Universidade Federal Rural do Semiárido
Pró-Reitoria de Pesquisa e Pós-Graduação
http://periodicos.ufersa.edu.br/index.php/sistema

ISSN 0100-316X (impresso)
ISSN 1983-2125 (online)

# CHARACTERIZATION OF THE TREE COMPONENT IN A SEMIDECIDUOUS FOREST IN THE ESPINHAÇO RANGE: A SUBSIDY TO CONSERVATION[1]

LEONARDO DE MELO VERSIEUX[2*], MARIA CLÁUDIA MELO PACHECO DE MEDEIROS[3], TEREZA CRISTINA SOUZA SPÓSITO[4], JOÃO RENATO STEHMANN[4]

**ABSTRACT -** This study was conducted in the Private Reserve Mata do Jambreiro (912 ha), localized in the Iron Quadrangle, Minas Gerais, southeastern portion of the Espinhaço Range, which is predominantly covered by semideciduous seasonal montane forest. Three topographically and physiognomic similar areas located within a continuum forest fragment, distant by 1.3 to 1.5 km were sampled by the point-quadrat method. In each area, 30 points were marked. Individuals with a minimum perimeter at the breast height (PBH) of 15 cm were sampled, totaling 111 species belonging to 40 families. The most representative family was Fabaceae, with 14.29% of the total number of species. Low floristic similarity (5.3% to 34.4%) was observed between the areas, pointing out the importance of distribution of sample units in continuous fragments. Shannon diversity index (H') found was 4.22 and Pielou equability (J) 0.894. Soil analysis showed some differences in chemical composition between the three studied areas and was an important component for the interpretation of the floristic variation found. The low floristic similarity observed here for close areas justify the requirement of more detailed inventories by Brazilian Environmental Agencies for the legal authorization procedures prior to the establishment of new enterprising projects. Also, the professionals that conduct rapid inventories, mainly the Environmental Consultants, should give more attention to this kind of floristic variation and to the methods used to inventory complex forests.

**Keywords**: Floristic similarity. Iron Quadrangle. Mata do Jambreiro. Minas Gerais. Phytosociology.

## CARACTERIZAÇÃO DO COMPONENTE ARBÓREO NUMA FLORESTA SEMIDECÍDUA NA SERRA DO ESPINHAÇO: UM SUBSÍDIO À CONSERVAÇÃO

**RESUMO -** Este estudo foi realizado na RPPN Mata do Jambreiro (912 ha), situada no Quadrilátero Ferrífero, Minas Gerais, porção sudeste da Serra do Espinhaço, que é coberta predominantemente por floresta estacional semidecidual montana. Três áreas de estudo, com fisionomia e topografia similares, localizadas num fragmento florestal contínuo e separadas por distâncias entre 1,3 e 1,5 km foram amostradas pelo método de pontos-quadrantes. Em cada área, 30 pontos foram marcados. Os indivíduos com perímetro à altura do peito (PAP) mínimo de 15 cm foram amostrados, totalizando 111 espécies pertencentes a 40 famílias. A família mais representativa foi Fabaceae, com 14,29% do total de espécies. Uma baixa similaridade florística (5,3% a 34,4%) foi observada entre as áreas, realçando a importância da distribuição das unidades amostrais dentro de fragmentos florestais contínuos. O índice de diversidade de Shannon (H') encontrado foi 4,22 e a equabilidade de Pielou (J) 0,894. A análise do solo apresentou algumas diferenças de composição química entre as três áreas estudadas, mostrando-se importante na interpretação das diferenças florísticas encontradas. A baixa similaridade florística observada justifica a exigência de realização de inventários mais detalhados, por parte dos órgãos ambientais brasileiros, para procedimentos de autorização legal, antes do estabelecimento de novos projetos empreendedores. Adicionalmente, os profissionais que conduzem inventários rápidos, principalmente consultores ambientais, deveriam dar mais atenção a esses padrões de variação florística e aos métodos empregados para se inventariar florestas complexas.

