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Jean Daniel Morel[1], Rubens Manoel dos Santos[1], Marco Aurélio Leite Fontes[1], Paulo Oswaldo Garcia[2], Fernanda Maria de Souza[1]

FLORISTIC COMPARISON BETWEEN TWO TREE COMMUNITIES ASSOCIATED WITH HABITAT DESCRIPTOR VARIABLES

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Plant ecology
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Floristic composition,
Environmental variables

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ABSTRACT: The knowledge about the influence of habitat variables is essential to understand the underlying ecological patterns in vegetation. This study compared the floristic composition of two forest communities located in different altitudes. Associated with this comparison, we used a methodology where habitat descriptor variables were scaled and interpreted by the biotic set sampled. We constructed one matrix with scores given to physical, biotic, vegetation, and anthropogenic variables in the field and one matrix with the species sampled and performed multivariate analyses. We found that the floristic communities differ between the different altitudes and that the methodology used showed significant variables for the ecological characterization of the sampled habitat.

COMPARAÇÃO FLORÍSTICA ENTRE DUAS COMUNIDADES ARBÓREAS ASSOCIADA A VARIÁVEIS DESCRITORAS DO AMBIENTE

Palavras chave:
Ecologia vegetal
Geoecologia
Composição florística
Variáveis ambientais

RESUMO: O conhecimento sobre a influência das variáveis ambientais é essencial para que se compreenda os padrões ecológicos atuantes sobre a vegetação. Este trabalho comparou a composição florística de duas comunidades florestais localizadas em diferentes altitudes. Associada a essa comparação, foi utilizada uma metodologia onde variáveis descritoras do ambiente foram escalonadas e interpretadas junto ao conjunto biótico amostrado. Através de uma matriz, com a pontuação dada em campo para variáveis físicas, bióticas, da estrutura da vegetação e de antropização, e de outra, contendo as espécies amostradas, análises multivariadas foram utilizadas. Constatou-se que as comunidades diferem floristicamente entre as diferentes altitudes e que a metodologia utilizada indicou variáveis importantes para a caracterização ecológica dos ambientes amostrados.

Correspondência:
morel.jean@gmail.com

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[1] Universidade Federal de Lavras - Lavras, Minas Gerais, Brasil
[2] Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas Gerais - Muzambinho, Minas Gerais, Brasil

INTRODUCTION

The distribution of plant species is determined by physicochemical and biological factors, and by a combination of these factors (CONTI; FURLAN, 2009; COX; MOORE, 2011). At the macroscale, climate is the major determinant of plant distribution, as it provides different conditions of temperature and precipitation (WHITTAKER, 1975; WALTER, 1985). Conversely, variations in topography and soils are the main determinants of vegetation at smaller scales (NEWTON, 2007; FERREIRA JÚNIOR et al., 2009). Moreover, interactions between species can also affect plant distribution, as the establishment and growth of several species can be inhibited or favored depending on the distribution of other plant species (KENT; COKER, 1992; SANTOS et al., 2012). Natural or anthropogenic disturbance events also cause changes in vegetation and may cause changes in the structure and dynamics of plant communities and populations (BEGON et al., 2007; GHAZOUL; SHEIL, 2010).

The influence of environmental variables on plant species may result in different distribution patterns that vary over time and space (MEIRELES et al., 2008; SANTOS et al., 2012). Variation in species distributions requires that the combined effects of vegetation and environmental variables be evaluated together (TER BRAAK, 1987), taking into account that some variables are more responsive than others when a particular group of species is considered. Thus, it is often necessary to combine methods with floristic surveys and forest structure studies to elucidate ecological patterns and processes. Nevertheless, some of the information that characterizes the habitat remains unknown due to measuring difficulties or the high cost of quantification.

This study aimed to evaluate the floristic variation of two plant communities at different altitudes from a qualitative method for habitat characterization that uses a set of scaled variables. We expect that this method may serve as support information for the evaluated communities and provides additional parameters to help explain the ecological patterns of vegetation.

