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Diversity and distribution of the bryophyte flora in montane forests in the Chapada Diamantina region of Brazil

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ABSTRACT

Bryophytes constitute an important component of tropical rain forests, which provide microhabitats favorable for their establishment. Bryophytes are also quite responsive to changes in microclimate, which makes them good bioindicators. This study aimed to determine the diversity and distribution of bryophytes in upper and lower montane forests of the Chapada Diamantina region of the state of Bahia, Brazil. To that end, we studied community aspects such as richness, diversity, substrates colonized, life forms and floristic similarity between areas and regions. In 2007 and 2008, we collected specimens from six forest sites, located from the north to the south of the Chapada Diamantina region. We identified a total of 205 infrageneric taxa. In comparison with the lower montane forests, the upper montane forests presented higher diversity and species richness, as well as greater numbers of substrates colonized, life form types, species of restricted geographic distribution and species typical of shaded areas. We also found low similarity in the species composition, the populations of the upper and lower montane forests forming two large and distinct groups. Although presenting relatively high floristic homogeneity among themselves, the Chapada Diamantina areas presented little similarity with those of the Atlantic Forest. This can be explained by the differences between the two regions in terms of environmental conditions, precipitation, seasonality, elevation and continentality.

Key words: Mosses, liverworts, community ecology, elevational gradient

Introduction

Brazil is one of the most species-rich countries in the world, with approximately 14% of the world's flora (Peixoto & Morin 2003), currently represented by over 43,000 plant species (Lista de Espécies da Flora do Brasil 2013). This great plant diversity is mainly due to the broad (continental) dimensions of Brazil and the wide range of climatic, geographic and geomorphologic characteristics, which provide considerable ecosystem variety. The Chapada Diamantina region, in the Brazilian state of Bahia, contributes to this biodiversity, due to its variety of vegetation formations, primarily *campos rupestres* (dry, rocky grasslands), forest, *cerrado* (savanna) and *caatinga* (shrublands), with a high degree of endemism (Conceição *et al*. 2005; Giulietti *et al*. 1996; Giulietti & Pirani 1988; Harley 1995; Harley & Simmons 1986). The region is one of centers of plant diversity in the Americas (Giulietti *et al*. 1997), is recognized as an ecoregion within the *caatinga* biome (IBGE 2004) and has been classified as a priority region for scientific investigation (MMA 2002).

The study of the flora within the Chapada Diamantina region, which encompasses Chapada Diamantina National Park, intensified after 1970, most of the research being focused on the *campos rupestres*. Beginning in the late 1990s, the focus shifted to the forest areas and floristic surveys became the norm (Funch 2008; Funch *et al.* 2005, 2008; Ribeiro-Filho *et al.* 2009). Such studies are widely recognized as being of great importance, because many forests in the region have been destroyed by human activities, mainly to create pasture and extract timber (Funch 2008). The bryophyte flora of the Chapada Diamantina region is rich and diverse, accounting for 80% of the taxa recorded for the State of Bahia (Valente *et al*. 2011), and 54% of those taxa occur in forest areas (Valente *et al*. 2013). Bryophyte diversity has also been studied in other forest areas of Bahia. Surveys of mosses and liverworts conducted in areas of lower montane Atlantic Forest, in the Serra da Jiboia

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mountain range, near the municipality of Santa Teresinha (Valente & Pôrto 2006a, 2006b; Valente *et al.* 2009), resulted in the identification of 121 bryophytes species. Similar studies, conducted in areas of lowland Atlantic Forest near the city of Igrapiúna (Bastos & Valente 2008; Bastos & Vilas Bôas-Bastos 2008; Vilas Bôas-Bastos & Bastos 2008), identified 225 species.

Bryophyte communities are known for the fact that their species composition and richness is strongly influenced by external factors, especially water, light and temperature (Mägdefrau 1982), which makes them efficient bioindicators (Frahm & Gradstein 1991). Therefore, they constitute an important component of tropical rain forests, which provide microhabitats with diverse substrates and moderate luminosity, important factors for the establishment of members of this plant group (Pócs 1982; Richards 1984; Pócs & Gradstein 1989). Bryophytes are also quite sensitive to differences in elevation, their species richness increasing at higher elevations (Van Reenen & Gradstein 1983, 1984; Kessler 2000; Frahm 1990; Frahm & Gradstein 1991; Ah-Peng *et al.* 2007).

On the basis of the aspects presented above, this study was aimed at expanding our knowledge of the diversity and distribution of bryophytes in the upper and lower montane forests of the Chapada Diamantina region, through the study of variables such as richness, diversity, substrates colonized, life forms and floristic similarity between areas. We also investigated the floristic similarity between these forests and areas of coastal Atlantic Forest.

Materials and methods

Study area

The Chapada Diamantina region (10°00'-14°00'S; 40°10'-44°30'W), in the central portion of the state of Bahia, comprises the northern end of the Espinhaço mountain range, the largest mountain range in eastern Brazil, which extends from Serra da Jacobina (10°00'S), in Bahia, to Serra de Ouro Branco, near the city of Ouro Preto (21°25'S), in the state of Minas Gerais. The approximate dimensions of the Chapada Diamantina region are 400 km from north to south and 50-100 km from east to west, with an overall area of 50,000 km^2 and elevations ranging from 600 m to 2000 m (MMA 2005). The average monthly temperature ranges from 15°C to 30°C, with extremes of as low as 0°C in winter (between June and August) and 30°C in summer (between December and January). At the higher elevations, throughout the region, mist precipitation is common (Nolasco *et al.* 2008).

The number of meteorological and rainfall stations in Chapada Diamantina is insufficient to model local microclimates (Nolasco *et al.* 2008), which can only be presented with a regional tendency based on data recorded over the years. The rainfall profile constructed according to the historical series from the last 20 years (Agritempo 2010) shows that the rainy season begins in November and ends in April, the average monthly rainfall peaking in December, at 139 mm, compared with 20 mm in August, during the dry season (May to October). The average monthly rainfall exceeds 100 mm during the rainy season, whereas it is only 35 mm during the dry season. The mean annual rainfall ranges from 600 mm to 1100 mm.

This study focuses on lower montane semideciduous forests and upper montane rain forests, vegetation formations of the Atlantic Forest, following the classification proposed by Oliveira-Filho *et al.* (2006), which, for latitudes ≤ 16°S, defines lowland formations as those occurring at elevations ≤ 400 m; submontane formations as those occurring at elevations of 400-800 m; lower montane formations as those occurring at elevations of 800-1200 m; and upper montane formations as those occurring at elevations > 1200 m. In the Chapada Diamantina region, the lower montane semideciduous forests occur mainly on the eastern faces of the mountains, typically consisting of trees with heights between 20 m and 30 m (Queiroz *et al.* 2008). In those forests, in general, there is considerable representation of the families Myrtaceae, Leguminosae, Euphorbiaceae, Melastomataceae and Chrysobalanaceae (Funch 2008; Funch *et al.* 2008). The upper montane rain forests are characterized by medium-sized tree species, ranging from 15 to 30 m in height (Queiroz *et al.* 2008). The herbaceous stratum presents species of various families, including Bromeliaceae and Eriocaulaceae. The soil is humid and dark with a thick layer of litter, reflecting the richness of the organic matter (Giulietti *et al.* 1996). In such forests, there is a predominance of species belonging to families typical of rain forests, such as Lauraceae and Myrtaceae, as well as a large number of epiphytic species (Queiroz *et al.* 2008).

