Ecological guilds of epiphytic diatoms (Bacillariophyta) on *Acrostichum danaeifolium* Längst. & Fisch in a subtropical wetland in southern Brazil

Guildas ecológicas de diatomáceas (Bacillariophyta) epífitas em *Acrostichum danaeifolium* Langst. & Fisch em uma área úmida subtropical do sul do Brasil

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Abstract: Aim: Seasonal patterns diatom community on *Acrostichum danaeifolium* were examined in a wetland in southern Brazil. **Methods:** The adhered diatoms were removed from the plant, species identification and growth forms were performed, and determined physical-chemical parameters of water. **Results:** In total, 96 taxa belonging to 46 genera were identified. *Nitzschia frustulum*, *Pseudostaurosira brevistriata* and *Plagiogramma tenuissimum* were abundant species. Distinct growth forms that formed low-and high-profile ecological guilds and a mobile guild were observed. *Navicula* and *Nitzschia* were the genera with the greatest number of species, and these diatoms formed mucilage tubes. The water temperature varied from 10-26 °C, the depth from 0.35-0.80 m, the transparency from 0.20-0.23 m, the flow from 9.4-42.12 $m^3 s^{-1}$, the pH from 7.08-8.89, the electrical conductivity from 0.65-15.83 mS cm^{-1}, the total organic phosphorus from 0.03-0.11 mg L^{-1}, and the total organic nitrogen from 0.29-0.49 mg L^{-1}. In summer, marine species such as *Thalassiosira eccentrica* and *Rhaphoneis castracanii* were also present. **Conclusions:** The high-profile guild prevailed in all seasons of the year, with higher number of growth forms in the guild in winter. The richness found on *A. danaeifolium* shows that this plant provide a favorable habitat for epiphytic diatoms in wetlands such as Lagoa Pequena.

Keywords: *Acrostichum danaeifolium*; epiphytic diatoms; growth forms; ecological guilds.

Resumo: Objetivo: Padrões sazonais da comunidade de diatomáceas epífitas em *Acrostichum danaeifolium* foram examinados em uma área úmida do sul do Brasil. **Métodos:** As diatomáceas aderidas foram removidas da planta, foi realizada a identificação das espécies e formas de crescimento, e determinados os parâmetros físicos e químicos da água. **Resultados:** Foram identificados 96 táxons distribuídos em 46 gêneros. *Nitzschia frustulum*, *Pseudostaurosira brevistriata* e *Plagiogramma tenuissimum* foram espécies abundantes. Foram observadas diferentes formas de crescimento que formaram guildas ecológicas de baixo e alto perfil e guilda móvel. *Navicula* e *Nitzschia* foram gêneros que apresentaram maior número de espécies e formaram tubos de mucilagem. A temperatura da água variou de 10-26 °C, a profundidade de 0,35-0,80 m, transparência de 0,20-0,23 m, fluxo da água de 9,4-42,12 $m^3 s^{-1}$, pH de 7,08-8,89, condutividade elétrica de 0,65-15,83 mS cm^{-1}, fósforo orgânico total de 0,03-0,11 mg L^{-1}, e nitrogênio orgânico total de 0,29-0,49 mg L^{-1}. No verão ocorreram espécies marinhas como *Thalassiosira eccentrica* e *Rhaphoneis castracanii*. **Conclusões:** A guilda de alto perfil prevaleceu em todas estações do ano, com maior número de formas de crescimento deste perfil no inverno. A riqueza encontrada sobre *A. danaeifolium* mostra que esta planta promove um habitat favorável para diatomáceas epífitas em áreas úmidas como a Lagoa Pequena.

Palavras-chave: *Acrostichum danaeifolium*; diatomáceas epífitas; formas de crescimento; guildas ecológicas.

1. Introduction

South America has large expanses of wetlands, and most of them (50%) are located in Brazil. Because wetlands comprise a large number of natural environments, ecological studies of these areas are highlighted as important tasks in limnology (Neiff, 2001; Naranjo, 1995; Esteves, 2011). In the State of Rio Grande do Sul, the Lagoa Pequena is a wetland designated as a conservation priority (Base de dados tropical, 2003).

Acrostichum (Pteridaceae) is a pantropical genus (Tryon & Tryon, 1982). *A. aureum* L. and *A. danaeifolium* Langst. & Fisch (neotropical) (Sehnem, 1972) occur in Brazil. *A. danaeifolium* has been described in mangrove areas of Costa Rica, Puerto Rico and Mexico (Coll et al., 2001; Mehltreter & Palacios-Rios, 2003; Sharpe, 2010). The species occurs in the United States (Florida), Paraguay, Brazil (Mehltreter & Palacios-Rios, 2003), the inshore and Amazon regions of Peru (Leon & Young, 1996) and in the wetlands of Bolivia (Killen & Schulenberg, 1998). In the state of Rio Grande do Sul (Brazil), it occurs in the Tramandaí wetland (Sehnem, 1972).