MATERIAL AND METHODS

We listed characteristics of native forest habitats based on a literature review, considering biotic and abiotic factors, arboreal physiognomy, and human disturbances. We selected 20 variables that were treated as habitat descriptor variables (HDV). These variables were grouped into the categories described below. A Abiotic descriptors: A1 Slope, A2 Rocky outcrops, A3 Leaf litter deposition, A4 Humidity, and A5 Wind exposure. B Biotic descriptors: B1 Bamboo density, B2 Bromeliad density, B3 Orchid density, B4 Bryophyte density, B5 Lichen density, and B6 Liana density. C Arboreal/sub-arboreal vegetation descriptors: C1 Density of individuals, C2 Size of individuals, C3 Canopy stratification, C4 Canopy openness, and C5 Understory stratification. D Anthropization descriptors: D1 Abundance of cut stumps, D2 Abundance of trails, D3 Abundance of cattle feces, and D4 Abundance of fire evidence.

With the selected variables we constructed a semiquantitative matrix for survey in the field, as in the methods of phenological assessment (FOURNIER, 1974; WHEELWRIGHT, 1985). We used a interval scale (0 – 4) to infer the influence of variables on sampling units, with 0 indicating the lack of influence, 1 indicating a 1 – 25% influence, 2 to 26 – 50% influence, 3 to 51 – 75% influence, and 4 indicating a 76 – 100% influence.

Two areas were sampled in the same region, in the municipality of Itamonte, on a hillside of the Mantiqueira range, southern Minas Gerais state, Brazil. The floristic composition was sampled at 1500 m and 1900 m above sea-level (a.s.l.), in 30 sample points (15 in each area) delimited by a circle with 10 m radius, totaling 0,942 ha of sampling. At each sample point, all arboreal and sub-arboreal species were sampled, considering all individuals over 1m high. Simultaneously to the vegetation survey, habitat descriptor variables were scaled using the habitat matrix.

Detrended Correspondence Analysis (DCA) (TER BRAAK, 1987) from a binary presence-absence species matrix and a categorical matrix of altitude was used to check the effect of altitude on the distribution of species independent of other habitat variables. Canonical Correspondence Analysis (CCA) (TER BRAAK, 1987) was used to infer the influence of HDVs on the distribution of species. In this case, in addition to the species matrix, we constructed a matrix with HDV data and used the Monte Carlo test to test the significance of correlations. CCA was performed on all habitat variables (CCA1) and on variables with correlation above 0.7 with the vegetation gradient (CCA2), considering the first two axes. The analyses were performed using PC-ORD 5.10 for Windows software (MCCUNE; MEFFORD, 2006).

RESULTS AND DISCUSSION

In total, 133 species were sampled, 98 at 1500 m and 78 at 1900 m. Of the total species sampled, 55 were unique to the lower altitude area and 35 were sampled in the higher altitude area only. These results are in accordance with the notion that species richness decreases with altitude in tropical forests (GENTRY, 1995; RAHBEK, 1995; ADAMS, 2010; SCHEER et al., 2011). The list of species is shown in Table 1. In addition to species surveys, understanding the influence of habitat variables on the organization of biological communities helps corroborate the patterns observed and provides the delimitation of groups and the knowledge of the relationships between these groups and their habitats. The survey of the variables (Table 2) provides a greater basis for

Table 1 List of arboreal and sub-arboreal species in sampling points at two altitudes in the Mantiqueira range, municipality of Itamonte, Minas Gerais state, Brazil (0 = absence of the specie; 1 = presence of the specie).

Tabela 1 Lista de espécies arbóreas e subarbóreas verificadas nos pontos amostrais de duas cotas altitudinais da Serra da Mantiqueira no município de Itamonte, Minas Gerais, Brasil (0 = ausência da espécie; 1 = presença da espécie).