The study areas are organized and identified in numerical sequence by latitude, from the north to the south of the Chapada Diamantina region, areas F1 to F4 corresponding to the lower montane semideciduous forests, whereas F5 and F6 correspond to the upper montane rain forests (Table 1).

Sampling and study material

In 2007 and 2008, we collected samples by free-walking the areas for approximately 7 h. The sampling effort was given by stabilization of the species accumulation curve. We investigated the various substrates available in the forest understory: soil, rock, tree trunks, rotting wood and leaves. For all study areas, we recorded the elevation and geographic coordinates.

The material was identified by following the basic literature—Fulford (1963; 1966; 1968), Crum (1984), Yano *et al.* (1985), Frahm (1991), Reese (1993), Sharp *et al.* (1994), Buck (1998), Gradstein *et al.* (2001), Allen (2002), Gradstein & Costa (2003) and Pursell (2007)—as well as the specific literature for many groups. We adopted the classification

Table 1. Characteristics of the six areas studied (F1 to F6) in the Chapada Diamantina region of the state of Bahia, Brazil.

Area	Municipality	Conservation unit	Elevation (m)	Coordinates	Type	Mean annual rainfall (mm)	Soil type
F1	Miguel Calmon	SPSP	1000	11°23'35.2"S; 40°32'14.4"W	LMSF	935	L
F2	Miguel Calmon	SPSP	1000	11°23'11.4"S; 40°31'33.6"W	LMSF	935	L
F3	Morro do Chapéu	-	920-940	11°36'49.5"S; 41°01'09.5"W	LMSF	680	O
F4	Palmeiras	CDNP	951-970	12°27'49.5"S; 41°28'34.4"W	LMSF	1068	L
F5	Abaíra	SB-EPA	1668-1730	13°16'10.2"S; 41°54'40.4"W	UMRF	1070	L
F6	Abaíra	SB-EPA	1604-1690	13°17'27.1"S; 41°54'01.1"W	UMRF	1070	L

SPSP – Sete Passagens State Park; LMSF – lower montane seasonal forest; L – lithosols; O – oxisols; CDNP – Chapada Diamantina National Park; SB-EPA – Serra do Barbado (Bahia) State Environmentally Protected Area; UMRF – upper montane rain forest.
Sources: Agritempo (rainfall data, http://www.agritempo.gov.br/agroclima/shdescritor?uf=BA); Embrapa (soil data, http://www.uep.cnps.embrapa.br/solos).

systems devised by Goffinet *et al.* (2009) for mosses and by Crandall-Stotler *et al.* (2009) for liverworts. The samples were deposited in the Herbarium of the Federal University of Feira de Santana (code, HUEFS) and the Federal University of Bahia Institute of Biology Alexandre Leal Costa Herbarium (code, ALCB), with some duplicates deposited in the Herbarium of the Federal University of Pernambuco (code, UFP).

The bryophyte life forms classification was based on Mägdefrau (1982), Richards (1984) and Bates (1998). The bryophyte flora was classified in relation to light tolerance, certain species having been identified in the literature as being typical of sunny areas, being typical of shaded areas, or being generalists (Costa 1999; Gradstein *et al.* 2001; Alvarenga & Pôrto 2007; Silva & Pôrto 2009).

Data analysis

The total richness of the forests of the Chapada Diamantina region was estimated as previously described (Chao 1984), with the software EstimateS (Cowell 2006). Species diversity was calculated for each area using the Shannon-Wiener index (H'), with the software PRIMER 5.1 (Clarke & Warwick 1994). The floristic similarity between areas was calculated based on the presence and absence of species, using the Bray-Curtis method and the software PRIMER 5.1 (Clarke & Warwick 1994).

Because of the small size and fragmented nature of the bryophyte community (Bates 1982), calculations of the diversity index and estimations of richness were performed by using the frequency of each species (*e.g.*, at how many points within the area the species was collected), rather than abundance (*e.g.*, total number of individuals of the species collected in the area). The species richness and diversity of the bryophytes were compared among the areas with t-tests, normality having been tested with the Kolmogorov-Smirnov test, and the level of statistical significance adopted was $p<0.05$. Statistical tests were performed with the aid of BioEstat 2.0 (Ayres *et al.* 2000).

To investigate the relationship between the bryophyte flora of the interior Atlantic Forest (sampled areas) and areas of the coastal Atlantic Forest, we performed a principal components analysis using the software MVSP 3.1 (Kovach 1999), as well as a similarity analysis using the Bray-Curtis method and the software PRIMER 5.1 (Clarke & Warwick 1994). In both, were only used species with more than five occurrences. Floristic data were used for the following areas: Veracel Station (lowland rain forests, 16°22'S; 39°10'W, municipality of Eunápolis, southern Bahia—Bastos, unpublished data), Michelin Nature Reserve, (13°48'S; 39°10'W, municipality of Igrapiúna, Bahia—Bastos & Valente 2008; Bastos & Vilas Bôas Bastos 2008; Vilas Bôas Bastos & Bastos 2008) and Serra da Jibóia (mountain rain forest, municipality of Santa Teresinha, Bahia—Valente & Pôrto 2006a; Valente *et al.* 2009).

Results and discussion

The forest areas of the Chapada Diamantina region have a rich bryophyte flora, presenting 205 infrageneric taxa (116 Marchantiophyta, 89 Bryophyta) distributed across 88 genera and 41 families (Tab. 2 and 3). This represents 94% of the total estimated species richness for the forests of Chapada Diamantina according to method devised by Chao (1984). The diversity index of the total forest areas studied (H'(log) = 4.92) and the mean diversity between the areas (H'(log) = 5.21) were high, the diversity index by area is presented in Tab. 2. The predominant families, in terms of the number of species, were Lejeuneaceae, Plagiochilaceae, Leucobryaceae, Radulaceae, Sematophyllaceae, Lepidoziaceae, Orthotrichaceae, Frullaniaceae, Calymperaceae and Brachytheciaceae, all cited in

Table 2. Richness, sampling and Shannon-Wiener diversity index (H' log) for bryophyte communities in the forest areas studied within the Chapada Diamantina region of the state of Bahia, Brazil.

Variable	F1	F2	F3	F4	F5	F6	Total
Number of species	37	58	25	32	101	127	208
Number of genera	27	39	14	24	54	59	88
Number of families	14	19	9	17	30	31	41
Number of samples	129	133	74	112	258	234	940
H'(log)	4.81	5.56	3.99	4.21	6.20	6.55	4.92

Table 3. Composition, frequency and type (by substrate colonized) of the bryophyte communities in the forest areas studied within the Chapada Diamantina region of the state of Bahia, Brazil.

