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Phytoplankton diversity in the middle Rio Doce lake system of southeastern Brazil

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ABSTRACT

This study presents results of the inventory of algal flora conducted between August 2007 and May 2008 in 18 lakes of the middle Rio Doce lake system, most of which is in the state of Minas Gerais, Brazil. We recorded 481 taxa, increasing the known total phytoplankton diversity of the region (gamma diversity) by 80%. The following classes were represented: Zygnematophyceae (171 taxa), Cyanobacteria (101), Chlorophyceae (71), Bacillariophyceae (42), Euglenophyceae (43), Trebouxiophyceae (24), Dinophyceae (8), Xanthophyceae (8), Chrysophyceae (6), Cryptophyceae (6) and Oedogoniophyceae (1). We identified 221 taxa that were rare (restricted to one or two lakes), and 101 that were considered representative (present in at least nine lakes). *Botryococcus braunii*, *Elakatothrix genevensis*, *Planktolyngbya limnetica*, *Peridinium pusillum*, *Trachelomonas volvocina*, *Cosmarium contractum*, *Staurastrum forficulatum*, *Staurastrum leptocladum*, *Staurastrum rotula,* and *Staurodesmus dejectus* were present in all lakes. Richness varied from 95 taxa (in Lake Gambazinho) to 168 taxa (in Lake Palmeirinha). Jaccard indices were low, and the highest similarities between lakes were 53% (Ferrugem/Ferruginha), 47% (Central/Almécega) and 46% (Águas Claras/Palmeirinha), demonstrating high environmental and biotic dissimilarities between lakes. Geographic distance was not significantly associated with floristic similarity, suggesting that local factors are more important than are regional ones in shaping the phytoplankton composition of lakes.

Key words: algal flora, inventory, tropical lakes

Introduction

Species richness is considered one of the simplest measures to express and quantify biological complexity in a given region (Nabout *et al.* 2007). In aquatic environments, species richness is influenced by several factors, including water temperature, mixing patterns of the water column, light, nutrient availability, and herbivory (Reynolds, 1987). Therefore, knowledge of richness patterns is essential to proposals for monitoring strategies and for biodiversity conservation activities (Downing & Leibold 2002; Declerck *et al.* 2005; Nogueira *et al.* 2008).

Diversity can be assessed on different scales. Local, or alpha, diversity is given by the total number of species in each habitat. Regional, or gamma, diversity is the total number of species observed in a range of habitats (Magurran 2004). The term beta diversity was introduced by Whittaker in the 1960s. At first the term was used in order to describe changes in species composition along gradients of altitude and humidity through differences in rates of gain and loss of species. However, beta diversity is now defined as the taxonomic difference between samples, whether occurring along an environmental gradient or not (Veech *et al.* 2002).

The middle Rio Doce lake system is a large freshwater system in southeastern Brazil, formed as a result of a mass of sediments (from the original drainages of Rio Doce and its tributaries) that acted as a natural dam, giving rise to a dense network of lakes (Pflug 1969 cited in de Meis & Tundisi 1997). The biological and ecological importance of the system was recently demonstrated by its recognition as an international Ramsar site, making it the 11th site in Brazil to be added to the Ramsar list of wetlands of international importance (Ramsar 2010).

Limnological research in the middle Rio Doce lake system was initiated in the 1970s (Tundisi & Saijo 1997). Since then, various aspects have been investigated (Barbosa & Tundisi 1980; Henry & Barbosa 1989; Rocha *et al.* 1989; Tundisi & Saijo 1997), increasing knowledge of the geological, morphological, physical, chemical, and biological characteristics of the lakes. However, specific studies on phytoplankton were mainly focused on Lake Dom Helvécio and Lake Carioca (Hino *et al.* 1986; Taniguchi *et al.* 2003;

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Barros *et al.* 2006; Souza *et al.* 2008). However, a recent survey evaluated plankton diversity in a larger number of lakes (Maia-Barbosa *et al.* 2006). Therefore, there is still little information on phytoplankton diversity in this lake system, as shown by Barbosa *et al.* (1994). The present study aims to contribute to the knowledge of phytoplankton diversity of this lake complex by presenting the results of an inventory of the algal flora in 18 lakes.

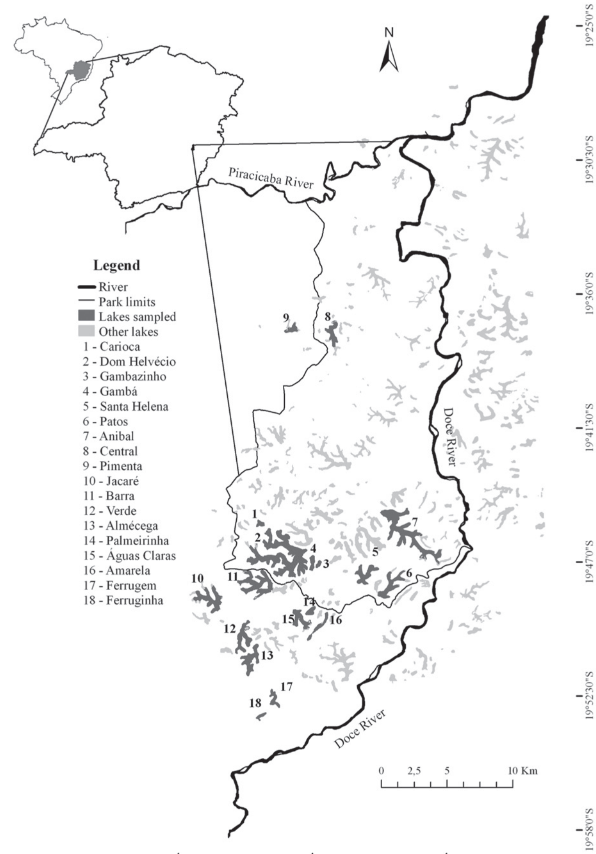

Figure 1. Middle Rio Doce lake system, showing the outline of Rio Doce State Park, sampled lakes (1 to 18), and limnetic fixed points of sampling (+). Digital base (shapefiles) provided by the Minas Gerais State Forestry Institute.

Material and methods

Study area

The Rio Doce basin is located at in southeastern Brazil, between the state of Minas Gerais (86% of the total area) and the state of Espírito Santo (14% of the total area), encompassing 83,400 km^2 (Marques & Barbosa, 2002). Two lake systems compose this basin: one, at the middle course, comprising ca. 250 lakes, distinct in their trophic status (Maillard *et al.* 2011), and another, at the lower course, comprising ca. 70 lakes (Cavati & Fernandes 2008). Approximately 50 lakes in the middle course are protected within Rio Doce State Park, a conservation unit created in 1939 and representing the largest contiguous remnant of the Atlantic Forest in Minas Gerais (359.76 km^2). Lakes located in the surrounding area are affected mainly by hardwood (*Eucalyptus* spp.) plantations and pastureland, among several municipalities.

For the purposes of this study, 18 lakes were selected: eight located inside the Rio Doce State Park limits and ten in the surrounding areas (Fig. 1; Tab. 1). In selecting the lakes, we took into account their greatest physiographic differences and their accessibility, mainly during the rainy (summer) season. The climate of the region is classified as tropical semi-humid with 4-5 months of dry weather, exhibiting mesothermal characteristics (Nimer, 1989) with temperatures of approximately 25°C. According to Tundisi (1997), the monthly precipitation is highest in December (350 mm) and lowest in July and August (10 mm).

Samplings

Field work was conducted quarterly, in August 2007, November 2007, February 2008, and May 2008. Samples were collected from a fixed point in the limnetic region of each lake. Samplings were authorized by the Minas Gerais State Forestry Institute (permit no. 005/07). Water transparency was estimated *in situ* by Secchi disk measurements (Cole 1983). Samples were collected for total phosphorus quantification (Mackereth *et al*. 1978).