**Palavras-chave**: Fitossociologia. Mata do Jambreiro. Minas Gerais. Quadrilátero Ferrífero. Similaridade florística.

---

[*]Autor para correspondência.
[1]Recebido para publicação em 15/07/2010; aceito em 16/10/2010.
Trabalho de monografia de conclusão do curso de graduação em biologia do primeiro autor.
[2]Departamento de Botânica, Ecologia e Zoologia, Centro de Biociências, Universidade Federal do Rio Grande do Norte, 59072-970, Natal - RN; lversieux@yahoo.com.br
[3]Programa de Pós-Graduação em Ciências (Botânica), Departamento de Botânica, Instituto de Biociências, Universidade de São Paulo, Rua do Matão, trav. 14, nº 321, 05508-090, São Paulo - SP; mclaudia82@yahoo.com.br
[4]Departamento de Botânica, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Caixa Postal 486, 31270-901, Belo Horizonte - MG; terezasposito@uol.com.br; stehmann@icb.ufmg.br

# INTRODUCTION

Since the beginning of the occupation of Minas Gerais state (MG), there has been an increasing pressure for natural resource use, which has strongly influenced the size and distribution of forests close to populated areas. In recent decades, deforestation due to the production of charcoal used in the steel industry, and the consequences of continual urban growth, agriculture, mining and grazing areas have contributed to the alarming rate of fragmentation of the Atlantic forest biome (DRUMMOND et al., 2005, VIANA; LOMBARDI, 2007). The extent of the fragmentation is clarified by the examination of the dominant biome in eastern and southern portions of MG (Atlantic forest), which have been reduced to 4% of its original coverage area (DRUMMOND et al., 2005).

The Espinhaço Mountain Range is considered to be one of the floristically richest regions of South America (GIULIETTI et al., 1997) and represents an important ecotonal zone, dividing part of the Atlantic forest domain to the eastern portion and the savanna domain to the western. Nevertheless the southern portion of this mountain range has been the focus of few recent studies regarding its forests (MEYER et al., 2004, SPÓSITO; STEHMANN, 2006) or its floristic and taxonomic aspects (FIGUEIREDO; SALINO, 2005, VIANA; LOMBARDI, 2007), despite the accelerate processes of urban growth, mining activities and deforestation. This region, known as Iron Quadrangle (*Quadrilátero Ferrífero*), hosts a large deposit of iron ore and have a very particular, diverse and endangered vegetation that can be found on iron rock outcrops and associated valleys (JACOBI et al., 2007; VERSIEUX; WENDT, 2007).

A considerable number of studies have been carried out on the floristic and structure of semideciduous forests in Minas Gerais' territory (ESPÍRITO-SANTO et al., 2002, CARVALHO et al., 2005, as examples). Some of them pointed out that considering soil and topographic properties are very important in the interpretation of observations about the floristic variation between areas closely sited inside forest fragments (LOURES et al., 2007, RODRIGUES et al., 2007). Since spatial heterogeneity in the physical environment is a huge stratification source (RESENDE et al., 2002), studies which deal with the description of the vegetation component in different forest fragments should consider soil properties whenever data are available, specially in smaller spatial scales (KOTCHETKOFF-HENRIQUES et al., 2005).

The objective of this work was to describe the floristic composition and structure of the tree component in an area of semideciduous seasonal mountain forest within the Natural Heritage Private Reserve (RPPN) Mata do Jambreiro. The vegetation of this reserve has been previously investigated but only for the herbaceous stratum (ANDRADE, 1992) or during a quick inventory of fragments located around Belo Horizonte that sampled only 120 trees within the Mata do Jambreiro (SPÓSITO; STEHMANN, 2006). It is important to highlight that this forest fragment is located in an urban area, being surrounded by mines and condominiums and that several research projects are carried out inside its limits, reinforcing the necessity to characterize and increase the amount of data about its vegetation. Additionally, we aim to list species threaten by extinction given the importance of gathering new data on the local biodiversity and the scarcity of descriptive works within this area. We expect that this updated list will be a valuable tool for environment consultants, as well as to provide data source for those interested in landscape restoration or in the cultivation of native tree species, within this severely threatened area, namely the *Quadrilátero Ferrífero*.