FAMILY / Specie	1500 m															1900 m														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ANNONACEAE																														
Annona cacans Warm.	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Annona sericea Dunal	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cardiopetalum calophyllum Schltdl.	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Guatteria australis A.St.-Hil.	1	0	1	1	1	1	0	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Guatteria sellowiana Schltdl.	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Rollinia sylvatica (A.St.-Hil.) Mart.	1	1	0	1	1	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
APOCYNACEAE																														
Aspidosperma olivaceum Müll.Arg.	1	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AQUIFOLIACEAE																														
Ilex conocarpa Reissek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ilex paraguariensis A.St.-Hil.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	0	0	1	0	0	0	0	0
ARALIACEAE																														
Schefflera calva (Cham.) Frodin & Fiaschi	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ARAUCARIACEAE																														
Araucaria angustifolia (Bertol.) Kuntze	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ASTERACEAE																														
Baccharis serrulata DC.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	1	0	1	0	0
Dasyphyllum tomentosum (Spreng.) Cabrera	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Vernonanthura divaricata (Spreng.) H.Rob.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	1	1	1	0	1	0	1
BIGNONIACEAE																														
Cybistax antisyphilitica (Mart.) Mart.	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Handroanthus catarinensis (A.H.Gentry) S.O.Grose	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
BURSERACEAE																														
Protium spruceanum (Benth.) Engl.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CARDIOPTERIDACEAE																														
Citronella paniculata (Mart.) R.A.Howard	0	1	1	0	1	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1

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FAMILY / Specie	1500 m															1900 m														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CELASTRACEAE																														
Maytenus evonymoides Reissek	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	1	1	0	1	0	0	1	1	1
Maytenus salicifolia Reissek	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
CHLORANTHACEAE																														
Hedyosmum brasiliense Miq.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLETHRACEAE																														
Clethra scabra Pers.	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
CLUSIACEAE																														
Chrysochlamys saldanhae (Engl.) Oliveira-Filho	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CUNONIACEAE																														
Lamanonia ternata Vell.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
CYATHEACEAE																														
Cyathea delgadii Sternb.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
ELAEOCARPACEAE																														
Sloanea monosperma Vell.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EUPHORBIACEAE																														
Alchornea triplinervia (Spreng.) Müll.Arg.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Croton floribundus Spreng.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Croton piptocalyx Müll.Arg.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	0	0	1
FABACEAE																														
Bauhinia longifolia (Bong.) D.Dietr.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coursetia rostrata Benth.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Dalbergia brasiliensis Vogel	0	1	1	1	0	0	1	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inga platyptera Benth.	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucochloron incuriale (Vell.) Barneby & J.W.Grimes	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machaerium nyctitans (Vell.) Benth.	1	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Machaerium villosum Vogel	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ormosia fastigiata Tul.	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Platycyamus regnellii Benth.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna splendida (Vogel) H.S.Irwin & Barneby	0	1	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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...Continuation

FAMILY / Specie	1500 m															1900 m														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LACISTEMATACEAE																														
Lacistema hasslerianum Chodat	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LAURACEAE																														
Cryptocarya aschersoniana Mez	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0	1
Endlicheria paniculata (Spreng.) J.F.Macbr.	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nectandra nitidula Nees	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ocotea diospyrifolia (Meisn.) Mez	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0
Ocotea odorifera (Vell.) Rohwer	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ocotea pulchella Mart.	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Persea major L.E.Kopp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Persea willdenowii Kosterm.	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	1	0
MAGNOLIACEAE																														
Magnolia ovata (A.St.-Hil.) Spreng.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MALPIGHIACEAE																														
Byrsonima laxiflora Griseb.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	1	1	0
MALVACEAE																														
Abutilon sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Luehea divaricata Mart.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudobombax grandiflorum (Cav.) A.Robyns	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudobombax longiflorum (Mart. & Zucc.) A.Robyns	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELASTOMATACEAE																														
Leandra aurea (Cham.) Cogn.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1
Leandra quinquedentata (DC.) Cogn.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	1	1	1	0	1	0	1	1
Miconia castaneiflora Naudin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	1	1	0	0	0	0
Miconia corallina Spring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Miconia latecrenata (DC.) Naudin	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	1	1	0	0	1	1	0	1	1	1	1	1	1
Miconia sellowiana Naudin	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	0	1	0	0	1	0	1	0	0	1	1
Miconia trianae Cogn.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Tibouchina estrellensis (Raddi) Cogn.	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MELIACEAE																														

