

## Moss and liverwort epiphytes on trunks of *Cyathea delgadii* in a fragment of tropical rain forest, São Paulo State, Brazil

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**Abstract:** This study is a survey of the bryophyte species that occur on the trunks of *Cyathea delgadii* Sternb. (Cyatheaceae), a native tree fern, encountered in a fragment of Atlantic forest located in the area of the „Parque Estadual das Fontes do Ipiranga (PEFI)“, São Paulo State, Brazil. Specimens of bryophytes were collected from March 2001 to October 2003. We found 35 bryophyte species (12 spp. of mosses and 23 of liverworts). *Ceratolejeunea dentacornuta* Steph. is presented as a new record for Brazil. A brief discussion about previous records of bryophyte species growing on trunks of tree ferns in Brazil is also presented.

### Introduction

It is known that the trunks of tree ferns are an excellent habitat for establishment of several groups of bryophytes (Beever 1984). Also, according to the same author, some mosses are regarded as specializing on tree ferns and rarely are found on other substrates. Among these are: *Calomnion laetum* Hook. f. & Wilson, *Rhizofabronia sphaerocarpa* (Dusén) M. Fleisch., and *Hymenodon aeruginosus* (Hook. f. & Wilson) Müll. Hal.

For Brazil, there is only one paper, Ahmed and Frahm (2002), reporting the occurrence of bryophytes (mosses, liverworts,

and hornworts) on trunks of tree ferns. In this paper the authors recorded a total of 142 bryophyte species on two tree fern species (*Cyathea arborea* (L.) J. Sm. and *Dicksonia sellowiana* Hook.) and five new bryophyte associations were described.

The aim of the present survey was to amplify our knowledge of the occurrence of bryophytes on trunk of tree ferns in a Brazilian tropical forest.

## Material and methods

*Study area:* The study was made in a fragment of a tropical rain forest (Atlantic forest) located in the city of São Paulo, São Paulo State, Brazil, 23°38'08"–23°40'18" S and 46°36'48"–46°38'00" W. This fragment of native forest belongs to the Botanical Garden of São Paulo, and is inside of the Parque Estadual das Fontes do Ipiranga (PEFI). The elevation in the area varies from 770 to 825 m (Barbosa *et al.* 2002). Temperatures are quite variable during the year, and range from 4.6 °C in winter to 35.6 °C in summer (Santos & Funari 2002). The upland Atlantic forest is the predominant vegetation in the area, but there are some open areas occupied by natural fields. During the last 60 years, this forest vegetation has been submitted to intense atmospheric pollution from the city of São Paulo. This pollution caused drastic alterations on forest composition during the 1980s, including the loss of species. More recently, as this pollution has been reduced, the forest is in better condition.

*Choice of the phorophyte:* *Cyathea delgadii* Sternb. was chosen because it is a native and common species in the study area. Ten individuals were selected for sampling with trunks that were at least 2 m tall, and 10–15 cm in diam. These phorophytes were numbered (#1–#10) and the date of each collection was noted. The phorophytes were located in the forest interior, under the canopy or near the forest margins. Vouchers of the phorophytes were placed in the Herbarium of the Instituto de Botânica (Herbarium SP).

*Sampling the bryophytes:* all individuals of bryophytes growing on the selected phorophytes were collected, from the ground level to 2 m up the trunk. The material was collected over the period of two years and seven months, from March 2001 to October 2003. Nomenclature follows Gradstein *et al.* (2001). Vouchers of all bryophyte species sampled were deposited in the Herbarium SP.

## Results

A total of 35 bryophytes species were found, 12 species of Musci and 23 species of Hepaticae (table 1).

Nine genera of mosses were found, and among them the best represented were *Fissidens*, *Syrrhopodon*, and *Thamniopsis* with two species each. Fourteen genera of liverworts were recorded. *Lejeunea*, *Lophocolea*, and *Plagiochila* were the most diverse with three species each followed by *Aphanolejeunea*, *Metzgeria*, and *Radula* with two species each (table 1).

*Thamniopsis langsdorffii* and *Lophocolea martiana* were the most common species and both were encountered growing on nine phorophytes, followed by *Isopterygium tenerum* and *Lejeunea flava* both registered from eight phorophytes (table 1). On the other hand, there were species that occurred on only one phorophyte: *Bryum beyrichianum*, *Campylopus filifolius*, *Fissidens weirii*, *Hymenodon aeruginosus*, *Syrrhopodon ligulatus*, cf. *Wijkia flagellifera*, *Aphanolejeunea* cf. *microscopica*, *A. subdiaphana*, *Frullania beyrichiana*, *Lepidolejeunea involuta*, *Plagiochila corniculata*, *Riccardia chamaedryfolia*, and *Schiffneriolejeunea polycarpa* (table 1).