# MATERIALS AND METHODS

The RPPN Mata do Jambreiro (19°58'59"S and 43°55'52"W) is located in the southern slope of Serra do Curral, in Nova Lima County, Minas Gerais state central-south region. It covers an area of 912 ha inside the metropolitan region of Belo Horizonte. This reserve is only 12 km far from downtown and is sited next to the Águas Claras mine that belongs to the Vale company (Figure 1).

Geologically, the region of Nova Lima County is located within the Iron Quadrangle area and consists of layers dating from the pre-cambrian of Velhas River Group and Minas Supergroup (CETEC, 1983). The first layer is predominantly made up of schist and phyllites and the second one with quartzites and itabirites. The relief is rugged and consists of crests intermingled with embedded valleys (IGA, 1980). The altimetry varies from 800 to 1100 meters above the sea level (m.a.s.l.), within the RPPN. Nova Lima is within the São Francisco River Basin, being drained from north to south by the Velhas River and its tributaries. The climate is classified as Cwa of Köeppen, with mild summers and dry winters. The rains primarily occur in the warmer semester (October to March), with the total annual rainfall ranging from 1.4 to 1.6 m. The median annual temperature is approximately 18 °C, with generally a maximum of 21 °C and a minimum of 14 ºC. The soil is classified as dystrophic Cambisol (CETEC, 1983).

The vegetation that covers most of the reserve is the semideciduous seasonal montane forest, according to the Veloso et al. (1991) classification. However the area of the forest fragment is smaller than the reserve itself because there are other vegetation types surrounding the forested area. Other less frequent physiognomies that can be seen along the periphery of the core-forested area include open

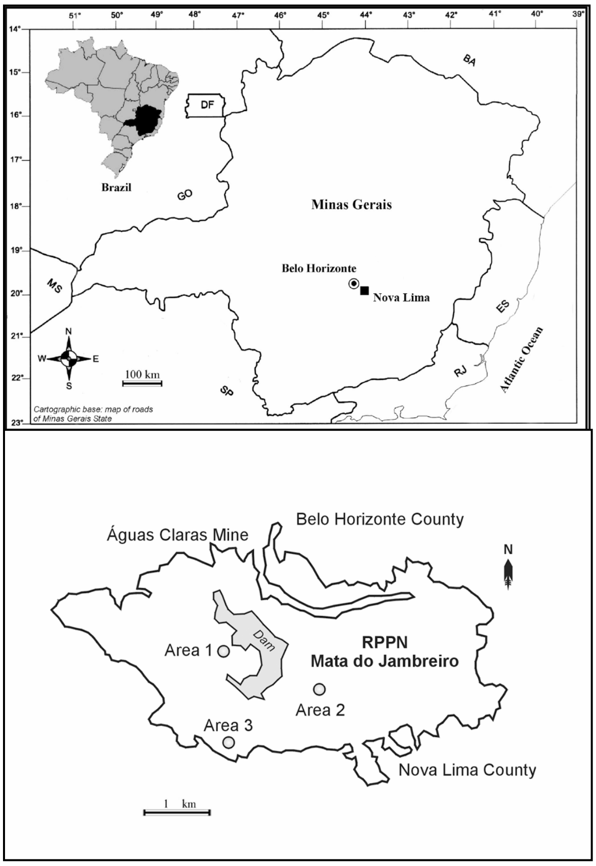


**Figure 1.** Map of Minas Gerais, showing Belo Horizonte (the capital of the State) next to Nova Lima County. The three study areas are shown within the Mata do Jambreiro reserve.

fields, and savanna. Nevertheless, the semidecidous forest fragment forms a continuum and there is connectivity among all the three sampling areas. It is a fragment of secondary forest, showing an irregular outline, which is approximately 60 years old. It shows signs of occupation in the past, such as small abandoned areas of coffee (*Coffea arabica* L.) and jambo (*Syzygium jambos* L. Alston) cultivation. In the areas of greater inclination exposed to higher sun light bamboo species tend to dominate.