The vast majority of studies of epiphytic diatoms are focused on macroalgae and the under growth of marine vegetation (Costa et al., 2009). In Brazil, there are records of diatoms in angiosperms, such as *Polygonum hydropiperoides* Michaux. and *Potamogeton polygonus* Cham. & Schltdl (Bertolli et al., 2010; Santos et al., 2011), and in China there are records of epiphytic diatoms on the angiosperm *Kandelia candel* L., (Chen et al., 2010). This work focused on the emergent aquatic macrophyte *A. danaeifolium* because this plant supports the colonization and development of adhered diatoms. There are no records of a study on the relation between epiphytic diatoms and this plant. The study of ecological guilds may reveal the potential of species to use resources and avoid system disturbances (Passy, 2007) while also indicating the complexity of the community through the presence of distinct guilds.

In this context, the objective of this work was to determine the specific composition of epiphytic diatom community on *A. danaeifolium* and the ecological guilds that are present, as well as to determine which environmental factors influence the presence of these guilds.

2. Material and Methods

2.1. Study area

The Pseudônimo stream (31°40’16,4” S and 52°04’51,4” O) is a water course connected to the Patos Lagoon estuary and is associated with the spillway of Lagoa Pequena, a Brazilian subtropical wetland located in the coastal plain of Rio Grande do Sul (Figure 1). The dominant vegetation is a Cyperaceae *Schoenoplectus americanus* (Pers.) Volk ex Schinz & Kell.

2.2. Sample collection and chemical and physical analysis

Twelve samples were collected seasonally (fall (May), winter (August), spring (December) and summer (January)) during the period from May 2011 to January 2012.

The samples were fixed with 4% formalin. The adhered diatoms were removed with the aid of a 10 mm brush and distilled water jets. Each sample contained 20 ml, and 2 ml was removed for the preparation of the permanent slides with Naphrax® resin, according to the methods of Simonsen (1974). Twenty-four permanent slides were analyzed, which included two slides per sample.

To study the ecological guilds, one sample (not fixed) was collected at each station to facilitate observations of the diatom growth forms on simple slides (slide and cover glass). The slides were observed with an optic microscope Olympus BX 40. The diatoms were grouped according to the growth morphology of the three guild types according to Passy (2007).

Environmental values were determined for pH (pHmeter Lutron pH-206), electrical conductivity (conductivimeter, Lutron CD-4303), water temperature (thermometer, Arba), depth, water transparency (Secchi disk) and flow rate, which was calculated according to Carvalho (2008). One-liter water samples were collected to determine total phosphorus (Valderrama, 1981; Baumgarten et al., 1996) and total organic nitrogen (method of Mackereth et al., 1978).

2.3. Analysis of the diatom community

At least 400 valves of diatoms were counted per sample, with counts of approximately 200 valves per permanent slide. Relative abundance was calculated based on the number of valves counted and the number of species found on each slide. Species with values higher than the average calculated for each slide were considered abundant (Lobo & Leighton,