Among the phorophytes, the samples #1, #4, and #7 had the highest number of bryophyte species with 17 spp., 14 spp, and 13 spp., respectively (table 2).

*Ceratolejeunea dentatocornuta* was recorded for two phorophytes (#4 and #6) and it is the first record of this species for Brazil. This species was previously known only from the type collection for Ecuador (Bonner 1953), inside forests near river margins and from French Guiana (Onraedt 1989) occurring as an epiphyte on „Sabralia“. This species can be recognized by having a perianth that normally has four keels that are extended distally into narrow horn-like projections.

Eight of the 35 species found on *Cyathea delgadii* in the present work were also reported by Ahamed and Frahm (2002) on trunks of *Dicksonia sellowiana* and *Cyathea arborea*. These included the two mosses *Hymenodon aeruginosus* and *Isopterygium tenerum*, and six

liverworts *Anoplolejeunea conferta*, *Lejeunea flava*, *Lophocolea martiana*, *L. muricata*, *Radula kegelii*, and *R. nudicaulis*.

### Discussion

According to the checklist by Visnadi and Vital (2000), in the area of the PEFI there are 74 species of Hepaticae, 2 spp. of Anthocerotae, and 87 of mosses. While the majority of mosses have a terrestrial habit, the opposite is true for the liverworts, where the epiphytic habit is dominant. Although mosses, including terrestrial and epiphytic species, are more diverse in the area, the liverworts were found more often on the trunks of *Cyathea delgadii* (23 spp.).

The presence of a large number of species on the phorophytes #1, #4, and #7 probably could be attributed to the age and larger diameter (ca. 15 cm) of their trunks.

*Hymenodon aeruginosus*, an example of a specialized moss (Beever 1984), reported on phorophyte #2, was previously cited for Brazil growing on tree ferns (*Cyathea* and *Nephelea*) by Churchill and Salazar-Allen (2001).

Despite the comparison made with the paper by Ahmed and Frahm (2002), we believe that the identification of the phorophyte, *Cyathea arborea* cited in that paper, may be wrong. According to Proctor (1985, 1989), *C. arborea* is restricted to the Caribbean region (Greater and Lesser Antilles) and northern Colombia. The similarity of species found between the phorophytes studied in the present work with those studied by Ahmed and Frahm (2002) suggests that both phorophytes could be the same species (*C. delgadii*), but more evidence is necessary. Although Ahmed and Frahm (2002) did not cite which bryophyte species occurred on *Dicksonia sellowiana* and *Cyathea arborea* separately, our data show that eight species found on *C. delgadii* in the area of the PEFI were also reported by Ahmed and Frahm (2002) that studied a wide area along the Atlantic forest in southeastern Brazil.

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### Literature

- AHMED, J. & FRAHM, J.-P. (2002). Moosgesellschaften auf Baumfarnstämmen in Südostbrasilien. *Trop. Bryol.* 22: 135–178.
- BARBOSA, L. M., POTOMATI, A. & PECCININI, A. A. (2002). O PEFI: histórico e legislação. In D.C. Bicudo, M.C. Forti & C.E.M. Bicudo (eds), Parque Estadual das Fontes do Ipiranga, Unidade de Conservação que Resiste à Urbanização de São Paulo: 1–28. Secretaria do Meio Ambiente do Estado de São Paulo, São Paulo.
- BEEVER, J.E. (1984). Moss epiphytes of tree-ferns in a warm temperate forest, New Zealand. *J. Hattori Bot. Lab.* 56: 89–95.
- BONNER, C.E.B. (1953). A contribution to the study of the genus *Cerotolejeunea* (Spruce) Schiffner. *Candollea* 14: 163–256.
- CHURCHILL, & SALAZAR-ALLEN (2001). Mosses. In S. R. Gradstein, S.P. Churchill, N. Salazar-Allen & G. Raetmaekers (eds.), Guide to the bryophytes of tropical America. *Mem. New York Bot. Gard.* 86: 240–571.
- GRADSTEIN, R.S., CHURCHILL, S.P., SALAZAR-ALLEN, N. & RAETMAEKERS, G. (2001). Guide to the bryophytes of tropical America. *Mem. New York Bot. Gard.* 86: 1–577.
- ONRAEDT, M. (1989). Contribution a la flore bryologique de Guiane Française. IV. Cryptogamie, *Bryol. Lichénol.* 10(2): 119–129.
- PROCTOR, G.R. (1985). Ferns of Jamaica. British Museum of Natural History, London.
- PROCTOR, G.R. (1989). Ferns of Puerto Rico and the Virgin Islands. *Mem. New York Bot. Gard.* 53: 1–389.
- SANTOS, P.M. & FUNARI, F.L. (2002). Clima local. In D.C. Bicudo, M.C. Forti & C.E.M. Bicudo (eds), Parque Estadual das Fontes do Ipiranga, Unidade de Conservação que Resiste à Urbanização de São Paulo: 29–48. Secretaria do Meio Ambiente do Estado de São Paulo, São Paulo.
- VISNADI, S.R. & VITAL, D.M. 2000. Lista das briófitas ocorrentes no Parque Estadual das Fontes do Ipiranga-PEFI. *Hoehnea* 27: 279–294.

