus* var. *bicaudatus*, d) *D. communis*, e) *D. denticulatus*, f) *D. dispar*, g) *D. granulatus*, h) *D. lunatus*, i) *D. maximus*, j) *D. opoliensis* var. *mononensis*, k) *D. spinosus*, l) *D. spinulatus*, m) *Hariotina reticulata*, n) *Scenedesmus baculiformis*, o) *S. ecornis*, p) *S. indicus*, q) *S. obtusus*, r) *Tetradescmus dimorphus*, s) *T. lagerheimii*, t) *T. obliquus*. Bar: 10 μ m.

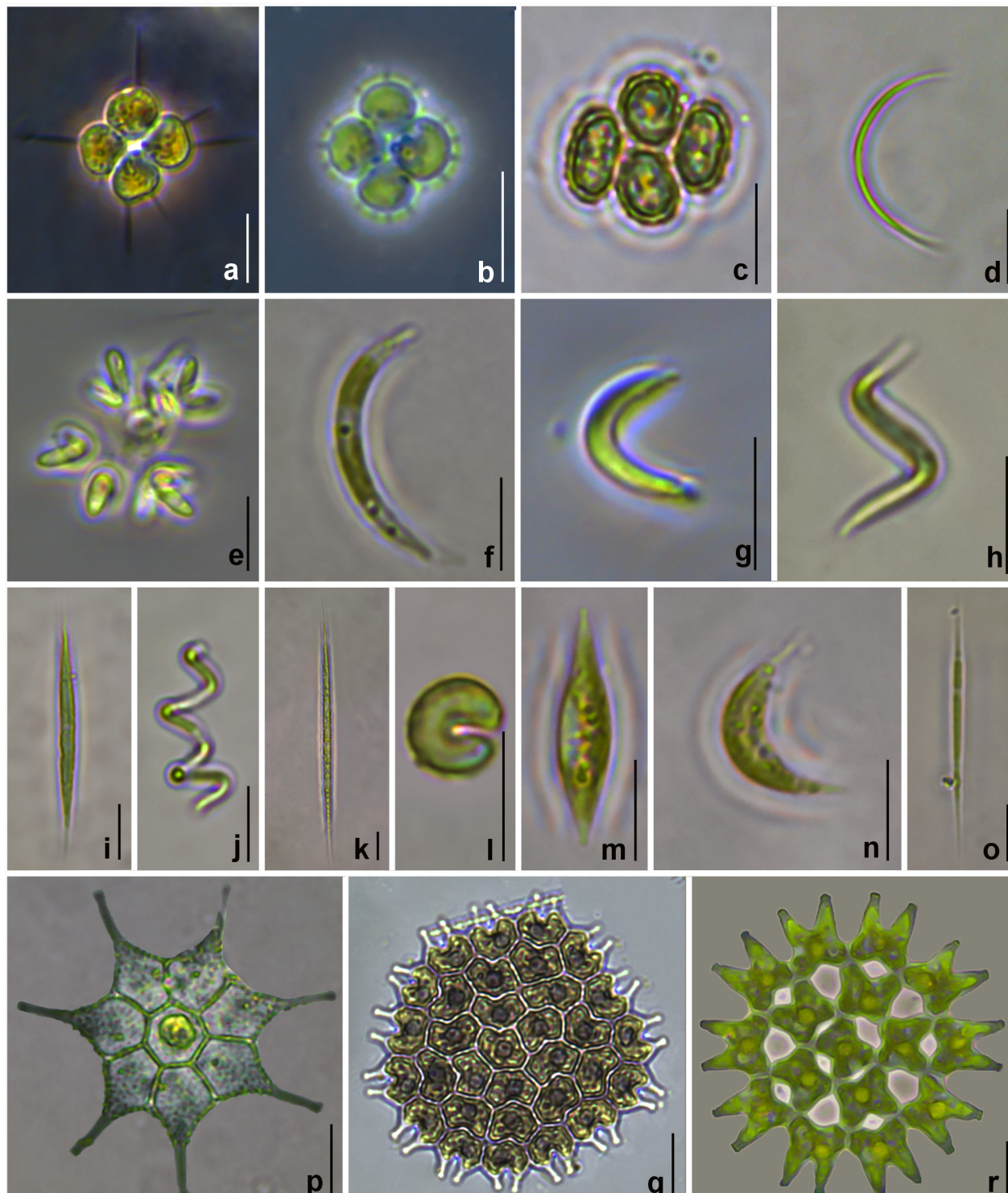


Figure 8. Chlorophyta taxa. a) *Tetrastrum heteracanthum*, b) *T. staurogeniiforme*, c) *Verrucodesmus verrucosus*, d) *Ankistrodesmus arcuatus*, e) *Kirchneriella diana*, f) *Monoraphidium caribeum*, g) *M. circinale*, h) *M. contortum*, i) *M. griffithii*, j) *M. irregulare*, k) *M. komarkovae*, l) *M. nanum*, m) *M. pusillum*, n) *M. subclavatum*, o) *M. tortile*, p) *Monactinus simplex* var. *echinulatum*, q) *Pediastrum angulosum* r) *P. duplex*. Bar: 10 µm.

