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Species richness and distribution of bryophytes within different phytophysiognomies in the Chapada Diamantina region of Brazil[1]

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ABSTRACT

The Chapada Diamantina ecoregion is within the *caatinga* (shrublands) biome of Brazil. Environmental factors determine the phytophysiognomies that distinguish the ecoregion from the surrounding areas. This study aimed to investigate the distribution of bryophyte flora in this ecoregion, by phytophysiognomy and elevational zone. Analyzing specimens we collected from five municipalities in the region, together with specimens (previously collected from the region) in herbaria, we identified 400 taxa. The phytophysiognomies that presented the highest species richness and the greatest numbers of exclusive taxa were forests and *campos rupestres* (dry, rocky grasslands), which respectively accounted for 51% and 40% of the taxa, compared with only 5% and 4%, respectively, for the *caatinga* and *cerrado* (savanna). Species richness and the numbers of exclusive taxa were highest in the lower and upper montane zones. There was a predominance of neotropical taxa and a significant number of disjunct species found in Brazil and in the Andes region. We conclude that the Chapada Diamantina region is an important center of bryophyte diversity, harboring not only a great number of species overall but also a considerable number of species exclusive to the region, primarily in forests and *campos rupestres* at elevations above 800 m.

Key words: Mosses, liverworts, forests, *campos rupestres*, elevational zonation

Introduction

The ecoregion of Chapada Diamantina, in the state of Bahia, Brazil, is one of the centers of plant diversity of the Americas (Giulietti *et al.* 1997). It is located within the *caatinga* (shrublands) biome (IBGE 2004), constituting one of its eight ecoregions (Velloso *et al.* 2002), and is entirely surrounded by the ecoregion of the Sertaneja Meridional Depression, the borders between the two being defined primarily by changes in physical aspects such as elevation, geological formation, climate, rainfall, topography and soil type (Rocha *et al.* 2005), which result in a mosaic of vegetation in the former (Giulietti & Pirani 1988). According to the Brazilian Ministry of the Environment (MMA 2005), the vegetation in the Chapada Diamantina ecoregion comprises *campos rupestres* (dry, rocky grasslands), semi-deciduous montane forests, montane rain forests, *cerrado* (savanna) and *caatinga*.

Bryophytes, which represent the object of this study, are strongly influenced by external factors, particularly water and light, and differences in their physiognomy, composition, richness and abundance are evident among different vegetation formations and habitats (Mägdefrau, 1982). Numerous studies have indicated that bryophyte composition varies along an elevational gradient, showing greater diversity with increasing elevation (Van Reenen & Gradstein, 1983, 1984; Frahm, 1990; Frahm & Gradstein, 1991; Gradstein 1995; Kessler, 2000; Andrew *et al*., 2003; Ah-peng, 2007), this feature is also a consequence of high bryophyte sensitivity to climatic conditions.

In Brazil, the elevational zonation of bryophytes has been examined in two separate studies, both conducted in the Atlantic Forest within the state of Rio de Janeiro (Costa & Lima, 2005; Santos & Costa, 2010a). In both studies, the authors found that there is a variation in bryophyte flora composition along an elevational gradient, and that species richness, the number of exclusive taxa and the number of endemic taxa are highest in montane forests (*sensu* Veloso *et al.* 1991), followed by upper montane formations, lower montane formations and lowlands (*sensu* Veloso *et al.* 1991).

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As previously mentioned, the vegetation formations found in the Chapada Diamantina ecoregion include forests, *campos rupestres*, *cerrado* and *caatinga*. Among those, the highest bryophyte species richness and abundance is found in the forests. Therefore, in Brazil as a whole, systematic floristic studies of bryophytes have most often been conducted in forests, including those in the states of Rio de Janeiro (Costa 1999; Costa & Lima 2005; Molinaro & Costa 2001; Santos & Costa 2010a, 2010b), Espírito Santo (Costa & Silva 2003; Yano 2005), São Paulo (Visnadi 2005; Visnadi & Vital 2000; Peralta & Yano 2005), Pernambuco (Pôrto 1990, 1992; Germano & Pôrto 1996; Campelo & Pôrto 2007; Alvarenga & Pôrto 2007), Alagoas (Silva & Pôrto 2009) and Bahia (Valente & Pôrto 2006; Bastos & Valente 2008; Bastos & Vilas Bôas-Bastos 2008; Vilas Bôas-Bastos & Bastos 2008; Valente *et al*. 2009). Studies of bryophytes in the *cerrado* have been conducted in the states of São Paulo (Egunyomi & Vital 1984; Visnadi 2004), Bahia (Vilas Bôas-Bastos & Bastos 1998) and Piauí (Castro *et al*. 2002), as well as in the Federal District of Brasília (Câmara & Costa 2006; Câmara 2008a, 2008b). In the *campos rupestres*, bryophytes have been studied in the state of Minas Gerais—in the Serra do Cipó (Yano 1987), Serra da Piedade (Yano & Carvalho 1995) and Grão Mogol (Yano & Peralta 2009)—and in the state of Bahia, specifically within the Chapada Diamantina ecoregion (Harley 1995; Bastos *et al*. 1998a, 2000). Studies of bryophytes in the *caatinga* have been conducted in the states of Pernambuco (Pôrto *et al*. 1994) and Bahia (Bastos *et al*. 1998b).

The fact that there have been few studies of bryophytes in the Chapada Diamantina ecoregion is most likely attributable to the small number of researchers in this field of botany and the enormity of the region. The first contribution to knowledge of the bryophyte flora of this region was a species list compiled by Harley (1995), which included 28 species of liverworts and 37 species of mosses identified in the Pico das Almas region, near the municipality of Rio de Contas. Later, Bastos *et al.* (1998a) reported 27 species of mosses, collected in *campos rupestres* and in gallery forests near the town of Lençóis. In addition, Bastos *et al.* (2000) identified 65 species belonging to the divisions Bryophyta (n = 41) and Marchantiophyta (n = 24) in *campos rupestres*. Those authors stated that the majority of the bryophyte taxa surveyed in the Chapada Diamantina ecoregion have not been found elsewhere in the state of Bahia. A recently published Checklist of Bryophytes in the Chapada Diamantina region (Valente *et al*. 2011) lists 414 taxa, including various new records for the state of Bahia, for northeastern Brazil and for Brazil as a whole.

Considering the physical and climatic conditions, the phytophysiognomies within the Chapada Diamantina ecoregion and the bryophyte response to these conditions, this study aimed to investigate the distribution of the bryophyte flora in the phytophysiognomies and elevational zones in this ecoregion within the *caatinga* biome of Brazil.