**Table 1:** Mosses and liverworts growing on trunks of *Cyathea delgadii*.

Phorophyte	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Musci										
<i>Bryum beyrichianum</i> (Hornsch.) Müll.Hal.							x			
<i>Campylopus filifolius</i> (Hornsch.) Mitt.	x									
<i>Fissidens elegans</i> Brid.								x**	x**	
<i>Fissidens weirii</i> Mitt.	x									
<i>Hymenodon aeruginosus</i> (Hook. f. & Wilson) Müll. Hal.			x							
<i>Isopterygium tenerum</i> (Sw.) Mitt.	x	x		x	x**		x	x	x	x
<i>Sematophyllum subpinnatum</i> (Brid.) E. Britton	x				x**	x	x	x**	x	
<i>Syrrhopodon ligulatus</i> Mont.	x									
<i>Syrrhopodon prolifer</i> Schwägr.	x		x**	x						
<i>Thamniopsis incurva</i> (Hornsch.) W.R. Buck	x				x**	x				
<i>Thamniopsis langsdorffii</i> (Hook.) W. R. Buck	x	x	x	x	x**	x	x	x		x
cf. <i>Wijkia flagellifera</i> (Broth.) H. A. Crum				x***						
Hepaticae										
<i>Anoplolejeunea conferta</i> (Meissn.) A. Evans	x			x			x			
<i>Aphanolejeunea</i> cf. <i>microscopica</i> (Taylor) A. Evans				x**						
<i>Aphanolejeunea subdiaphana</i> (Jovet-Ast) Pócs										x**
<i>Ceratolejeunea dentatocornuta</i> Steph.						x				
<i>Drepanolejeunea mosenii</i> (Steph.) Bischl.				x**			x			
<i>Frullania beyrichiana</i> (Lehm & Lindenb.) Lehm. & Lindenb.				x						
<i>Lejeunea caespitosa</i> Lindenb.							x	x**	x**	
<i>Lejeunea flava</i> (Sw.) Nees	x	x	x	x	x**		x	x	x	
<i>Lejeunea glaucescens</i> Gott.	x			x			x			x
<i>Lepidolejeunea involuta</i> (Gott.) Grolle				x*						
<i>Lophocolea bidentata</i> (L.) Dumort.					x	x				
<i>Lophocolea martiana</i> Nees	x	x	x	x	x**	x	x	x	x	
<i>Lophocolea muricata</i> (Lehm) Nees					x	x	x			
<i>Metzgeria albinea</i> Spruce								x**	x**	
<i>Metzgeria myriopoda</i> Lindb.		x	x	x	x		x			
<i>Plagiochila corniculata</i> (Dumort.) Dumort.	x									
<i>Plagiochila corrugata</i> Nees & Mont.	x			x						
<i>Plagiochila micropterys</i> Gott.	x	x			x				x	
<i>Radula kegelii</i> Gott. ex Steph.	x					x				
<i>Radula nudicaulis</i> Steph.								x	x	
<i>Riccardia chamaedryfolia</i> (With.) Grolle				x						
<i>Schiffneriolejeunea polycarpa</i> (Nees) Gradst.				x						
<i>Telaranea nematodes</i> (Gott. ex Austin) M. Howe	x			x			x		x**	x

\* predominant; \*\* fragments; \*\*\* doubtful

**Table 2:** Number of bryophyte species per phorophyte of *Cyathea delgadii* in the study area.

	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Mosses	8	3	3	3	4	3	4	4	3	2
Liverworts	9	4	6	11	6	5	9	5	7	3
Total species	17	7	9	14	10	8	13	9	10	5