Taxa	F1	F2	F3	F4	F5	F6	Forest type	Species type (by substrate)	Distribution	Life form
Acroporium caespitosum (Hedw.) W.R. Buck	0	0	1	0	0	0	L	Ex	Brazil and West Indies	M
Acroporium estrellae (Müll. Hal.) W.R. Buck & Schaf.-Verw.	0	0	1	0	0	0	L	Co	Neotropical	M
Adelothecium bogotense (Hampe) Mitt.	0	0	0	0	4	1	U	Co	Pantropical	M
Anoplolejeunea conferta (C.F.W. Meissn. ex Spreng.) A. Evans	4	4	0	1	4	1	U, L	Co, Ex	Neotropical	W
Aphanolejeunea asperrima (Steph.) Steph.	0	0	0	0	0	1	U	Co	Brazil and Patagonia	M
Aphanolejeunea cornutissima R.M. Schust.	0	0	0	0	1	0	U	Ep	Neotropical	M
Aptychopsis pyrrophylla (Müll. Hal.) Wijk & Margad.	0	0	0	0	7	1	U	Co, Ex, Ru	Brazil	TF
Bazzania aurescens Spruce	0	1	0	0	0	0	L	Co	Neotropical	W
Bazzania heterostipa (Steph.) Fulford	0	0	0	8	0	3	U, L	Ex, Ru	Brazil	W
Bazzania hookeri (Lindenb.) Trevis	0	1	0	0	3	3	U, L	Co, Ex, Ru, Te	Neotropical	W
Brachiolejeunea leiboldiana (Lindenb. & Gottsche) Schiffn.	0	0	0	0	0	1	U	Co	Neotropical	M
Bryum limbatum Müll. Hal.	2	0	0	0	0	0	L	Ex	Neotropical	TF
Calypogeia laxa Lindenb. & Gottsche	0	0	0	0	1	0	U	Ru, Te	Neotropical	W
Calypogeia peruviana Nees	0	0	0	0	5	1	U	Ru, Te	Neotropical	W
Campylopus arctocarpus (Hornsch.) Mitt.	8	1	0	0	1	1	U, L	Co, Ru, Te	Cosmopolitan	TF
Campylopus filifolius var. *filifolius* (Hornsch.) Mitt.	0	0	1	1	0	1	U, L	Ex, Ru,Te	Neotropical	TF
Campylopus filifolius var. *humilis* (Mont.) J.-P. Frahm	2	6	1	0	5	1	U, L	Ex, Ru,Te	Neotropical	TF
Campylopus filifolius var. *longifolius* (E.B. Bartram) E.B. Bartram	0	0	0	0	3	3	U	Co, Ru	Neotropical	TF
Campylopus julaceus A. Jaeger	0	0	0	0	0	1	U	Ru, Te	Tropical and Subtropical America	TF
Campylopus lamellinervis var. *lamellinervis* (Müll. Hal.) Mitt.	0	0	0	0	1	1	U	Ru, Te	Neotropical	TF
Campylopus lamellinervis var. *exaltatus* (Müll. Hal.) J.-P. Frahm	0	1	0	0	0	0	L	Te	Neotropical	TF
Campylopus pilifer Brid.	2	0	0	0	0	2	U, L	Co, Ru, Te	Cosmopolitan	TF
Campylopus savannarum (Müll. Hal.) Mitt.	2	0	4	0	0	0	L	Ru, Te	Pantropical	TF
Cephaloziella cf. *granatensis* (J.B. Jack) Fulford	0	0	1	0	0	0	L	Ex	Neotropical and Madeira	W
Cheilolejeunea acutangula (Nees) Grolle	0	2	0	0	2	0	U, L	Co, Ex	Brazil and Central America	W
Cheilolejeunea holostipa (Spruce) Grolle & R.L. Zhu	0	0	0	0	1	0	U	Ep	Neotropical	W
Cheilolejeunea oncophylla (Ångstr.) Grolle & M.E.Reiner	0	0	0	0	8	2	U	Co, Ex, Ru	Neotropical	W
Cheilolejeunea rigidula (Mont.) Schust.	3	4	0	0	0	1	U, L	Co, Ex	Africa and the Americas	W
Cheilolejeunea unciloba (Lindenb.) Malombe	3	0	7	0	9	1	U, L	Co, Ep, Ex	Africa and the Americas	M
Cheilolejeunea xanthocarpa (Lehm. & Lindenb.) Malombe	1	3	1	0	5	3	U, L	Co, Ep, Ex	Pantropical	M
Chiloscyphus martianus (Nees) J.J. Engel & R.M. Schust.	0	0	0	0	1	1	U	Co, Ru	Africa and South America	W
Cololejeunea cf. *hildebrandii* (Austin) Steph.	0	0	0	0	1	0	U	Ep	Pantropical	W
Cololejeunea subcardiocarpa Tixier	0	0	0	0	6	0	U	Ep	Neotropical	W

Continues

Table 3. Continuation.