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FAMILY / Specie	1500 m															1900 m														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cabralea canjerana (Vell.) Mart.	1	1	1	0	1	0	0	1	0	0	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cedrela fissilis Vell.	0	1	0	1	1	1	1	0	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichilia lepidota Mart.	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichilia pallens C.DC.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MONIMIACEAE																														
Macropeplus dentatus (Perkins) I.Santos & Peixoto	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Mollinedia clavigera Tul.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1
MORACEAE																														
Sorocea bonplandii (Baill.) W.C.Burger et al.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MYRSINACEAE																														
Myrsine coriacea (Sw.) Roem. & Schult.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0
Myrsine lineata (Mez) Imkhan.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	1	1	0	1	0	0
Myrsine umbellata Mart.	1	1	1	1	1	1	0	1	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0
MYRTACEAE																														
Calyptranthes brasiliensis Spreng.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0
Calyptranthes widgreniana O.Berg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1
Campomanesia guazumifolia (Cambess.) O.Berg	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eugenia acutata Miq.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eugenia dodonaeifolia Cambess.	1	1	1	0	0	0	0	1	0	0	0	0	0	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0
Marlierea excoriata Mart.	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Marlierea laevigata (DC.) Kiaersk.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Marlierea racemosa (Vell.) Kiaersk.	1	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myrceugenia miersiana (Gardner) D.Legrand & Kausel	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	1	1	1	0	1	0	0	1	1	1
Myrceugenia rufescens (DC.) D.Legrand & Kausel	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	0	0	1	0	1	1	1	1	0
Myrcia hebepetala DC.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Myrcia pulchra (O.Berg) Kiaersk.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Myrcia splendens (Sw.) DC.	0	1	1	0	0	0	0	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1
Myrcia tomentosa (Aubl.) DC.	1	0	1	1	1	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myrcia venulosa DC.	1	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

...be continue

...Continuation

FAMILY / Specie	1500 m															1900 m														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Myrciaria floribunda (H.West ex Willd.) O.Berg	1	1	0	1	0	1	0	1	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Pimenta pseudocaryophyllus (Gomes) Landrum	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	0	0	1	1	0
Psidium cattleianum Sabine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Psidium rufum DC.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Siphoneugena densiflora O.Berg	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Siphoneugena reitzii D.Legrand	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Siphoneugena widgreniana O.Berg	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1
OCHNACEAE																														
Ouratea floribunda Engl.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	1	0	0	1	1	1
OPILIACEAE																														
Agonandra excelsa Griseb.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERACEAE																														
Pera glabrata (Schott) Poepp. ex Baill.	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PIPERACEAE																														
Piper aduncum L.	1	1	1	1	1	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pothomorphe umbellata L. Miq	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PROTEACEAE																														
Euplassa legalis (Vell.) I.M.Johnst.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roupala montana Aubl.	1	1	0	1	1	0	1	1	0	1	1	1	1	1	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Roupala rhombifolia Mart. ex Meisn.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1
ROSACEAE																														
Prunus myrtifolia (L.) Urb.	1	1	1	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0
RUBIACEAE																														
Chomelia sericea Müll.Arg.	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cordiera sessilis (Vell.) Kuntze	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	1	1	1	0
Guettarda uruguensis Cham. & Schltdl.	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychotria deflexa DC.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Psychotria hastisepala Müll.Arg.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0
Psychotria stachyoides Benth.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Psychotria suterella Müll.Arg.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psychotria vellosiana Benth.	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	0	1