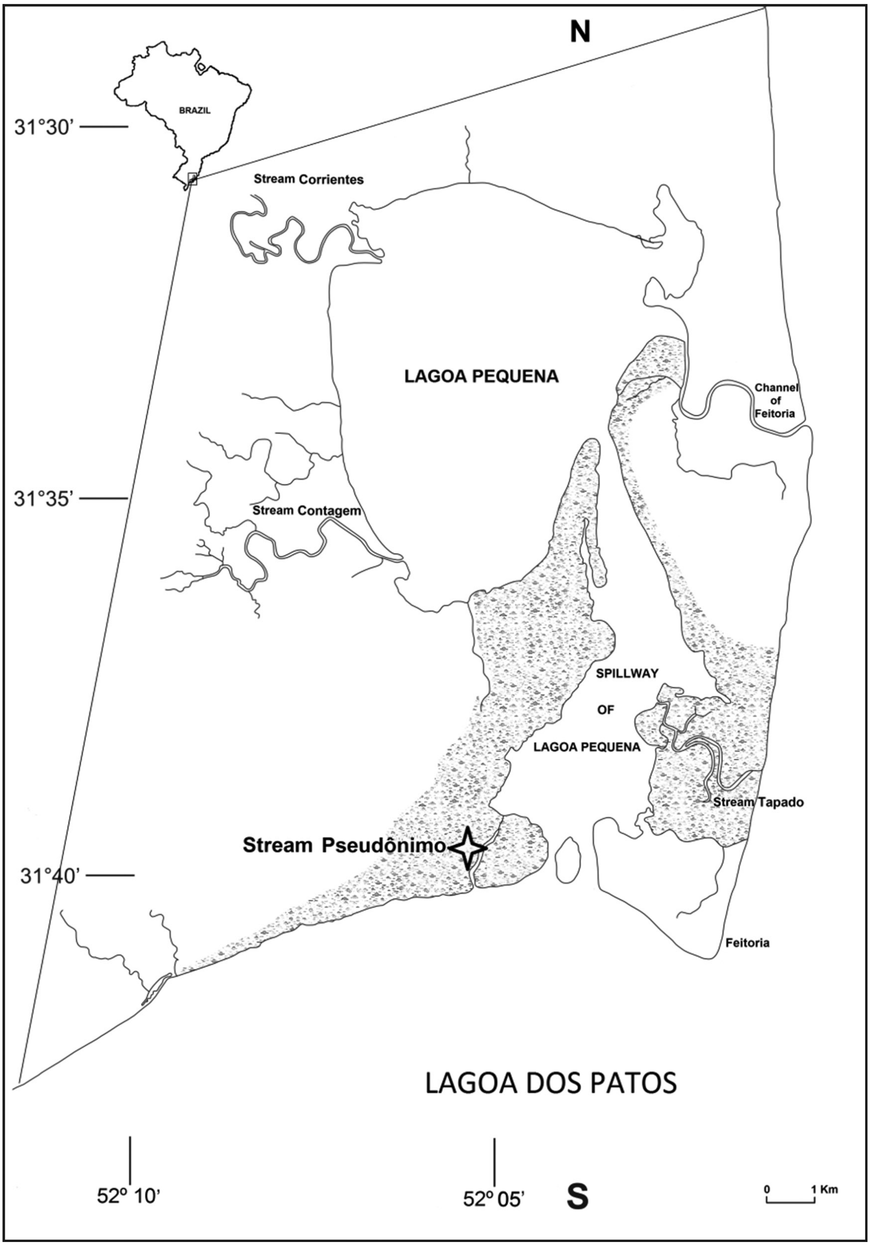

Figure 1. Location of Pseudônimo Stream in southern Brazil.

1986). The calculated parameters include diversity index (Shannon), equitability and dominance, and these calculations were performed with the software PAST (Hammer et al., 2001). Also, to compare the specific diversity among the seasons, the "t" test was used ($\alpha = 0.05$).

The relations between the diatom community and environmental factors (with the exception of the autumn flow data, due to the lack of data) were examined using canonical correspondence analysis (CCA) (based on 56 taxa with relative abundance greater than 1% in at least one sample) using the software R (R Development Core Team, 2007).

3. Results and Discussion

3.1. General characteristics of the diatom community

In total, 96 species of diatoms distributed in 46 genera were identified from the 12 samples examined. Most of the species found were from freshwater and brackish environments and have a cosmopolitan distribution. The two genera that showed the greatest species richness were *Nitzschia* (19 spp) and *Navicula* (6 spp) (Figure 2). Species richness was 29 (winter), 72 (autumn), 45 (spring) and 64 (summer).

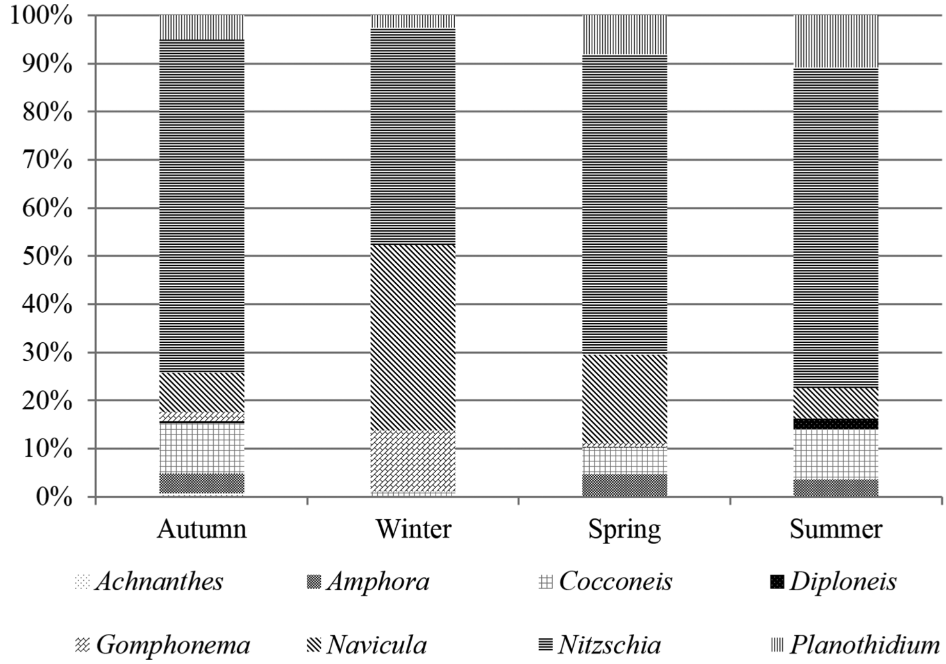

Figure 2. Relative distribution of the genus that accounts for at least three species of epiphytic diatoms in *A. danaeifolium* the period of May 2011 to January 2012 (total number of valves counted).

Through the study of live samples (simple slides), the ecological guild was determined to comprise 21 species. In addition, a high density of epiphytic diatoms with different growth forms (erect, adnate, chain, with mucilage tube, stalked (peduncle of mucilage) and mobile), were part of the low-profile, high-profile and motile guilds (Table 1).