Taxa	F1	F2	F3	F4	F5	F6	Forest type	Species type (by substrate)	Distribution	Life form
Colura tenuicornis (A. Evans) Steph.	0	0	0	0	1	0	U	Ep	Pantropical	W
Cyclolejeunea convexistipa (Lehm. Ex. Lindenb.) Evans	0	1	0	0	0	0	L	---	Neotropical	W
Cyclolejeunea luteola (Spruce) Grolle	0	4	0	0	0	0	L	Co, Ep, Ex	Neotropical	W
Cylindrocolea planifolia (Steph.) R.M. Schust.	0	0	0	0	0	1	U	Ru	Neotropical	W
Cylindrocolea rhizantha (Mont.) R.M. Schust.	0	0	1	0	0	0	L	Ex	Neotropical	W
Daltonia longifolia Taylor	0	0	0	0	0	1	U	Co	Neotropical	M
Dicranodontium pulchroalare subsp. *brasiliense* (Herzog) J.-P. Frahm	0	0	0	0	0	1	U	Co, Ru	Brazil	TF
Diplasiolejeunea unidentata (Lehm. & Lindenb.) Steph.	0	0	0	0	0	1	U	Co	Neotropical	W
Donnellia commutata (Müll. Hal.) W.R. Buck	2	2	0	0	0	0	L	Ex	Tropical and Subtropical America	M
Drepanolejeunea anoplantha (Spruce) Steph.	3	7	0	0	1	1	U, L	Co, Ex, Ep	Antilles and Tropical South America	M
Drepanolejeunea araucariae Steph.	0	4	0	0	1	0	U, L	Co, Ep	Tropical and Subtropical America	M
Drepanolejeunea campanulata (Spruce) Steph.	0	0	0	0	1	0	L	Ep	Brazil and Andean countries	M
Drepanolejeunea fragilis Bischl.	0	0	0	0	2	0	U	Co, Ep	Neotropical	M
Drepanolejeunea orthophylla Bischl.	0	0	0	0	0	1	U	Ex	Neotropical	M
Fissidens serratus var. *serratus* Müll. Hal.	0	0	0	0	1	0	U	Co	Neotropical	M
Fissidens weirii var. *hemicraspedophyllus* (Cardot) Pursell	0	0	0	0	0	1	U	Te	Neotropical	M
Floribundaria flaccida (Mitt.) Broth.	0	4	0	0	0	0	L	Co, Ep	Neotropical	P
Frullania arecae (Spreng.) Gottsche	0	0	0	0	0	1	U	Ex	Pantropical	W
Frullania atrata (Sw.) Dumort.	0	1	0	0	4	2	U, L	Co	Neotropical	W
Frullania brasiliensis Raddi	0	3	0	0	1	7	U, L	Co	Neotropical	W
Frullania breuteliana Gottsche	0	0	0	0	1	0	U	Co	Neotropical	W
Frullania griffithsiana Gottsche	0	0	0	0	1	3	U	Co	Neotropical	W
Frullania caulisequa (Nees) Nees	4	0	0	0	2	1	U, L	Co, Ex, Ru	Neotropical	M
Frullania kunzei Lehm. & Lindenb.	0	0	8	0	0	1	U, L	Co, Ex	Neotropical	M
Frullania lindenbergii Lehm.	0	0	0	0	0	2	U	Co	Brazil and Africa	W
Frullania mucronata (Lehm. & Lindenb.) Lehm. & Lindenb.	0	0	0	0	0	2	U	Co	Neotropical	W
Frullania setigera Steph.	0	0	0	0	0	1	U	Co, Ru, Te	Neotropical	W
Frullanoides densifolia Raddi	0	0	0	0	0	1	U	Co	Neotropical	W
Gemmabryum exile (Dozy & Molk.) J.R. Spence & H.P. Ramsay	0	0	0	0	0	1	U	Te	Cosmopolitan	TF
Harpalejeunea stricta (Lindenb. & Gottsche) Steph.	0	0	0	0	4	1	U	Co, Ex, Ep	Neotropical	M
Harpalejeunea subacuta A. Evans	1	5	0	0	3	1	U, L	Co, Ex	Brazil and West Indies	M
Herbertus juniperoideus subsp. *bivittata* (Spruce) Feldberg & J. Heinrichs	0	0	0	0	1	0	U	Co	Neotropical	TF
Holomitrium crispulum Mart.	6	0	0	0	2	1	U, L	Co, Ex, Ru	Neotropical	TF
Holomitrium olfersianum Hornsch.	0	0	0	1	0	0	L	Co	Neotropical	TF
Isopterygium byssobolax (Müll. Hal.) Paris	0	0	0	0	0	1	U	Co	Tropical and Subtropical America	M
Isopterygium jamaicense (E.B. Bartram) W.R. Buck	0	0	3	0	0	1	U, L	Ex	Mexico, Central America and Brazil	M
Isopterygium tenerifolium Mitt.	0	4	2	2	0	0	L	Co, Ex	Neotropical	M
Isopterygium tenerum (Sw.) Mitt.	0	0	7	0	0	1	U, L	Co, Ex, Te	Pantropical	M
Jaegerina scariosa (Lorentz) Arzeni	0	0	0	2	0	0	L	Co	Neotropical	W
Jungermannia sphaerocarpa Hook.	0	0	0	0	1	0	U	Te	Holarctic	W
Kurzia capillaris (Sw.) Grolle	2	1	0	0	0	1	U, L	Ex, Te	Africa and the Americas	W
Lejeunea cerina (Lehm. & Lindenb.) Gottsche, Lindenb. & Nees	0	0	0	0	0	3	U	Co, Ru	Neotropical	W
Lejeunea cochleata Spruce	0	1	0	0	0	0	L	Ex	Neotropical	M

Continues

Table 3. Continuation.

Taxa	F1	F2	F3	F4	F5	F6	Forest type	Species type (by substrate)	Distribution	Life form
Lejeunea controversa Gott.	0	1	0	0	0	0	L	Co	Neotropical	M
Lejeunea flava (Sw.) Nees	0	2	1	0	2	6	U, L	Co, Ep, Ex, Ru, Te	Pantropical	M
Lejeunea grossitexta (Steph.) E. Reiner	0	0	0	0	3	3	U	Co	Tropical and Subtropical America	M
Lejeunea laetevirens Nees & Mont.	0	0	0	1	0	3	U, L	Co, Ex, Ru	Neotropical	M
Lejeunea oligoclada Spruce	2	0	0	0	3	2	U, L	Co, Ep, Ex	Brazil	M
Lejeunea phyllobola Nees & Mont. ex Mont.	0	0	0	0	1	7	U	Co, Ex	Neotropical	M
Lejeunea raddiana Lindenb.	0	0	0	0	0	2	U	Co	Neotropical	M
Lepidozia coilophylla Taylor	1	4	0	0	0	0	L	Co, Te, Ru	Neotropical	W
Lepidozia cupressina (Sw.) Lindenb.	0	0	0	0	1	5	U	Co, Ru, Te	Cosmopolitan	W
Lepidozia inaequalis Lehm. & Lindenb.	0	0	0	0	2	1	U	Co, Ru, Ex	Brazil and Andean countries	W
Leucobryum albicans (Schwägr.) Lindb.	2	0	0	0	0	1	U, L	Ru, Te	Neotropical	CU
Leucobryum clavatum var. *brevifolium* Broth.	0	1	0	0	0	2	U, L	Co, Ex, Ru	Brazil	CU
Leucobryum crispum Müll. Hal.	0	0	0	4	1	1	U, L	Co, Ex, Ru, Te	Neotropical	CU
Leucobryum giganteum Müll. Hal.	0	3	1	0	0	1	U, L	Co, Te, Ex	Neotropical	CU
Leucobryum martianum (Hornsch.) Hampe ex Müll. Hal.	4	0	0	0	1	0	U, L	Ex, Ru, Te	Neotropical	CU
Leucoloma cruegerianum (Müll. Hal.) A. Jaeger	4	0	0	0	0	0	L	Co, Ru	Neotropical	TF
Leucoloma serrulatum Brid.	0	0	0	0	1	3	U	Co, Ex, Ru, Te	Asia and the Americas	TF
Lophocolea bidentata (L.) Dumort.	0	0	0	0	0	1	U	Ru	Cosmopolitan	W
Macrocoma Braziliensis (Mitt.) Vitt	0	0	0	0	0	1	U	Co	Neotropical	TF
Macrocoma orthotrichoides (Raddi) Wijk & Margad.	0	0	0	0	0	0	L	Co	Pantropical	TF
Macromitrium frustratum B.H. Allen	0	0	0	0	0	1	U	Co	Neotropical	TF
Macromitrium microstomum (Hook. & Grev.) Schwägr.	6	3	0	0	0	1	U, L	Co, Ex, Ru, Te	Pantropical	TF
Macromitrium podocarpi Müll. Hal.	0	0	0	0	1	0	U	Ex	Neotropical	TF
Macromitrium punctatum (Hook. & Grev.) Brid.	0	0	0	0	7	0	U	Co, Ru, Ex	Neotropical	TF
Macromitrium sejunctum B.H. Allen	0	0	0	0	0	1	U	Co	Neotropical	TF
Marchesinia brachiata (Sw.) Schiffn.	0	1	0	11	0	1	U, L	Co, Ru	Africa and the Americas	W
Metalejeunea cucullata (Reinw., Blume & Nees) Grolle	0	0	0	0	1	0	U	Ex	Pantropical	M
Meteoridium remotifolium (Müll. Hal.) Manuel	0	0	0	3	0	0	L	Co	Tropical and Subtropical America	P
Meteorium nigrescens (Sw. ex Hedw.) Dozy & Molk.	0	0	0	4	0	0	L	Co	Cosmopolitan	P
Metzgeria decipiens (C. Massal.) Schiffn.	0	0	0	0	2	0	U	Co, Ep	Pantropical	TL
Metzgeria furcata (L.) Corda	0	0	0	3	0	0	L	Co	Cosmopolitan	TL
Metzgeria hegewaldii Kuwah.	0	0	0	0	0	4	U	Co, Ex	Brazil and Andean countries	TL
Metzgeria myriopoda Lindb.	0	0	0	0	0	1	U	Co	Americas	TL
Microlejeunea bullata (Taylor) Steph.	0	0	0	0	0	1	U	Ex	Neotropical	W
Microlejeunea cystifera Herzog	1	2	0	0	4	1	U, L	Co, Ep, Ex	Brazil and French Guiana	W
Microlejeunea epiphylla Bischl.	0	0	0	0	1	1	U	Co	Neotropical	W
Micropterygium reimersianum Herzog	0	0	0	0	0	2	U	Ru, Te	Brazil and Andean countries	W
Mittenothaminium reptans (Hedw.) Cardot	0	0	0	1	1	1	U, L	Ru, Te	Pantropical	W
Mittenothamnium substriatum (Mitt.) Cardot	0	0	0	0	3	1	U	Co, Ex, Te	Neotropical	W
Neckeropsis undulata (Hedw.) Reichardt	0	0	0	4	0	0	L	Co, Ru	Tropical and Subtropical America	F
Neesioscyphus homophyllus (Nees) Grolle	0	0	0	0	0	1	U	Te	Tropical and Subtropical America	W
Neurolejeunea breutelii (Gottsche) A. Evans	0	2	0	0	2	0	U, L	Co, Ru	Neotropical	M

