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Periphytic algal community in artificial and natural substratum in a tributary of the Rosana reservoir (Corvo Stream, Paraná State, Brazil)

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ABSTRACT. Periphytic algal community in artificial and natural substratum in a tributary of the Rosana reservoir (Corvo Stream, Paraná State, Brazil). This study evaluated the heterogeneity in periphytic algal community, under the influence of time colonization on artificial substratum. We also examined which abiotic variables most influenced the community in natural and artificial substratum. *Egeria najas* Planchon was used as natural substratum, and a plastic plant, as artificial. This experiment was carried out in a lateral arm from Rosana Reservoir, formed by Corvo Stream (Paranapanema river basin), in the period from November 21st to December 12nd, 2003, characterized as a warm and rainy period. Changes in species composition were assessed using the similarity indices. 495 taxa were registered in the phycoperiphytic community, distributed in 133 genera and 11 classes. Zygnemaphyceae, Bacillariophyceae, Chlorophyceae and Cyanophyceae presented higher species number, in both substrata. *Staurodesmus*, *Closterium*, *Staurastrum* and *Cosmarium* (Desmidiales); *Gomphonema* and *Eunotia* (Pennales); *Characium*, *Scenedesmus* and *Desmodesmus* (Chlorococcales); *Anabaena* and *Aphanocapsa* (Nostocales and Chroococcales, respectively) were the most species-rich genera. The epiphytic community reached the highest species richness in the 15th successional day. Regardless the substratum type, the number of species was probably related to the high concentrations of nutrients (phosphorus and nitrogen).

Key words: ecology, colonization, phycoperiphyton, Zygnemaphyceae, similarity.

RESUMO. Comunidade de algas perifíticas em substrato artificial e natural em um tributário do reservatório de Rosana (Ribeirão do Corvo, Estado do Paraná, Brasil). Este trabalho objetivou analisar a composição da comunidade de algas perifíticas sob influência do tempo de colonização em substrato artificial. Ainda procurou responder quais variáveis abióticas mais influenciaram na comunidade em substrato artificial e natural. Utilizou-se *Egeria najas* Planchon como substrato natural e planta de plástico semelhante à *Egeria* como artificial. O experimento foi realizado no rio do Corvo, tributário do reservatório de Rosana (bacia do Paranapanema). As amostragens foram realizadas de 21 de novembro a 12 de dezembro de 2003, quando o clima é caracterizado como quente e chuvoso. As alterações na composição específica do ficoperifíton foram analisadas utilizando-se o índice de similaridade. A comunidade de algas perifíticas compreendeu 495 táxons, distribuídos em 133 gêneros e 11 classes. Zygnemaphyceae, Bacillariophyceae, Chlorophyceae e Cyanophyceae apresentaram maior número de espécies, em ambos os substratos. *Staurodesmus*, *Closterium*, *Staurastrum* e *Cosmarium* (Desmidiales); *Gomphonema* e *Eunotia* (Pennales); *Characium*, *Scenedesmus* e *Desmodesmus* (Chlorococcales); *Anabaena* e *Aphanocapsa* (Nostocales e Chroococcales, respectivamente) foram os gêneros mais representativos. A comunidade perifítica do substrato artificial atingiu maior número de espécies no 15º dia sucessional. O número de espécies independentemente do tipo de substrato foi relacionado à maior disponibilidade de nutrientes (fósforo e nitrogênio).

Palavras-chave: ecologia, colonização, ficoperifíton, Zygnemaphyceae, similaridade.

Introduction

The species diversity plays an important role in the processes of production, consumption, respiration and decaying, mainly at littoral regions, since the aquatic vegetation is generally associated to different communities. The high availability of habitats provided by the diversity of aquatic vegetation favors the establishment and development of several organisms, mostly the periphyton (WETZEL, 1981; WETZEL; LIKENS, 1991).

The periphyton is a sessile community that responds punctually to environmental conditions. This community presents short life cycle (3 - 10 days) which allows quick answers to environmental changes (HAMBROOK, 2002; RODRIGUES et al., 2003; WU et al., 2009). The heterogeneity in the structure of phycoperiphytic community may be understood through the species composition in different successional stages. The studies about the distribution and mobility of algae from this community, when analyzed in short time scale, are more suitable due to population changes (WETZEL, 1983). This distribution extremely homogeneous of periphyton and its interaction with natural substrata, coupled to the need to standardize the community development time and the substratum nature, have motivated the use of artificial substrata. The review made by Cattaneo and Amireault (1992) indicated that 60% from published papers had used different types of artificial substrata.

In Brazil, among the published researches with artificial substratum reproducing a natural one are those using glass tubes (MOSCHINI-CARLOS et al., 2000), glass slides (RODRIGUES; BICUDO, 2001, 2004) and plastic tubes (FERNANDES; ESTEVES, 2003) to compare with petioles of emerging macrophytes, whereas other studies had used polyamide strings (OLIVEIRA et al., 2001) and glass slides (VERCELLINO; BICUDO, 2006) to analyze the structure and dynamic of periphytic algae community. Although Brazil presents one of the major hydroelectric parks of the world, the knowledge about periphyton in these environments is still scarce.

This study hypothesized that the composition of periphytic algae varies in function to the type of substratum (artificial and natural) and/or due to abiotic conditions of the system. The prediction is that in the course of time the phycoperiphytic community from an artificial substratum will be similar to that found in natural one, considering the species composition, and that both communities will be mainly influenced by nutrient concentrations. Therefore, we analyzed (a) the floristic composition from the community of periphytic algae in both substrata of one tributary of Rosana reservoir, Corvo Stream, during a warm and rainy period; (b) the algae similarity, between artificial and natural substratum; and (c) the principal abiotic factors influencing the species composition and richness of phycoperiphytic community, in both substrata.

Material and methods

Study area

The samplings location is one tributary that flows into the lacustrine region from Rosana reservoir (Corvo Stream, 22°39'S; 052°46'W, Figure 1), near the dam. This river is situated in Paraná State, between the counties of Diamante do Norte and Terra Rica. The sampling station was 4.95 km far from the lacustrine region of the reservoir.

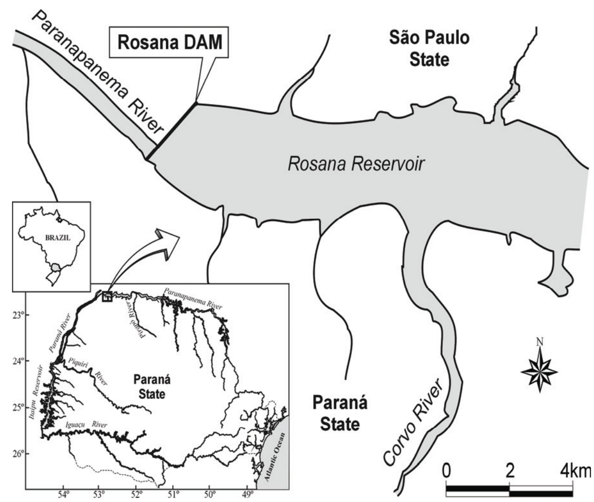

Figure 1. Map with the location of Corvo Stream, tributary of Rosana reservoir (Paranapanema river watershed).