Samples for qualitative analysis of phytoplankton were collected by successive vertical and horizontal throws with a 20-µm mesh plankton net, then fixed with 4% formaldehyde solution. For each qualitative sample (four samples/lake), eight slides were analyzed, for a total of 32 slides per lake. Organisms were identified under light microscopy down to the lowest possible taxonomic level using a specific bibliography: Föster (1969; 1974), Prescott *et al.* (1975; 1977; 1981; 1982), Komárek & Fott (1983), Sant'Anna (1984), Komárek & Anagnostidis (1989; 1999), Menezes *et al.* (1995), and Bicudo & Menezes (2006). Samples for quantitative analyses were collected with van Dorn bottles at three depths (100%, 10%, and 1% of incident light, as defined with Secchi disk measurements) and fixed with Lugol's solution. Quantitative analysis followed the method described by Utermöhl (1958).

Data analysis

For each lake, species richness was assessed on the basis of the number of taxa identified, considering the qualitative and quantitative data. Species richness for the sampled region (gamma diversity) was estimated with the first-order jackknife estimator (Nabout *et al.* 2007), using Stimate S software (Colwell 2006). Beta diversity was estimated by the difference between gamma diversity (total species recorded for the set of lakes) and average alpha diversity (mean species richness per lake), as suggested by Crist *et al.* (2003):

$$\beta = \gamma - \text{mean } \alpha$$

Table 1. Geographic coordinates, depth, margin development index, area, transparency, and total phosphorous concentration of 18 lakes sampled in the middle Rio Doce lake system, between August 2007 and May 2008.

Location	Lake (abbreviation)	Geographic coordinates	Depth (m)	DL	Area (km²)	Secchi (m)	Total phosphorous (μg/L)
State Park	Aníbal (AN)	19°06'47.1"S; 42°29'54.5"W	6.0	4.29	2.79	2.44 ± 0.13	30.12 ± 18.74
	Carioca (CA)	19°45' 26.0"S; 42°37'06.2"W	10.0	1.28	0.13	1.70 ± 0.32	17.31 ± 6.75
	Central (CE)	19°37'39.0"S; 42°34'12.5"W	5.0	2.03	0.44	0.81 ± 0.18	30.44 ± 10.72
	Dom Helvécio (DH)	19°46'55.7"S; 42°35'28.9"W	28.0	4.93	5.27	2.48 ± 0.55	20.13 ± 8.86
	Gambá (GA)	19°47'15.1"S; 42°35'01.0"W	12.0	1.13	0.22	3.23 ± 0.67	13.27 ± 4.46
	Gambazinho (GN)	19°47'07.7"S; 42°34'45.5"W	10.0	2.9	0.09	1.78 ± 0.22	23.29 ± 8.51
	Patos (PT)	19°48'19.9"S; 42°32'12.7"W	8.0	2.01	1.09	2.47 ± 0.82	27.33 ± 6.69
	Santa Helena (SH)	19°47'48.8"S; 42°33'04.7"W	10.5	2.42	0.86	2.26 ± 0.44	26.77 ± 11.81
Surroundings	Águas Claras (AC)	19°49'06.9"S; 42°35'42.5"W	9.5	2.24	0.62	3.28 ± 1.35	16.16 ± 7.35
	Almécega (AL)	19°51'25.4"S; 42°37'31.9"W	7.0	2.44	1.3	2.81 ± 0.55	19.21 ± 14.10
	Amarela (AM)	19°49'23.1"S; 42°34'28.7"W	2.5	1.82	0.27	0.86 ± 0.11	75.46 ± 64.80
	Barra (BA)	19°48'11.1"S; 42°37'43.6"W	7.0	3.45	1.94	2.45 ± 0.76	47.91 ± 32.13
	Ferrugem (FE)	19°52'39.0"S; 42°36'34.3"W	3.5	1.61	0.42	0.93 ± 0.25	49.96 ± 21.92
	Ferruginha (FN)	19°53'17.5"S; 42°36'59.4"W	4.0	1.4	0.12	1.03 ± 0.05	32.99 ± 12.53
	Jacaré (JA)	19°48'37.8"S; 42°38'57.0"W	8.5	1.28	1.22	1.95 ± 0.17	42.49 ± 18.30
	Palmeirinha (PA)	19°49'41.8"S; 42°36'25.4"W	6.0	2.83	0.23	2.26 ± 0.60	28.36 ± 17.93
	Pimenta (PI)	19°37'27.4"S; 42°35'44.3"W	3.5	1.63	1.24	1.13 ± 0.25	37.78 ± 22.38
	Verde (VE)	19°49'55.2"S; 42°37'54.1"W	19.0	2.29	0.83	2.19 ± 0.58	14.38 ± 4.24

DL – development index.

where β is beta diversity, γ is gamma diversity, and α is alpha diversity.

Differences in relation to water transparency and total phosphorus levels were determined using ANOVA. Spearman's correlation coefficient was used in order to test for relationships between the morphometric features (area, depth, and margin development index) and physico--chemical variables. Hierarchical cluster analysis using Jaccard distance and Ward's method (Ward 1963) were performed in order to assess similarity between lakes in terms of the phytoplankton species composition. These statistical analyses were conducted using Past 1.90 software (Hammer *et al.* 2001).

Results and discussion

Morphometric features, such as depth, margin development index, and area, varied among lakes (Table 1). Secchi depth and total phosphorus concentrations also differed among lakes (F=996.888; p=0.000 and F=730.533; p=0.000, respectively) and correlated with depth ($p<0.05$; r=0.630 for Secchi disk measurements and r=0.596 for total phosphorus concentrations). Lakes that were shallower (<5 m: Pimenta, Central, Amarela, Ferrugem, and Ferruginha) showed lower Secchi disappearance depths (>1.2 m) and higher levels of total phosphorus (>30 μg/L; especially Lakes Amarela and Ferrugem, in which total phosphorus was >50 μg/L), than did the lakes that were deeper (>7 m: Dom Helvécio, Águas Claras, Almécega, Gambá, and Verde), which showed greater water transparency (down to 2.2 m) and lower values of the trophy indicator (below 21 μg/L of phosphorus).

Richness extrapolation indices, such as the jackknife, although not usually used for phytoplankton (Nabout *et al.* 2007; Nogueira *et al.* 2008), can be important tools to assess the representativeness of the sampling effort. In the present study, a total of 481 taxa were recorded (Fig. 2), corresponding to 77% of the expected richness, estimated using first-order jackknife (jackknife 1 = 624). The relationship between the observed and estimated values for richness indicated that our methods were appropriate for a diversity survey. In addition, the known phytoplankton diversity in the middle Rio Doce lake system was high in comparison with the 267 species reported for seven lakes in the system by Maia-Barbosa *et al.* (2006). Gamma diversity increased by 80% with the expansion of the number of studied environments, reinforcing the observed environmental and biotic heterogeneity.

Eleven classes were identified: Zygnematophyceae (171 taxa), Cyanobacteria (101), Chlorophyceae (71), Bacillario-

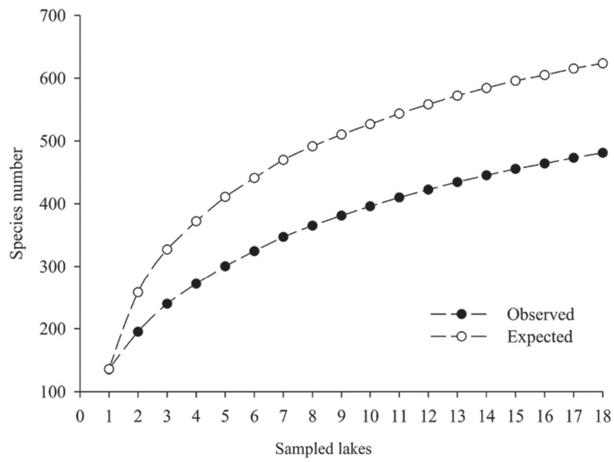

Figure 2. Species accumulation curve of 18 lakes sampled in the middle Rio Doce lake system, between August 2007 and May 2008.

phyceae (42), Euglenophyceae (43), Trebouxiophyceae (24), Dinophyceae (8), Xanthophyceae (8), Chrysophyceae (6), Cryptophyceae (6) and Oedogoniophyceae (1); Appendix 1. The predominance of desmids, especially those of the genera *Cosmarium*, *Staurastrum* and *Staurodesmus*, in the middle Rio Doce lakes was previously reported by Reynolds (1997), who attributed the dominance of this group to oligotrophic conditions and good preservation of the lakes. It has also been suggested that the thermal stratification pattern known as atelomixis (characterized by unusual, irregular circulation periods of short duration) is a key factor for desmid prevalence (Barbosa & Padisák 2002; Souza *et al.* 2008), because it allows these species, which have relatively high specific density (Padisák *et al.* 2003), to remain within the upper layers of the water column.