Continues

Table 3. Continuation.

Taxa	F1	F2	F3	F4	F5	F6	Forest type	Species type (by substrate)	Distribution	Life form
Octoblepharum albidum Hedw.	0	1	10	0	0	0	L	Co, Ex, Ru, Te	Pantropical	CU
Octoblepharum cocuiense Mitt.	6	0	0	0	0	0	L	Ru, Te	Neotropical	CU
Odontoschisma Braziliense Steph.	1	1	0	0	0	0	L	Ex, Te	Brazil	W
Omphalanthus filiformis (Sw.) Nees	0	4	0	0	8	7	U, L	Co, Ep, Ru	Neotropical	W
Oryzolejeunea saccatiloba (Steph.) Gradst.	3	2	0	0	0	0	L	Co, Ex	Neotropical	M
Orthostichopsis praetermissa W.R. Buck	2	1	0	2	4	6	U, L	Co, Te	Neotropical	M
Pallavicinia lyellii (Hook.) Gray	0	0	0	0	1	0	U	Te	Cosmopolitan	TL
Phyllogonium viride Brid.	0	0	0	0	10	2	U	Co, Ru, Te	Neotropical	P
Plagiochila aerea Taylor	0	0	0	4	0	0	L	Co, Ru	Neotropical	W
Plagiochila bifaria (Sw.) Lindenb.	0	0	0	0	4	1	U	Co, Te, Ru	Neotropical	W
Plagiochila bryopterioides Spruce	0	0	0	0	1	2	U	Co	Neotropical	W
Plagiochila cf. *distinctifolia* Lindenb.	0	0	0	0	0	1	U	Co	Neotropical	W
Plagiochila raddiana Lindenb.	0	0	0	0	0	0	L	Ru	Neotropical	W
Plagiochila patentissima Steph.	0	0	0	1	0	0	L	Ru	Neotropical	W
Plagiochila compressula (Nees) Lindenb.	0	0	0	0	1	0	U	Co	Neotropical	W
Plagiochila corrugata (Nees) Nees & Mont.	5	1	0	6	2	15	U, L	Co, Ex, Ru, Te	Neotropical	W
Plagiochila cristata (Sw.) Dumort.	0	0	0	0	2	1	U	Co, Ex	Neotropical	W
Plagiochila disticha (Lehm. & Lindenb.) Mont.	1	1	0	0	0	1	U, L	Co, Ru	Neotropical	W
Plagiochila exigua (Taylor) Taylor	0	1	0	0	0	1	U, L	Co	Cosmopolitan	W
Plagiochila fragilis Taylor	0	0	0	0	1	1	U	Co, Ru	Neotropical	W
Plagiochila gymnocalycina Lindenb.	0	0	0	1	1	5	U, L	Co, Te	Neotropical	W
Plagiochila patula (Sw.) Lindenb.	0	0	0	5	0	2	U, L	Co, Ru	Neotropical	W
Plagiochila simplex (Sw.) Lindenb.	0	2	0	0	1	1	U, L	Co, Ex, Ru, Te	Neotropical	W
Plagiochila subplana Lindenb.	0	3	0	4	1	1	U, L	Co, Ex, Ru	Neotropical	W
Pogonatum pensilvanicum (W. Bartram ex Hedw.) P. Beauv.	0	0	0	0	0	1	U	Te	Cosmopolitan	TF
Polytrichum juniperinum Hedw.	0	0	0	0	1	2	U	Ru	Cosmopolitan	TF
Porella brasiliensis (Raddi) Schiffn.	0	0	0	1	1	0	U, L	Ru	Tropical and Subtropical America	F
Porella reflexa (Lehm. & Lindenb.) Trevis.	0	0	0	0	1	0	U	Co	Tropical and Subtropical America	F
Porella swartziana (F. Weber) Trevis.	0	0	0	28	0	0	L	Co, Ru	Neotropical	F
Pyrrhobryum spiniforme (Hedw.) Mitt.	0	7	0	0	2	1	U, L	Co, Ru, Te	Pantropical	TF
Racopilum tomentosum (Hedw.) Brid.	0	0	0	0	0	0	L	Ex	Cosmopolitan	M
Radula cf. *conferta* Lindenb. & Gottsche	0	0	0	0	1	0	U	Ex	Cosmopolitan	M
Radula cubensis K. Yamada	0	0	0	0	6	1	U	Co	Brazil and Cuba	M
Radula fendleri Gottsche ex Steph.	0	0	0	0	0	8	U	Co	Neotropical	M
Radula inflexa Gottsche ex Steph.	0	0	0	0	5	1	U	Co, Ex	Neotropical	M
Radula javanica Gottsche	0	0	0	0	0	1	U	Ex	Pantropical	M
Radula kegelii Gottsche	0	0	0	1	2	0	U, L	Co, Ru	Neotropical	M
Radula mexicana Steph.	0	0	0	0	10	0	U	Co, Ex	Tropical and Subtropical America	M
Radula pseudostachya Spruce	0	0	0	0	0	2	U	Co	Neotropical	M
Radula tenera Mitt. ex. Steph.	2	5	0	0	0	0	L	Co	Brazil and Andean countries	M
Radula recubans Taylor	0	0	0	0	3	1	U	Co, Te	Tropical and Subtropical America	M
Radula sinuata Steph.	0	0	0	0	1	2	U	Co, Ep	Brazil, Bolivia and Colombia	M
Radula wrightii Castle	0	0	0	0	2	0	U	Co, Ex	Brazil and Cuba	M

Continues

Table 3. Continuation.