Corvo Stream presents, in the sampling local, approximately 250 m of width and 5.8 m of depth. The banks practically did not present arborous vegetation, and the littoral region present several ecological types of aquatic macrophytes: emerged (*Typha* sp., *Sagittaria* sp. and *Eichhornia azurea* Kunth), floating (*Eichhornia crassipes* (Mart.) Solms, *Nymphaea* sp. and *Salvinia* sp.) and rooted-submersed (*Cabomba furcata* (Schult.) Schult., *Egeria densa* Planchon, *Egeria najas* Planchon, *Miriophyllum* sp. and *Utricularia foliosa* Lineau).

Samplings and analyses

Periphyton samplings were performed from November 21st to December 12nd, 2003, a period characterized as warm and rainy. Two types of substrata were chosen for the samplings: *Egeria najas* (natural substratum) and a plastic plant (artificial substratum), similar to natural substratum (Figure 2).

For the natural substratum, a fragment of *Egeria najas* was removed from the environment, and a median part was detached (about 7 to 8 cm of length), excluding the apex and base. Afterwards, this median part was transfered to previously moistened flasks, and kept in ice, and later the periphyton was removed for analysis. The samplings of both substrata were carried out in the lacustrine region of the environment. For the artificial substratum, each one was washed in running water and after this; each branch was attached to a weight (pebbles wrapped in plastic) using a nylon line, and Styrofoam pieces as buoys. These sets were put in Corvo Stream, close to the left bank, about 60 cm of depth, in November 21^{st}.

Figure 2. Types of substrata, *Egeria najas* Planchon (natural) and a plastic plant, sampled in Corvo Stream (tributary of Rosana reservoir), during the study period.

Samplings of artificial substratum occurred every three days, between November 24^{th} (1^{st} sampling and 3^{rd} successional days) and December 12^{nd}, 2003 (last sampling and 21^{st} day), while for the natural substratum, the samplings began at the first day of installation of artificial substratum (11/21), and during alternate days (11/26; 01, 06, 09 and 12/12), totaling 13 samples (six for the natural substratum, and seven for the artificial one). The periphyton was washed from the substrata using brush and distilled water, and then transferred to transparent flasks. The samples were preserved with Transeau solution (BICUDO; MENEZES, 2006).

Abiotic data evaluated in the study were furnished by Limnology Laboratory, from Núcleo de Pesquisas em Limnologia, Ictiologia e Aquicultura – Nupélia. Water temperature (YSI 55 portable oximeter), turbidity (LaMotte portable turbidimeter) and wind (anemometer) were measured during the samplings. The concentrations of total nitrogen, total phosphorus and total dissolved phosphorus were determined based on Valderrama (1981), nitrate, ammonium and orthophosphate were estimated according to Mackereth et al. (1978), Solorzano (1969) and Golterman et al. (1978), respectively.

The taxonomical study of periphytic algae was accomplished using approximately 15 temporary slides, by sample. For this procedure, we used optical microscope with micrometric ocular. Some genera of green filamentous algae, as *Bulbochaete*, *Oedogonium*, *Mougeotia* and *Spirogyra*, were distinguished only in vegetative groups, based on the cells diameter and length, due to the absence of reproductive structures in the analyzed individuals.

The algae identification was based on classical literature, as Croasdale and Flint (1986, 1988), Dillard (1990, 1991), Förster (1982), Komárek and Anagnostidis (1999, 2005), Krammer and Lange-Bertalot (1986, 1988, 1991), Patrick and Reimer (1966, 1975), Prescott (1982), Prescott et al. (1981, 1982) among others. Regarding the classification system of algae, we adopted Round (1965, 1971), following the recommendation made by Bicudo and Menezes (2006).

The species richness, expressed in number of taxa for both substrata, was obtained from qualitative samples complemented with quantitative samples.

The similarity of periphytic algae from artificial and natural substratum, between the sampled periods, was analyzed using the Jaccard similarity index (species presence/absence data), using NTSYS software, version 2.1 (ROHLF, 2000) and unweighted average (UPGMA).

The values of total richness of algae classes from both substrata were correlated with the abiotic variables, through Pearson correlation analysis, using Statistica software, version 7.1 (STATSOFT, 2005).

Results

Floristic composition

The community of periphytic algae comprised 495 taxa distributed in 133 genera and 11 classes, considering both substrata (natural and artificial) (Table 1). Among these taxa, 403 occurred in the natural substratum, and 401 in the artificial one. In the table 1, the complete list of species is presented, and, from this total, 86 taxa occurred exclusively in the natural substratum, and 98 in the artificial. The most representative classes in the natural and artificial substratum were Zygnemaphyceae (37.2 and 36.4%, respectively) Bacillariophyceae (21.6 and 24.7%, respectively), Chlorophyceae (17.4 and 17.2%, respectively) and Cyanophyceae (13.2 and 12%, respectively).

Amongst Zygnemaphyceae, S*taurodesmus*, *Closterium*, *Staurastrum* and *Cosmarium* (66.5% from the total of Desmidiales) were the best represented genera, in both substrata. Bacillariophyceae, Order Pennales, presented *Gomphonema* and *Eunotia* as the most representative genera regarding the number of taxa. Among Chlorophyceae, *Characium*, *Desmodesmus* and *Scenedesmus* were the best represented (Table 1).

Table 1. Taxa of periphytic algae surveyed in Corvo Stream (tributary of Rosana reservoir), in the study period.