Material and methods

Study area

The Chapada Diamantina ecoregion is 400 km in length and covers an area of 50,000 km^2, representing approximately 9% of the State of Bahia. Elevations in the region range from 400 m to 2033 m, making it the highest point in northeastern Brazil (MMA 2005). According to Nolasco *et al.* (2008), the average monthly temperature can be as low as 0°C in the winter (June through August) or as high as 30°C in the summer (in December and January). The rainy season is from November to April, with maximum rainfall in December (139 mm), and the dry season is from May to October, with minimum rainfall in August (20 mm). The average monthly rainfall exceeds 100 mm during the rainy season, compared with approximately 35 mm during the dry season. The average annual rainfall ranges from 600 mm to 1100 mm (Agritempo 2010). Geologically, the Chapada Diamantina ecoregion consists of quartzite and sandstone outcrops, and there are a number of rivers in the region (Rocha *et al*. 2005).

The type of phytophysiognomy that is the most characteristic of the Chapada Diamantina ecoregion is *campos rupestres*, which typically occur at elevations above 900 m and are characterized mainly by rocky outcrops associated with herb-shrub areas, typically on quartzite soils, the predominant species belonging to the families Velloziaceae, Melastomataceae, Eriocaulaceae, Xyridaceae and Orchidaceae (Conceição *et al.* 2005). Forest types, including semideciduous forest, premontane rain forest and montane rain forest, typically to the east of the main mountain range, also occur on plateaus (plateau forests), along the banks of rivers (riparian forests) and between large rocky cliffs (cove forests) (Funch *et al.* 2005; Funch 2008; Queiroz *et al.* 2008). Throughout the region, *cerrado* occurs at elevations of 900-1200 m and is interspersed with *campos rupestres*, where rocky outcrops and shallow soils appear more frequently. At lower elevations, the *cerrado* is replaced by various forms of dry forest or *caatinga* (Harley *et al.* 2005). *Caatinga*, or phytophysiognomies associated with it, cover the greatest area in the region, albeit quite diverse in its physiognomy, floristic composition and community structure, and is found mainly to the west of the main mountain range (Queiroz *et al*. 2005).

Sampling

Specimens were collected during 11 field campaigns conducted between 2007 and 2009 in the Chapada Diamantina ecoregion, in the municipalities of Morro do Chapéu and Miguel Calmon (located in the north of the region) Lençóis and Palmeiras (in the center); and Piatã and Abaíra (in the south). The municipalities were selected considering the preexisting knowledge about the diversity of other plant groups (MMA 2005) and the presence of the target phytophysiognomies and elevational zones. In each municipality, three to six sites were surveyed. The areas were walked for approximately seven hours, and the sampling effort was given by stabilization of the species accumulation curve. The samples collected were deposited in the Herbarium of the Estate University of Feira de Santana (code, HUEFS), with duplicates in the Herbarium of the Federal University of Pernambuco (code, UFP). We employed traditional methods of collection and preservation, as described by Yano (1989b).

The sampling sites were located across five ecologically protected areas (Chapada Diamantina National Park; the Marimbus/Iraquara Environmentally Protected Area; the Serra do Barbado Environmentally Protected Area, in the municipality of Abaíra; Sete Passagens State Park, in the municipality of Miguel Calmon; and the Cachoeira do Ferro Doido Monument), as well as in areas external to conservation units. National herbaria with representative collections of bryophyte of this region were consulted: the Alexandre Leal Costa Herbarium (code, ALCB), affiliated with the Federal University of Bahia Institute of Biology; the Herbarium of the Estate University of Feira de Santana (HUEFS), in the state of Bahia; the Herbarium of the Center for Cacao Research (CEPEC), in the state of Bahia; the Herbarium of the Botanical Institute of São Paulo (SP); and the University of São Paulo Herbarium of Phanerogamae (acronym, SPF). In addition, the species list was supplemented with data from the literature (Yano 1981, 1984, 1989a, 1995, 1996a, 2006, 2008; Yano & Bastos 1994; Harley 1995; Bastos *et al*. 1998a, 2000; Yano & Peralta 2006; Peralta & Vital 2006; Ballejos & Bastos 2009a, 2009b). Regardless of the source (herbaria or literature), we analyzed only those data related to samples for which there was information about the vegetation formation of origin or elevation. Overall, approximately 2300 samples were analyzed, covering nine cities within the Chapada Diamantina ecoregion: in the north (Morro do Chapéu, Miguel Calmon and Jacobina); in the south (Abaíra, Rio de Contas and Piatã); and in the center (Lençóis, Palmeiras and Mucugê).

Study material and data analysis

The taxa identification was based mainly on Crum (1984), Yano *et al.* (1985), Frahm (1991), Reese (1993), Zander (1993), Sharp *et al.* (1994), Buck (1998), Gradstein *et al.* (2001), Gradstein & Costa (2003) and Pursell (2007). We adopted the classification systems presented by Goffinet *et al.* (2009) for mosses and by Crandall-Stotler *et al.* (2009) for liverworts. The taxa authority name abbreviations were based on Brummitt & Powell (1992). The Brazilian state abbreviations are in accordance with the Brazilian Institute of Geography and Statistics guidelines. The geographic distribution of species was based on Yano (1981; 1984; 1989; 1995; 1996; 2006; 2008), Bastos & Yano (2009), Ballejos & Bastos (2009a; 2009b), and Forzza *et al.* (2012).

We performed a comparative analysis between the different bryophyte flora, based on the presence or absence of species, using the Bray-Curtis method and the software PRIMER 5.1 (Clarke & Warwick 1994). To analyze the geographic distribution of the taxa in Brazil, we defined the following categories of species distribution: restricted, occurring in four of fewer states; moderate, occurring in five to nine states; and broad, occurring in ten or more states (Valente & Pôrto 2006). For the analysis of the elevational distribution of the bryophyte flora from the Chapada Diamantina ecoregion, we used the elevational zones established by Oliveira-Filho *et al*. (2006) for latitudes < 16°S, in which lowland formations are defined as occurring at elevations ≤ 400 m; premontane formations are defined as occurring at elevations of 400-800 m; lower montane formations are defined as occurring at elevations of 800-1200 m; and upper montane formations are defined as occurring at elevations > 1200 m. However, we evaluated only the last three of those zones.

Results and discussion

We identified a total of 400 taxa (Tab. 1). Moss species predominated over liverworts in all phytophysiognomies, except in the forest. Species richness and the number of exclusive taxa were greatest in the forests (272 species, 157 exclusive), followed by *campos rupestres* (212 species, 93 exclusive), *caatinga* (29 species, 18 exclusive) and Cerrado (20 species, three exclusive). This result was predictable, because the bryophyte composition and richness reflect the environmental conditions in each phytophysiognomy. We should point out that the *caatinga* and the *cerrado*, when compared with the forest and the *campos rupestres*, present conditions that are much more restrictive for the development and establishment of most bryophyte species, mainly due to low humidity and high light intensity. Although the *campos rupestres* could also be considered restrictive, humidity from the frequent occurrence of fog and from localized accumulations of water, as well as the quite rugged topography, in which there are numerous rock clefts, provides a myriad of microhabitats that are favorable to the growth of the bryophyte flora adapted to those conditions.