A significant difference in diversity was observed in the different seasons ($p = 0.001$). Greater diversity and numbers of species occurred in autumn and summer; and lower in winter and spring (Table 2). Greater numbers of abundant species occurred in autumn (9) and summer (16); and lower numbers occurred in winter (5) and spring (7) (Table 1).

The temperature can have a significant effect on the growth and mortality rates of epiphytes (Borowitzka et al., 2006) and can be the main parameter related to the species richness and abundance both in winter and in summer. In winter, with a decrease of 8 °C, richness decreases by approximately 60% by decreasing the number of abundant species from nine to five. In summer, with an increase of 14 °C (relative to the winter) species richness increases to approximately 56% and the numbers of the abundant species also increases.

In ecological terms, algae epiphytes are an important food source for invertebrates living in the Patos Lagoon estuary, such as the polychaete *Laeonereis acuta* (Benvenuti & Colling, 2010), and for important fishery species, such as mullet *Mugil liza* (Vieira, 1991), the pink shrimp *Farfantepenaeus paulensis* and the blue crab *Calinectes sapidus* (D'Incao & Dumont, 2010). Thus, epiphytic diatoms of the Pseudônimo Stream can contribute to the trophic relations and productivity of the Lagoa dos Patos estuary.

Abundant species that were present in all seasons of the year were indicated as follows: *Nitzschia frustulum*, *Navicula* sp1, *Pseudostaurosira brevistriata, Plagiogramma tenuissimum*, *Gomphonema parvulum, Nitzschia filiformis* var. *filiformis, Bacillaria paxillifera*, *Cocconeis placentula, Catenula adhaerens* and *Planothidium delicatulum*, with maximum abundance values of 49%, 39.5%, 31.1%, 13.7%, 10.5%, 7.9%, 7.3%, 4.7% 3.3% and 2.5%. In particular, *P. tenuissimum* was abundant in three of the study periods, along with *B. paxillifera*, *Navicula* sp1 and *P. brevistriata*.

The occurrence of *Navicula* and *Nitzschia* as epiphytes is rare; the most common occurrence was of *Cocconeis* in marine environments (Chen et al., 2010) and *Gomphonema* in freshwater environments (Tremarin et al., 2009).

Acrostichum danaeifolium showed restricted distribution in Lagoa Pequena, occurring only in a fragment of 500 meters along the western margin of the Pseudônimo Stream (Figure 3).

Table 1. List of taxa that were used in the canonical correspondence analysis (with abundance >1% and acronyms) including 25 abundant species (bold), and 21 growth forms.

Acronyms	Taxa	Abundance				Growth forms
		Aut	Win	Spr	Sum	
Amp.cop	*Amphora copulata* (Kützing) Schoeman & Archibald	0.4	-	0.9-2.7	0.9-1.6	Mobile (summer)
Aul.gran	*Aulacoseira granulata* (Ehrenberg) Simonsen	0.4	0.4	0.4	2.3	
Bac.pax	***Bacillaria paxillifera*** (O.F.Müller) T. Marsson	**2.8-7.3**	0.4-3.6	**0.4-5.3**	**0.4-3.6**	Chains (autumn and summer)
Bir.cir	*Biremis circuntexta* (Meister ex Hustedt) H. Lange-Bertalot & A. Witkowski	0.4	-	0.5	0.4-1.9	
Cat.adh	***Catenula adhaerens*** (Mereschkowsky) Mereschkowsky	0.6-1.2	0.4-1.9	0.4-2.9	**1.2-3.3**	
Coc.flu	*****Cocconeis fluviatilis*** Wallace	**2.1-5.7**	-	0.4-2.5	-	
Coc.hau	*Cocconeis hauniensis* A. Witkowski	0.2-1.2	-	-	-	
Coc.pla	***Cocconeis placentula*** Ehrenberg	0.2-2.0	0.4-1.8	**0.4-4.6**	**0.8-4.7**	Adnate (autumn)
Coc.sp	*****Cocconeis* sp**	0.7-1.3	**-**	**-**	**1.4-2.9**	
Cte.pul	*Ctenophora pulchella* (Ralfs ex Kützing) Williams & Round	-	0.4-3.3	1	-	Erect and Tube (winter)
Dia.con	*Diadesmis contenta* (Grunow ex Van Heurck) D.G.Mann	1.6-2.2	-	-	-	
Dip.pue	*Diploneis puella* (Schumann) Cleve	0.2	-	-	0.8-1	
Ent.orn	*****Entomoneis ornata*** (Bailey) Reimer	-	-	-	**0.8-2.8**	
Fal.sp	*****Fallacia* sp**	0.2-0.6	**-**	0.4-2.1	**0.8-3.2**	
Gom.aff	***Gomphonema affine*** (Kützing)	0.4	**0.4-8.9**	-	-	
Gom.par	***Gomphonema parvulum*** (Kützing) Kützing	0.8-1.4	**7.1-10.5**	0.4-2.4	0.4	Peduncle (winter and summer)
Gyr.sp	*Gyrosigma* sp	-	-	-	0.8-1	Mobile (summer)
Mel.mon	*Melosira moniliformis* (Müller) Agardh	-	-	-	2.8	
Mel.var	*Melosira varians* Agardh	0.2	0.4-3.8	0.4	0.8-2.8	Chain (winter)
Nav.ger	*Navicula germainii* Wallace	0.4-0.8	0.4-0.9	0.4-1.9	0.4-1.2	
Nav.sch	*Navicula schroeterii* Meister	0.8-1.7	-	-	-	
Nav.sp1	*****Navicula* sp.1**	**0.4-3.4**	**33-39.5**	**3.8-12.5**	0.8-1.6	Tube (autumn and winter)
Nav.sp3	*****Navicula* sp.3**	1.4-2.1	-	1.3-3.3	**1.4-1.9**	
Nit.cla	*Nitzschia clausii* Hantzsch	0.4-3.0	0.4	-	-	Tube (autumn)
Nit.cnf	*****Nitzschia filiformis* var. *conferta*** (Richter) Lange-Bertalot	**1.2-3.5**	-	2.9-4.2	2.8	Tube (spring)
Nit.fil	***Nitzschia filiformis* var. *filiformis*** (W. Smith) Van Heurk	**4.6-7.6**	0.8-2.8	**1.9-7.9**	0.4-0.9	Tube (autumn and winter)
Nit.fon	*Nitzschia fonticola* var. *pelagica* Hustedt	1.9	0.4	-	-	
Nit.fru	***Nitzschia frustulum*** (Kützing) Grunow	0.4-4.7	**0.4-49**	**0.9-35**	0.8-4.2	Mobile (all seasons)
Nit.gra	*Nitzschia gracilis* Hantzsch	-	-	-	1.2-1.7	
Nit.in	*Nitzschia intermedia* Hantzsch ex Cleve & Grunow	-	-	-	1.6-2.9	