Bacillariophyceae	
Achnanthidium exiguum (Grun.) Czarn.	*Gomphonema augur* Ehr.**
A. minutissimum (Kütz.) Czarn.	*Gomphonema augur* Ehr. var. *turris* (Ehr.) Lang.-Bert.
Amphipleura lindheimerii Grun.	*Gomphonema* cf. *auritum* Braun *ex* Kütz.
Amphora copulata (Kütz.) Schoem. & Arch.	*Gomphonema brasiliense* Grun.
Amphora cf. *ovalis* (Kütz.) Kütz.**	*Gomphonema gracile* Ehr.
Amphora sp.	*Gomphonema parvulum* Kütz.
Aulacoseira granulata (Ehr.) Sim	*Gomphonema subtile* Ehr.**
Aulacoseira granulata (Ehr.) Sim. var. *angustissima* (O. Müll.) Sim. **	*Gomphonema* cf. *truncatum* Ehr.*
Aulacoseira sp. *	*Gomphonema* sp.
Brachysira neoxilis Hor. Lang.-Bert. & Mos.	*Gomphonema* sp.1*
Capartogramma crucicula (Grun. & Cleve)**	*Hantzschia amphioxys* (Ehr.) Grun.
Cyclotella stelligera (Cleve & Grun.) V. Heur.	*Navicula aikenensis* Patr.
Cymbella acuta (A. Schm.) Cleve	*Navicula constans* Hust.
Cymbella affinis Kütz.	*Navicula cryptocephalla* Kütz.
Cymbella cuspidata Kütz.	*Navicula cryptotonella* Lang.-Bert.
Cymbella cf. *moreirae* (Rod.) Ludw.	*Navicula* cf. *drouetiana* Patr.**
Cymbella cf. *mycrocephala* Grun.*	*Navicula* cf. *menisculus* Schum.**
C. naviculiformes Auer. *ex* Heib.	*Navicula* cf. *tenera**
Diatoma sp.	*Navicula* sp.*
Diploneis cf. *subovalis* Cleve	*Nitzschia amphibia* Grun.
Encyonema lunatum (Smith) V. Heur.*	*Nitzschia frustulum* Grun.**
Encyonema mesianum (Chol.) Mann*	*Nitzschia* cf. *intermedia* Hantz. *ex* Cleve & Grun.
Encyonema minutum (Hil.) Mann*	*Nitzschia* cf. *linearis* Grun.
Encyonema cf. *perpusillum* Cleve & Mann*	*Nitzschia palea* (Kütz.) Smith
Encyonema silesiacum (Bleis.) Mann*	*Nitzschia* sp.*
Encyonema sp.	Penales unidentified 1
Encyonema sp.1	Penales unidentified 2*
Eunotia bilunaris Ehr.	*Pinnularia* cf. *braunii* Grun.*
Eunotia camelus Ehr.	*Pinnularia divergens* Smith
Eunotia curvata (Kütz.) Lagerst.	*Pinnularia gibba* Ehr.
Eunotia didyma Hust.	*Pinnularia interrupta* Smith
Eunotia cf. *faba* (Ehr.) Grun.*	*Pinnularia luculenta* A. Schm.
Eunotia flexuosa Bréb.	*Pinnularia maior* (Kütz.) Rab.
Eunotia formica Ehr.	*Pinnularia mesolepta* (Ehr.) Smith
Eunotia indica Grun.	*Pinnularia* cf. *microstauron* (Ehr.) Cleve*
Eunotia lineolata Hust.	*Pinnularia subcapitata* Greg. *
Eunotia maior (Smith) Rab.	*Pinnularia viridis* (Nitz.) Ehr.
Eunotia cf. *minor* (Kütz) Grun.*	*Pinnularia* sp.
Eunotia monodon Ehr.*	*Placoneis disparilis* (Hust.) Lang.-Bert.
Eunotia pectinalis (Dillw.) Rab.	*Planothidium lanceolatum* (Bréb.) Round & Bukh.*
Eunotia pectinalis (Dillw.) Rab.var. *ventricosa* Grun.	*Pleurosira laevis* (Ehr.) Comp.
Eunotia sudetica O. Müll.	*Rhopalodia* cf. *brebissoni* Kram.*
Eunotia zygodon Ehr.*	*Rhopalodia gibberula* (Ehr.) O. Müll.**
Fragilaria capucina Desm.	*Sellaphora pupulla* Kütz.
Fragilaria capucina Desm. var. *gracilis* (Oestrup) Hust.	*Stauroneis phoenicenteron* (Nitz.) Ehr.
Fragilaria delicatissima (Smith) Lang.-Bert.	*Stenopterobia delicatissima* (Lew.) Bréb. *ex* V. Heur.
Fragilaria javanica Hust.*	*Stenopterobia intermedia* (Lew.) V. Heur.
Frgilaria pinnata Ehr.*	*Surirella bisseriata* Bréb.
Frustulia rhomboides (Ehr.) De Toni var. *rhomboides*	*Surirella linearis* Smith
Frustulia rhomboides (Ehr.) De Toni var. *crassinervia* (Bréb. *ex* Smith) Ross	*Surirella* cf. *robusta* Hust.**
Frustulia rhomboides (Ehr.) De Toni var. *saxonica* (Rab.) De Toni	*Surirella sublinearis* Hust.
Frustulia cf. *vitrea* Oestrup*	*Surirella* sp.
Frustulia vulgaris (Thwait.) De Toni*	*Synedra acus Kütz. var. angustissima Grun.**
Frustulia sp.*	*Synedra goulardii* Bréb.*
Gomphonema affine Kütz.	*Ulnaria ulna* (Nitz.) Ehr.
Gomphonema cf. *apicatum* Ehr.*	*Talassiosira* sp.**