To characterize the soil in each of the areas, three simple samples of topsoil (~20 cm deep) from each individual transect area were collected and mixed. Analyses of samples were conducted at the Instituto Mineiro de Agropecuária laboratory. The comparison of edaphic characteristics of the three areas was done via principal components analysis (PCA) of the major components, with the aid of PCOrd 4.0.

Three different areas were chosen for sampling: area 1 (19°58'35"S and 43°53'50"W) which is near to the rejects dam, about 920 m.a.s.l.; area 2 (19°58'43.7"S and 43°53'02.7"W) which is the most isolated, located about 1 km away from the Center of Environmental Education, about 835 m.a.s.l. and area 3 (19°59'21.6"S and 43°53'36.5"W) which is next to the border between RPPN and Ouro Velho Mansões residential condominium, about 870 m.a.s.l. The three areas presented similar topographic conditions and had transects opened along the slopes of hills. The distances in a straight line found between areas 1 and 2, 1 and 3 and 2 and 3 were 1.34, 1.48 and 1.45 km respectively.

Three parallel transects of 150 m long and separated from 20 m were opened in each sampling area. The method of sampling used was the point-quadrat (COTTAM; CURTIS, 1956, revised in MARTINS, 1991). In each transect 10 points were marked, with distances of 15 m. The criterion adopted for inclusion of individuals in the sample was the perimeter of the trunk at the breast height (1.30 m above the ground) ≥ 15 cm. A cross of wood was aligned with the transect and in each quadrant of the cross the distance from the closest tree to the center of the cross was measured. Dead individuals that were still standing were also sampled. Trees measurements were taken for the perimeter at the breast height (PBH). Tree stem and maximum crown heights were estimated using a reference. Samples were collected in fertile or vegetative state and identified with the aid of the taxonomic literature, consultation with specialists, and by comparison with specimens already collected in the region of Iron Quadrangle, which were deposited in the BHCB Herbarium, in Federal University of Minas Gerais. The fertile material was included in the collection of BHCB. The floristic list was produced according to the classification proposed by APG III (2009). The floristic similarities between the sampled areas were calculated with the Jaccard coefficient. The following phytosociological parameters were estimated using the program Fitopac 1 (SHEPHERD, 1995): frequencies, densities and dominances, and value of importance. The diversity indices of Shannon (H') and the equability of Pielou (J) (PIELOU, 1975) were also calculated.

## RESULTS AND DISCUSSION

**Soil analysis** - Comparing the characteristics evaluated in the soil chemical analysis from the three areas (Table 1), it was noticed that the soil from area 1 presented the highest levels of calcium ($Ca^{2+}$) and magnesium ($Mg^{2+}$), leading to the highest sum of bases (BS) and index of base saturation (V). It also showed the highest levels of phosphorus (P), potassium (K), carbon (C), nitrogen (N) and organic matter (OM). This soil can be characterized, regarding its texture, as clay loam, according to the triangle for classification of soil's textural classes adopted by the Brazilian Society of Soil Science. The soil of area 2 presented the highest total acidity ($H^{+}$ + $Al^{3+}$) and exchangeable acidity (exchangeable aluminum, $Al^{3+}$) and therefore the highest values for the capacity of cations exchange (T). Regarding texture, this soil is also classified as clay loam. The soil from area 3, in turn, showed the highest values for pH and the saturation of aluminum (m). It is noteworthy that all areas showed soil samples with high values for m, which gives them alic character. Area 3 also consists of clay loam soil.

The PCA principal components were used to illustrate the cited differences (Figure 2). The first two axes explained the total variance of data. The first axis explained 64.93% of the variance and highlighted the differences in the values of saturation of bases and phosphorus content, which separated the soil of area 1 from the others. The second axis, in turn, explained 35.07% of data variance, and highlight the changes of the values for certain characteristics, such as exchangeable aluminum content, capacity of cations exchange and total acidity, which distinguishes area 2 from the others.