*Indicates especies not recorded as an abundant epiphyte in other estuaries and wetlands of the American continents.

Table 1. Continued...

Acronyms	Taxa	Abundance				Growth forms
		Aut	Win	Spr	Sum	
Nit.mic	*Nitzschia microcephala* Grunow	1	-	-	-	
Nit.pal	***Nitzschia palea*** (Kützing) W.Smith	**6.5-8.8**	-	-	0.9-7.1	Tube (autumn) erect (winter)
Nit.sig	*Nitzschia sigma* (Kützing) W. Smith	0.2	-	1.7	0.4-1.2	
Nit.sp2	*Nitzschia* sp.2	0.9-1.8	1.8	-	-	
Nit.spi	****Nitzschia spiculoides*** Hustedt	0.2	-	-	**9.8-15.3**	
Nit.sub	****Nitzschia subacicularis*** Hustedt	-	-	-	**2.3-14.3**	Erect and mobile (summer)
Nit.sub.1	****Nitzschia subchoaerens*** (Grun.) Van Heurck **var. *scotica* (**Grunow) van Heurck	**19-20.7**	-	-	**2.4-14**	Tube (autumn and spring)
Plag	****Plagiogramma tenuissimum*** Hustedt	**5.5-9.6**	0.8-5.1	**8.4-12.1**	**9.5-13.7**	
Plan.del	****Planothidium delicatulum*** (Kütz.) Round & Bukhtiyarova	0.4-1.9	0.4	0.4-2.3	**0.4-2.5**	
Plau.fre	*Planothidium frequentissimum* (Lange-Bertalot) Round &L.Bukhtiyarova	0.2-0.6	1.3-5.1	0.8-2.9	0.4	
Plau.hau	*Planothidium haukianum* (Grunow) Round & L.Bukhtiyarova	0.4-1.4	-	-	-	
Plau.min	****Planothidium minutissimum*** (Krasske) Lange-Bertalot	0.2-1.4	-	0.4-4.8	**1.9-5.4**	
Pleu.lea	*Pleurosira laevis* (Ehrenberg) Compère	-	-	2.7	-	Chain (spring)
Pleu.sal	*Pleurosigma salinarum* (Grunow) Grunow	0.4	-	0.4-1	-	
Psam	*Psammodictyon* sp	0.4-0.9	-	0.4-3.2	0.8-1.4	
Pse.ech	****Pseudopodosira echinus*** (Frenguelli) Metzeltin, Lange-Bertalot & García-Rodríguez	-	-	-	**1.9-2.3**	
Pseu.bre	***Pseudostaurosira brevistriata*** (Grunow) Williams & Round	1.9-3.4	**1.9-10**	**11.1-28.4**	**18.5-31.1**	Chain (except in spring)
Pseu.geo	*Pseudostaurosiropsis* cf. *geocollegarum* (Witkowski) E.A Morales	6.3	0.4	0.5-0.9	0.4-2.3	
Rho.run	*Rhopalodia rumrichiae* Krammer	1.2-2.4	-	0.4	0.9-1.2	
Sem.str	*Seminavis strigosa* (Hustedt) Danielidis & Economou-Amilli	0.4	-	0.4	0.4-2.3	
Skel	****Skeletonema* sp**	**-**	**-**	**-**	**0.8-3.8**	
Stau.mrty	*Staurosirella martyi* (Hèribaud-Joseph) E.A.Morales & K.M.Manoylov	0.2-1.0	-	0.4-2.7	0.8-2.3	
Sur.lit	*Surirella litoralis* Hustedt	-	1.3-4.9	-	-	
Tab.fas	***Tabularia fasciculata*** (C.A. Agardh) Williams & Round	**6.7-8.1**	-	-	0.8-1.4	
Try.acu	*Tryblionella acuminata* W.Smith	-	-	0.5-1.4	0.8-1.4	
Forms of growth not included in CCA						
Encyonema silesiacum (Bleisch) D.G.Mann						Mobile (summer)
Eunotia bilunaris (Ehrenberg) Schaarschmidt						Chain (winter)
Navicula norae Metzeltin, Lange-Bertalot & García-Rodríguez						Mobile (summer)
Tabularia tabulata (C.A. Agardh) Snoeijs						Erect (winter)