...be continue

...Continuation

FAMILY / Specie	1500 m															1900 m														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rudgea jasminoides (Cham.) Müll.Arg.	0	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
SALICACEAE																														
Casearia decandra Jacq.	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Casearia lasiophylla Eichler	1	1	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Casearia obliqua Spreng.	0	1	1	1	1	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Casearia sylvestris Sw.	1	1	1	0	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xylosma prockia (Turcz.) Turcz.	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SAPINDACEAE																														
Cupania vernalis Cambess.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cupania zanthoxyloides Cambess.	1	1	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SIPARUNACEAE																														
Siparuna cujabana (Mart.) A. DC.	0	0	0	1	1	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLANACEAE																														
Brunfelsia uniflora (Pohl) D.Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	1	0	0	0	0	0	0	0
Cestrum schlechtendalii G.Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Solanum asperum Rich.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
Solanum leucodendron Sendtn.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	1	0	1	0	1	0	0	1	0
Solanum pseudoquina A.St.-Hil.	1	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	1	1	0	0
SYMPLOCACEAE																														
Symplocos affinis Hort. ex Pasq.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Symplocos celastrinea Mart. ex Miq.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	1	0	1	1	1
Symplocos insignis Brand	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	1	1	1	1	1
THYMELAEACEAE																														
Daphnopsis brasiliensis Mart. & Zucc.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Daphnopsis coriacea Taub.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	0	1	1	0	1	0	0	1	0	0
VOCHYSIACEAE																														
Vochysia magnifica Warm.	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vochysia tucanorum Mart.	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WINTERACEAE																														
Drimys brasiliensis Miers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0

Table 2 Habitat descriptor variables evaluated in points at two altitudes in the Mantiqueira range, municipality of Itamonte, Minas Gerais state, Brazil (0 = lack of influence; 1 = 1 – 25% influence; 2 = 26 – 50% influence; 3 = 51 – 75% influence; 4 = 76 – 100% influence).

Tabela 2 Variáveis descritoras do ambiente avaliadas nos pontos amostrais de duas cotas altitudinais da Serra da Mantiqueira no município de Itamonte, Minas Gerais, Brasil (0 = ausência de influência; 1 = 1 – 25% de influência; 2 = 26 – 50% de influência; 3 = 51 – 75% de influência; 4 = 76 – 100% de influência).

A Abiotic descriptors																														
A1 Slope																														
Altitude	1500 m															1900 m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	1	1	1	2	2	2	4	3	2	3	1	2	2	1	1	1	1	1	1	1	1	1	2	2	2	2	1	2	2	2
A2 Rocky outcrops																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	1	0	1	0	1	1	1	0	1	2	1	3	3	2	0	0	3	0	0	0	0	0	0	0	0	0	2	1	0	0
A3 Leaf litter deposition																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	3	3	3	3	3	3	3	3	3	3	2	2	2	4	2	2	3	2	3	3	3	3	3	3	3	2	4	3	3	3
A4 Humidity																														
Altitude	1500m																													
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	2	2	2	2	2	2	1	2	1	1	2	2	2	2	4	1	1	1	1	1	1	1	1	1	2	2	3	2	2	2
A5 Wind exposure																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	1	1	1	1	1	1	2	2	1	1	2	2	2	2	2	2	4	2	2	4	4	3	3	4	2	4	4	2	2	3
B Biotic descriptors																														
B1 Bamboo density																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	0	0	0	0	0	3	4	4	4	1	0	0	1	1	0	0	4	3	3	3	4	3	3	4	2	2	3	2	0	0

...be continue

...Continuation

B2 Bromeliad density																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	2	1	1	1	2	1	2	1	1	1	1	1	1
B3 Orchid density																														
A Abiotic descriptors																														
A1 Slope																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	1	1
B4 Bryophyte density																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	1	2	2	2	2	2	1	2	2	1	1	2	2	2	1	4	3	3	3	2	2	3	3	1	3	3	1	3	4	4
B5 Lichen density																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	1	2	1	1	1	1	1	1	1	2	2	2	2	3	2	4	3	4	3	3	3	3	3	3	3	3	3	3	3	4
B6 Liana density																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	3	2	3	3	3	3	3	4	4	4	2	2	2	3	2	2	4	4	4	1	3	1	2	4	1	4	4	1	1	1
C Arboreal/sub-arboreal vegetation descriptors																														
C1 Density of individuals																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	3	3	3	4	3	2	2	2	2	3	3	3	3	3	3	3	1	3	3	1	1	3	3	1	2	1	1	3	3	3
C2 Size of individuals																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	2	3	3	3	3	2	2	2	2	2	3	3	3	3	3	2	2	2	2	3	2	2	2	3	4	2	2	2	2	3