As a result of the analysis of bryophyte flora similarity among the phytophysiognomies, we identified clusters in which the forests and *campos rupestres* shared 46% of the species, compared with only 15% for the *cerrado* and *caatinga*. This might be explained by the previously mentioned factors (higher humidity presence and shaded microhabitats) in forests and *campos rupestres*.

In the forests, Lejeuneaceae, Plagiochilaceae, Radulaceae, Leucobryaceae, Sematophyllaceae and Orthotrichaceae were the most representative families in terms of the number of species. These families are typical of tropical rain forests (Pócs 1982; Richards 1984; Gradstein & Pócs 1989; Gradstein 1995; Gradstein *et al*. 2001). The majority of their constituents are adapted to the low-light conditions, like most bryophytes, with leaves consisting of a single layer of

Table 1. Distribution of Bryophyte species in the Chapada Diamantina ecoregion, in the state of Bahia, Brazil, by elevational zone and phytophysiognomy.

Species	Elevational zone/phytophysiognomy
Acrolejeunea emergens (Mitt.) Steph.	LM/cr, ce
Acrolejeunea torulosa (Lehm. & Lindenb.) Schiffn.	LM/cr, ce
Acroporium caespitosum (Hedw.) W.R. Buck	LM/cr, f
Acroporium estrellae (Müll. Hal.) W.R. Buck & Schäf.-Verw.	UM, LM/cr, f
Acroporium pungens (Hedw.) Broth.	-/cr, f
Adelanthus decipiens (Hook.) Mitt.	-/cr
Adelothecium bogotense (Hampe) Mitt.	UM/cr, f
Anastrophyllum piligerum (Nees) Steph.	UM/cr
Anoplolejeunea conferta (Meissn.) A. Evans	UM, LM/cr, f
Aphanolejeunea asperrima (Stephani) Steph.	UM/
Aphanolejeunea cornutissima R.M. Schust.	UM/f
Aptychopsis pyrrophylla (Müll. Hal.) Wijk & Marg.	UM, LM/cr, f
Archidium clavatum I.G. Stone	LM/ca
Archidium donnellii Aust.	LM/ca
Archidium ohioense Schimp. ex Müll. Hal.	LM/ca
Atractylocarpus brasiliensis (Müll. Hal.) R.S. Williams	LM/f
Bazzania aurescens Spruce	LM/f
Bazzania falcata (Lindenb.) Trevis.	UM/cr
Bazzania heterostipa (Steph.) Fulford	UM, LM/cr, f
Bazzania hookeri (Lindenb.) Trevis.	UM/f
Bazzania nitida (Web.) Grolle	UM/cr
Bazzania stolonifera (Sw.) Trevis.	UM/cr
Brachiolejeunea leiboldiana (Gott. & Lindenb.) Schiffn.	UM, LM/cr, f
Brachymenium systylium (Müll. Hal.) A. Jaeger	LM/ca
Breutelia tomentosa (Sw. ex Brid.) A. Jaeger	LM/cr
Bryopteris diffusa (Sw.) Nees	LM/cr, f
Bryum argenteum Hedw.	UM, LM, PM/cr
Bryum limbatum Müll. Hal.	UM, LM/cr, f
Bryum paradoxum Schwägr.	UM/cr
Callicostella merkelii (Hornsch.) A. Jaeger	LM/cr
Callicostella pallida (Hornsch.) Ångstr.	LM/cr
Callicostella rufescens (Mitt.) A. Jaeger	LM/f
Calymperes palisotii Schwägr.	LM/cr
Calypogeia andicola Bischl.	LM
Calypogeia laxa Lindenb. & Gottsche	UM/cr, f
Calypogeia peruviana Nees	UM/f
Campylopus arctocarpus (Hornsch.) Mitt.	UM, LM/cr
Campylopus arctocarpus var. *caldense* (Angström) J.-P. Frahm	UM/cr
Campylopus cf. *subcuspidatus* (Hampe) A. Jaeger	UM/cr
Campylopus controversus (Hampe) A. Jaeger	-/cr
Campylopus cuspidatus (Hornsch.) Mitt.	UM/cr
Campylopus dichrotis Paris	LM/cr
Campylopus filifolius (Hornsch.) Mitt.	UM, LM/cr, f
Campylopus filifolius var. *humilis* (Mont.) J.-P. Frahm	UM/cr, f

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Campylopus filifolius var. *longifolius* (E.B. Bartram) E.B. Bartram	UM, LM/cr, f
Campylopus fragilis (Brid.) Bruch & Schimp.	UM, LM, PM/cr
Campylopus heterostachys (Hampe) A. Jaeger	UM, LM/cr
Campylopus introflexus (Hedw). Brid.	LM/cr
Campylopus julaceus A. Jaeger	UM, LM/cr, f
Campylopus julicaulis Broth.	LM/-
Campylopus lamellinervis (Müll. Hal.) Mitt.	UM/cr, f
Campylopus lamellinervis var. *exaltatus* (Müll. Hal.) J.-P. Frahm	-/F
Campylopus occultus Mitt.	UM, LM, PM/cr
Campylopus pilifer Brid.	UM, LM, PM/cr
Campylopus richardii Brid.	LM/-
Campylopus savannarum (Müll. Hal.) Mitt.	UM, LM, PM/cr, f, ce, ca
Campylopus surinamensis Müll. Hal.	UM/cr
Campylopus trachyblepharon (Müll. Hal.) Mitt.	LM/cr, f, ca
Campylopus uleanus (Müll. Hal.) Broth.	-/cr
Campylopus viridatus (Müll. Hal.) Broth.	-/cr
Campylopus widgrenii (Müll. Hal.) Mitt.	UM, LM/cr
Cardotiella quinquefaria (Hornsch.) Vitt	UM/-
Cephaloziella cf. *granatensis* (J.B. Jack) Fulford	LM/f
Cephaloziopsis intertexta (Gottsche) R.M. Schust.	LM, PM/-
Ceratolejeunea guianensis (Nees & Mont.) Steph.	LM/cr
Ceratolejeunea laetefusca (Austin) R.M. Schust.	UM/f
Cheilolejeunea acutangula (Nees) Grolle	UM/f
Cheilolejeunea discoidea (Lenm & Lindenb.) Kachroo & R.M. Schust.	LM/ce
Cheilolejeunea holostipa (Spruce) Grolle & R.L. Zhu	UM/f
Cheilolejeunea oncophylla (Ångstr.) Grolle & M.E. Reiner	UM, LM/cr, f
Cheilolejeunea rigidula (Mont.) R.M. Schust.	UM, LM/f, ca
Cheilolejeunea trifaria (Reinw., Blume & Nees) Mizut.	LM/cr, f
Cheilolejeunea unciloba (Lindenb.) Malombe	UM, LM/f
Cheilolejeunea xanthocarpa (Lehm. & Lindenb.) Malombe	UM, LM/cr, f
Chiloscyphus bidentatus Steph.	UM/f
Chiloscyphus latifolius (Nees) J.J. Engel & R.M. Schust.	UM/cr
Chiloscyphus martianus (Nees) J.J. Engel & R.M. Schust.	UM, LM/cr, f
Chiloscyphus martianus subsp. *bidentulus* Nees	UM/cr, f
Colobodontium vulpinum (Mont.) S.P. Churchill & W.R. Buck	UM, LM/cr
Cololejeunea cf. *hildebrandii* (Austin) Steph.	UM/f
Cololejeunea minutissima (Sm.) Schiffin.	LM/ce
Cololejeunea subcardiocarpa Tixier	UM/f
Colura tenuicornis (A. Evans) Steph.	UM/f
Cronisia weddellii (Mont.) Grolle	LM/ca
Ctenidium malacodes Mitt.	-/f
Cyclolejeunea convexistipa (Lehm. ex. Lindenb.) A. Evans	LM/f
Cyclolejeunea luteola (Spruce) Grolle	LM/f
Cylindrocolea planifolia (Steph.) R.M. Schust.	UM/f