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Chlorophyceae	
Ankistrodesmus falcatus (Corda) Ralfs	_Dimorphococcus lunatus_ Braun*
Ankistrodesmus fusiformis Corda	_Drepanochloris uherkovichii_ Marvan
Ankistrodesmus spiralis (Turn.) Lemm.	_Gloeocystis_ cf. _gigas_ (Kütz.) Lagerh.**
Aphanochaete repens Braun	_Golenkinia radiata_ (Chod.) Wille**
Bicuspidela cf. _incus_ Pasch.	_Kirchneriella lunaris_ (Kirch.)*
Botryococcus sp.	_Kirchneriella obesa_ (West) West & G.S.West*
Chaetosphaeridium globosum (Nord.) Kleb.	_Monoraphidium arcuatum_ (Korsh.) Hind.
Chaetosphaeridium sp.*	_Monoraphidium caribeum_ Hind.
Characiellopsis skujae (Fott) Kom.	_Monoraphidium circinale_ (Nyg.) Nyg.
Characium cf. _acuminatum_ Braun**	_Monoraphidium contortum_ (Thur.) Kom.-Legn.
Characium ambiguum Herm.	_Monoraphidium griffithii_ (Berk.) Kom.-Legn.**
Characium cf. _cucurbitinum_ (Biss.) Teil.*	_Monoraphidium_ sp.*
Characium ensiforme Herm.	_Oocystis lacustris_ Chod.*
Characium guttula Play.	_Pediastrum duplex_ Meyen
Characium ornithocephalum (Braun) var. _ornithocephalum_	_Pediastrum duplex_ Meyen var. _subgranulatum_ Racib.
Characium ornithocephalum (Braun) var. _hapochytriiforme_ Prin.	_Pediastrum tetras_ (Ehr.) Ralfs
Characium ornithocephalum (Braun) var. _pringsheimii_ (Braun) Kom.	_Planktosphaeria gelatinosa_ Smith
Characium sp.**	_Radiococcus_ sp.*
Chlamydomonas cf. _globosa_ Snow	_Scenedesmus antennatus_ Bréb.
Chlamydomonas sp.	_Scenedesmus acuminatus_ (Lagerh.) Chod.
Closteriopsis acicularis (Smith) Belc. & Swale	_Scenedesmus_ cf. _acunae_ Comas**
Coelastrum indicum Turner	_Scenedesmus acutus_ (Meyen) Chod.
Coleochaete cf. _irregularis_ Prings.**	_Scenedesmus acutus_ (Meyen) Chod. var. _alternans_ Hortob.
Coleochaete orbicularis Prings.**	_Scenedesmus acutus_ (Meyen) Chod. var. _globosus_ Hortob.
Coleochaete sp.	_Scenedesmus bijugus_ (Turp.) Kütz.
Crucigenia sp.	_Scenedesmus javanensis_ Chod.*
Desmodesmus cf. _abundans_ (Kirch.) Hegew.	_Scenedesmus linearis_ Kom.*
Desmodesmus armatus (Chod.) Hegew.	_Scenedesmus_ cf. _regularis_ Svir.*
Desmodesmus armatus (Chod.) var. _bicaudatus_ (Gugl.) Hegew.	_Scenedesmus wisconsinensis_ (Smith) Chod.**
Desmodesmus cf. _armatus_ (Chod.) var. _spinosus_ (Frit. & Rich) Hegew.**	_Scenedesmus_ sp.
Desmodesmus communis (Hegew.) Hegew.	_Selenastrum gracile_ (Rein.)
Desmodesmus denticulatus (Lagerh.) Friedl & Hegew.	_Selenastrum rinoi_ Kom. et Com.*
Desmodesmus denticulatus (Lagerh.) Friedl & Hegew. var. _linearis_ (Hansg.) Hegew.	_Sphaerocystis schroeteri_ Chod.**
Desmodesmus dispar Bréb.	_Stigeoclonium_ sp.
Desmodesmus maximus (W. &. G.S. West) Hegew.	_Tetraedron caudatum_ (Corda) Hans.**
Desmodesmus opoliensis (Rich.) Hegew. var. _carinatus_ (Lemm.) Hegew.*	_Tetraedron minimum_ (Braun) Hans.*
	Tetraedron regulare Kütz.**
Desmodesmus perforatus (Lemm.) Hegew.	_Tetrastrum_ sp.**
Desmodesmus quadricauda (Turp.) Hegew.	_Westella_ sp.
Desmodesmus serratus (Corda) Friedl & Hegew.	Chlorococcales unidentified
Desmodesmus spinosus (Chod.) Hegew.	Chlorococcales unidentified 1
Dictyosphaerium pulchellum Wood*	Chlorococcales unidentified 2
Dictyosphaerium sp.*	
Cyanophyceae	
Anabaena cf. _affinis_ Lemm.**	_Lyngbya maior_ Men.
Anabaena cf. _circinalis_ Rab.**	_Merismopedia glauca_ (Ehr.) Kütz.**
Anabaena spiroides Kleb.	_Merismopedia tenuissima_ Lemm.
Anabaena sp.	_Merismopedia_ sp.*
Anabaena sp.1**	_Microcrocis_ cf. _irregularis_ (Lagerh.) Geitler
Aphanocapsa elachista W. & G.S. West	_Microcrocis_ cf. _pulchella_ (Buell) Geitler**
Aphanocapsa delicatissima W. & G.S. West**	_Microcystis aeruginosa_ (Kütz.) Lemm.
Aphanocapsa grevillei Raben.	_Microcystis firma_ (Bréb. et Len.) Schm.
Aphanocapsa cf. _pulchra_ (Kütz.) Raben.*	_Oscillatoria_ cf. _curviceps_ Agardh.**
Aphanocapsa sp.	_Oscillatoria principes_ Vaucher
Calothrix sp.*	_Oscillatoria sancta_ (Kütz.) Gom.
Chamaesiphon incrustans Grun.	_Planktolyngbya limnetica_ (Lemm.) Kom.-Legn.
Chamaesiphon sp.	_Planktolyngbya_ sp.
Chroococcus minor (Kütz.) Näg.	_Phormidium_ cf. _chlorinum_ (Kütz.) Umez. & Wat.
Chroococcus minimus (Keis.) Lemm.	_Phormidium irriguum_ (Kütz. ex Gom.) Anag. & Kom.
Chroococcus sp.	_Planktothrix agardhii_ Anag. & Kom.*

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Coelosphaerium aerugineum Lemm.*	*Pseudanabaena catenata* Laut.
Geitleribactron periphyticum Kom.**	*Pseudanabaena lonchoides* Anag.
Geitlerinema jasorvense (Vouk) Anag.**	*Pseudanabaena moniliformes* Kom. & Kling
Geitlerinema splendidum (Grev.) Anag.	*Pseudanabaena mucicula* (Hub.-Pest. & Naum.) Schw.
Gloeocapsa cf. *rupestris* Kütz.**	*Radiocystis fernandoi* Kom. & Kom.-Legn.
Gloeocapsa sp.	*Rhabdoderma irregulare* (Naum.) Geitler**
Gloeocapsopsis sp.**	*Rhabdoderma lineare* Schm. & Laut.
Jaaginema quadripunctulatum (Brühl. & Bisw.) Anag. & Kom.	*Rhabdoderma vermiculare* Fott
Komvophoron crassum (Voz.) Anag. & Kom.	*Rhabdoderma* sp.**
Komvophoron minutum (Skuja) Anag. & Kom.*	*Snowella* sp.
Komvophoron schmidlei (Jaag) Anag. & Kom.	*Spirulina laxa* Smith
Leptolyngbya fragilis (Gom.) Anag. & Kom.**	*Synechocystis* sp.*
Leptolyngbya lagerheimii (Gom.) Anag. & Kom.	*Woronichinia elorantae* Kom. & Kom.-Legn.*
Leptolyngbya perelegans (Lemm.) Anag. & Kom.	Chroococcales unidentified*
Lyngbya comperei Senna	
Chrysophyceae	
Bicoeca cf. *synoica* Skuja	*Salpingoeca serpettei* Bourr.**
Dinobryon divergens Imhof	*Salpingoeca urceolata* Kent
Dinobryon sertularia Ehr.	*Salpingoeca* sp.
Mallomonas sp.	*Synura* sp.*
Salpingoeca marsonii Lemm.*	
Cryptophyceae	
Cryptomonas ovata Ehr.**	*Cryptomonas* sp.
Dinophyceae	
Peridinium cf. *cinctum* O. Müll.*	*Peridinium* sp.*
Peridinium cf. *volzii* Lemm.	
Euglenophyceae	
Colacium sp.	*Phacus* cf. *pusillus* Lemm.**
Euglena cf. *acus* Ehr.**	*Phacus* cf. *raciborskii* Drez.**
Euglena cf. *gracilis* Klebs	*Phacus* sp.**
Euglena cf. *spirogyra* Ehr.*	*Strombomonas* sp.**
Euglena viridis Ehr.**	*Trachelomonas* cf. *bernardi* Wolos.**
Euglena sp.	*Trachelomonas crispa* Balech
Lepocinclis sp.	*Trachelomonas hispida* (Perty) Stein.*
Phacus acuminatus Stokes	*Trachelomonas intermedia* Dang.
Phacus curvicauda Swir.*	*Trachelomonas klebsii* Ehr.**
Phacus cf. *polytrophos* Poch.*	*Trachelomonas* sp.
Oedogoniophyceae	
Bulbochaete sp.*	*Oedogonium* sp.
Bulbochaete sp.1	*Oedogonium* sp.1
Bulbochaete sp.2	*Oedogonium* sp.2
Bulbochaete sp.3 *	*Oedogonium* sp.3
Bulbochaete sp.4	*Oedogonium* sp.4
Ulothricophyceae	
Ulothrix sp.	*Uronema* sp.**
Uronema elongatum Hodg.	
Xanthophyceae	
Characiopsis acuta (Braun) Borzi**	*Characiopsis sphagnicola* Pascher**
Characiopsis aquilonaris Skuja	*Isthmochloron lobulatum* (Näg.) Skuja**
Characiopsis elegans Ettl	*Stipitococcus vasiformis* Tiff.
Characiopsis minuta (Braun) Lemm.**	
Zygnemaphyceae	
Actinotaenium diplosporum (Lund.) Teil.**	*Haplotaenium minutum* (Ralfs) Bando**
Actinotaenium globosum (Bulnh.) Teil.	*H. minutum* (Ralfs) Bando var. *attenuatum* (W. West) Bando**
Actinotaenium lagenarioides (Roy) Teil.*	*Hyalotheca dissiliens* (Smith) Bréb. *ex* Ralfs
Closterium acutum Ehr.*	*Micrasterias abrupta* West & G.S. West*
C. acutum Ehr. var. *variabile* (Lemm.) W. Krieg.	*Micrasterias furcata* Ralfs
Closterium closterioides (Ralfs) Louis & Peet.*	*Micrasterias laticeps* Nordst. var. *acuminata* W. Krieg.**
Closterium closterioides (Ralfs) Louis & Peet. var. *intermedium* (Roy & Biss.) Ruz.*	*Micrasterias laticeps Nordst. var. laticeps*
Closterium cornu Ehr. *ex* Ralfs	*Micrasterias mahabuleshwarensis* Hobs.
Closterium cynthia de Not.	*Micrasterias radiosa* Ralfs var. *radiosa*
Closterium dianae Ehr. *ex* Ralfs var. *minus* Hieron.	*Micrasterias radiosa* Ralfs var. *elegantior* (G.S. West) Croasd.