**Table 1.** Results of the soil chemical analysis from the studied areas in RPPN Mata do Jambreiro, Nova Lima, Brazil.

| Characteristics | Area 1 | Area 2 | Area 3 |
|---|---|---|---|
| pH ($H_2O$) | 4.2 | 4 | 4.3 |
| H + Al ($cmol_c/dm^3$) | 12.01 | 16.57 | 11.74 |
| $Al^{+++}$ ($cmol_c/dm^3$) | 3.55 | 3.84 | 3.29 |
| $Ca^{++}$ ($cmol_c/dm^3$) | 0.18 | 0.15 | 0.1 |
| $Mg^{++}$ ($cmol_c/dm^3$) | 0.08 | 0.07 | 0.06 |
| P ($mg/dm^3$) | 3.2 | 1.3 | 1.6 |
| K ($mg/dm^3$) | 36 | 30 | 25 |
| BS ($cmol_c/dm^3$) | 0.36 | 0.3 | 0.22 |
| T ($cmol_c/dm^3$) | 12.36 | 16.87 | 11.97 |
| t ($cmol_c/dm^3$) | 3.91 | 4.14 | 3.51 |
| m (%) | 90.85 | 92.7 | 93.67 |
| V (%) | 2.9 | 1.79 | 1.86 |
| OM (dag/Kg) | 6.3 | 5.63 | 5.16 |
| C (dag/Kg) | 3.65 | 3.27 | 2.99 |
| N (dag/Kg) | 0.28 | 0.25 | 0.23 |
| Thick sand (%) | 4.7 | 5.3 | 12.4 |
| Fine sand (%) | 26.08 | 32.82 | 30.1 |
| Silt (%) | 34.08 | 33.1 | 25.44 |
| Clay (%) | 35.14 | 28.78 | 32.06 |

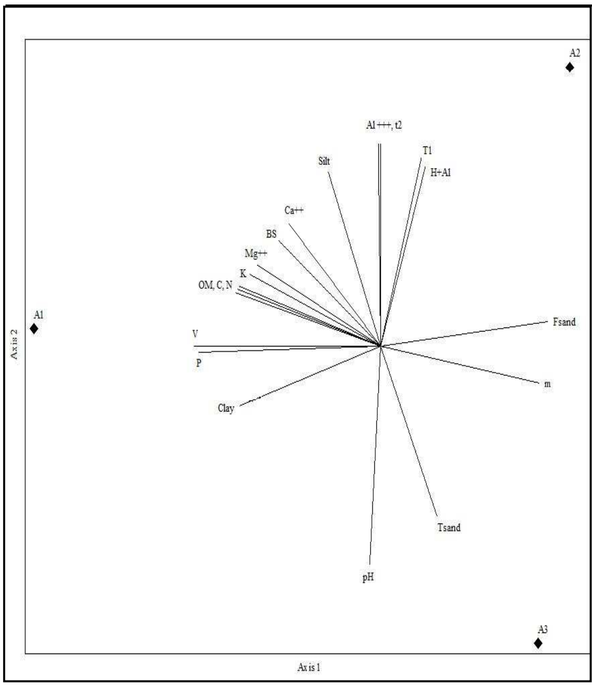


**Figure 2.** Analysis of major components of soil characteristics of the three studied areas in RPPN Mata do Jambreiro, Nova Lima, Minas Gerais, Brazil.