*Indicates especies not recorded as an abundant epiphyte in other estuaries and wetlands of the American continents.

Table 2. Seasonal changes in the richness, dominance, equitability, and diversity of the diatom community in *A. danaeifolium*.

Period/ Biological Variables	Aut* May 2011	Win* August 2011	Spr* December 2011	Sum* January 2012
Diversity (Shannon H)	3.24	1.86	2.67	2.99
Dominance (D)	0.07	0.25	0.11	0.10
Equitability (J)	0.75	0.55	0.70	0.71
Richness	72	29	45	64

*Seasons with significative difference in diversity (α=0.05).

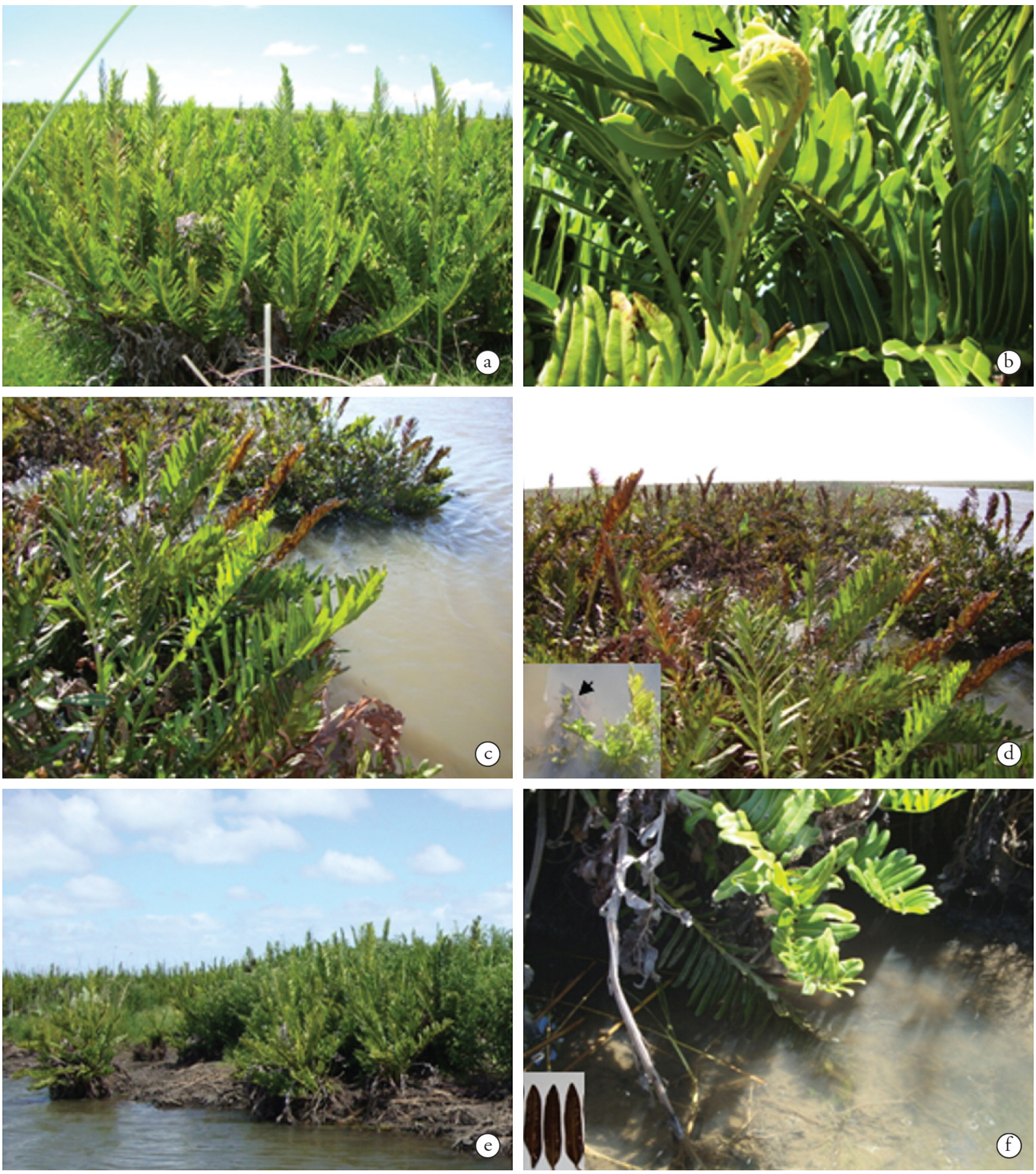

Figure 3. *Acrostichum danaeifolium.* (a) General view of the fragment of vegetation along the western margin of the Pseudônimo Stream. (b) Detail of the baculum. (c and d) Vegetation during the normal level (winter) and in (d), detail of the periphyton adhered to the pinnae. (e and f) Period of low water level (summer) with few fronds in contact with water, and in (f) detail of the pinnae (the part collected for observation of the diatoms).

3.2. Seasonal patterns of the diatom community

In the community of diatoms associated with *A. danaeifolium,* 20% of the taxa were present in all seasons. A high-profile guild was present throughout the entire study period (Figure 4). In the autumn, there was a predominance of mucilage tubes (73.4%). The winter also a high percentage of mucilage tubes (39.3%), along with chain (5.2%), erect (2.1%), peduncle (10.4%) (high-profile guild) and mobile forms (42.7%) (mobile guild). The spring had high percentage of mucilage tubes (25.4%) and chain (2.5%) (high-profile guild) and mobile forms (71.9%) (motile guild). The summer had high percentage of chain (67.7%) (high-profile guild) and mobile forms (32%) (motile guild).