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Closterium ehrenbergii Menegh. *ex* Ralfs★★	*Micrasterias rotata* (Grev.) Ralfs *ex* Ralfs ★★
Closterium exiguum West & G.S. West★	*Micrasterias truncata* (Corda) Bréb. *ex* Ralfs var. *pusilla* G.S. West
Closterium gracile Bréb.	*Mougeotia* sp.
Closterium incurvum Bréb.	*Mougeotia* sp.1
Closterium jenneri Ralfs	*Mougeotia* sp.2
Closterium laterale Nordst.★★	*Mougeotia* sp.3
Closterium leibleinii Kütz. *ex* Ralfs	*Mougeotia* sp.4
Closterium moniliferum (Bory) Ehr. *ex* Ralfs	*Mougeotia* sp.5★★
Closterium navicula (Bréb.) Lütk.	*Netrium digitus* (Ehr.) Itzigs. & Rothe
Closterium nematodes Josh. var. *proboscideum* Turn.★★	*Netrium digitus* (Ehr.) Itzigs. & Rothe var. *parvum* (Borge) Krieg.★★
Closterium pusillum Hantzsch★★	*Netrium oblongum* (De Bary) Lütk.★
Closterium setaceum Ehr. *ex* Ralfs	*Octacanthium mucronulatus* (Nordst.) Comp.
Closterium tortum B.M. Griffiths ★★	*Onychonema laeve* Nordst.
Closterium toxon W. West	*Penium exiguum* West ★
Closterium tumidum Johns.	*Penium margaritaceum* (Ehr.) *ex* Bréb.
Closterium tumidum Johns. var. *nylandicum* Grönbl.	*Pleurotaenium ehrenbergii* (Bréb.) de Bary
Closterium venus Kütz. *ex* Ralfs★	*Pleurotaenium nodosum* (Bail.) Lund.★★
Closterium sp.	*Sphaerozosma aubertianum* W. West★
Cosmarium abbreviatum Racib. var. *minus* (West & G. S. West) W. Krieg. & Gerl.	*Spirogyra* sp.
Cosmarium cf. *abruptum* Lund.★	*Spirogyra* sp.1
Cosmarium anisochondrum Nordst. var. *tetrachondrum* Scott & Grönbl.★	*Spirogyra* sp.2★
Cosmarium bayleyi Wolle★	*Spirogyra* sp.3★★
Cosmarium bitriangulum Grönbl. var. *groenbladii* Grönbl.	*Spirogyra* sp.4★★
Cosmarium blytty Wille	*Spondylosium moniliforme* Lund.
Cosmarium brasiliense (Wille) Nordst.	*Spondylosium panduriforme* (Heimerl) Teil. var. *limneticum* (West & G. S. West) Först.
Cosmarium cf. *clevei* (Lund.) Lütk.★★	*Spondylosium planum* (Wolle) West & G.S. West
Cosmarium comissurale (Bréb.) Ralfs var. *crassum* Nordst.	*Spondylosium pulchelum* Arch.★★
Cosmarium contractum Kirch.	*Spondylosium pulchrum* Bail.
Cosmarium excavatum Nordst.	*Spondylosium pygmaeum* (Cooke) W. & G.S. West★
Cosmarium galeritum Nordst. var. *borgei* Krieg. & Gerl.	*Staurastrum ambiguum* Turner
Cosmarium granatum Bréb. *ex* Ralfs	*Staurastrum anatinum* Cooke & Wills
Cosmarium impressulum Elfv.	*Staurastrum bineanum* Rabenh.★★
Cosmarium laeve Rabenh. var. *laeve*	*Staurastrum boreale* West & G.S. West
Cosmarium laeve Rabenh. var. *westii* Krieg. & Gerl.★	*Staurastrum brasiliense* Nordst.★★
Cosmarium lagoense (Nordst.) Nordst. var. *amoebum* Först. & Eck.★★	*Staurastrum brebissonii* Arch. var. *brasiliense* Grönbl.
Cosmarium mamiliferum Nordst.★★	*Staurastrum claviferum* West & G.S. West
Cosmarium margaritatum (Lund.) Roy & Biss. var. *margaritatum* f. *minor* (Boldt) West & G.S. West	*Staurastrum cyclacanthum* West & G.S. West
Cosmarium minimum var. *subrotundatum* W. & G.S. West	*Staurastrum dilatatum* (Ehr.) Ralfs
Cosmarium moerlianum Lütk. var. *brasiliense* Borge	*Staurastrum hagmannii* Grönbl.
Cosmarium naegelianum Bréb.	*Staurastrum hantzschii* Reinsch
Cosmarium norimbergense Reinsch var. *depressum* (West & G. S. West) W. Krieg. & Gerl.	*Staurastrum leptacanthum* Nordst. var. *borgei* Först.★
Cosmarium panamense Presc.★	*Staurastrum leptocladum* Nordst. var. *leptocladum*
Cosmarium phaseolus var. *phaseolus* Bréb. *ex* Ralfs f. *minus* Boldt.	*Staurastrum leptocladum* Nordst. var. *cornutum* Wille★★
Cosmarium portianum Arch.	*Staurastrum margaritaceum* (Ehr.) Ralfs
Cosmarium protractum (Näg.) de Bary	*Staurastrum muticum* (Bréb.) Ralfs
Cosmarium pseudobroomei Wolle	*Staurastrum nudibrachiatum* Borge
Cosmarium pseudoconnatum Nordst.	*Staurastrum orbiculare* (Ehr.) Ralfs var. *orbiculare*
Cosmarium pseudoexiguum Racib.	*Staurastrum orbiculare* (Ehr.) Ralfs var. *depressum* Roy & Biss.
Cosmarium cf. *pseudopyramidatum* Lund.★★	*Staurastrum* cf. *polymorphum* Bréb.★
Cosmarium punctulatum Bréb.	*Staurastrum* cf. *pseudotetracerum* (Nordst.) West & G. S. West
Cosmarium cf. *pyramidatum* Bréb. (Ralfs)★	*Staurastrum quadrangulare* Bréb. *ex* Ralfs var. *quadrangulare*
Cosmarium quadrum Lund. var. *minus* Nordst.	*Staurastrum quadrangulare* Bréb. *ex* Ralfs var. *contectum* (Turn.)★
Cosmarium quadrum Lund. var. *sublatum* (Nordst.) West & G.S. West	*Staurastrum quadricornnutum* Roy & Biss.
Cosmarium quinarium Lund.★	*Staurastrum rotula* Nordst.★★
Cosmarium regnellii Wille★★	*Staurastrum sebaldi* Reinsch var. *ornatum* Nordst.
Cosmarium regnesii Reinsch	*Staurastrum minesotense* Wolle
Cosmarium regnesii Reinsch var. *montanum* Schm.	*Staurastrum setigerum* Cleve var. *pectinatum* West & G.S. West
Cosmarium reniforme (Ralfs) Arch. var. *reniforme*	*Staurastrum subavicula* West & G.S. West
Cosmarium reniforme (Ralfs) Arch. var. *compressum* Nordst.	*Staurastrum tetracerum* (Kütz.) Ralfs