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Cylindrocolea rhizantha (Mont.) R.M. Schust.	LM/f
Daltonia gracilis Mitt.	UM, LM/cr, f
Daltonia longifolia Taylor	UM/f
Dicranella cf. *harrisii* (Müll. Hal.) Broth.	UM/f
Dicranodontium pulchroalare subsp. *brasiliense* (Herzog) J.-P. Frahm	UM/f
Diplasiolejeunea latipuense Tixier	LM/f
Diplasiolejeunea pellucida (C.F.W. Meissn. ex Spreng.) Schiffn.	LM/f
Diplasiolejeunea rudolphiana Steph.	PM/f
Diplasiolejeunea unidentata (Lehm. & Lindenb.) Steph.	UM/f
Donnellia commutata (Müll. Hal.) W.R. Buck	UM, LM/cr, f
Drepanolejeunea anoplantha (Spruce) Steph.	UM/cr, f
Drepanolejeunea araucariae Steph.	UM, LM/f
Drepanolejeunea campanulata (Spruce) Steph.	UM/cr
Drepanolejeunea fragilis Bischl.	UM, LM, PM/f
Drepanolejeunea mosenii (Steph.) Bischl.	LM/f
Drepanolejeunea orthophylla Bischl.	UM/f
Eccremidium floridanum H.A. Crum	LM, PM/-
Ectropothecium leptochaeton (Schwäegr.) W.R. Buck	LM/f
Entodon macropodus (Hedw.) Müll. Hal.	LM, PM/cr, f
Entodontopsis leucostega (Brid.) W.R. Buck & Ireland	LM/cr, ce
Erpodium biseriatum (Austin) Austin	-/f
Erythrodontium squarrosum (Hampe) Paris	-/f
Fabronia ciliaris (Brid.) Brid.	PM/cr, ce
Fabronia ciliaris var. *polycarpa* (Hook.) W.R. Buck	PM/ce
Fabronia macroblepharis Schwägr.	UM, LM/cr, ce
Fissidens elegans Brid.	-/cr
Fissidens pellucidus Hornsch.	UM, LM/f
Fissidens ramicola Broth.	LM/ca
Fissidens serratus Müll. Hal.	-/f
Fissidens termitarum (Herzog) Pursell	LM/ca
Fissidens weirii var. *hemicraspedophyllus* (Cardot) Pursell	UM/f
Floribundaria flaccida (Mitt.) Broth.	-/cr
Fossombronia porphyrorhiza (Nees) Prosk.	UM, LM/cr, ca
Frullania arecae (Spreng.) Gottsche	UM/f
Frullania atrata (Sw.) Dumort.	UM, LM/f
Frullania beyrichiana (Lehm. & Lindenb.) Lehm. & Lindenb.	UM, LM/cr, f
Frullania brasiliensis Raddi	UM, LM/cr, f
Frullania breuteliana Gottsche	UM/f
Frullania caulisequa (Nees) Nees	UM/f, ce
Frullania ericoides (Nees ex Mart.) Mont.	LM/ce, ca
Frullania gibbosa Nees	LM/cr, ca
Frullania glomerata (Lehm. & Lindenb.) Nees & Mont.	LM/ca
Frullania griffithsiana Gottsche	UM/cr, f
Frullania kunzei Lehm. & Lindenb.	UM, LM/cr, f, ce

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Frullania lindenbergii Lehm.	UM/f
Frullania mucronata (Lehm. & Lindenb.) Lehm. & Lindenb.	UM, LM/f
Frullania riojaneirensis (Raddi) Spruce	LM/cr
Frullania setigera Steph.	UM/cr, f
Frullanoides densifolia Raddi	UM/f
Funaria hygrometrica Hedw.	UM/cr
Funaria hygrometrica var. *calvescens* (Schwägr.) Mont.	UM/cr
Gemmabryum coronatum Schwägr.	UM, LM, PM/cr
Gemmabryum exile (Dozy & Molk.) J.R. Spence & H.P. Ramsay	UM, LM/cr, f
Gemmabryum radiculosum (Brid.) J.R. Spence & H.P. Ramsay	UM, LM/cr
Groutiella apiculata (Hook.) H. A. Crum & Steere	-/f
Groutiella tomentosa (Hornsch.) Wijk & Margad.	LM/cr
Groutiella tumidula (Mitt.) Vitt	LM/-
Harpalejeunea schiffneri S. Arnell	UM/f
Harpalejeunea stricta Schiffn.	UM/f
Harpalejeunea subacuta A. Evans	UM/f
Helicophyllum torquatum (Hook.) Brid.	-/ca
Herbertus juniperoideus (Swartz) Grolle	-/cr
Herbertus juniperoideus subsp. *bivittatus* (Spruce) Feldberg & J. Heinrichs	UM, LM/f
Holomitrium arboreum Mitt.	UM, LM/cr
Holomitrium crispulum Mart.	UM, LM/cr
Holomitrium olfersianum Hornsch.	UM, LM/cr
Hyophila involuta (Hook.) A. Jaeger	LM, PM/cr, f
Hyophiladelphus agrarius (Hedw.) R.H. Zander	LM, PM/ca
Hypopterygium tamarisci (Sw.) Brid. ex Müll. Hal.	LM
Isopterygium byssobolax (Müll. Hal.) Paris	UM/f
Isopterygium jamaicense (E.B. Bartram) W.R. Buck	UM, LM, PM/cr, f
Isopterygium subbrevisetum (Hampe) Broth.	LM/-
Isopterygium tenerifolium Mitt.	UM, LM, PM/cr, f
Isopterygium tenerum (Sw.) Mitt.	UM, LM, PM/cr, f
Jaegerina scariosa (Lorentz) Arz.	LM/f
Jamesoniella rubricaulis (Nees) Grolle	UM/cr
Jungermannia sphaerocarpa Hook.	UM/cr, f
Kurzia brasiliensis (Steph.) Grolle	UM, LM/cr, f
Kurzia capillaris (Sw.) Grolle	UM, LM, PM/cr, f
Lejeunea caespitosa Lindenb. & G.L.Nees	LM/f
Lejeunea cerina (Lehm. & Lindenb.) Gottsche, Lindenb. & Nees	UM/f
Lejeunea cochleata Spruce	UM,LM/f
Lejeunea flava (Sw.) Nees	UM, LM/cr, f
Lejeunea grossitexta (Steph.) E. Reiner & Goda	UM/f
Lejeunea immersa Spruce	UM/f
Lejeunea laetevirens Nees & Mont.	UM, LM/f
Lejeunea maxonii (Evans) X.-L. He	LM, PM/f
Lejeunea oligoclada Spruce	-/f