**Preliminary floristic composition -** A total 40 families and 111 species were found. From the latter, 18 were only identified down to the genus level and 11 at the familial level. The families with the highest genus richness were Fabaceae with nine genera, Myrtaceae with six, Rubiaceae with five and Annonaceae, Euphorbiaceae and Rutaceae were represented by three each. Regarding species richness per family, Fabaceae was the richest with 16 species (14.29% of all species sampled), Myrtaceae with 14 (12.5%), Lauraceae and Rubiaceae with ten (8.93%), and Apocynaceae, Euphorbiaceae, Annonaceae, Salicaceae and Melastomataceae with four species (3.57%) each. Of the remaining 31 families, 23 (74.2%) are represented by only one species. Fabaceae, Myrtaceae, Lauraceae and Rubiaceae were also reported in previous studies carried out in other areas within the Iron Quadrangle and also in studies that recorded common tree families in the semideciduous forests in southeastern Brazil (OLIVEIRA-FILHO; FONTES, 2000, SPÓSITO; STEHMANN, 2006).

Of the total number of species, only eight occurred in all three of the sampled areas, 29 were present in two areas and 74 were exclusive to only one area. Area 1 had the largest number of unique species (34), followed by area 2 (21) and area 3 (19). The total number of species found in each area, however, did not vary so much: area 1 showed 50 species, area 2 had 55, and area 3 showed 51. As was expected, in view of the large number of unique species in each sampled area, the values found for the Jaccard coefficient show that the similarity among the studied areas was low: 5.3% (areas 1 and 3), 8.3% (Areas 1 and 2) and 34.4% (areas 2 and 3).

The low values found for Jaccard coefficient indicate that despite the proximity between the areas (less than 1.5 km) and their connectivity there are important differences in their floristic composition. Several factors could have contributed to this low amount of similarity such as patterns of species distribution and different histories of anthropogenic disturbance for each area. It is known that many species have populations that are naturally broadly dispersed, in which individuals are located far from each other. In other cases, populations can be aggregated, and sampling may indicate that these species as rare but in actuality, this can be a limitation of the method. Furthermore, the secondary forests, in the process of succession, are complex and may be atypical, varying from one place to another according to the differences of substrate, preliminary stages of succession, type and frequency of disturbance and also by the distance from seed source. Low similarities among areas close to each other were found in other studies (e.g. GIRALDO-CAÑAS, 2000, SPÓSITO; STEHMANN, 2006). Areas exposed to comparable anthropogenic disturbance may present more similarity floristic composition, as highlighted by Araujo et al. (2010) for the Caatinga vegetation. In the present study there is no data to confirm whether or not there was a different historic of impacts among the three areas, which all look alike at a first glance. Nevertheless, it is important to mention that area 2 is more restrict accessed than the others. The floristic variations observed may also result from the influence of water and drought sensitivity (ENGELBRECHT et al., 2007) and nutrients availability in soil of the three different areas, as was already shown by Botrel et al. (2002) for a forest similar to the one studied here. Soil analyses show that there are significant differences in the chemical composition in all areas, which may influence the floristic composition, as well. Generally, the soil characteristics varied over short distances, which can lead to intricate patterns of resource availability that may influence vegetation growth and biodiversity (RESENDE et al., 2002). An increase in species number will be expected after the addition of randomized collections along the entire area of the RPPN. Some examples of tree species that have been observed within the reserve but were not sampled in the transects are *Anadenanthera colubrina* (Vell.) Brenan, *Cariniana legalis* Kuntze, and *Cecropia glaziovi* Snethlage.

The 90 points sampled are equivalent to 0.289 ha. Thus, the 360 sampled individuals resulted in an approximated value of total density of 1274 individuals per hectare. Nineteen of the 360 individuals (5.3%) were dead trees, which appears to be common in Brazilian forests (CAVASSAN et al., 1984), although the densities found for this group of individuals did not usually exceed 10%. The total basal area was 6.715 $m^2$, which corresponds to 23.272 $m^2$ per hectare.

The ten families with the highest importance value (VI) totalized 72.76%. Rubiaceae contributed with 13.36%, Myrtaceae with 11.95% and Fabaceae with 11.93%. The high VI of Rubiaceae is due to the large number of sampled individuals, while the other cited families presented high values due to their basal area, as shown by their dominance values.