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Cosmarium sublobatum (Bréb.) Arch. var. *brasiliense* Borge	*Staurastrum trifidum* Nordst. var. *inflexum* West & G.S. West
Cosmarium subspeciosum Nordst. var. *subspeciosum*	*Staurastrum* sp.*
Cosmarium subspeciosum Nordst. var. *validius* Nordst. *	*Staurodesmus brevispina* (Bréb.) Croas.
Cosmarium subtumidum Nordst.	*Staurodesmus clepsydra* (Nordst.) Teil.
Cosmarium trilobulatum Reinsch	*Staurodesmus corniculatus* (Lund.) Teil. var. *spinigerum* W. West
Cosmarium vexatum W. West	*Staurodesmus cuspidatus* (Bréb. *ex* Ralfs) Teil.
Cosmarium sp.*	*Staurodesmus dejectus* (Bréb.) Teil. var. *dejectus*
Cosmarium sp.1	*Staurodesmus dejectus* (Bréb.) Teil. var. *apiculatus* (Bréb.) Teil.
Cylindrocystis brebisonnii (Menegh. *ex* Ralfs) de Bary	*Staurodesmus dejectus* (Bréb.) Teil. var. *brevispinus* (Nygaa.) Coesel *
Desmidium aptogonium Bréb. *	*Staurodesmus dickiei* (Ralfs) S. Lill.
Desmidium baileyi (Ralfs) Nordst.**	*Staurodesmus glaber* (Ehr. *ex* Ralfs) S. Lill.*
Desmidium grevillii (Kütz.) de Bary**	*Staurodesmus grandis* Teil. var. *parvus* W. & G.S. West**
Desmidium pseudostreptonema West & G.S. West**	*Staurodesmus lobatus* (Börges.) Bourr.**
Desmidium swartzii Agardh**	*Staurodesmus mamillatus* (Nordst.) Teil.
Euastrum abruptrum Nordst.	*Staurodesmus patens* (Nordst.) Croas.
Eaustrum denticulatum (Kirchn.) Gay	*Staurodesmus* cf. *spencerianus* (Mask.) Teil.*
Euastrum evolutum (Nordst.) W. & G.S. West**	*Staurodesmus* sp.
Euastrum monocylum (Nordst.) Racib. var. *borgei* Grönbl.	*Teilingia granulata* (Roy et Biss.) Bourr.
Groenbladia undulata Nordst.*	*Teilingia quadrispinata* (Scott et Grönbl.) Bourr.*
Gonatozygon aculeatum Hast.	*Zygnema* sp.
Gonatozygon monotaenium de Bary	*Zygnema* sp.1
Gonatozygon pilosum Wolle*	Desmidiaceae unidentified

*taxa exclusive to artificial substratum; **taxa exclusive to natural substratum.

Therefore, independently of substratum type, we verified the predominance of Zygnemaphyceae (desmids), followed by Bacillariophyceae (diatoms), Chlorophyceae and Cyanophyceae (Table 1, Figure 4).

The number of species, in natural substratum, ranged from 156, in December 12nd (final of the experiment, 6th sampling) to 261 taxa, in November 26th (beginning of the experiment, 2nd sampling), thus, we observed a sudden decrease in the number of species during the final phase (Figure 3). In relation to artificial substratum, this number varied between 169, in December 9th (18th day), and 259 taxa, in December 6th (15th day).

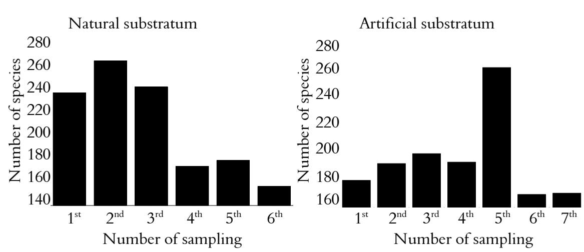

Figure 3. Number of periphytic species in natural (11/21 = 1st; 11/26 = 2nd; 12/01 = 3rd; 12/06 = 4th; 12/09 = 5th; 12/12 = 6th sampling) and artificial substratum (11/24 = 1st; 11/27 = 2nd; 11/30 = 3rd; 12/03 = 4th; 12/06 = 5th; 12/09 = 6th; 12/12 = 7th sampling), sampled in Corvo Stream (tributary of Rosana reservoir).

In the natural substratum, there was a change in the number of desmids taxa, in December 6th (4th sampling), when we registered an expressive contribution of diatoms. The same was observed for the artificial substratum, however, in the last two samplings (December 9th and 12th, 18th and 21st successional days, Figure 4).