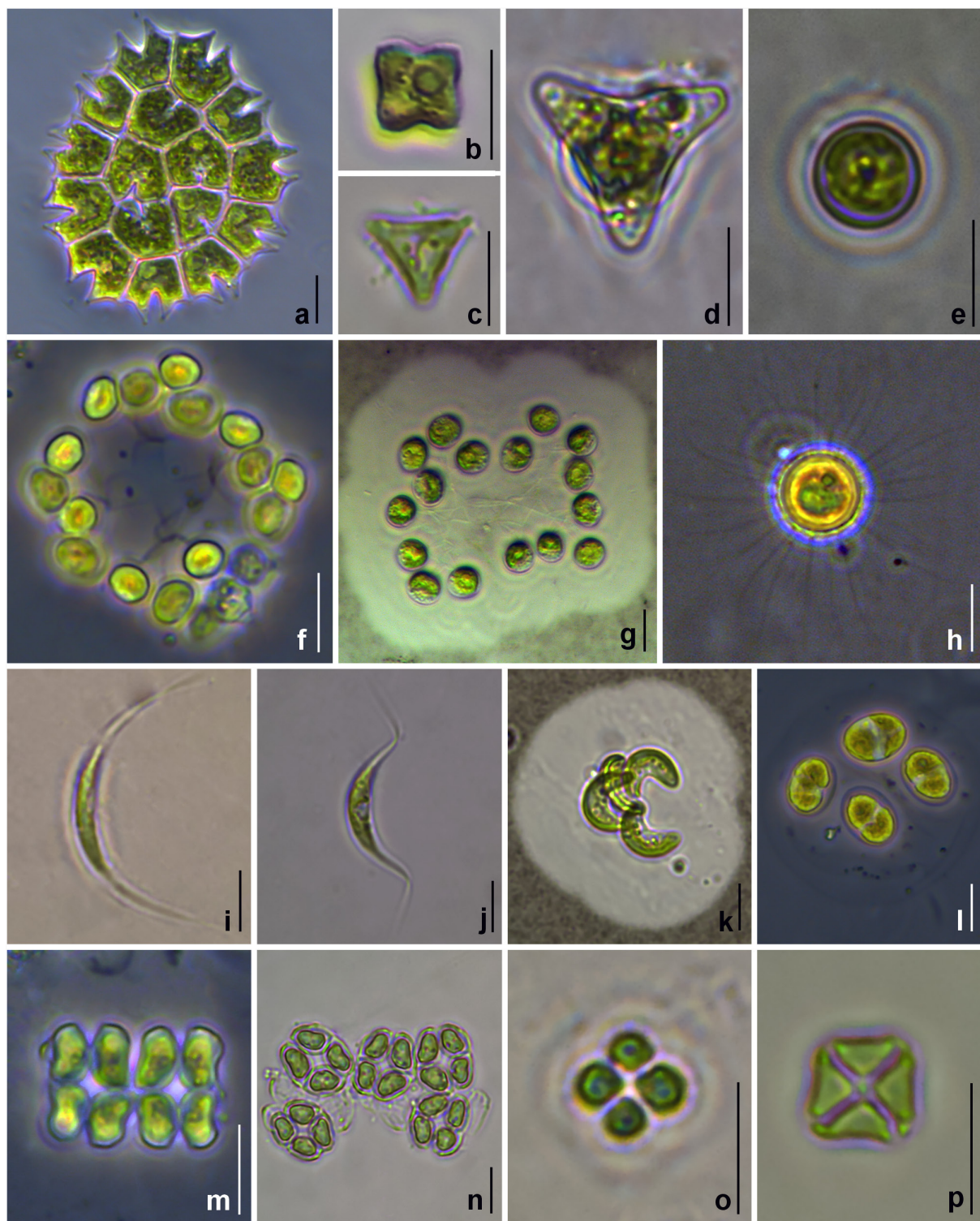


Figure 9. Chlorophyta taxa. a) *Stauridium tetras*. b) *Tetraëdron minimum*, c) *T. triangulare*, d) *T. tumidulum*, e) *Chlorella* sp., f) *Dictyosphaerium ehrenbergianum*, g) *Mucidosphaerium pulchellum*, h) *Golenkinia radiata*, i) *Schroederia indica*, j) *S. spiralis*, k) *Nephrochlamys allanthoidea*, l) *Oocystis marssonii*, m) *Willea apiculata*, n) *W. crucifera*, o) *Lemmermannia komarekii*, p) *L. tetrapedia*. Bar: 10 µm.