Of the 481 taxa identified, 221 were rare, occurring exclusively in one or two lakes, and 101 exhibited high frequency, occurring in at least nine lakes (Tab. 2). In addition, 10 species were common to all lakes: *Botryococcus braunii* Kützing, *Elakatothrix genevensis* (Reverdin) Hindák, *Planktolyngbya limnetica* (Lemmerman) Komárkova-Legnerová and Cronberg, *Peridinium pusillum* (Pénard) Lemmerman, *Trachelomonas volvocina* Ehrenberg, *Cosmarium contractum* Kirchner, *Staurastrum forficulatum* Lundell, *Staurastrum leptocladum* Nordstedt, *Staurastrum rotula* Nordstedt, and *Staurodesmus dejectus* (Brébisson) Teiling.

Phytoplankton richness ranged from 95 taxa (Lake Gambazinho) to 168 taxa (Lake Palmeirinha). In general, the most representative groups for each lake were the same observed for the data set: Zygnematophyceae > Chlorophyceae > Cyanobacteria; exceptions occurred for Lake Amarela, where the number of Euglenophyceae species (25) exceeded that of Cyanobacteria species (15), and for Lake Gambazinho, which had more Bacillariophyceae species (22) than Cyanobacteria species (12) (Fig. 3). The predominance of Euglenophyceae in Lake Amarela, previously reported by Reynolds (1997), is associated with its late successional stage, shallowness, and broad macrophyte coverage of the surface area, mainly with *Nymphaea* sp., *Utricularia* sp., and *Eleocharis* sp.

Table 2. List of the most common species in the 18 lakes sampled in the middle Rio Doce lake system between August 2007 and May 2008

50-79%			*80-100%*	
Bacillariophyceae	**Chrysophyceae**	**Oedogoniophyceae**	**Bacillariophyceae**	**Euglenophyceae**
Cyclotella sp.	*Dinobryon bavaricum*	*Oedogonium* NI	*Synedra acus*	*Trachelomonas volvocina*
Encyonema sp. 1	*Dinobryon sertularia*	**Xanthophyceae**	**Chlorophyceae**	**Zygnemaphyceae**
Eunotia lineolata	**Cryptophyceae**	*Isthmochloron lobulatum*	*Botryococcus braunii*	*Cosmarium asphaerosporum*
Gomphonema gracile	*Cryptomonas* sp2	*Tetraplekton* sp1	*Botryococcus terribilis*	*Cosmarium contractum*
Stenopterobia curvula	*Cryptomonas* sp4	**Zygnemaphyceae**	*Chlorella* sp.	*Cosmarium moniliforme*
Urosolenia cf. *longiseta*	*Cryptomonas* sp5	*Cosmarium bioculatum*	*Closteriopsis* sp. 1	*Cosmarium pseudoconnatum*
Chlorophyceae	**Cyanobacteria**	*Cosmarium depressum*	*Elakatothrix genevensis*	*Staurastrum forficulatum*
Ankistrodesmus fusiformis	*Anabaena* cf. *solitaria*	*Cosmarium monomazum*	*Eutetramorus planctonicus*	*Staurastrum ionatum*
Ankistrodesmus sp.2	*Aphanocapsa delicatissima*	*Cosmarium quadrum*	*Monoraphidium contortum*	*Staurastrum laeve*
Botryococcus protuberans	*Aphanocapsa* sp.	*Micrasterias truncata*	Monoraphidium sp.	*Staurastrum leptocladum*
Coelastrum pulchrum	*Coelomorum* sp.	*Spondylosium panduriforme*	*Nephrocytium agardhianum*	*Staurastrum rotula*
Coelastrum reticulatum	*Coelosphaerium* sp.	*Staurastrum cerastes*	*Oocystis* sp. 4	*Staurastrum smithii*
Coelastrum sphaericum	*Cylindrospermopsis raciborskii*	*Staurastrum* cf. *muticum*	*Tetraedron caudatum*	*Staurastrum trifidum*
Crucigenia tetrapedia	*Limnothrix redekei*	*Staurastrum chaetoceras*	**Cryptophyceae**	*Staurastrum* sp5
Crucigeniella retangularis	*Lyngbya* sp.	*Staurastrum manfeldtii*	*Cryptomonas brasiliensis*	*Staurodesmus crassus*

Continues

Table 2. Continuation.

50-79%			*80-100%*	
Desmodesmus armatus	*Merismopedia tenuissima*	*Staurastrum setigerum*	**Cyanobacteria**	*Staurodesmus dejectus*
var. *bicaudatus*	*Microcystis aeruginosa*	*Staurastrum tetracerum*	*Aphanocapsa elachista*	*Staurodesmus jaculiferus*
Dictyosphaerium pulchellum	*Oscillatoria* sp1	*Staurastrum* sp6	*Chroococcus minutus*	*Staurodesmus* sp3
Keratococcus sp.	*Planktolyngbya contorta*	*Staurodesmus convergens*	*Planktolyngbya limnetica*	*Teilingia granulata*
Kirchneriella lunaris	*Pseudanabaena limnetica*	*Staurodesmus cuspidatus*	*Pseudanabaena galeata*	
Oocystis lacustris	**Dinophyceae**	*Staurodesmus subulatus*	**Dinophyceae**	
Oocystis sp. 3	*Peridinium* cf. *africanum*		*Gymnodynium* sp.	
Scenedesmus bijugus	**Euglenophyceae**		*Peridinium pusillum*	
Scenedesmus quadricauda	*Phacus longicauda*		*Peridinium baliense*	
Tetraedron minimum	*Phacus raciborskii*			