Table 2 shows the values of phytosociological parameters for the sampled species at RPPN Mata Jambreiro. It is notable that among the ten species that presented the highest VIs, *Amaioua guianensis* and *Aparisthmium cordatum* are highlighted by their relatively high density parameter. These two species were responsible for 14.7% of the total number of sampled individuals. *Amaioua guianensis* has a large distribution area throughout Brazil, occurring discontinuously from the northern to the southern region. It is indifferent to soil moisture conditions and can be found in rain forests and in areas of savanna at high altitudes, often on sloping land composed of sandy soils (LORENZI, 2002b). It is also a shade tolerant species and is commonly observed in the intermediary forest stratum, but can also be found in the canopy level, thus being considered a "supertramp" species (OLIVEIRA-FILHO et al., 1996). These species also had one of the largest VI in the Special Protection Area (APE) Barreiro (RIBEIRO, 1998), a seasonal forest that is also part of the Iron Quadrangle. By relative dominance *Myrcia detergens*, *Aspidosperma discolor*, *Ocotea divaricata, Sparattosperma leucanthum*, *Aspidosperma parvifolium*, *Xylopia sericea* and *Vismia brasiliensis* stand out. All these species presented robust individuals that contribute to their higher values of basal area. Finally, *Marlierea parviflora* is highlighted by its relatively high frequency. *Aspidosperma discolor* and *Copaifera langsdorfii* also have a broad distribution over several Brazilian states. The first one mainly occurs from the Amazon region to Bahia, Goiás, and Minas Gerais, and it is indifferent to soil physical conditions. *Copaifera langsdorfii* is more selective and occurs in the states of Minas Gerais, Goiás, Mato Grosso do Sul, São Paulo, and Paraná, mainly along transitional areas between savanna and semideciduous forests (LORENZI, 2002a). These species occurred in all the sample areas.

**Table 2.** Species sampled in the three studied areas in RPPN Mata do Jambreiro, Nova Lima, Minas Gerais and their phytosociological parameters, listed in descending order of value of importance (VI). NI = number of individuals; BA ($m^2$) = basal area in square meters; RDe (%) = relative density; RDo (%) = relative dominance; RF (%) = relative frequency; A1 = Area 1; A2 = Area 2; A3 = Area 3; BHCB = number of voucher material in Herbarium BHCB.