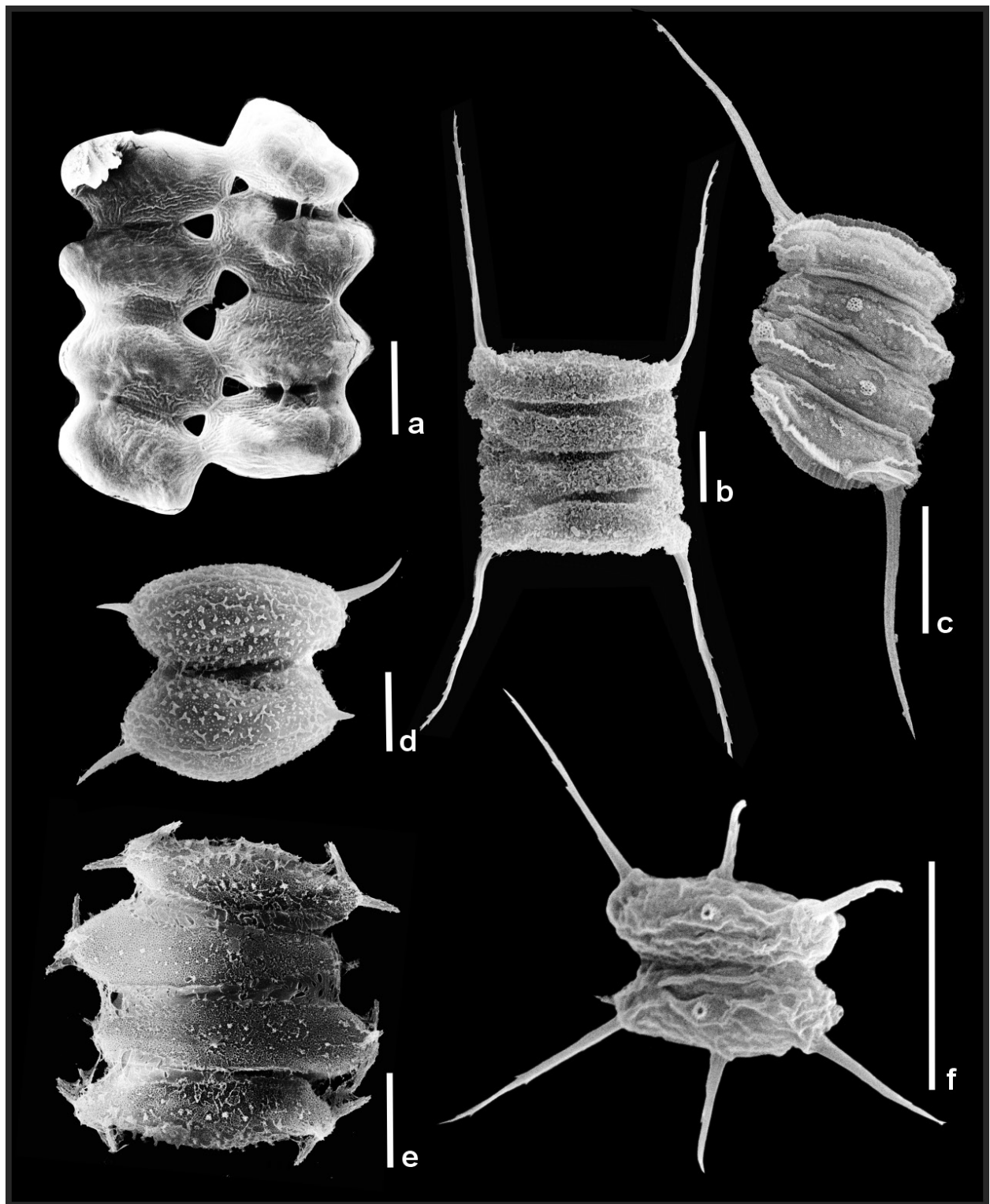


Figure 10. Scanning electron microscopy of Chlorophyta taxa. a) *Comasiella arcuata* var. *platydisca*, b) *Desmodesmus maximus*, c) *D. armatus* var. *bicaudatus*, d) *D. dispar*, e) *D. spinulatus*, f) *D. spinosus*. Bar: 5 μ m.