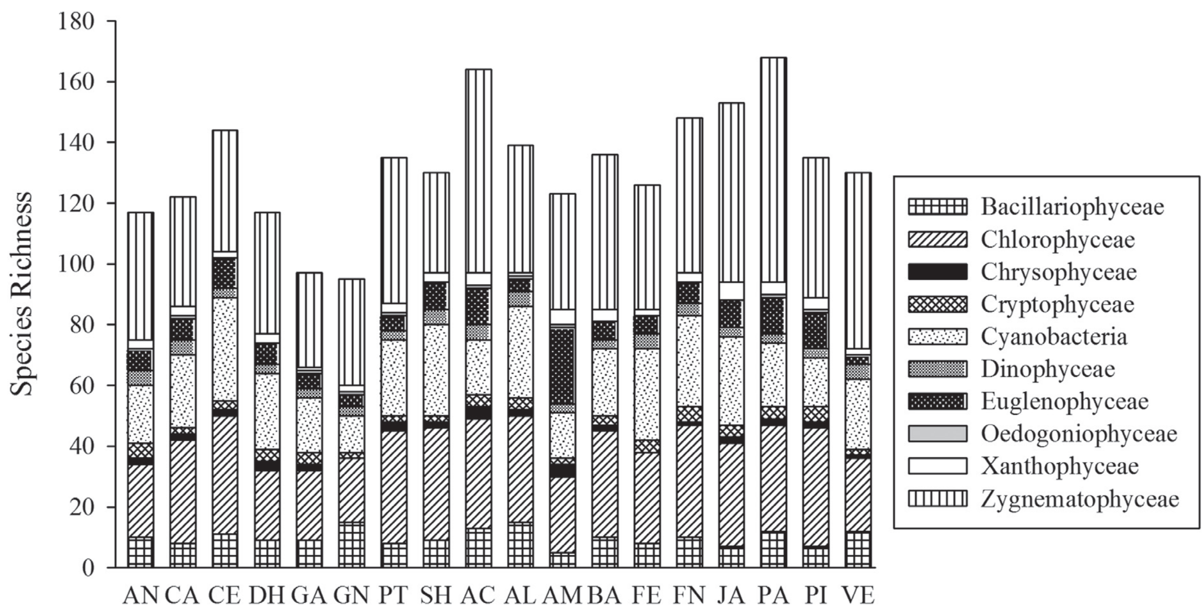

Figure 3. Species richness and contribution of each taxonomic class of 18 lakes sampled in the middle Rio Doce lake system, between August 2007 and May 2008: Águas Claras (AC), Almécega (AL), Amarela (AM), Aníbal (AN), Barra (BA), Carioca (CA), Central (CE), Dom Helvécio (DH), Ferrugem (FE), Ferruginha (FN), Gambá (GA), Gambazinho (GN), Jacaré (JA), Palmeirinha (PA), Patos (PT), Pimenta (PI), Santa Helena (SH), and Verde (VE).

Lake Amarela showed the highest number of exclusive taxa (26), followed by Lakes Gambazinho (15), Jacaré (13), and Palmeirinha (13). The lowest numbers of exclusive species were observed in Lakes Ferrugem (1), Carioca (2), and Ferruginha (2).

The fact that the incidence of exclusive species was highest in Lakes Amarela and Gambazinho indicates the great importance of the shoreline regions, given that, in the case of Lake Gambazinho, the main representative species were diatoms of the order Pennales (6 taxa) and large desmids (5 taxa), the latter also prevailing in Lake Amarela (12 taxa), together with Euglenophyceae (7 taxa). Those two lakes are quite distinct from the other lakes of the region and from those presented here. In Lake Amarela, high amounts of organic matter reflect its advanced state of eutrophication, as evidenced by the total phosphorous and transparency values. Lake Gambazinho has a polymictic pattern of thermal stratification, in contrast to the more common warm-monomictic pattern of thermal stratification observed in the majority of the middle Rio Doce lakes. Such characteristics seem to have been responsible for the higher numbers of typically periphytic species in the samples collected from these lakes.

We obtained low Jaccard indices. The highest similarities were 53% for Lake Ferrugem versus Lake Ferruginha, followed by 47% for Lake Central versus Lake Almécega, and 46% for Lake Águas Claras versus Lake Palmeirinha. Lake Amarela showed the lowest similarity with the other lakes, ranging from 14% to 25%.

On the basis of phytoplankton species composition, we identified five clusters of lakes (Fig. 4): cluster 1-Lakes Aníbal, Carioca, Pimenta, Dom Helvécio, and Santa Helena; cluster 2-Lakes Central, Almécega, Ferrugem, and Ferruginha; cluster 3-Lakes Águas Claras, Palmeirinha, Patos, Barra, Jacaré, and Verde; cluster 4-Lakes Gambá and Gambazinho, and cluster 5-Lake Amarela. Geographic distance between lakes did not correlate significantly with interlake similarity in phytoplankton composition ($r = 0.03$; $p > 0.05$).

With the exception of a few pairs of lakes that are geographically proximal and were all included in the same cluster-Gambá and Gambazinho (500 m apart); Ferrugem and Ferruginha (1200 m apart); and Águas Claras and Palmeirinha (1500 m apart)-it should be noted that the clusters were composed of lakes that were distant from one another, some located within the Rio Doce State Park and others located in the surrounding areas. In addition, the difference between the gamma diversity and the mean alpha diversity, considered here as an estimate of beta diversity, was high: 347 species. This suggests that the phytoplankton species composition of such lakes is more dependent on local factors than on regional factors.

Considering that diversity and rarity are important criteria for assessing the conservation value of a given region (Coesel 2001), the possibility of protecting the middle Rio Doce lake system as a whole should be considered. That will require specific strategies for the environments surrounding the state park, with the primary objective of maintaining phytoplankton diversity at the regional level.

Acknowledgments

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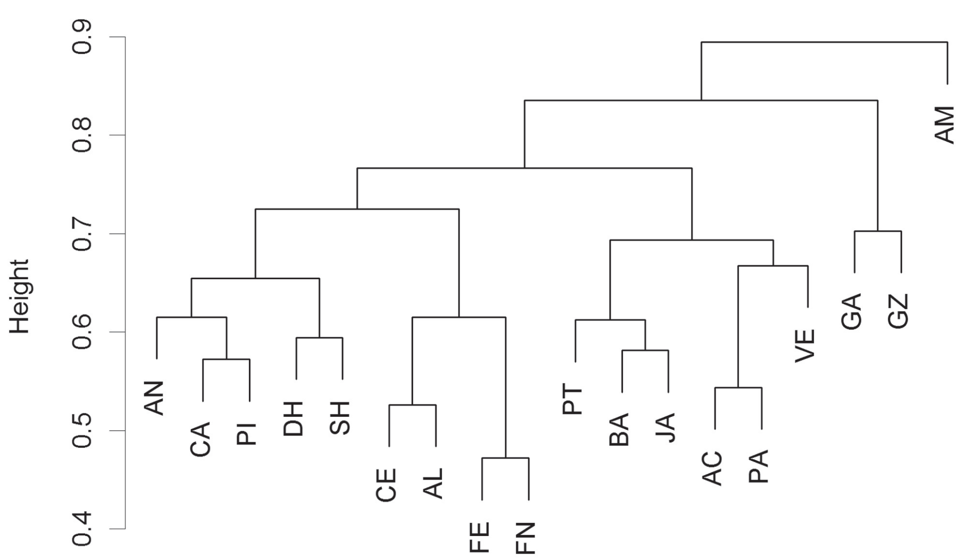

Figure 4. Cluster obtained from data of 18 lakes sampled in the middle Rio Doce lake system, between August 2007 and May 2008, considering presence and absence of species. Cluster 1-Aníbal (AN), Carioca (CA), Pimenta (PI), Dom Helvécio (DH), and Santa Helena (SH); Cluster 2-Central (CE), Almécega (AL), Ferrugem (FE), and Ferruginha (FN); Cluster 3-Águas Claras (AC), Palmeirinha (PA), Patos (PT), Barra (BA), Jacaré (JA), and Verde (VE); Cluster 4-Gambá (GA) and Gambazinho (GN); Cluster 5-Amarela (AM).

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Appendix 1. List of species recorded between August 2007 and May 2008 in the 18 lakes sampled in the middle Rio Doce lake system: **Águas Claras (AC), Almécega (AL), Amarela (AM), Aníbal (AN), Barra (BA), Carioca (CA), Central** (CE), Dom Helvécio (DH), Ferrugem (FE), Ferruginha (FN), Gambá (GA), Gambazinho (GN), Jacaré (JA), Palmeirinha (PA), Patos (PT), Pimenta (PI), Santa Helena (SH), and Verde (VE).