...be continue

...Continuation

C3 Canopy stratification																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	3	3	3	3	2	3	2	2	3	3	3	3	3	4	3	3	2	3	3	2	2	3	3	2	3	2	3	3	3	3
C4 Canopy openness																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	4	2	2	4	4	3	2	4	3	3	4	2	2	2
C5 Understory stratification																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	4	3	3	3	3	2	1	1	1	2	3	3	3	3	3	3	2	4	4	2	2	3	3	2	4	3	3	3	3	4
D Anthropization descriptors																														
D1 Abundance of cut stumps																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D2 Abundance of trails																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D3 Abundance of cattle feces																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D4 Abundance of fire evidence																														
Altitude	1500m															1900m														
Point	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Score	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

inferences and better understanding of the influence of the variables used on vegetation patterns.

Ordination analysis showed that arboreal and sub-arboreal vegetation differed between altitudes (Figure 1). Axis 1, which represents the main floristic gradient, indicates that each altitude has a different group of species. The eigenvalue of this axis (0.558) shows a long gradient, indicating the occurrence of species unique to each altitude (TER BRAAK, 1995). Moreover, there is a greater cohesion in the group of species from 1900 m a.s.l. due to the presence of species typical of higher elevations such as *Byrsonima laxiflora*, *Drimys brasiliensis*, and *Symplocos celastrinea*, in addition to the genus *Ilex* (OLIVEIRA FILHO; FONTES, 2000).

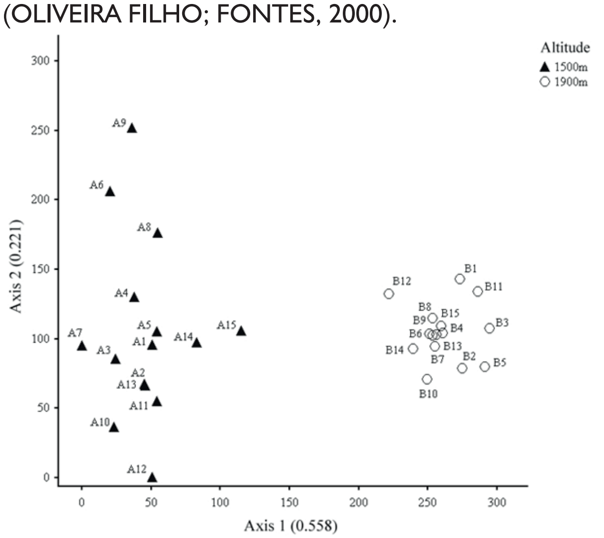

Figure 1 Detrended Correspondence Analysis (DCA) diagram of the distribution of arboreal and sub-arboreal species sampled at two altitudes in the Mantiqueira range, municipality of Itamonte, Minas Gerais state, Brazil. A = points at 1500 m; and B = points at 1900 m.

Figura 1 Diagrama gerado pela Análise de Correspondência Retificada para a distribuição das espécies arbóreas e subarbóreas amostradas em duas cotas altitudinais da Serra da Mantiqueira no município de Itamonte, Minas Gerais, Brasil.

The difference in species composition between the two areas sampled was due to the differential distribution of species along the altitudinal gradient. Nevertheless, altitudinal variations comprise a complex set of variables related to temperature, air humidity, water availability, wind exposure, in addition to soil depth and drainage classes (CARVALHO et al., 2005; HOMEIER et al., 2010; BLUNDO et al., 2012).