In the summer, a high number of mobile species (6spp) were present; however, the presence of chain-forming species (*Bacillaria paxilifera* and *Pseudostaurosira brevistriata*) met the definition for a high-profile guild for this season of the year. The mucilage tubes were formed by the genera *Nitzschia*, *Navicula* and *Ctenophora* (this last one was observed only once in the winter). Three species occurred in the spring, four in summer and seven in autumn. In spring and summer (during lower water flow), a greater number of species were expected to form the high-profile guild because, according to Passy (2007), the lower flow favors this profile. However, this was not observed, and the largest species number observed in the high-profile guild occurred in greater flow (winter).

The sorting of the samples according the physical and chemical variables (Table 3) and the composition of species as descriptors revealed the separation of the samples by the seasons of the year (autumn, winter, spring and summer) in two main groups (Figure 5).

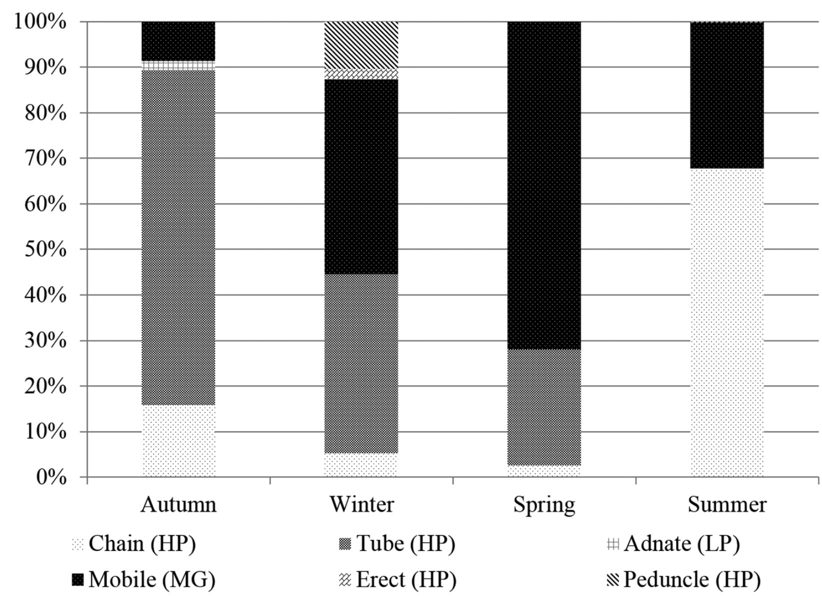

Figure 4. Relative distribution of the growth forms and type of guild (HP = high profile, LP = low profile and MG = mobile guild) in *A. danaeifolium* in the Pseudônimo Stream in the period of May 2011 to January 2012.

Table 3. Physical and chemical variables in Pseudônimo Stream during the study period (May 2011 to January 2012).