Taxa	Occurrence
Bacillariophyceae	
Aulacoseira ambigua (Grunow) Simonsen	GN; AL
Aulacoseira granulata (Ehrenberg) Simonsen	SH; AC
Aulacoseira sp. 1	CE; PT; AL; FE; FN; VE
Aulacoseira sp. 2	AL; FN
Caloneis cf.	GN
Cyclotella sp.	All except GA, PT; FE, FN
Encyonema sp. 1	AN; CA; CE; PT; SH; AC; FN; PA; VE
Encyonema sp. 2	DH; SH; FE; JA
Encyonema sp. 3	GN
Encyonema sp. 4	JA
Eunotia lineolata Hustedt	All except CA, GA, GN, PT
Eunotia zygodon Ehrenberg	GA; PT
Eunotia sp. 1	AN; CA; GA; SH; AC; AL; PA
Eunotia sp. 2	DH; AC
Eunotia sp. 3	GN; AL; PA
Eunotia sp. 4	PT; AC; VE
Eunotia sp. 5	GN
Frustulia crassinervia (Brébisson) Costa	GN; PA; VE
Frustulia krammeri Lange-Bertalot e Metzeltin	CE; GA; GN
Frustulia sp. 1	FN
Gomphonema gracile Ehrenberg	All except CA; GA; GN
Gomphonema subtile Ehrenberg	PI
Hantzschia amphioxys (Ehrenberg) Grunow	GA
Melosira varians Agardh	AL; VE
Navicula sp.	CE; DH; PT; AL; BA; FN; PA; VE
Neidium sp.	GA; GN; BA
Nitzschia sp.	AN
Pinnularia viridis (Nitzsch) Ehrenberg	AN; CA; CE; AC; BA
Pinnularia sp. 1	AL
Pinnularia sp. 2	GN
Pinnularia sp. 3	GN
Pinnularia sp. 4	AC
Pinnularia sp. 5	PA
Stauroneis phoenicenteron (Nitzsch) Ehrenberg	GN; AM
Stenopterobia curvula (Wm. Smith) Krammer	All except CE; SH; AL; AM; JA
Surirella linearis W. Smith	CA; GN; AL; VE
Synedra acus Kützing	All except GN; VE
Urosolenia cf. *eriensis* (H.L.Smith) Round & R.M. Crawford	GA; BA
Urosolenia cf. *longiseta* (Zacharias) Edlung & Stoermer	AN; CA;CE; DH;GA;SH;AC;AL; FE; FN; PA; PI; VE
Pennales NI 1	GN;
Pennales NI 2	CE; AL; FE; VE
Pennales NI 3	BA; JA

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Chlorophyceae	
Ankistrodesmus densus Korsikov	CE; SH; VE
Ankistrodesmus falcatus (Corda) Ralfs	FN
Ankistrodesmus fusiformis Corda	CA;CE; DH; GA; PT;SH; AC;AL; BA; FE; JA; PI
Ankistrodesmus gracilis (Reinsch) Korsikov	AC
Ankistrodesmus spiralis (Turner) Lemmermann	PT; FN; PA; VE
Ankistrodesmus sp. 1	SH
Ankistrodesmus sp. 2	CA; DH; GA; PT; AC; AM; BA; FE; PA; VE
Ankyra judayi (G.M. Smithi) Fott	CE; PT; SH; AL; AM; PI; VE
Chlamydomonadaceae NI2	AC; PA
Coelastrum cambricum Archer	CE; GA; AL; FE; FN; PA; PI
Coelastrum microporum Nägeli	CE; PT; AL; JA
Coelastrum pseudomicroporum Korsikov	JA
Coelastrum pulchrum Schmidle	CE; DH; GN; SH; AC; JA; PA; PI; VE
Coelastrum reticulatum (P.A.Dangeard) Senn	AN; CA; CE; GN; PT; AL; FE; FN; PI; VE
Coelastrum sphaericum Nägeli	AN; CA; CE; AC; AL; FE; JA; PA; VE
Desmodesmus armatus var. *bicaudatus* (Guglielmetti) Hegewald	CA; CE; SH; AC; BA; FN; JA; PA; PI
Desmodesmus denticulatus (Lagerheim) S.S.An, T.Friedl & E.Hegewald	AN; AC; PA; PI
Dimorphococcus cf. *lunatus* A. Braun	AC; AM
Elakatothrix cf. *biplex* (Nyg.) Hindák	GN
Elakatothrix genevensis (Reverdin) Hindák	All lakes
Eudorina elegans Ehrenberg	DH; PT; BA; PA
Eutetramorus planctonicus (Korsikov) Bourrely	All except AN; DH; AM
Glaucocystis cf. *nostochinearum* Itzigsohn	SH
Gloeomonas sp.	AN; CE; SH; VE
Golenkinia radiata Chodat	CA; AC; BA; JA; PA
Gregiochloris cf.	PI
Kirchneriella lunaris (Kirchner) K. Möbius	All except AN; PT; SH; JA
Kirchneriella cf. *obesa* (W.West) Schmidle	CA; CE; AL; FN
Kirchneriella roselata Hindák	PT; SH
Korschikoviella sp.	AM
Monoraphidium contortum (Thuret) Komàrková-Legnerová	All except GA; AL; AM
Monoraphidium sp.	All except PI; VE
Nephrocytium agardhianum Nägeli	All except SH; PI; VE
Nephrocytium cf. *lunatum* W. West	AM
Pectodictyon aff.	DH
Pediastrum duplex Meyen	CA; AC; PI
Pediastrum sp. 1	AM
Planktonema cf.	PT; SH
Quadrigula closterioides (Bohlin) Printz	CE; DH; PT; AL; FN; PA
Radiococcus cf.	PT; SH; VE
Scenedesmus acuminatus (Lagerheim) Chodat	CA; CE; SH; AC; BA; FE; FN; PI
Scenedesmus acuminatus f. *maximus* Uherkovich	JA; PI
Scenedesmus arcuatus Lemmermann	AN; CE; AC; BA; PI

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Scenedesmus bijugus (Turpin) Kutzing	All except DH; GA; FE; PI
Scenedesmus bijugus var. *disciformis* (Chodat) Leite	PT; AC; BA; FN; JA; PA; PI
Scenedesmus acunae Comas	GN; AC; PA
Scenedesmus quadricauda (Turpin) Brébisson	CA; GN; SH; AC; AL; FE; FN; PA; PI; VE
Scenedesmus regularis Swir	PI
Scenedesmus spinosus Chodat	CE; AL
Selenastrum sp. 1	GA; FN
Sphaerocystis sp. 1	CE; GA; PT; BA; FE
Sphaerocystis sp. 2	AL
Stauridium privum (Printz) Hegewu	PT; AL; BA; FN; PA; PI
Stauridium tetras (Ehrenberg) Ralfs	FN; PI
Tetraedron caudatum (Corda) Hansgirg	All except AM
Tetraedron incus (Teiling) G.M. Smithi	GA; PT; BA
Tetraedron minimum (A. Braun)	AN; CA;CE;DH;GA; PT; AL;BA; FE; FN; JA;PA
Tetrallantos lagerheimii Teiling	DH; SH; AC; FE; FN; JA; PI
Tetranephris brasiliense Leite & C. Bicudo	CA; SH
Tetranephris cf.	CA; DH
Ulothrix sp. 1	PI
Ulothrix sp. 2	AM
Ulothrix sp. 3	AM
Volvocales NI	SH; PI
Chaetophorales NI	GN
Chlorococcales NI1	GA; FN
Chlorococcales NI2	GN
Chlorococcales NI3	JA
Chlorococcales NI4	SH
Chlorococcales NI5	SH
Chrysophyceae	
Dinobryon bavaricum Imhof	CA; CE; DH; GA; PT; AC; AL; AM; JA; PA; PI
Dinobryon sertularia Ehrenberg	All except GN; PT; FE; JA
Dinobryon sp.	AC
Mallomonas cf.	PT; SH; AC; AM; BA; JA
Pteromonas cf.	DH; PT; AM
Synura cf.	AN
Cryptophyceae	
Cryptomonas brasiliensis Castro, C. Bicudo & D. Bicudo	All except PT; AM; VE
Cryptomonas marssonii Skuja	AN;GA;PT; AC; AL;AM; BA; FN; JA; PA;PI;VE
Cryptomonas sp. 1	AN; DH; AC; AL; PI
Cryptomonas sp. 2	CE; GA; AC; AM; FE; FN; JA; PA; VE
Cryptomonas sp. 3	All except SH; AC; AM; VE
Rhodomonas sp.	AN; DH; SH; FE; FN; PI
Cyanobacteria	
Anabaena planctonica Brunnthaler	PT; AL; PA
Anabaena cf. *solitaria* Klebahn	AN; DH; GA; PT; SH; AM; FE; JA; PA; PI