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Lejeunea phyllobola Nees & Mont. ex Mont.	UM/f
Lejeunea raddiana Lindenb.	UM/f
Lepidolejeunea involuta (Gottsche) Grolle	LM/f
Lepidopilidium portoricense (Müll. Hal.) H.A. Crum	LM/f
Lepidopilum scabrisetum (Schwägr.) Steere	LM/f
Lepidozia coilophylla Taylor	UM/f
Lepidozia cupressina (Sw.) Lindenb.	UM, LM/cr, f
Lepidozia inaequalis (Lehm. & Lindenb.) Gott. *et. al.*	UM/cr, f
Leptodontium viticulosoides var. *sulphureum* (Müll. Hal.) R.H. Zander	UM/cr, f
Leptoscyphus amphibolius (Nees) Grolle	UM/cr
Leucobryum albicans (Schwägr.) Lindb.	UM, LM/cr, f
Leucobryum albidum (Brid. ex P. Beauv.) Lindb.	UM/cr
Leucobryum clavatum Hampe	UM/f
Leucobryum clavatum var. *brevifolium* Broth.	UM/cr
Leucobryum crispum Müll. Hal.	UM, LM/cr, f
Leucobryum giganteum Müll. Hal.	UM, LM/cr, f
Leucobryum martianum (Hornsch.) Hampe ex Müll. Hal.	UM, LM, PM/cr, f
Leucobryum sordidum Ångstr.	LM/cr
Leucolejeunea caducifolia Gradst. & Schaeff.-Verwimp	LM/f
Leucolejeunea conchifolia (Evans) Evans	LM/f
Leucoloma cruegerianum (Müll. Hal.) A. Jaeger	UM, LM/f
Leucoloma serrulatum Brid.	UM, LM/cr, f
Macrocoma brasiliensis (Mitt.) Vitt	LM/cr
Macrocoma cf. *gastonyi* D.H. Norris & Vitt	UM/f
Macrocoma orthotrichoides (Raddi) Wijk & Margad.	LM, PM/f
Macrocoma tenuis subsp. *sulivantii* (Müll. Hal.) Vitt.	LM/f, ce
Macromitrium cf. *longifolium* (Hook.) Brid.	UM/f
Macromitrium cirrosum (Hedw.) Brid.	UM, LM/cr, f
Macromitrium frustratum B.H. Allen	UM/f
Macromitrium microstomum (Hook. & Grev.) Schwägr.	UM, LM/cr, f
Macromitrium podocarpi Müll. Hal.	UM/cr, f
Macromitrium punctatum (Hook. & Grev.) Brid.	UM, LM/cr, f
Macromitrium richardii Schwägr.	LM/cr, f
Macromitrium sejunctum B.H. Allen	UM/f
Marchesinia brachiata (Sw.) Schiffn.	UM, LM/cr, f
Mastigolejeunea auriculata (Wilson & Hook.) Schiffn.	LM/f
Mastigolejeunea plicatiflora (Spruce) Steph.	LM/f
Metalejeunea cucullata (Reinw., Blume & Nees) Grolle	UM/f
Meteoridium remotifolium (Müll. Hal.) Manuel	LM, UM/f
Meteorium nigrescens (Sw. ex Hedw.) Dozy & Molk.	LM/f
Metzgeria brasiliensis Schiffn.	LM/f
Metzgeria cf. *liebmanniana* Lindenb. & Gottsche	UM/f
Metzgeria decipiens (C. Massal.) Schiffn.	UM/f
Metzgeria furcata (L.) Dum	LM/f

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Metzgeria hegewaldii Kuwah.	UM, LM/f
Metzgeria myriopoda Lindb.	UM/f
Metzgeria scyphigera A. Evans	LM/f
Microlejeunea bullata (Taylor) Steph.	UM/f
Microlejeunea cystifera Herzog	LM/f
Microlejeunea epiphylla Bischl.	UM, LM/f
Micropterygium campanense Spruce ex Reimers	LM/f
Micropterygium reimersianum Herzog	UM, LM/cr, f
Micropterygium trachyphyllum Reimers	UM/cr
Mittenothaminium reptans (Hedw.) Cardot	UM, LM/f
Mittenothamnium substriatum (Mitt.) Cardot	UM/f
Neckeropsis undulata (Hedw.) Reichardt	LM/f
Neesioscyphus homophyllus (Nees) Grolle	UM/f
Neesioscyphus sp.	UM
Neurolejeunea breutelii (Gott.) A.Evans	UM/cr, f
Nowellia curvifolia (Dicks.) Mitt.	UM/cr
Ochrobryum gardneri (Müll. Hal.) Mitt.	LM/cr, f
Octoblepharum albidum Hedw.	UM, LM, PM/cr, f, ce, ca
Octoblepharum cocuiense Mitt.	UM, LM, PM/cr
Octoblepharum cylindricum Schimp. ex Mont.	LM/cr
Octoblepharum erectifolium Mitt. ex R.S. Williams	LM/cr, f
Octoblepharum pulvinatum (Dozy & Molk.) Mitt.	-/cr
Odontolejeunea lunulata (F. Weber) Schiffn.	-/f
Odontoschisma brasiliense Steph.	UM/cr
Odontoschisma denudatum (Nees) Dumort.	UM, LM/cr
Odontoschisma falcifolium Steph.	UM/cr
Odontoschisma longiflorum Steph.	LM/cr
Omphalanthus filiformis (Sw.) Nees	UM/cr, f
Orthodotium gracile (Wilson) Schwägr. ex B.S.G.	LM/f
Orthostichella versicolor (Müll. Hal.) B.H. Allen & W.R. Buck	LM/cr
Orthostichopsis crinita (Sull.) Broth.	UM/-
Orthostichopsis praetermissa W.R. Buck	UM, LM/cr, f
Orthostichopsis tetragona (Sw. ex Hedw.) Broth.	LM/f
Orthostichopsis tortipilis (Müll. Hal.) Broth.	LM/cr, f
Oryzolejeunea saccatiloba (Steph.) Gradst.	-/f
Pallavicinia lyellii (Hook.) Gray	UM, LM, PM/cr, f
Philonotis cernua (Wilson) D.G. Griffin & W.R. Buck	UM/cr, f
Philonotis elongata (Dism.) H.A. Crum & Steere	LM/f
Philonotis hastata (Duby) Wijk & Margad.	LM, UM/cr, f
Philonotis sphaerocarpa (Hedw.) Brid.	-/cr
Philonotis uncinata (Schwägr.) Brid.	PM/cr
Phyllodon truncatulus (Müll. Hal.) W.R. Buck	LM/cr
Phyllogonium fulgens (Hedw.) Brid.	LM/f
Phyllogonium viride Brid.	UM, LM/cr, f