Taxa	F1	F2	F3	F4	F5	F6	Forest type	Species type (by substrate)	Distribution	Life form
Rhodobryum beyrichianum (Hornsch.) Müll. Hal.	0	0	0	1	0	0	L	Ru	Tropical and Subtropical America	TF
Riccardia cataractarum (Spruce) Schiffn.	0	0	0	0	2	0	U	Te	South America	TL
Rosulabryum densifolium (Brid.) Ochyra	0	0	0	0	10	5	U	Ru, Te	Neotropical	TF
Saccogynidium caldense (Ångstr.) Grolle	0	1	0	0	2	2	U, L	Co, Te, Ru	Brazil	W
Schiffneriolejeunea polycarpa (Nees) Gradst.	0	1	0	0	0	0	L	Co, Ex	Pantropical	W
Schlotheimia jamesonii (Arn.) Brid.	2	1	0	0	0	1	U, L	Co, Ru	Neotropical	TF
Schlotheimia rugifolia (Hook.) Schwägr.	6	1	0	0	4	5	U, L	Co, Ru, Ex	Tropical and Subtropical America	TF
Schloteimia tecta Hook. f. & Wilson	0	0	0	0	1	1	U	Co, Ru	Neotropical and India	TF
Schlotheimia torquata (Sw. ex Hedw.) Brid.	2	0	0	0	0	0	L	Ru	Neotropical	TF
Sematophyllum adnatum (Michx.) E. Britton	2	1	0	0	2	1	U, L	Co, Ex, Ru, Te	Cosmopolitan	W
Sematophyllum galipense (Müll. Hal.) Mitt.	18	0	0	0	1	1	U, L	Co, Ex, Ru, Te	Neotropical	W
Sematophyllum subpinnatum (Brid.) E. Britton	0	1	0	0	0	1	U, L	Co, Ex, Ru	Cosmopolitan	W
Sematophyllum subsimplex (Hedw.) Mitt.	0	1	0	0	0	0	L	Co, Ex, Ru, Te	Neotropical	W
Sematophyllum swartzii (Schwägr.) W.H. Welch & H.A. Crum	0	0	0	0	6	3	U, L	Co, Ex, Te	Neotropical	W
Sphagnum capillifolium var. *capillifolium* (Ehrh.) Hedw.	2	3	0	0	0	2	U, L	Ru, Te	Cosmopolitan	TF
Sphagnum subsecundum Nees	0	0	0	0	1	0	U	----	Cosmopolitan	TF
Sphagnum magellanicum Brid.	0	0	0	0	0	1	U	Ru, Te	Cosmopolitan	TF
Sphagnum oxyphyllum Warnst.	0	0	0	0	1	0	U	Te	Neotropical	TF
Sphagnum palustre L.	0	1	0	0	0	1	U, L	Ru, Te	Cosmopolitan	TF
Sphagnum perichaetiale Hampe	0	1	0	0	0	1	U, L	Te, Ru	Cosmopolitan	TF
Squamidium brasiliense (Hornsch.) Broth.	0	0	0	0	1	1	U	Co, Ex, Ep	Africa and the Americas	P
Squamidium nigricans (Hook.) Broth.	0	0	0	0	1	0	U	----	Neotropical	P
Squamidium leucotrichum (Taylor) Broth.	0	2	0	0	0	0	L	Co, Ru, Ex, Ep	Neotropical	P
Symphyogyna brasiliensis Nees	0	0	0	0	1	0	U	Te	Africa and the Americas	TL
Syrrhopodon elongatus var. *glaziovii* (Hampe) W.D. Reese	8	0	0	0	1	0	L	Co, Ru, Te	Neotropical	TF
Syrrhopodon gaudichaudii Mont.	4	4	0	0	5	4	U, L	Co, Ex, Ru, Te	Pantropical	TF
Syrrhopodon parasiticus (Sw. ex Brid.) Paris	0	0	0	0	0	1	U	Co	Pantropical	TF
Syrrhopodon prolifer var. *prolifer* Schwägr.	0	0	0	0	2	1	U	Co, Ex, Ru, Te	Neotropical	TF
Syrrhopodon prolifer var. *scaber* (Mitt.) W.D. Reese	0	0	0	0	1	0	U	Ex, Ru, Te	Neotropical	TF
Syzygiella cf. *integerrima* Steph.	0	0	0	0	4	0	U		Neotropical	W
Syzygiella liberata Inoue	0	0	0	0	0	1	U	Te, Ru	Brazil and Andean countries	W
Syzygiella sp.	0	4	0	0	1	1	U, L	Co, Ru		W
Taxilejeunea cf. *convexa* Steph.	0	0	0	0	0	1	U	Co	Neotropical	W
Telaranea diacantha (Mont.) J.J. Engel & G.L. Merr.	0	0	0	0	4	0	U	Ex, Te	Pantropical	W
Telaranea nematodes (Austin) M. Howe	0	0	0	0	0	1	U	Te	Africa and the Americas	W
Thuidium delicatulum (Hedw.) Schimp.	0	0	0	0	1	1	U	Te	Cosmopolitan	W
Thuidium tomentosum Schimp.	0	0	0	0	0	0	L	Ru	Neotropical	W
Tortella tortuosa (Hedw.) Limpr.	0	0	0	0	0	1	U	Te	Cosmopolitan	TF
Trichocolea brevifissa Steph.	0	0	0	0	2	0	U	Ru	Neotropical	TF
Trichostomum tenuirostre (Hook. & Taylor) Lindb.	0	2	0	0	0	0	L	Te, Ru	Cosmopolitan	W
Wijkia flagellifera (Broth.) H.A. Crum	0	0	1	0	1	0	U, L	Co, Ex, Ru	Brazil and West Indies	W
Wijkia subnitida (Hampe) H.A. Crum	0	0	0	0	0	1	U	Co, Ex, Ru	Neotropical	W
Zelometeorium patulum (Hedw.) Manuel	0	1	0	4	0	0	L	Co	Tropical and Subtropical America	P
Zoopsidella integrifolia (Spruce) R. M. Schust.	0	1	0	0	0	0	L	Ru	Neotropical	W

U – upper montane forest; L – lower montane forest; Co – corticolous; Ex – epixylous; Ep – epiphyllous; Ru – rupicolous; Te – terricolous; CU – cushion; F – fan; M – mat; P – pendant; T – tail; Tl – thallose; TF – turf; W – weft.

the literature as the richest in tropical rain forests (Pócs 1982; Richards 1984; Gradstein *et al.* 2001). As can be seen in Tab. 2 and 3, there was no homogeneity in their representativeness among the areas, which corroborates the findings of previous studies conducted in the Chapada Diamantina region, indicating the variety of vegetation formations, conditioned by their physical and climatic characteristics, which create the great differences in their compositions, even among areas that are in close geographic proximity (Zappi *et al.* 2003; Conceição & Pirani 2007).