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Anabaena sp. 1	AM
Anabaena sp. 2	DH; SH; AC; FE; JA; PI; VE
Anabaena sp. 3	CA; AL; BA; JA
Aphanizomenon sp.	AN
Aphanocapsa delicatissima W. West & G. S. West	CA; CE; GA; GN; PT; SH; AL; BA; FE; FN; JA; VE
Aphanocapsa elachista W.West & G.S.West	All except AM
Aphanocapsa holsatica (Lemmermann) Cronberg & Komárek	GA; GN; PT; JA
Cyanobacteria	
Aphanocapsa planctonica (G.G.Smith) Komárek et Anagnostidis	CE; AL
Aphanocapsa sp.	AN; CA; CE; SH; AL; BA; FE; FN; PI; VE
Aphanothece cf. *stagnina* (Sprengel) A Braun	AN; DH; SH; AL; FE; VE
Aphanothece sp. 1	CE; GA; GN; FN
Aphanothece sp. 2	FE
Aphanothece sp. 3	CA; DH; SH
Aphanothece sp. 4	JA; PA
Asterocapsa sp.	CA; SH; JA
Calothrix sp.	CA; DH; PT; AC; AL; AM; PA
Chroococcus minutus (Kütz) Nägeli	All except GN; PI
Chroococcus sp. 1	PT; AM; JA
Coelomorum sp.	CE; DH; SH; AC; AL; FE; FN; JA; VE
Coelosphaerium sp. 1	CA; CE; DH; GN; SH; AL; BA; FE; FN; JA
Coelosphaerium sp. 2	SH
Cyanodictyon cf. *iac* Cronberg & Komárek	AL; FN; VE
Cyanodictyon imperfectum Cronberg & Weibull	CE; AL; FE; FN
Cylindrospermopsis raciborskii (Woloszynska) Seenayya & Subba Raju	DH; PT; SH; AL; BA; FE; FN; PI; VE
Epigloeosphaera sp. 1	CE; DH; PT; SH; AL; FE; FN; PA
Epigloeosphaera sp. 2	CE; FE; FN
Eucapsis sp.	CE
Geitlerinema cf. *amphibium* (Agardh ex Gomont) Anagnostidis	AN; DH; SH
Geitlerinema splendidum (Greville ex Gomont) Anagnostidis	AN; PT; AM
Geitlerinema unigranulatum (Singh) Komárek & Azevedo	CE; AC; JA
Johannesbaptistia sp.	AM
Leptoplyngbya sp.	AC; AM
Limnothrix redekei (Van Goor) Meffert	All except AL; AM; JA; PA
Lyngbya sp.	AN; CA; CE; DH; PT; AC; AM; BA; JA; VE
Merismopedia glauca (Ehrenberg) Kützing	AN; CA; PT; BA; FE; FN
Merismopedia tenuissima Lemmermann	All except AN; GN; AM; VE
Microcrocis cf.	JA
Microcystis aeruginosa (Kützing) Kützing	CA; CE; PT; SH; AL; BA; FE; FN; JA; PA; VE
Microcystis novacekii (Komárek) Compère	SH; FE; JA
Microcystis protocystis Crow	CA; CE; SH; AL; BA; FE; JA; VE
Microcystis wesenbergii Komárek	AN; SH; AL; FN; JA
Nostoc sp. 1	VE
Nostoc sp. 2	SH

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Nostoc sp. 3	BA
Oscillatoria sp. 1	CA;DH; GA; PT; SH;AC; AM; BA; FN;JA;PA;PI
Oscillatoria sp. 2	AN; CE; AM; FE; FN; JA; PA; VE
Planktolyngbya contorta (Lemmermann) Anagnostidis & Komárek	CA;CE;DH;GA;GN; SH; AL; BA; FE; FN; PI; VE
Planktolyngbya microspira Komárek et Cronberg	GN; BA
Planktolyngbya sp.	VE
Planktolyngbya limnetica (Lemmermann) J.Komárková-Legnerová & G.Cronberg	All lakes
Planktothrix sp.	CA; DH; AC; AM
Porphyrosiohon cf.	DH
Pseudanabaena catenata Lauterborn	AN; SH; BA; VE
Pseudanabaena galeata Böcher	All except AN; AM; PA
Pseudanabaena limnetica (Lemmermannn) Komárek	AN; CA; CE; GA; AL; BA; FE; FN; PA; PI; VE
Pseudanabaena mucicola (Nauman & Hubber-Pestalozzi) Bourrelly	DH; GN; FE
Pseudanabaena sp. 1	AN; PT; PI
Pseudanabaena sp. 2	SH; AC; JA; PA
Rabdoderma cf.	FN
Radiocystis cf.	CE; GA
Radiocystis fernandoi Komárek & Komárkova-Legnerová	SH; AL; FE; FN
Raphidiopsis cf.	CE
Snowella cf.	JA
Sphaerocavum brasiliense Azevedo & Sant'Anna	DH
Spirulina sp. 1	PT; PI
Spirulina sp. 2	PT; AM
Synechococcus cf.	DH; AC; JA; PA
Synechocystis cf.	AL; BA; FE
Chroococcales NI 1	CE; AL
Chroococcales NI 2	CE; AL
Chroococcales NI 3	PT; FN
Chroococcales NI 4	CE; FE
Chroococcales NI 5	CE
Chroococcales NI 6	FN
Chroococcales NI 7	GA
Chroococcales NI 8	SH
Chroococcales NI 9	PI
Chroococcales NI 10	CA
Chroococcales NI 11	CA; AM
Chroococcales NI 12	GA
Chroococcales NI 13	GA
Chroococcales NI 14	CE; DH; AL; FN
Chroococcales NI 15	AL; FE; FN
Chroococcales NI 16	CE; AL
Nostocales NI 1	CA; GN; AC; JA; VE
Nostocales NI 2	VE

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Nostocales NI 3	PA
Nostocales NI 4	PA
Nostocales NI 5	PI
Nostocales NI 6	PA
Oscillatoriales NI 1	CE; GA
Oscillatoriales NI 2	AN; CE; FN; PA
Oscillatoriales NI 3	AN
Pseudanabaenaceae NI 1	AC
Pseudanabaenaceae NI 2	CE; PA
Pseudanabaenaceae NI 3	PT
Pseudanabaenaceae NI 4	PA
Stigonematales NI 1	PT
Stigonematales NI 2	JA
Dinophyceae	
Gymnodynium sp.	All except AM; BA
Peridinium baliense Lindemann	All except PT; AM
Peridinium cf. *africanum* Lemmermann	AN; CA; PT; SH; AC; AL; AM; FE; FN; VE
Peridinium cf. *volzii* Lemmermann	AL; AM; BA; FE
Peridinium pusillum (Pénard) Lemmermann	All lakes
Peridinium sp. 1	VE
Peridinium sp. 2	AN; CA; AC
Peridinium sp. 3	SH
Euglenophyceae	
Euglena acus Ehrenberg	CE; AC; AM; PA; PI
Euglena ehrenbergii Klebs	PT; AC; AL; AM
Euglena oxyuris Schmarda	AN; CA; CE; AC; AM; PA
Lepocinclis fusiformis (H.J.Carter) Lemmermann	AM; PI
Lepocinclis cf. *ovum* (Ehrenberg) Lemmermann	SH
Lepocinclis sp. 1	CA; CE; DH; AM; PA; VE
Lepocinclis sp. 2	GN
Lepocinclis sp. 3	AM
Lepocinclis sp. 4	JA
Monomorfina cf. *pyrum* (Ehrenberg) Mereschkowski	DH; SH; AC; PA
Phacus hamatus Pochmann	AN; PT; AM; BA; FN; JA; PI
Phacus longicauda (Ehrenberg) Dujardin	AN; JA; GN; SH; AC; AM; BA; FN; JA; PI
Phacus onyx Pochmann	CA; CE; AM
Phacus raciborskii Drezepolski	CA; CE; JA; GA; PT; AM; JA; PA; PI; VE
Phacus suecicus Lemmermann	AL; AM; BA
Phacus sp. 1	AM
Phacus sp. 2	JA; SH; AC; AM
Phacus sp. 3	GN; FN
Rhabdomonas sp.	GA
Strombomonas cf. *encifera*	PI
Strombomonas cf. *gibberosa*	AM