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Pilopogon guadalupensis (Brid.) J.-P. Frahm	LM
Pilotrichella flexilis (Hedw.) Ångstr.	UM/f
Plagiochila aerea Taylor	LM/f
Plagiochila bifaria (Sw.) Lindenb.	UM/f
Plagiochila bryopterioides Spruce	UM/f
Plagiochila compressula (Nees) Lindenb.	LM/f
Plagiochila corrugata (Nees) Nees & Mont.	UM, LM, PM/cr, f
Plagiochila cristata (Sw.) Dumort.	UM/f
Plagiochila disticha (Lehm. & Lindenb.) Mont.	UM, LM/f
Plagiochila exigua (Taylor) Taylor	UM/f
Plagiochila fragilis Taylor	UM/cr, f
Plagiochila gymnocalycina Lindenb.	UM, LM/f
Plagiochila patentissima Steph.	LM/f
Plagiochila patula (Sw.) Lindenb.	UM, LM/f
Plagiochila raddiana Lindenb	LM/f
Plagiochila rutilans Lindenb.	UM/cr, f
Plagiochila simplex (Sw.) Lindenb.	UM, LM/cr, f
Plagiochila subplana Lindenb.	UM/f
Plaubelia sprengelii (Schwägr.) R.H. Zander	LM, PM/ca
Pogonatum pensilvanicum (Hedw.) P. Beauv.	UM/f
Pohlia papillosa (Müll. Hal. ex A. Jaeger) Broth.	LM/-
Polytrichum angustifolium Mitt.	UM/cr, f
Polytrichum commune Hedw.	-/cr
Polytrichum juniperinum Hedw.	UM, LM/cr, f
Porella cf. *reflexa* (Lehm. & Lindenb.) Trevis.	LM/f
Porella brasiliensis (Raddi) Schiffn.	UM, LM/f
Porella swartziana (Weber) Trevis.	LM/f
Porothamnium leucocaulon (Müll. Hal.) M. Fleisch.	UM/-
Pterogonidium pulchellum (Hook.) Müll. Hal.	UM, LM/f
Pyrrhobryum spiniforme (Hedw.) Mitt.	UM, LM/cr, f
Racopilum tomentosum (Hedw.) Brid.	LM/cr, f
Radula aff. *conferta* Lindenb. & Gottsche	UM/f
Radula cubensis K. Yamada	UM/f
Radula fendleri Gottsche ex Steph.	UM/f
Radula inflexa Gottsche ex Steph.	UM/f
Radula javanica Gottsche	UM/cr, f
Radula kegelii Gottsche	UM, LM/f
Radula mexicana Steph.	UM/cr, f
Radula pseudostachya Spruce	UM/f
Radula recubans Taylor	UM/f
Radula sinuata Steph.	UM/f
Radula tenera Mitt. ex Steph.	LM/f
Radula wrightii Castle	UM/f
Rhacopilopsis trinitensis (Müll. Hal.) E. Britton & Dixon	UM, LM/cr

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Rhacorcarpus purpurascens (Brid.) Par.	UM/cr
Rhodobryum aubertii (Schwägr.) Thér.	LM/f
Rhodobryum beyrichianum (Hornsch.) Müll. Hal.	LM/cr, f
Rhodobryum grandifolium (Taylor) Schimp.	-/cr, f
Rhodobryum roseum (Hedw.) Limpr.	LM/f
Riccardia cataractarum (Spruce) Schiffn.	PM/cr
Riccardia chamedryfolia (With.) Grolle	LM/-
Riccardia digitiloba (Spruce ex Steph.) Pagán	-/ca
Riccia erythrocarpa Jovet-Ast.	-/ca
Riccia lindmanii Steph.	LM/ca
Riccia squamata Nees	LM/ca
Riccia vitalii Jovet-Ast.	LM/ca
Riccia weinionis Steph.	LM/ca
Rosulabryum billarderi (Schwägr.) J.R. Spence	-/cr
Rosulabryum capillare (Hedw.) J.R. Spence	LM/ce
Rosulabryum densifolium (Brid.) Ochyra	UM, LM/f
Rosulabryum huillense (Welw. & Duby) Ochyra	LM/f
Saccogynidium caldense (Ångstr.) Grolle	UM/f
Schiffneriolejeunea polycarpa (Nees) Gradst	LM/f
Schlotheimia jamesonii (Arn.) Brid.	UM, LM/cr, f
Schlotheimia rugifolia (Hook.) Schwägr.	UM, LM/cr, f, ce
Schlotheimia tecta Hook. f. & Wilson	UM, LM/cr, f
Schlotheimia torquata (Sw. ex Hedw.) Brid.	UM, LM/cr, f
Schlotheimia trichomitria Schwägr.	UM, LM/cr, f
Sematophyllum adnatum (Michx.) E. Britton	UM, LM/cr, f, ce, ca
Sematophyllum galipense (Müll. Hal.) Mitt.	UM, LM/cr, f, ce
Sematophyllum sp.	UM, LM
Sematophyllum subpinnatum (Brid.) E. Britton	UM, LM, PM/cr, f, ce
Sematophyllum subsimplex (Hedw.) Mitt.	LM/cr, f
Sematophyllum swartzii (Schwägr.) W.H. Welch & H.A. Crum	UM, LM/cr, f
Sematophyllum tequendamense (Hampe) Mitt.	LM/cr, f, ce
Sphagnum aciphyllum Müll. Hal.	UM,LM/-
Sphagnum alegrense Warnst.	UM/f
Sphagnum brevirameum Hampe	UM/cr
Sphagnum capillifolium (Ehrh.) Hedw.	UM, LM/cr, f
Sphagnum chi-chiense H.A. Crum	UM/cr
Sphagnum contortulum H.A. Crum	LM, PM/cr
Sphagnum harleyi H.A. Crum	UM, LM/cr
Sphagnum longistolo Müll. Hal.	UM, LM, PM/cr
Sphagnum magellanicum Brid.	UM, LM/cr, f
Sphagnum oxyphyllum Warnst.	UM, LM/cr
Sphagnum palustre L.	UM, LM, PM/cr, f
Sphagnum papillosum Lindb.	-/cr