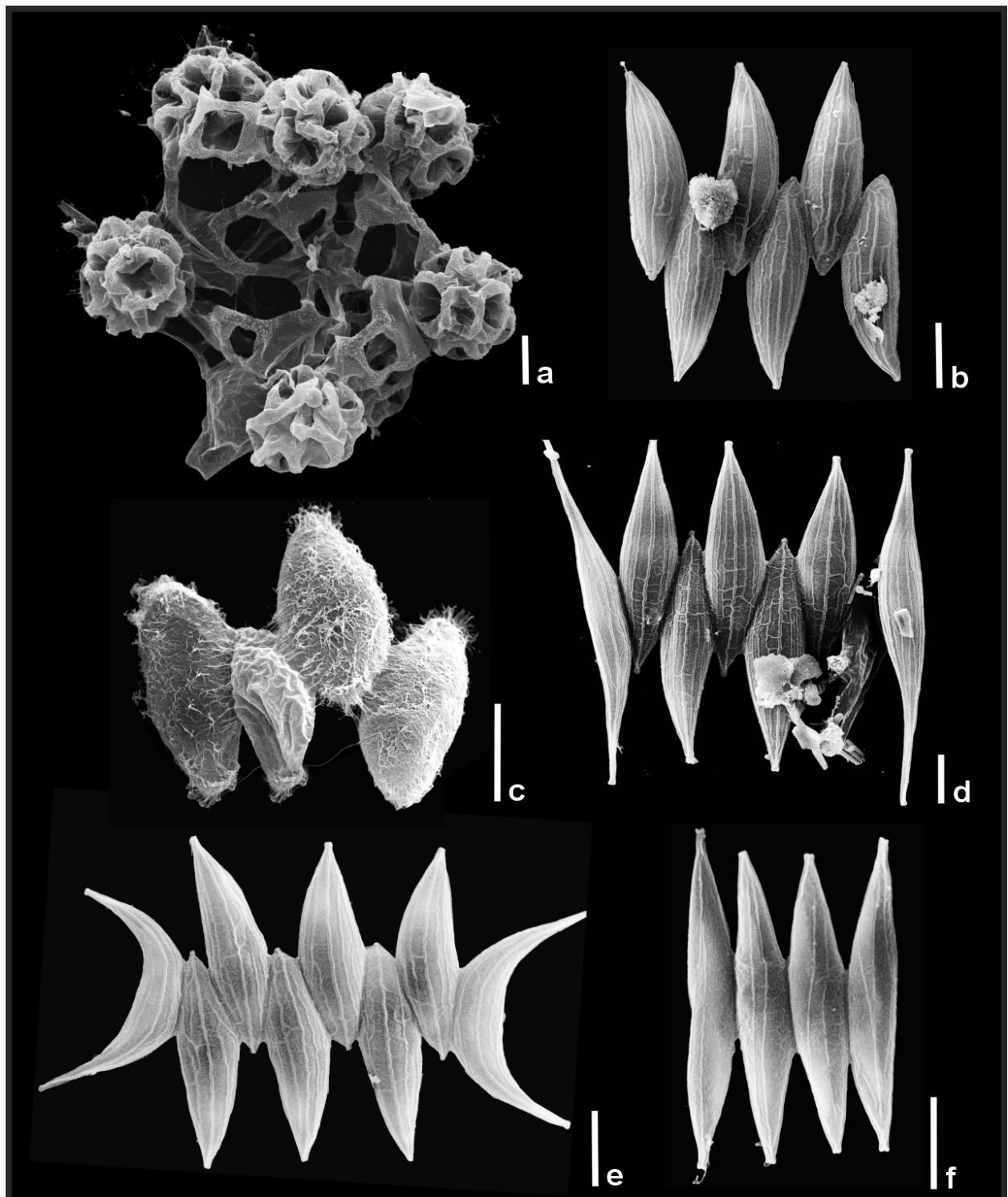


Figure 11. Scanning electron microscopy of Chlorophyta taxa. a) *Hariotina reticulata*, b) *Scenedesmus baculiformis*, c) *S. obtusus*, d) *Tetradesmus dimorphus*, e) *T. lagerheimii*, f) *T. obliquus*. Bar: 5 μm .