The most common species, in descending order, were as follows: *Plagiochila corrugata*, *Porella swartziana*, *Sematophyllum galipense*, *Leucolejeunea unciloba*, *Omphalanthus filiformis*, *Schlotheimia rugifolia*, *Syrrhopodon gaudichaudii*, *Sematophyllum adnatum*, *Campylopus filifolius* var. *humilis*, *Orthostichopsis praetermissa* and *Rosulabryum densifolium.*

In relation to the distribution of bryophyte flora by elevation, the composition differed considerably, species richness and the proportion of exclusive species being 60.0% and 50.5%, respectively, in the upper montane forests (at 1600-1730 m), compared with only 28.3% and 21.2%, respectively, in the lower montane forests (at 900-1000 m). In the similarity analysis, areas F5 and F6, located on Serra do Barbado, in the southern part of the Chapada Diamantina region, presented the highest similarity (47.7%), followed by areas F1 and F2, located within Sete Passagens State Park, also in the southern part of the region, which showed a similarity of 39.8%. Areas F3 and F4 presented the lowest indices of similarity with the other areas and did not form groups. Those two areas also presented the lowest diversity indices and species richness. This low similarity was confirmed in the principal components analysis of the areas. Therefore, there was low similarity between the upper and lower montane forests, which form two large, distinct groups in terms of the composition of the bryophyte flora.

The higher species richness in the upper montane forests (areas F5 and F6) can be explained, mainly, by the humidity provided by the daily mists present at the higher elevations, as opposed to the marked typical seasonality in the region as a whole (Harley 1995; Giulietii *et al.* 1996; Nolasco *et al*. 2008; Agritempo 2010). The lower species richness and lower diversity observed in area F3 and the low similarity between its composition and that of other forest areas, might be related to factors such as reduced humidity (in the Morro do Chapéu region, the mean annual rainfall is 680 mm), together with the seasonality and higher temperatures, which alters the forest structure in that the tree canopy becomes less dense, allowing more light to pass. In addition, area F3 is not an environmentally protected area and is easily accessed, making it subject to the effects of human activities.

Lejeuneaceae was the most representative family in all areas, except in area F4, where there was a predominance of Plagiochilaceae. Among the mosses, Leucobryaceae was the most predominant in the four areas with the highest species richness. Located within Chapada Diamantina National Park, area F4 is especially noteworthy because of its peculiarities, given that it presented low species richness and low diversity, despite the fact that many taxa typical of shaded environments, such as species of the genera *Plagiochila*, *Radula*, *Porella* and *Metzgeria* (Gradstein *et al.* 2001), were identified in the area. The absence of species of the families Calymperaceae, Orthotrichaceae and Frullaniaceae, commonly well represented in tropical forests (Gradstein & Pócs 1989; Pócs 1982) and that include the more generalist taxa in relation to luminosity and tolerance to desiccation, was also observed. In addition, the highest rainfall indices were registered for the region in which this area is located, revealing its potential for a rich bryophyte flora. In a floristic, phytosociological study of the tree species in this area, Sousa (unpublished data) found that this forest is in a secondary succession stage, high numbers of individuals being found to be in the initial classes of diameter and height, suggesting a population composed of young and growing individuals, which could explain these peculiarities.

In the Chapada Diamantina region as a whole, we identified five types of bryophyte communities, in terms of the substrate colonized: corticolous, epixylous, rupicolous, terricolous and epiphyllous, corticolous being predominant. However, the distribution of these communities are not uniform between the areas. Only areas F2 and F5 were found to comprise all five categories; areas F1 and F6 presented all categories except epiphyllous; and we identified only three categories each in area F3 (corticolous, epixylous and terricolous) and area F4 (corticolous, epixylous and rupicolous). The corticolous community was present in all areas, the proportion of corticolous species being highest (over 50%) in areas F2 and F4, although it was over 30% in all of the other areas. Substrate exclusivity was observed in 89 species: 44 corticolous, 16 epixylous, 13 rupicolous, 11 terricolous and 5 epiphyllous. The substrate colonization, especially in the upper montane forests, was similar to that reported for the humid tropical forests in that there was a predominance of corticolous species and the presence of epiphyllous species in zones of higher humidity (Richards 1984, 1988; Gradstein & Pócs 1989). Bryophyte colonization of leaves is characteristic of humid preserved forests (Richards 1984). The typical species of this community are known by their peculiar morphophysiological and reproductive characteristics, their need for high humidity and their vulnerability to any event or factor that is damaging to the structure of the forest (Richards 1984; Pócs 1996; Gradstein 1997). In the upper montane forests, the fact that the available substrates are totally covered by bryophytes, as occurs in most humid montane tropical forests (Richards 1984; Gradstein & Pócs 1989; Frahm & Gradstein 1991; Gradstein 1995), is evident to even the casual observer. However, we noted many instances in which tree trunks were totally covered by a single species, such as *Phyllogonium viride*.

Among the species classified by tolerance to light, there was a predominance of generalist species in all of the areas investigated, followed by those typical of shaded areas and those typical of sunny areas (Tab. 4). In the upper montane forests, 75% of the species are classified as typical of shaded areas, whereas in the lower montane forests, generalist species account for 73%. The high representativeness of the generalist species, in all areas, in relation to that of those typical of shaded areas, was expected, because these forests receive irregular rainfall, with two well-defined seasons (dry and rainy), and the species that have a broader ecological niche have a higher probability of surviving this seasonality (Gradstein *et al.* 2001). This ecological amplitude is related, among other factors, to physiological adaptations to light and to desiccation tolerance. Such adaptations are the most variable characteristics among the different populations and species of bryophytes and are related to the specific morphology and biochemistry of each (Proctor *et al.* 2007). These adaptations allow bryophytes to retain water, to recover from a lack of it and to change strategies according to the season. They also protect the photosynthetic cells from the damage caused by ultraviolet radiation (Glime 2007; Proctor *et al.* 2007).

The life forms were distributed in various ways among the areas and were represented by eight types, among which the weft type predominated, accounting for 47.0%, followed by the types turf (23.0%); mat (18.0%); pendant (4.0%); cushion and thalloid (3.0%); fan (2.0%); and tail (0.4%). These results corroborate the patterns reported for other humid forest formations, with frequent nebulosity and high elevation, where the bryophytes and their respective life forms have shown themselves to be richer and more exuberant, in contrast with what has been observed for open formations in which there is more exposure to

Table 4. Classification, by light tolerance, of the bryophyte species found in forest areas within the Chapada Diamantina region of the state of Bahia, Brazil.