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Sphagnum perichaetiale Hampe	UM, LM/cr, f
Sphagnum recurvum P. Beauv.	UM, LM/cr, f
Sphagnum sparsum Hampe	LM/cr
Sphagnum strictum Sull.	-/cr
Sphagnum subsecundum Nees	UM, LM/cr, f
Sphagnum vitalii H.A. Crum	UM, LM/f
Squamidium brasiliense (Hornsch.) Broth.	UM, LM/f
Squamidium leucotrichum (Taylor) Broth.	LM/f
Squamidium nigricans (Hook.) Broth.	LM/f
Symphyogyna aspera Steph. ex MacCormick	LM/cr
Symphyogyna brasiliensis Nees	LM/cr
Symphyogyna leptothelia Taylor	PM/cr
Symphyogyna podophylla (Thunb.) Mont. & Nees	UM/cr
Syrrhopodon elongatus Sull.	UM/f
Syrrhopodon elongatus var. *glaziovii* (Hampe) W.D. Reese	LM/cr, f
Syrrhopodon gardneri (Hook.) Schwägr.	UM, LM/cr, f
Syrrhopodon gaudichaudii Mont.	UM, LM/cr, f
Syrrhopodon incompletus Schwägr.	LM/-
Syrrhopodon leprieurii Mont.	LM/cr
Syrrhopodon ligulatus Mont.	LM/cr, f
Syrrhopodon lycopodioides (Sw. ex Brid.) Müll. Hal.	-/cr
Syrrhopodon parasiticus (Sw. ex Brid.) Paris	UM, LM, PM/f
Syrrhopodon prolifer Schwägr.	UM, LM, PM/cr, f
Syrrhopodon prolifer var. *acanthoneuros* (Müll. Hal.) Müll. Hal.	LM/-
Syrrhopodon prolifer var. *scaber* (Mitt.) W.D. Reese	LM/cr, f
Syrrhopodon prolifer var. *tenuifolius* (Sull.) W.D. Reese	UM/cr
Syzygiella aff. *integerrima* Steph.	UM/f
Syzygiella liberata Inoue	UM/cr, f
Taxiphyllum taxirameum (Mitt.) M. Fleisch.	LM/-
Taxithelium planum (Brid.) Mitt.	-/f
Telaranea diacantha (Mont.) J.J. Engel & G.L. Merr.	UM, LM/f
Telaranea nematodes (Gott. ex Aust.) Howe	UM, LM, PM/cr, f
Thamniopsis undata (Hedw.) W.R. Buck	LM/cr
Thuidium delicatulum (Hedw.) Schimp.	UM/f
Thuidium subtamariscinum (Hampe) Broth.	-/cr
Thuidium tomentosum Schimp.	LM/f
Thuidium urceolatum Lorentz	LM/f
Tortella humilis (Hedw.) Jenn.	UM, LM, PM/cr, f
Tortella tortuosa (Hedw.) Limpr.	UM/f
Trichocolea brevifissa Steph.	UM/f
Trichocolea flaccida (Spruce) Jack & Steph.	UM/cr
Trichosteleum microstegium (Besch.) A. Jaeger	LM/cr, f

Continues

Table 1. Continuation.

Species	Elevational zone/phytophysiognomy
Trichosteleum sentosum (Sull.) A. Jaeger	LM/cr, f
Trichosteleum subdemissum (Schimp. ex Besch.) A. Jaeger	LM/cr
Trichostomum tenuirostre (Hook. & Tayl.) Lindb.	UM, PM/f
Wijkia flagellifera (Broth.) H.A. Crum	UM, LM/cr, f
Wijkia subnitida (Hampe) H.A. Crum	UM/f
Zelometeorium patulum (Hedw.) Manuel	LM/f
Zoopsidella integrifolia (Spruce) R. M. Schust.	LM/f

ca – *caatinga*; c – *cerrado*; cr – *campos rupestres*; f – forest; - – not determined; UM – upper montane; LM – lower montane; PM – premontane.

cells and chlorophyll-containing cells directly exposed to the light. However, such species have a low chlorophyll *a*/*b* ratio, are capable of adjusting their number of chloroplasts according to the levels of light and are poikilohydric, having the ability to rehydrate rapidly (Glime 2007).

In *campos rupestres*, the most representative families were Lepidoziaceae, Pallaviciniaceae, Jungermanniaceae, which also include members with high demand for shaded areas and humidity, as well as Sphagnaceae, Bartramiaceae, Calymperaceae and Leucobryaceae. The latter group includes species with morphological and physiological adaptations to high light intensity and desiccation and therefore have a better chance of enduring prolonged exposure to sunlight, such adaptations including the presence of hyaline cells, which filter the light reaching the photosynthesis cells; cancellinae, for water storage; and hydroids, cells that constitute the water conduction and support tissues (Glime 2007; Proctor 2007).

The particularities of the environmental conditions of the *caatinga* allow the occurrence of families such as Ricciaceae, which are adapted to the typical arid conditions of the region (Jovet-Ast 1991). Species of the genus *Riccia*, which are common residents of ephemeral habitats, absorb water by capillarity among the rhizoids on the inferior surface of the thallus. Under drought conditions, the gametophyte furls itself, exposing the rhizoids, which serve to absorb water and provide a reflective surface that protects the chlorophyll-containing cells of the thallus. Some species are capable of surviving for seven years in this desiccated state, and even if the vegetative part dies, the spores can persist because of the great quantity of nutrients they store. The annual species compensate for this water loss by producing a large number of spores and using their ornamentation to attract animals for their dispersion (Glime 2007; Vanderpoorten & Goffinet 2009). As in the present study, other floristic studies of bryophytes in the *caatinga* (Pôrto *et al.* 1994; Bastos *et al.* 1998b) have shown low species richness, with representative species typically being tolerant of exposure to intense light and heat, such as those of the families Pottiaceae and Ricciaceae. A little over one third of the species recorded in the present study were also included in the flora listed in the literature cited above.

We found no families that were exclusive to the *cerrado*, and the flora of our study sites had low floristic affinity with those described in other studies of the *cerrado* in northeastern Brazil (Vilas Bôas-Bastos & Bastos 1998; Castro *et al.* 2002). It is noteworthy that the areas of *cerrado* investigated in our study were quite dry, and some bore evidence of recent fires.