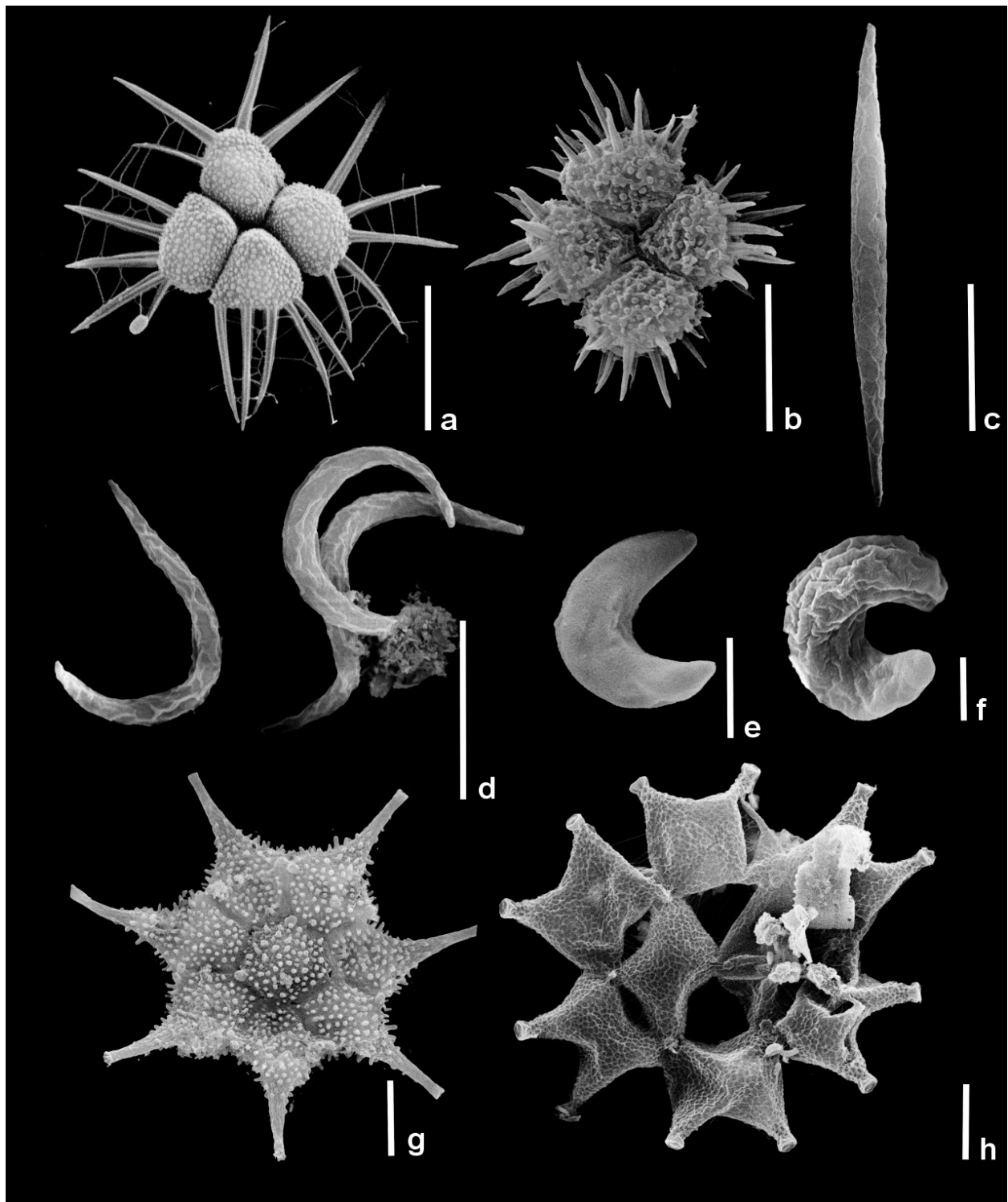


Figure 12. Scanning electron microscopy of Chlorophyta taxa. a) *Tetrastrum heteracanthum*, b) *T. staurogeniiforme*, c) *Monoraphidium griffithii*, d) *M. circinale*, e-f) *M. nanum*, g) *Monactinus simplex* var. *echinulatum*, h) *Pediatrux duplex*. Bar: 5 μ m