Generalist	Shade epiphyte	Sun epiphyte
Anoplolejeunea conferta	*Acroporium estrellae*	*Frullania brasiliensis*
Aptychopsis pyrrophylla	*Cylindrocolea rhizantha*	*Frullania caulisequa*
Ceratolejeunea laetefusca	*Leucobryum martianum*	*Frullania kunzei*
Cheilolejeunea oncophylla	*Leucoloma cruegerianum*	*Harpalejeunea stricta*
Cheilolejeunea holostipa	*Leucoloma serrulatum*	*Lejeunea laetevirens*
Cheilolejeunea rigidula	*Leucobryum giganteum*	*Leucolejeunea xanthocarpa*
Cololejeunea subcardiocarpa	*Meteorium nigrescens*	*Macromitrium punctatum*
Drepanolejeunea anoplantha	*Phyllogonium viride*	*Schlotheimia rugifolia*
Drepanolejeunea fragilis	*Plagiochila corrugata*	*Syrrhopodon parasiticus*
Holomitrium crispulum	*Plagiochila disticha*	
Isopterygium tenerifolium	*Plagiochila gymnocalycina*	
Isopterygium tenerum	*Plagiochila patula*	
Lejeunea flava	*Plagiochila subplana*	
Lejeunea controversa	*Porella swartziana*	
Lejeunea grossitexta	*Radula cubensis*	
Lophocolea martiana	*Radula fendleri*	
Neckeropsis undulata	*Radula mexicana*	
Octoblepharum albidum	*Radula kegelii*	
Omphalanthus filiformis	*Radula tenera*	
Orthostichopsis praetermissa	*Taxithelium planum*	
Pyrrhobryum spiniforme	*Telaranea diacantha*	
Rosulabryum densifolium		
Sematophyllum adnatum		
Sematophyllum galipense		
Sematophyllum subsimplex		
Sematophyllum subpinnatum		
Sematophyllum swartzii		
Syrrhopodon prolifer var. prolifer		
Squamidium leucotrichum		
Zelometeorium patulum		

light (Richards 1984; Pócs 1996; Gradstein *et al.* 2001; Holz *et al.* 2002).

The proliferation of many species of the pendant type of life form, typical of humid forests (Mägdefrau 1982; La Farge-England 1996), was common in the areas with the highest species richness and diversity (F2, F5 and F6). In areas F2 and F5, the presence of epiphyllous species, which also require preserved and humid environments, allows us to associate the high richness of those areas with these environmental factors.

Considering the worldwide geographic distribution of the bryophytes identified in the forests studied, there was a predominance of taxa whose distribution is neotropical (52%), followed by those whose distribution is cosmopolitan (12%); pantropical (11%); in tropical and subtropical America (6%); in Brazil and Andean countries (4%); in Africa and the Americas (4%); in Brazil alone (endemic, 4%); and disjunct (7%). Similar results have been reported in other bryophyte flora studies carried out in the forests of Brazil (Costa & Lima 2005; Santos & Costa 2010a, 2010b; Valente & Pôrto 2006a; Valente *et al.* 2009). The significant representativeness of the taxa with the Brazil-Andean countries (north and central) distribution, observed by Santos & Costa (2010a) for the bryophyte flora of mountainous regions in the state of Rio de Janeiro, can be explained by the similarity in the physical and climatic conditions present in these mountainous regions that function as a refuge for many species.

The similarity analysis among the montane forest areas studied in Chapada Diamantina and the coastal Atlantic Forest areas in Bahia, in terms of the bryophyte flora, resulted in two major groups. The first comprises the four areas with the highest species richness within Chapada Diamantina, including two subgroups: the upper and lower montane forests. The second comprises the coastal Atlantic Forest areas. These groupings indicate the low floristic similarity between the two regions. The two lower montane Forest areas from Chapada Diamantina that did not form groups in the previous analysis, remained ungrouped in this similarity analysis (Fig. 1). This low similarity can be explained, in part, by the mean annual rainfall, which is noticeably higher, as well as being more regularly distributed throughout the year, in the coastal Atlantic Forest areas, whereas there is a well-defined seasonality in the Chapada Diamantina region. In addition, the elevation and geomorphology affect temperature, humidity and luminosity, as does continentality, likely contributing to increasing the distance, in terms of the richness and composition of the bryophyte flora, between these two forest groups.

In two different studies, each employing a different approach to evaluating tree flora, Funch *et al.* (2008) and Nascimento (2010) investigated floristic relationships between forest areas within the Chapada Diamantina region (lower and upper montane forests) and other types of forests, including the coastal Atlantic Forest. Those authors obtained similar results, in terms to the groups found, the lower and upper montane forests from Chapada Diamantina having been shown to form distinct groups, despite the fact that there is greater floristic affinity among those groups than between the Chapada Diamantina region and the coastal Atlantic Forest areas.

It can be concluded that the distribution of bryophyte communities, according to the analyzed parameters, varies among the forest areas of the Chapada Diamantina region, species richness being considerably higher in the upper montane forests (which account for 60% of the species) than in the lower montane forests, as well as that, as a group, the Chapada Diamantina forest areas differ from the coastal Atlantic Forest areas in composition and richness. In addition to their greater richness and diversity, the upper montane forests of the Chapada Diamantina region are distinct in that their bryophyte communities colonize a greater number of substrates, present a wider variety of life forms and harbor more species typical of shaded areas, as well as featuring a higher number of taxa that are unique and restricted in their distribution.

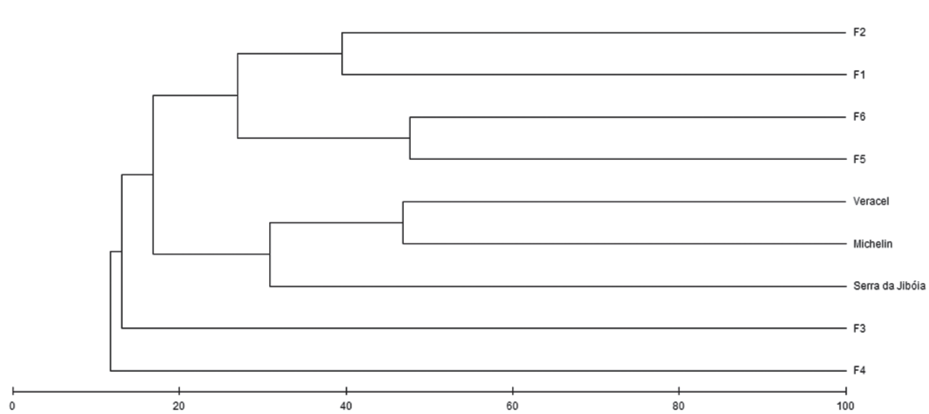

Figure 1. Dendrogram of similarity between the composition of the bryophyte communities of the forest areas studied within the Chapada Diamantina region—F1-F6—and within areas of coastal Atlantic Forest—Veracel (Bastos, unpublished data), Michelin (Bastos & Valente 2008; Bastos & Vilas Bôas-Bastos 2008; Vilas Bôas-Bastos & Bastos 2008), and Serra da Jibóia (Valente & Pôrto 2006a; Valente *et al.* 2009)—state of Bahia, Brazil.

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