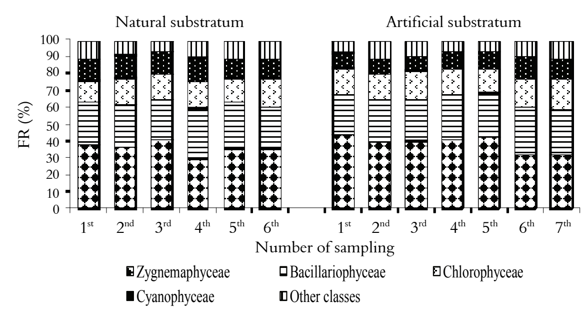

Figure 4. Relative contribution of taxonomic classes in Corvo Stream (tributary of Rosana reservoir), during the study period. (Other classes: Chrysophyceae, Cryptophyceae, Dinophyceae, Euglenophyceae, Oedogoniophyceae, Ulothricophyceae and Xanthophyceae).

Taxonomic similarity in periphytic community

In the diagram from the grouping analysis performed with periphytic algae from both substrata, there was a separation of groups, for the distinct substrata. Two groups were distinguished for artificial and natural substratum (Figure 5). For the artificial substratum, the assemblages of species referring to 3rd and 6th successional days (1st and 2nd samplings) were distinguished amongst themselves, and from the other days; a second group was formed, between the 9th and 12nd days (3rd and 4th samplings). The 15th successional day (5th sampling) was distinct from the others, however presented higher similarity with the final phase of the experiment, between the 18th and 21st days (Figure 5).

For the natural substratum, the results pointed higher similarity among the samples from the three last samplings (December 6th, 9th and 12th), otherwise, the sample of the beginning of the experiment (November, 21st) was grouped with intermediary experimental phase (November 26th, and December 1st; Figure 5).

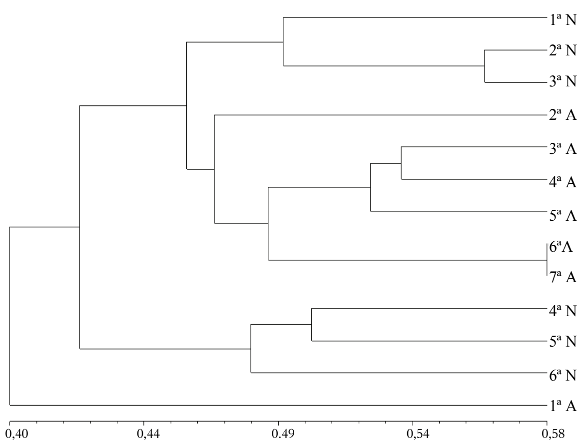

Figure 5. Dendrogram, resulting from Jaccard similarity index (UPGMA), among species of periphytic algae in Corvo Stream, from 13 sampling units. Mantel Test with r = 0.78. Substratum: Natural = N; Artificial = S.

The values referring to physical and chemical parameters of the water, electric conductivity, dissolved oxygen, water temperature and pH presented more constant values, while the other variables as nutrient concentrations and turbidity presented higher variation (Table 2).

Relationship between abiotic variables and phycoperiphytic community

In Paranapanema river watershed, as well as in Corvo Stream (lateral arm from Rosana reservoir), here is a precipitation regime, with concentration of rainfall between November to February, period characterized as warm and rainy. In the study period (November-December), there was higher volume of precipitation at the end of November (11/28, 1st study week) and beginning of December (12/01, Figure 6), two days before the 4th sampling, 12nd successional day at artificial substratum.

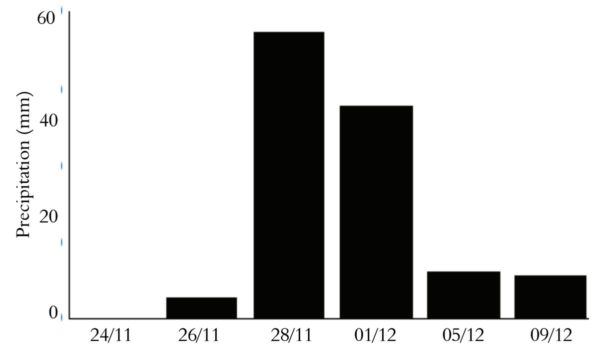

Figure 6. Precipitation values in Corvo Stream (tributary of Rosana reservoir), in the period of 21/11 to 12/12/03.

This high precipitation along with the strong winds during the study period was responsible for the high quantity of material carried into the reservoir, contributing to increase the turbidity and nutrients concentration, which influenced the species composition of periphytic algae. In this way, the number of taxa recorded in the natural substratum was positively correlated to NT (r = 0.95), PT (r = 0.88), PO_4^{-3} (r = 0.93), PDT (r = 0.84) during the 1st week. This community attribute was also positively correlated to PO_4^{-3} (r = 0.92) during the 2nd week, and also with the turbidity (r = 0.93) in the 3rd week.

Considering the artificial substratum, during the 1st week, the species richness of phycoperiphitic species was positively correlated to PT (r = 0.93), NH_4^+ (r = 0.97), turbidity (r = 0.91), and wind (r = 0.99).

Table 2. Values of abiotic variables in Corvo Stream (Rosana reservoir), during the period of 11/21 to 12/12/03. (DO = dissolved oxygen, PT = total phosphorus, PDT = total dissolved phosphorus, PO_4^{-3} = orthophosphate, NT = total nitrogen, NO_3^- = nitrate, NH_4^+ = ammonium).

Weeks	1st week				2nd week			3rd week		
Variable	11-21	11-24	11-26	11-27	11-30	12-01	12-03	12-06	12-09	12-12
Wind (m s^{-1})	2.8	3.1	1.5	1.0	5.6	1.0	3.4	3.0	6.7	2.3
Conductivity (μS cm^{-1})	36.1	40.0	44.8	43.9	37.0	37.6	34.8	40.5	42.6	46.2
Water temperature (°C)	26.0	28.2	27.5	26.8	26.7	26.5	27.0	26.9	26.7	28.6
DO (mg L^{-1})	7.0	7.6	6.4	6.6	6.4	6.6	6.0	6.6	5.8	7.8
pH	6.9	7.0	7.0	6.7	6.7	6.5	6.3	6.6	6.0	6.2
Turbidity (NTU)	2.9	2.8	2.5	3.0	4.2	6.6	11.9	4.1	27.0	18.7
PT (μg L^{-1})	5.7	9.6	13.1	11.1	18.0	17.8	22.4	22.7	21.6	26.3
PDT (μg L^{-1})	3.1	3.2	5.2	4.4	9.0	8.8	9.2	9.5	8.2	16.6
PO_4^{-3} (μg L^{-1})	2.3	3.3	4.3	4.2	7.0	6.9	3.7	4.7	4.5	3.8
NT (μg L^{-1})	322.1	409.0	392.6	346.8	300.0	299.8	236.5	310.0	300.6	339.5
NO_3^- (μg L^{-1})	185.3	215.1	206.3	176.6	120.0	119.0	114.4	136.0	134.0	97.6
NH_4^+ (μg L^{-1})	18.0	20.9	31.7	65.1	66.0	29.2	35.8	75.0	73.9	44.0

During the 2nd week, positive correlations were observed between the species richness and NO_3^- (r = 0.95), and wind (r = 0.88), whereas negative correlations were verified with PDT (r = -0.97), and turbidity (r = -0.93). In the 3rd week, a negative correlation was registered with the turbidity (r = -0.98).