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Trachelomonas mirabilis var. *spinosa* Svirenko	AM; PA; PI
Trachelomonas armata (Ehrenberg) Stein	AN; CA; PT; AC; AM; FN; JA; PI
Trachelomonas cf. magdaleniana Deflandre	AM
Trachelomonas cf. oblonga Lemmermann	SH
Trachelomonas cf. spinosa Stokes	JA
Trachelomonas hispida var. *coronata* Lemmermann	CE; AC
Trachelomonas hispida var. *duplex* Deflandre	SH; AM; BA; JA; PA; JA
Trachelomonas cf. *zingeri* Roll	CE; JA; PA
Trachelomonas lacustris Drezepolski	AM; JA; FN; JA; PA; JA
Trachelomonas megalacantha Da Cunha	AM
Trachelomonas volvocina Ehrenberg	All lakes
Trachelomonas sp. 1	SH; AL
Trachelomonas sp. 2	CA; CE; AC; AM; JA; FN
Trachelomonas sp. 3	AN; SH
Trachelomonas sp. 4	AC; JA; PA
Trachelomonas sp. 5	AM
Trachelomonas sp. 6	AM
Trachelomonas sp. 7	DH
Euglenales NI 1	AN; AC; AM; BA; JA; PA; JA
Euglenales NI 2	GA
Euglenales NI 3	GA
Euglenales NI 4	CE
Oedogoniophyceae	
Oedogonium sp.	CA; GA; GN; PT; AC; AL; AM; PA; JA
Trebouxiophyceae	
Actinastrum aciculare Playfair	AN; CA; GA; FE; FN; JA; PA; PI
Actinastrum hantszchii Lagerheim	GA
Botryococcus braunii Kützing	All lakes
Botryococcus protuberans W.West & G.S.West	All except DH; GA; SH; FE
Botryococcus terribilis J. Komárek & P. Marvan	All except GN; BA; VE
Chlorella sp.	All except PA
Closteriopsis sp. 1	All except VE
Closteriopsis sp. 2	CA; GN; SH; AC; JA; PI; VE
Crucigenia cf. *fenestrata* (Schimidle) Shimidle	AL; BA; JA; VE
Crucigenia cf. *quadrata* Morren	CE
Crucigenia tetrapedia (Kirchner) W.West & G.S.West	All except DH; GA; GN; FE
Crucigeniella crucifera (Wolle) Komárek	PI
Crucigeniella retangularis (Nägeli) Komárek	AN; CA; CE; PT; AL; AM; BA; FE; JA; PA; PI
Dictyosphaerium erenbergianum Nägeli	GN; AL; FE; JA
Dictyosphaerium pulchellum Wood	All except DH; GA; GN; BA; VE
Keratococcus sp.	AN; CA; CE; PT; SH; AL; BA; FN; PI
Oocystis cf. *nephrocytioides* Fott & Cado	PT; SH

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Oocystis cf. *solitaria* Wittrock	AN; GA; PT; FE
Oocystis lacustris Chodat	All except AN; CA; GA; GN
Oocystis sp. 1	CE; GA; AL; BA; PA;
Oocystis sp. 2	All except GA; GN; PI; VE
Oocystis sp. 3	All except AN; GN; PA
Oocystis sp. 4	AM; BA
Oocystis sp. 5	DH
Xanthophyceae	
Centritractus sp.	CA; PT; SH; BA; JA; JA
Isthmochloron lobulatum (Nägeli) Skuja	AN; DH; GN; PT; AL; AM; BA; JA; JA; VE
Isthmochlorum gracile (Reinsch) Skuja	CA; CE; SH; PA; JA
Pseudostaurastrum sp.	AC; AM; JA
Tetraplektron cf. *bourrelyi* Ettl	AN; DH; GA; AC; AM; BA; PI
Tetraplektron torsum (Skuja) Dedus.	AC; AM; FN; JA; PA
Tetraplektron sp. 1	CA; CE; DH; GN; PT; SH; AC; FN; JA; PA; PI;VE
Tetraplektron sp. 2	AN; AM; BA; FE; FN; JA; PA
Zygnematophyceae	
Actinotaenium sp.	AM; JA
Bambusina Brébissonii Kützing	AC; AM
Bourrellyodesmus jolyanus C. Bicudo & Azevedo	PT; SH; AC; JA; PA; VE
Closterium cf. *setaceum* Ehrenberg	PT; AC; AM; PA; PI; VE
Closterium closterioides (Ralfs) Louis & Peeters	GN; AC
Closterium dianae Ehrenberg	CE
Closterium gracile Brébisson ex Ralfs	CA; AC; AM; BA; FN; PA; PI
Closterium kuetzingii Brébisson	AN; CE; DH
Closterium moniliferum (Bory) Ehrenberg ex Ralfs	GN
Closterium cf. *turgidum* Ehrenberg	AC
Closterium sp. 1	CE; AL
Closterium sp. 2	GN; AM
Closterium sp. 3	GN; AM
Closterium sp. 4	PA
Cosmarium asphaerosporum Wittrock	All except AM
Cosmarium bioculatum Brébisson in Ralfs	AN; CA; GA; SH; AC; BA; FE; FN; JA; PA; PI
Cosmarium conspersum Ralfs	CE; PT; FE; PI
Cosmarium contractum Kirchner	All lakes
Cosmarium depressum (Nageli) Lundell	
Cosmarium lagoense Nordstedt	AL; BA
Cosmarium moniliforme West & West	All except AM; PI
Cosmarium monomazum P.Lundell	AN; CE; DH; PT; AC; BA; FN; JA; PA; VE
Cosmarium ornatum Ralfs	JA; PA
Cosmarium portianum Archer	GN; AC; JA; PA
Cosmarium pseudoconnatum Nordstedt	All except GA; AM
Cosmarium cf. *pseudopyramidatum* Lundell	GN

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Cosmarium pyramidatum Brébisson in Ralfs	DH; GA; AC; BA; FE; FN; PA; VE
Cosmarium quadrum P.Lundell	CE; DH; GA; GN; AC; AL; BA; FN; JA; VE
Cosmarium trilobulatum Reinsch	PA
Cosmarium cf. *zonatum* P.Lundell	AC
Cosmarium sp. 1	CE; AL; AM
Cosmarium sp. 2	AN; AL; PA
Cosmarium sp. 3	BA; FN; PA
Cosmarium sp. 4	BA
Cosmarium sp. 5	AC; FE; FN; JA; PA; VE
Cosmarium sp. 6	BA; VE
Cosmarium sp. 7	VE
Cosmarium sp. 8	CA; GN; PA
Cosmarium sp. 9	AM
Cosmarium sp. 10	AM
Cosmarium sp. 11	AC; AM; PA
Cosmarium sp. 12	AM
Cosmarium sp. 13	AM
Cosmarium sp. 14	AM
Cosmarium sp. 15	PA
Cosmarium sp. 16	PA
Cosmarium sp. 17	JA
Desmidium aptogonum Brébisson	SH; BA
Desmidium grevillei (Kützing ex Ralfs) De Bary	CA
Desmidium swartzii Agardh	SH
Euastrum cf. *abruprum* Nordstedt	GN; PT; FN
Euastrum didelta (Turpin) Ralfs	GN
Euastrum elegans (Brébisson) Kützing	AM
Euastrum pulchellum Brébisson	PT; BA
Gonatozygon Brébissonii De Bary	AM; BA; PI
Gonatozygon cf. *pillosum* Wolle	GA; PT
Gonatozygon monotaenium De Bary in West & G.S.West	GN; BA
Haplotaenium minutum (Ralfs) Delponte	DH; AC; PI; VE
Hyaloteca sp.	PT; AC; AL; JA; PA; VE
Micrasterias abrupta West & G.S.West	AC; PA
Micrasterias arcuata Bailey	AC
Micrasterias borgei H. Krieger	GN
Micrasterias crux-melitensis (Ehrenberg) Ralfs	FN; VE
Micrasterias oscitans var. *mucronata* (R.V.Dixon) J.N.F.Wille	AC; PA
Micrasterias pinnatifida (Kützing) Ralfs	AC; AL; JA; PA
Micrasterias tropica Nordstedt	AM
Micrasterias truncata (Corda) Bréb. ex Ralfs	AN; DH; AC; AL; AM; JA; JA; PA; PI; VE
Mougeotia sp. 1	AN; GN; PT; AC; AM
Mougeotia sp. 2	AM