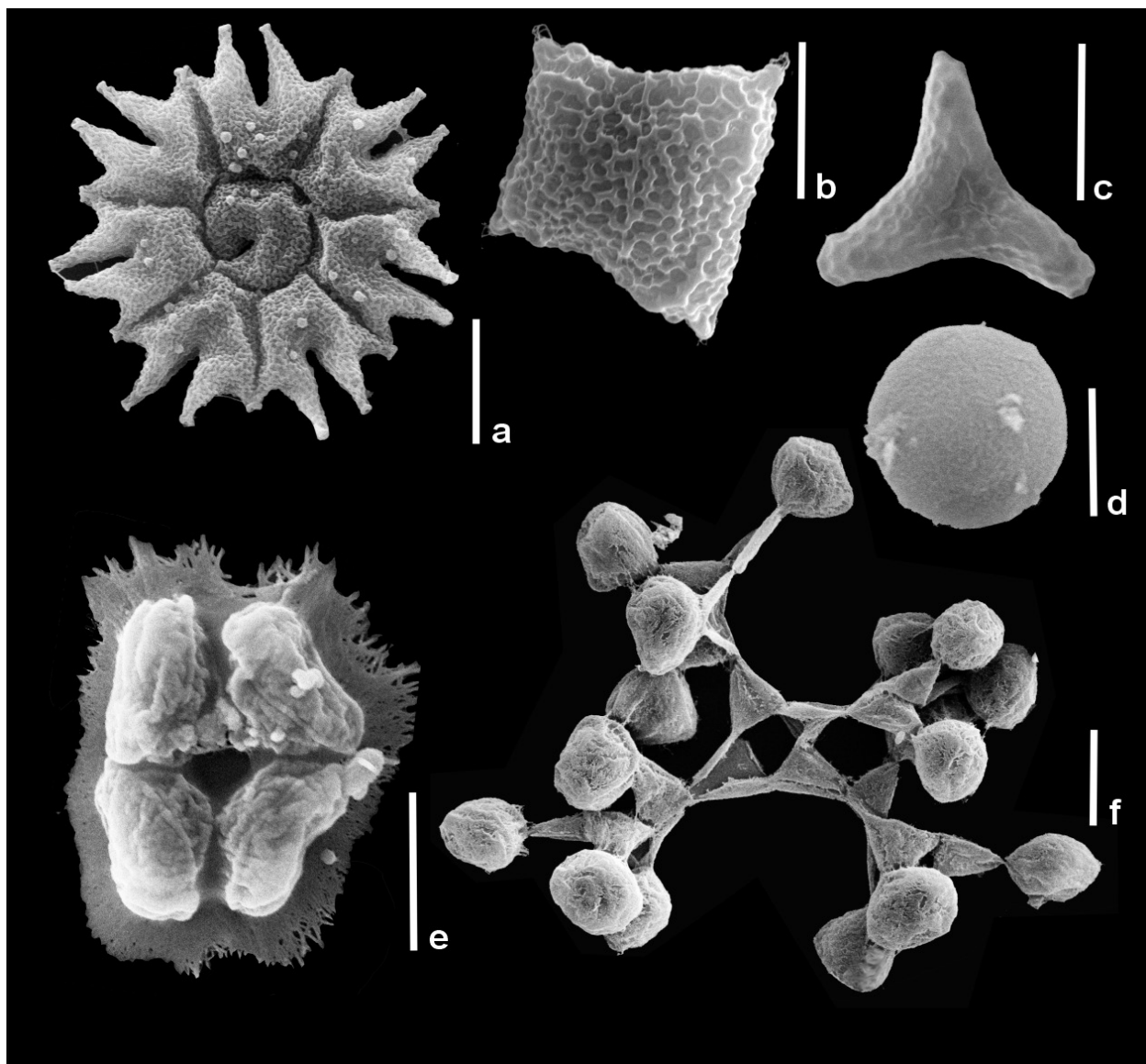


Figure 13. Scanning electron microscopy of Chlorophyta taxa. a) *Stauridium tetras*. b) *Tetraëdron minimum*, c) *T. tumidulum*, d) *Chlorella* sp., e) *Willea crucifera*, f) *Dictyosphaerium ehrenbergianum*. Bar: 5 µm.

Although the Municipal Environmental Code, through Complementary Law No. 1612/92, established minimum preservation areas around water bodies, which are 30 m for lakes and ponds, 50 m for water holes and springs, and 100 m for some ponds in the urban area, framed as Permanent Protection Areas (APP), disorderly urban expansion and a lack of municipal supervision have caused environmental degradation in the ponds (Santo et al. 2021).

Analyzing the physicochemical properties of a body of water and its biotic communities is an excellent tool for evaluating environmental changes, whether anthropogenic or natural (Kruk et al. 2012, Barreto et al. 2013, Silva et al. 2016). The abiotic variables correlated with the taxa identified in the present study revealed different environmental preferences and tolerances. These occurred in well-oxygenated environments ($5.8\text{--}12.3\text{ mg L}^{-1}$), with high conductivity (400–1000

$\mu\text{S cm}^{-1}$), pH conditions ranging from neutral to slightly alkaline (pH 7-8), and an average water temperature showing little variation (26-27 °C) (Table II). Water transparency was reduced, ranging from 0.16-0.30 (m) in the Lagoa Grande and Laguneville ponds, and from 0.27-0.55 (m) in the Parque da Lagoa and Pindoba. This decrease in transparency can be attributed to the urban location of the ponds, which are subjected to continuous anthropogenic pressures. Lagoa Grande receives large amounts of domestic sewage (Riley et al. 2022).

The pH, water temperature (°C), and dissolved oxygen (mg L^{-1}) values recorded in this study are similar to those reported by Chellappa et al. (2008) and Oliveira et al. (2019) for water bodies in northeastern Brazil's semiarid region, respectively, the public dam of Cruzeta in Rio Grande do Norte and the reservoirs of Saco I and Cachoeira II in Pernambuco. In terms of phytoplankton representatives, our findings were comparable to those of Chellappa et al. (2008), who identified 42 taxa. Phytoplankton communities are intrinsically complex and are shaped by a series of environmental fluctuations (Çelekli et al. 2014, Oterler et al. 2018, Yang et al. 2022).