Canonical Correspondence Analyses showed significant correlations between habitat variables and community organization (Table 3). All habitat descriptor variables (HDV), except for the four anthropogenic variables (scored value 0), were used in CCA1, totaling 16 quantitative variables and one categorical variable (altitude). This analysis showed that the distribution of species correlated significantly with HDVs ($p < 0.01$).

Table 3 Summary of Canonical Correspondence Analysis (CCA) results of arboreal and sub-arboreal species sampled at two altitudes in the Mantiqueira range, municipality of Itamonte, Minas Gerais state, Brazil.

Tabela 3 Resumo dos resultados da Análise de Correspondência Canônica para as espécies arbóreas e subarbóreas amostradas em duas cotas altitudinais da Serra da Mantiqueira no município de Itamonte, Minas Gerais, Brasil.

	p	Axis 1	Axis 2	Axis 3
CCA1				
Monte Carlo test	0.001			
Eigenvalue		0.548	0.258	0.221
Species–environment correlation		0.996	0.976	0.978
Cumulative percentage variance of species presence data		13.40	19.70	25.10
Cumulative percentage variance of species–environment		18.80	27.20	34.90
CCA2				
Monte Carlo test	0.001			
Eigenvalue		0.523	0.234	0.171
Species–environment correlation		0.978	0.958	0.969
Cumulative percentage variance of species presence data		12.80	18.50	22.70
Cumulative percentage variance of species–environment		42.80	61.10	75.60

CCA2 was calculated using the five variables that correlated with the vegetation gradient ($r > 0.7$, considering the first two axes): humidity, wind exposure, bromeliad density, orchid density, and lichen density (Table 4). According to CCA2, axis 2 showed the correlation between humidity with the distribution of species sampled at 1500 m (Figure 2).

It should be noted that humidity, which is important for temperature regulation and nutrient transport in soil (CONTI; FURLAN, 2009), favors the establishment of species adapted to the microclimate provided by it. This effect was observed in the area at 1500 m, which was close to a water course. In fact, this variable probably favored the establishment of species such as *Casearia obliqua*, *Endlicheria paniculata*, *Luehea divaricata, Magnolia ovata, Platycyamus regnellii, Protium spruceanum,* and *Vochysia magnifica*, whose occurrences were previously associated with humid habitats (OLIVEIRA FILHO; FLUMINHAN FILHO, 1999; BOTREL et al., 2002; SOUZA et al., 2003; CARVALHO et al., 2005; ROCHA et al., 2005).

The variable wind exposure, most associated with the axis 1, is correlated to the distribution of species at 1900 m. This variable is associated with high altitudes and acts on the composition, structure and distribution of tree species in communities located in elevated areas (NEWTON, 2007; HOMEIER et al., 2010; BERTONCELLO et al., 2011). In study along a 2.5 km transect ranging in tropical montane cloud forests in north-western Costa Rica, Häger (2010) considered the wind exposure as a key variable to tree species turnover along environmental gradients on a local scale, therefore the constancy of the wind acts upon the air temperature and the cloudiness. Considering the ecology of cloud forests, the author also points out that these variables determine the occurrence of species, including endemic species, in habitat with strict conditions. (HÄGER, 2010).

Between the two communities evaluated the wind exposure should be acting in this way, contributing to the differentiation of the area located 1900 m a.s.l. In addition to the relationship with altitude wind exposure may also be associated with the occurrence of bamboos and canopy openness. Despite not entering in the inclusion criteria of CCA2, these two variables showed significant correlations with axis 1 to the area located at 1900 m.

Another variables more strongly associated with species distributions at 1900 m with greater amplitude along axis 2 were orchid, bromeliad and lichen density, all of which typical of montane forests (ADAMS, 2010; GHAZOUL; SHEIL, 2010; SCHEER et al., 2011). The presence of these botanicals groups in montane forests is related to the constant water supply provided by the cloudness, which makes its typical species of this habitat type (ADAMS, 2010; ACHARYA, 2011; BLUM et al., 2011; KRÖMER et al., 2013; DYMYTROVA et al., 2014). Thus, some tree species characteristics of high altitude as *Ilex paraguariensis, Croton piptocalyx, Leandra aurea, Ouratea floribunda, Roupala rhombifolia* e *Symplocos insignis*, exclusive from community located at 1900 m and sampled in majority points, may have their local occurrence related to microclimate conditions.