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Netrium sp.	PA
Octacanthium mucronulatum (Nordstedt) P.Compère	CA; PA; PI; VE
Octacanthium sp.	JA
Onychonema laeve Nordstedt	PT
Pleurotaenium cf. *baculoides* (Skuja) Krieger	AC
Pleurotaenium sp.	AM; PA; VE
Sirogonium cf.	AM
Sphaerozosma sp.	CE; DH; SH; FE; FN; JA; PA; PI
Spirogyra sp. 1	AN
Spirogyra sp. 2	VE
Spirogyra sp. 3	AM
Spondylosium panduriforme (Heimerl) Teiling	AN; CE; DH; PT; SH; AL; AM; BA; JA; PA; VE
Spondylosium planum (Wolle) West & G.S.West	JA
Staurastrum avicula Brébisson	All except PT; SH; BA
Staurastrum brasiliense Nordstedt	PT
Staurastrum cerastes Lundell	AN; DH; PT; AL; BA; FN; PA; PI; VE
Staurastrum chaetoceras (Schröder) G.M.Smith	AN; CA; CE; DH; GA; GN; PT; SH; FN; PA; PI
Staurastrum *curvimarginatum* Scott et Grönblad	PA
Staurastrum depressiceps Scott et Grönblad	CE; BA; FE; JA; PA
Staurastrum forficulatum Lundell	All lakes
Staurastrum gemelliparum Nordstedt	CA; FN
Staurastrum grallatorium Nordstedt	GA; PT; AC; AL; BA; JA; PA; VE
Staurastrum ionatum Wolle	All except AM; FE
Staurastrum cf. *hagmannii* Grönblad	PT; BA; PA
Staurastrum cf. *hirsutum* Borge	DH; SH
Staurastrum laeve Ralfs	All except GN; AM
Staurastrum leptacanthum Nordstedt	CA; PT; AC; BA; FE; JA; VE
Staurastrum leptocladum Nordstedt	All lakes
Staurastrum manfeldtii Delponte	PT; SH; AC; AL; FN; JA; PA; PI; VE
Staurastrum minnesotense Wolle	AN; PT; FE; FN; JA
Staurastrum cf. *muticum* (Brébisson) Ralfs	AN; CE; GA; GN; PT; AC; FE; FN; PA; PI
Staurastrum nudibrachiatum Borge	PT; AL; BA; JA; VE
Staurastrum orbiculare (Ehrenberg) Ralfs	CA; AM; PI
Staurastrum quadrangulare Brébisson	AC; BA; PI
Staurastrum rotula Nordstedt	All lakes
Staurastrum sebaldii Reinsch	SH; PI
Staurastrum setigerum Gleve	All except CA; CE; AM; PA; PI
Staurastrum sexangulare Bulnheim (Rabenhorst)	PT
Staurastrum smithii (G.M. Smith) Teiling	All except GN; AM; VE
Staurastrum taylorii Grönblad	CA; DH; AC; AM; JA; PA; VE
Staurastrum teliferum Ralfs	AN; CE; DH; AC
Staurastrum teliferum Ralfs var. 2	PT; SH; AC; FE; FN; PA; VE

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Appendix 1. Continuation.

Taxa	Occurrence
Staurastrum tentaculiferum Borge	AC; PA; VE
Staurastrum tetracerum (Kützing) Ralfs ex Ralfs	AN;CA; DH; SH; AC; BA;FE;FN; JA; PA; PI;VE
Staurastrum trifidum Nordstedt	All except SH; AM
Staurastrum wolleanum Butler cited in Wolle	AN; PT; AL; PA; VE
Staurastrum sp. 1	All except DH; AM
Staurastrum sp. 2	AN; CE; DH; GA; AC; AL; FE; JA; VE
Staurastrum sp. 3	CE; AC; AL; AM; VE
Staurastrum sp. 4	GN; AL; FE; FN; VE
Staurastrum sp. 5	CE; PT; BA; JA; PA
Staurastrum sp. 6	FN
Staurastrum sp. 7	CA; PT; JA; PA; PI
Staurastrum sp. 8	DH; SH; BA; PA; PI
Staurastrum sp. 9	BA
Staurastrum sp. 10	DH; SH; AC; BA; JA; PA; PI; VE
Staurastrum sp. 11	GA; PT; SH; AC; AM; BA; JA; PA
Staurastrum sp. 12	SH; JA
Staurastrum sp. 13	PI
Staurastrum sp. 14	VE
Staurastrum sp. 15	AM
Staurastrum sp. 16	AN; CE; FE; FN; JA
Staurastrum sp. 17	PA
Staurastrum sp. 18	AC
Staurastrum sp. 19	AC
Staurastrum sp. 20	AC; JA
Staurastrum sp. 21	AC
Staurastrum sp. 22	GA; FE; FN
Staurodesmus convergens (Ehrenberg Ex Rafs) Teiling	All except GN; PT; AM; JA; VE
Staurodesmus convergens (Ehrenberg Ex Rafs) Teiling var. 2	AC; BA; FN; JA; PI
Staurodesmus crassus (West & West) Florin	All except GN; AM
Staurodesmus cuspidatus (Brébisson) Teiling	All except GA; AC; AL; AM; VE
Staurodesmus dejectus (Brébisson) Teiling	All lakes
Staurodesmus cf. *extensus* (Anderson) Teiling	AC; PA
Staurodesmus incus (Brébisson) Teiling	CA; CE; FE; PI
Staurodesmus jaculiferus (W. West) Teiling	All except SH; AM
Staurodesmus lobatus (Borgesen) Bourrely	AC; AM; BA; FN; JA; PI; VE
Staurodesmus o'mearii (Archer) Teiling	CA; CE; DH; GA; FN; VE
Staurodesmus pachyrhynchus (Nordst.) Teiling	AL; BA; FN
Staurodesmus phimus (Turner) Thomasson	CE; PI; VE
Staurodesmus subulatus (Kützing) Croasdale	AN;CA;DH; GN;AL;AM; BA; FE; FN; JA; PA;PI
Staurodesmus sp. 1	DH; AC; AL; FE; FN; JA; PA; VE
Staurodesmus sp. 2	GA; AC; FN; PA; VE
Staurodesmus sp. 3	AN; CE; PT; AL
Staurodesmus sp. 4	FE; PA

Continues

Appendix 1. Continuation.

Taxa	Occurrence
Staurodesmus sp. 5	AN; AL
Staurodesmus sp. 6	JA
Staurodesmus sp. 7	AN; VE
Staurodesmus sp. 8	FN; JA; PA
Staurodesmus sp. 9	PT; PI
Staurodesmus sp. 10	CA; VE
Staurodesmus sp. 11	VE
Staurodesmus sp. 12	AM
Staurodesmus sp. 13	AM; PI
Staurodesmus sp. 14	JA
Staurodesmus sp. 15	AC
Teilingia granulata (J.Roy & Bisset) Bourrelly	All except AM
Teilingia sp. 1	GA
Teilingia sp. 2	GN; AL; VE
Triploceras gracile Bailey	JA; PA
Xanthidium regulare Nordstedt	PA
Zygnema aff.	GN