Discussion

The increase in species richness observed during the first days of colonization in the artificial substratum, was possibly due to the propagules present in the environment, since the habitat was not yet colonized, the migration processes favor the colonization and succession of species, allowing the composition of not only colonizing and opportunistic species of diatoms, as well as Chlorococcales, Desmidiales and filamentous algae, as *Bulbochaete* and *Oedogonium*. The immigration is an important process in the composition, colonization and increase of periphytic algae in artificial substratum (HILLEBRAND; SOMMER, 2000; PETERSON, 1996; STEVENSON; PETERSON, 1989).

The decrease in the number of species in the natural substratum over the experiment occurred during the days with higher pluviometric intensity. On the other hand, in artificial substratum, there was a different result, possibly, because this substratum is under succession process, since the increase in the number of species was gradate until November 30th (9th successional day and 3rd sampling), with a decrease in December 3rd (12nd day and 4th sampling). This reduction during the 4th sampling for both substrata may be related to the high precipitation that occurred in November 28th and mainly during the night of December 1st, i.e., two days before the sampling. From this period, the environmental conditions stabilized and hence, the number of species reached the maximum values during the 5th sampling (December 6th, 15th successional day), decreasing drastically again from the 6th sampling (December 9th, 18th day).

The oscillation in the species heterogeneity may be explained by the predominance of resilient species in phycoperiphytic community. These species can recover from disturbing events, as fluctuations in water level and large movement of the water column, caused by rainfall and constant winds. Based on studies about the succession of periphytic algae, the assemblages would be more resilient in more heterogeneous environments (more diversified environmental conditions in face of disturbing events, e.g., rainfall, wind), than in homogeneous ones, because the species diversity in one habitat, would increase the efficient use of available resources (STEVENSON, 1997). The high resistance of many diatoms to wave's effect, even flooding, shows competitive advantages (BIGGS; THOMSEN, 1995; PETERSON, 1996; SABATER et al., 1998; STEVENSON, 1996b), and allows greater representativeness in rivers with high frequency of flooding. *A. minutissimum*, e.g., (species present in all samplings from both substrata), is widely recorded as intermediary colonizer, and highly resistant to disturbances (BIGGS; THOMSEN, 1995; PETERSON, 1996).

The differentiation of phycoperiphytic community in artificial substratum, was evidenced by the grouping analysis, in three phases: the initial, mainly formed when the community receives a gradate increase of species; the intermediate, when there is still an increase in the number of species, reaching a maximum; and the final phase, when there is a severe decrease in number of species, probably due to the replacement and addition of species in different successional stages. The exposure time necessary to periphyton community reaches the maturity stage (maximum in the number and density of species) may vary from two weeks to longer periods, depending on the type of environment, water temperature and the type substratum (LOBO; BUSELATO-TONIOLL, 1985; PATRICK; REIMER, 1975; SABATER et al., 1998). In Corvo Stream, this phase was achieved until the 15th colonization day, as also verified in other studies (CATTANEO et al., 1975; LAM; LEI, 1999; RODRIGUES; BICUDO, 2001).

Moreover, the environmental processes of each habitat, exert a direct influence on the development, composition, and distribution of phycoperiphytic community, specifically concerning the algal flora of each location (CASCO; TOJA, 1994; STEVENSON, 1996a,). Consequently, the high variation in nutrient concentrations (especially phosphorus and nitrogen), mainly from rainfall and constant winds that cause greater displacement of allochthonous material into the environment, besides the resuspension of sediment for the water column, elevating the turbidity, indicate a possible influence on the number and composition of species. On the one hand, when these events are more intense (high precipitation, strong winds) there may be a negative influence, as seen during the 4th sampling, both in natural and artificial substrata, when a sharp decrease in species number was detected. Otherwise, the positive effects of environmental variables previously mentioned may be corroborated by the correlations between the species richness with nutrients (especially phosphorus and nitrogen), turbidity, wind and rainfall.

The highest number of Zygnemaphyceae species, followed by Bacillariophyceae, in both substrata, leads to a greater representativeness of these unicellular algae. Unicellular organisms are fast colonizers, due to their high reproductive rate; while the colonial or filamentous organisms are slower in propagation process (HILLEBRAND; SOMMER, 2000). These traits should influence the phycoperiphytic communities in the upper Paraná river floodplain, considering the high predominance of these non-flagellate unicellular forms, in the studied environments (RODRIGUES; BICUDO, 2004).

The contribution of diatoms, with several species of *Eunotia* (higher number of species in Penales), forming large filaments of cells aggregate in chains (*E. pectinalis*, *E. sudetica* and *E. camelus*), or composing extensive 'arborescent colonies' connected by the edges (*E. flexuosa* and *E. lineolata*), among others, may be associated to morphological and adaptive traits from each taxa, since these algae are better adapted to periphytic habit, besides being grouped and involved in mucilage sheaths that favor the better attachment to the substrata.

The great representativeness of Zygnemaphyceae (desmids) may be related in part to the amount of available substratum for colonization (diversity of aquatic vegetation), and the high values of nutrients and to the water temperature; and also due to the unicellular condition with mucilage sheaths around the cells. In a study of colonization by periphytic algae in glass slides close to macrophyte stands, Rodrigues and Bicudo (2001) related the high richness of desmids in the periphytic community to the presence of macrophyte stands. Diversified flora of desmids presents faster growth at warmer temperatures, with optimum ranging from 25ºC to 30ºC (COESEL, 1996; COESEL; WARDENAAR, 1990; FELISBERTO; RODRIGUES, 2005a and b). In this way, Corvo Stream, tropical environment, with temperatures varying between 26 and 28°C, with high nutrient concentrations and diversity of aquatic vegetation, is a favorable local to the development of this algal flora.

Regarding the Chlorococcales, *Desmodesmus* and *Scenedesmus* are exceptionally common in any environment, oligo, meso or eutrophic (BICUDO; MENEZES, 2006; LÜRLING, 2003), and are among the first to colonize the environment (BICUDO; MENEZES, 2006). The high variation in nutrient concentrations of the studied environment allowed the development of species from this Order. Additionally, *Characium* species, possibly due to the development stage of periphytic biofilm, were favored by the increase of filamentous green algae (as *Oedogonium* and *Bulbochaete*) and also by the quantity of species from the *Eunotia* genus, to which they were fixed through attaching discs.

In summary, the results of taxonomical composition of periphytic algae in natural (*Egeria najas* Planchon) and artificial (plastic plant) substratum were similar, revealing that the development of these algae were also related to environmental conditions, over time. The grouping analysis enabled to register three growth phases of the community, with a maximum peak at 15º successional day, which allow suggesting that the community achieved the maturity stage. Thus, we may state that the heterogeneity in the structure of phycoperiphytic community may be understood through species composition in different succession stages. Furthermore, the number of species, regardless the substratum type, was positively related to the higher nutrient availability, higher values of turbidity, especially during the first week; and negatively related to the turbidity, during the second and third weeks.

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