The use of HDVs explained a large part of the variance of the data. The cumulative variance of the first three axes in CCA2 was 22.7% for species data and 75.6% for the relationship between species and habitat variables (Table 3). Prado et al. (2002) argued that, in many cases, the first two or three axes explain a large

Table 4 Correlations between habitat variables and the first three axis in the Canonical Correspondence Analyses (CCA1) for communities located at two altitudes in the Mantiqueira range, municipality of Itamonte, Minas Gerais state, Brazil.

Tabela 4 Correlações entre variáveis ambientais e os três primeiros eixos da Análise de Correspondência Canônica (CCA1) para comunidades localizadas em duas altitudes na Serra da Mantiqueira, no município de Itamonte, Minas Gerais, Brasil.

Variable		Correlations		
		Axis 1	Axis 2	Axis 3
A1	Slope	0.256	-0.288	-0.056
A2	Rocky outcrops	0.390	-0.105	0.296
A3	Leaf litter deposition	0.040	-0.196	-0.295
A4	Humidity	0.301	0.783	0.155
A5	Wind exposure	-0.725	0.223	-0.014
B1	Bamboo density	-0.387	-0.090	-0.565
B2	Bromeliad density	-0.855	-0.092	0.015
B3	Orchid density	-0.857	-0.238	0.067
B4	Bryophyte density	-0.678	-0.385	-0.054
B5	Lichen density	-0.886	-0.058	0.219
B6	Liana density	0.249	-0.016	-0.467
C1	Density of individuals	0.358	-0.086	0.404
C2	Size of individuals	0.222	0.161	0.446
C3	Canopy stratification	0.164	-0.050	0.245
C4	Canopy openness	-0.612	0.103	-0.151
C5	Understory stratification	-0.299	0.026	0.483

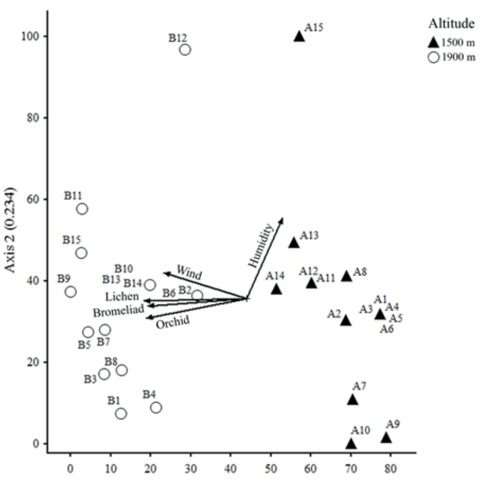

Figure 2 Canonical Correspondence Analysis (CCA) diagram of the distribution of arboreal and sub-arboreal species sampled at two altitudes in the Mantiqueira range, municipality of Itamonte, Minas Gerais state, Brazil. A = points at 1500 m; and B = points at 1900 m.

Figura 2 Diagrama gerado pela Análise de Correspondência Canônica para a distribuição das espécies arbóreas e subarbóreas amostradas em duas cotas altitudinais da Serra da Mantiqueira no município de Itamonte, Minas Gerais, Brasil.

part of the variance (60–90%), which enables to use the results to describe the system without significant loss of information. Thus, even when the first two axes only are considered, the percentage values obtained in this study are high.

We consider that the use of HDVs provided parameters that allowed us to interpret and discuss the floristic composition of the sampled communities more widely, since in addition to the altitude, other habitat features were added. With the largest number of variables were obtained parameters allowed to extend the discussion. In addition to corroborate the influence of altitude the variables used showed characteristics of communities that extended their ecological interpretation.

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