Period/ Variables	T °C Water	Conductivity mS cm⁻¹	pH	Depth (m)	Transprency (Secchi) (m)	Stream flow m³s⁻¹	TP mg L⁻¹	TN mg L⁻¹
Autumn (May 2011)	18°	3.80	7.08	0.76	Total	-	0.09	0.29
Winter (August 2011)	10°	0.65	8.65	0.80	0.20	42.12	0.03	0.44
Spring (December 2011)	26°	3.43	7.82	0.35	0.23	12.02	0.11	0.49
Summer (January 2012)	24°	15.83	8.89	0.35	Total	9.4	0.04	0.40

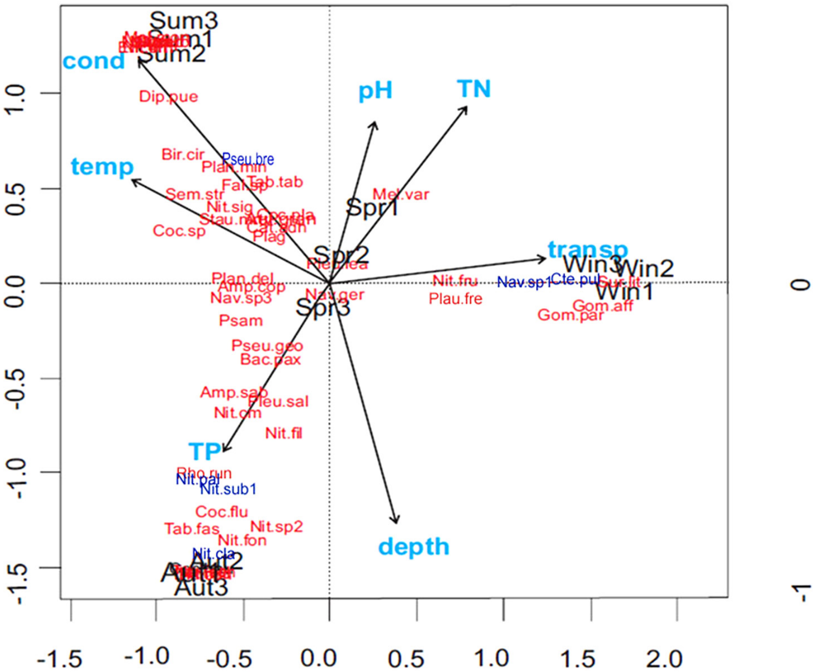

Figure 5. Canonical correspondence analysis (CCA) showing the distribution of the diatom community in relation to environmental factors (temperature (temp), electrical conductivity (cond), total phosphorus (TP), depth, transparency (transp), total nitrogen (TN) and pH) and seasons (autumn (Aut), winter (Win), spring (Spr) and summer (Sum)).

The first group (summer and autumn) showed a positive correlation with temperature, conductivity and total phosphorus and a negative correlation with the depth, transparency, total nitrogen and pH. This group was defined as predominant in the Pseudônimo Stream.

The second group (winter) showed a positive correlation with water transparency, depth, total nitrogen and pH, and a negative correlation with electrical conductivity, temperature and total phosphorus.

The values of the nutrients observed during the study period in Pseudônimo Stream allowed the stream to be considered of good quality because the phosphorus was within the limits established by the National Council on the Environment (Brasil, 2005) for brackish waters of class 1. The sorting of samples also showed that some species of the high-profile guild (chain-forming, tubesand erect) responded (with greater abundance) to environmental factors such as temperature in summer (*Pseudostaurosira brevistriata*), total phosphorus in autumn (*N. subchoaerens* var. *scotica*, *N. palea* and *N. clausii*) and water transparency in winter (*Navicula* sp. and *Ctenophora pulchella*) (Figure 5).

3.3. Epiphytic diatoms on different substrates

According to Passy (2007), *Navicula* and *Nitzschia* are part of the mobile guild, but in *A. danaeifolium, Navicula* spp. and *Nitzchia* spp. were found to be mobile and formed mucilage tubes, thus representing both the high-profile guild and the mobile guild.

Of the 25 abundant species in *A. danaeifolium*, only six (*Bacillaria paxilifera*, *Nitzschia filiformis*, *Gomphonema parvulum*, *Nitzschia palea*, *Cocconeis placentula* and *Tabularia tabulata*) have been recorded as abundant epiphytes on the American continents and in the subtropical region of China (Azevedo, 1999; Chen et al., 2010; Gómez et al., 2003; Kulesza et al., 2008).

3.4. Seasonal change in diatom community

The low-profile guild was represented by *Cocconeis placentula* and *Gomphonema parvulum*; the latter was assigned to this guild for presenting short peduncles, according to Passy (2007). *Cocconeis placentula* was abundant in the spring and summer, when there was a reduction in the number of mucilage tube-forming species, which favored its abundance.

4. Conclusions

This work presents an unprecedented study on epiphytes in pteridophytes. The richness found on *A. danaeifolium* shows that this plant provide a favorable habitat for epiphytic diatoms in wetlands such as Lagoa Pequena. Different growth forms occurred on *A. danaeifolium*.

The high-profile guild was present throughout the study period, and this can be interpreted as an expression of a community adapted to the environmental conditions of the Pseudônimo Stream, mainly in winter. According to Passy (2007), the competitive ability of this guild makes it prevalent in slightly disturbed habitats, as is the case of the Pseudônimo Stream.

Given that *A. danaeifolium* is present in only a small stretch in the Pseudônimo Stream, conservation strategies should be implemented to ensure the permanence of this plant in the environment.

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