The NMDS analysis revealed significant differences in taxa composition among the ponds (PERMANOVA: $F = 18.553$, $p < 0.001$) (Fig. 5).

The Laguneville pond had more variability in its samples than the other ponds, as evidenced by its distribution in the NMDS space, indicating greater heterogeneity in taxonomic composition, which may reflect disturbances in environmental conditions (Anderson et al. 2006).

The Parque da Lagoa, Lagoa Grande, and Pindoba, on the other hand, had a more aggregated distribution in the NMDS space, indicating a more homogeneous composition among the variables analyzed. According to Legendre & Legendre (2012), an aggregate

distribution may indicate more stable conditions over time or similar conditions between sampling sites.

The findings of this study show that despite anthropogenic pressure, urban aquatic bodies support diverse phytoplankton communities. The biodiversity found in ponds demonstrates the resilience of aquatic environments to anthropogenic influences. These findings highlight the critical need to take action to restore and conserve urban ponds in Feira de Santana. These measures are critical for preserving the health of these ecosystems and preventing biodiversity loss and ensuring the provision of critical ecosystem services, such as local climate regulation.

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AJSP and CWNM contributed to the concept, data collection, analysis, figures, and manuscript writing; GJPR, MAS, KLMB, and AT assisted in taxonomic identification and writing of the manuscript; PMV contributed to the study statistics and writing; AJSP wrote the first draft of the manuscript; and all authors provided feedback on previous drafts. The final manuscript has been read and approved by all authors.