Among the bryophytes we identified in the Chapada Diamantina ecoregion, the geographic distribution in Brazil was categorized as restricted for 30% of the taxa, moderate for 32% and broad for 38%. Many of the taxa classified as having a restricted or moderate distribution had previously been recorded only for the southeastern region of Brazil, particularly in mountainous areas, where environmental conditions, such as the mild temperatures and cloud cover associated with the upper elevations, enable the survival of species less tolerant to heat and desiccation. This corroborates the findings of Nascimento *et al.* (2010) regarding the floristic and biogeographical relationships between the arboreal flora of the upper montane forests in the south of the Chapada Diamantina ecoregion and those of the seasonal forest and rain forest formations in the Atlantic Forest of southeastern and southern Brazil, those authors having identified great floristic affinity between the two regions. In that same study, the authors point out a floristic continuation between the Serra do Espinhaço, to the south, and the central-south portion of the Chapada Diamantina ecoregion, as well as the occurrence of an extensive biogeographical province that connects the Chapada Diamantina ecoregion with the Serra da Mantiqueira, forming a corridor composed of *campos rupestres* and shrub-tree vegetation. That corridor would allow the transit of plant and animal species adapted to grassland and forest environments, where the humidity is higher and the temperatures are milder.

Our analysis of the worldwide geographical distribution of the bryophyte species identified showed a predominance of neotropical species (42%), followed by disjunct species (12%); cosmopolitan species (10%); pantropical species (9%); and species endemic to Brazil (4%), to the American tropics (3%) and to the American subtropics America (8%). In the upper elevations of the Chapada Diamantina ecoregion, there was a significant number of disjunct species with the distribution pattern eastern Brazil-Andes region (14 species), as previously observed for mountainous regions in southeastern Brazil (Santos & Costa 2010b), which can be explained by the similarities in climatic conditions between eastern Brazil and the Andes region. Such species, all of which were sampled in *campos rupestres* or forests, included *Chiloscyphus latifolius* (found in Brazil and Bolivia); *Radula tenera*, *Sematophyllum tequendamense*, *Syrrhopodon helicophyllus* and *Syzygiella liberata* (found in Brazil and Colombia); *Radula sinuata* (found in Brazil, Bolivia and Colombia); *Metzgeria hegewaldii* (found in Brazil and Peru); *Micropterygium reimersianum* (found in Brazil and Venezuela); *Micropterygium campanense* (found in Brazil, Venezuela and Peru); *Lepidozia brasiliensis* (found in Brazil, Colombia, Ecuador and Peru); *Calypogeia andicola* (found in Brazil, Colombia and Ecuador); *Lepidozia inaequalis* (found in Brazil, Ecuador, Bolivia and Peru); *Plagiochila fragilis* - (found in Brazil and Ecuador); and *Drepanolejeunea campanulata* (found in Brazil and the northern Andes). Other disjunctions were represented by *Adelothecium bogotense* (found throughout the neotropics, as well as in Madagascar and Tanzania); *Aphanolejeunea asperrima* (found in Brazil and Patagonia; *Archidium clavatum* (found in Brazil and Australia); *Riccia vitalii* (found in Brazil and Costa Rica); *Radula cubensis* and *R. wrightii* (found in Brazil and Cuba); *Diplasiolejeunea latipuense* (found in Brazil and Guyana); *Microlejeunea cystifera* (found in Brazil and French Guyana); *Acroporium caespitosum* and *Wijkia flagellifera* (found in Brazil and the West Indies); *Neesioscyphus homophyllus* (found in southeastern Brazil and northern Argentina); *Eccremidium floridanum* (found in Brazil and the United States); *Daltonia pulvinata* (found throughout the neotropics and on Reunion Island); *Schlotheimia tecta* (found throughout the neotropics and in India); *Jamesoniella rubricaulis* (found throughout the neotropics and in the Azores); and *Bryum paradoxum* (found throughout the neotropics and in Asia).

Four of the taxa identified are endemic to the Chapada Diamantina ecoregion, all of them belonging to the family Sphagnaceae and sampled in *campos rupestres*: *Sphagnum chichiense* var. *uvidulum*; *S. harleyi*; *S. contortulum*; and *S. vitalii*.

Bryophyte composition differed among the three elevational zones studied, species richness and the numbers of exclusive taxa being highest in the lower and upper montane formations: premontane (40 species, seven exclusive); lower montane (246 species, 121 exclusive), upper montane (241 species, 96 exclusive). Only eight taxa were sampled in all three zones; the premontane and lower montane zones had 33 taxa in common; and the lower and upper montane zones had 51 taxa in common.

The bryophyte flora found in the upper montane elevational zone of the Chapada Diamantina ecoregion comprise taxa previously identified as typical of mountainous regions in Brazil (Gradstein & Costa 2003; Costa & Lima 2005; Santos & Costa 2010a): *Adelanthus decipiens*, *Aptychopsis pyrrophylla*, *Atractylocarpus brasiliensis*, *Campylopus dichrostis*, *C. julicaulis*, *Drepanolejeunea araucariae*, *Frulania arecae*, *Herbertus juniperoideus* ssp. *bivittatus*, *Harpalejeunea subacuta*, *Jamesoniella rubricaulis*, *Jungermannia sphaerocarpa*, *Microlejeunea cystifera*, *Neesioscyphus homophyllus*, *Odontoschisma denudatum*, *Plagiochila cristata*, *Polytrichum brasiliense*, *Rhacocarpus purpurascens*, *Radula fendleri*, *Saccogynidium caldense*, *Schloteimia trichomitria*, *Sphagnum alegrense*, *Syzygiella* aff. *integerrima*, *S. liberata* and *Trichocolea flaccida*.

Among the species that occurred in the lower and upper montane formations and those of restricted distribution in Brazil, some are distinctive for their rarity within the Chapada Diamantina ecoregion, having been collected in forests or *campos rupestres* areas, with only one to five occurrences: *Adelothecium bogotense*, *Anastrophyllum piligerum*, *Harpalejeunea subacuta*, *Jungermannia sphaerocarpa*, Lophocolea mandonii, Micropterygium campanense, *Neesioscyphus homophyllus*, *Odontoschisma brasiliense*, *Sematophyllum swartzii*, *Sphagnum alegrense* and *Syzygiella liberata*. Some of those species have been listed as threatened in other Brazilian states.

Based on the results of this study, we conclude that the Chapada Diamantina ecoregion is an important center of bryophyte diversity, with high species richness, representing approximately 63% of the bryophyte flora of Bahia. A considerable proportion (83%) of the species identified were exclusive to montane zones (lower and upper), 30% being exclusive to the upper montane zone, mainly distributed in montane forests and *campos rupestres*. Despite its geological, ecological and biological importance, as well as its considerable size, to date only nine conservation units have been established in the region, representing only 8.1% of its area, and only three of those are totally protected areas, corresponding to a mere 3.9% of its total area (MMA 2005). Therefore, we can highlight the importance of preserving this region and of reducing the destructive impact of human activity, not only in the three areas already recognized for their high levels of diversity (the Serra do Barbado Environmentally Protected Area; Sete Passagens State Park; and Chapada Diamantina National Park) but also in the *campos rupestres*, seasonal forests and rain forests of the surrounding areas such as the municipalities of Piatã and Morro do Chapéu.

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