| Species | NI | BA | RDe | RDo | RF | VI | A1 | A2 | A3 | BHCH |
|---|---|---|---|---|---|---|---|---|---|---|
| *Amaioua guianensis* Aubl. | 32 | 0.3421 | 8.89 | 5.10 | 8.67 | 22.65 | x | x | x | 73132 |
| Dead tree | 19 | 0.3357 | 5.28 | 5.00 | 5.57 | 15.85 | | | | - |
| *Myrcia detergens* Miq. | 13 | 0.5834 | 3.61 | 8.69 | 3.10 | 15.40 | x | x | x | - |
| *Aparisthmium cordatum* Baill. | 21 | 0.2346 | 5.83 | 3.49 | 4.33 | 13.66 | | x | x | 40298 |
| *Aspidosperma discolor* A.DC. | 10 | 0.3622 | 2.78 | 5.39 | 2.79 | 10.96 | x | x | x | 82536 |
| *Ocotea divaricata* Mez | 9 | 0.2370 | 2.50 | 3.53 | 2.17 | 8.20 | | | x | 85905 |
| *Marlierea parviflora* Berg | 10 | 0.1417 | 2.78 | 2.11 | 3.10 | 7.98 | x | x | x | 74349 |
| *Sparattosperma leucantum* Schum. | 4 | 0.3838 | 1.11 | 5.72 | 0.93 | 7.76 | | x | | 85890 |
| *Aspidosperma parvifolium* A. DC. | 5 | 0.3156 | 1.39 | 4.70 | 1.24 | 7.33 | x | x | | 7822 |
| *Xylopia sericea* St. Hil. | 7 | 0.2064 | 1.94 | 3.07 | 2.17 | 7.19 | x | x | | 67412 |
| *Vismia brasiliensis* Choisy | 8 | 0.1589 | 2.22 | 2.37 | 1.86 | 6.45 | x | | | 79709 |
| *Inga cylindrica* Mart. | 5 | 0.2230 | 1.39 | 3.32 | 1.55 | 6.26 | | x | x | 82430 |
| *Casearia arborea* Urb. | 8 | 0.0985 | 2.22 | 1.47 | 2.48 | 6.17 | | x | x | 82524 |
| *Tapirira obtusa* (Benth.) J.D.Mitchell | 6 | 0.1733 | 1.67 | 2.58 | 1.86 | 6.10 | x | x | | 19754 |
| *Cupania ludowigii* Somner & Ferrucci | 8 | 0.1161 | 2.22 | 1.73 | 1.86 | 5.81 | | x | x | 4633 |
| *Cecropia hololeuca* Miq. | 6 | 0.1506 | 1.67 | 2.24 | 1.86 | 5.77 | | x | | 80544 |
| *Ocotea cf. spixiana* Mez | 7 | 0.0980 | 1.94 | 1.46 | 1.86 | 5.26 | | x | x | 35687 |
| *Copaifera langsdorfii* Desf. | 6 | 0.1131 | 1.67 | 1.68 | 1.86 | 5.21 | x | x | x | 82533 |
| *Ocotea laxa* Mez | 6 | 0.1121 | 1.67 | 1.67 | 1.86 | 5.19 | x | x | x | 814 |
| *Sclerolobium rugosum* Mart. ex Benth. | 3 | 0.2155 | 0.83 | 3.21 | 0.93 | 4.97 | | | x | 19149 |
| *Posoqueria latifolia* Roem. & Schult. | 5 | 0.0724 | 1.39 | 1.08 | 1.24 | 3.70 | x | | | 71635 |
| *Swartzia pilulifera* Benth. | 5 | 0.0656 | 1.39 | 0.98 | 1.24 | 3.60 | x | | | 67166 |
| *Ocotea odorifera* (Vell.) J.G.Rohwer | 4 | 0.0802 | 1.11 | 1.19 | 0.93 | 3.23 | | | x | 97021 |
| *Byrsonima ligustrifolia* A.Juss. | 4 | 0.0582 | 1.11 | 0.87 | 1.24 | 3.22 | | x | x | 126564 |
| Lauraceae sp. 2 | 4 | 0.0578 | 1.11 | 0.86 | 1.24 | 3.21 | x | x | x | - |
| *Machaerium villosum* Vog. | 3 | 0.0954 | 0.83 | 1.42 | 0.93 | 3.18 | x | | | 82538 |
| Rubiaceae sp. 1 | 4 | 0.0537 | 1.11 | 0.80 | 0.93 | 2.84 | | x | x | - |
| *Inga edulis* Mart. | 2 | 0.1294 | 0.56 | 1.93 | 0.31 | 2.79 | | x | | 99625 |
| *Psychotria vellosiana* Benth. | 4 | 0.0255 | 1.11 | 0.38 | 1.24 | 2.73 | x | x | x | 82537 |
| *Faramea* sp. | 4 | 0.0443 | 1.11 | 0.66 | 0.93 | 2.70 | x | | | - |
| *Vochysia magnifica* Warm. | 3 | 0.0587 | 0.83 | 0.87 | 0.93 | 2.64 | x | x | | 63657 |
| *Myrcia cf. rufipes* DC. | 4 | 0.0168 | 1.11 | 0.25 | 1.24 | 2.60 | x | | x | 73804 |
| *Gordonia fruticosa* (Schrad.) H.Keng | 2 | 0.0815 | 0.56 | 1.21 | 0.62 | 2.39 | x | x | | 122176 |
| *Salacia elliptica* (Mart.) Peyr. | 3 | 0.0392 | 0.83 | 0.58 | 0.93 | 2.35 | x | | x | 38171 |
| *Psychotria pleiocephala* Müll.Arg. | 4 | 0.0143 | 1.11 | 0.21 | 0.93 | 2.25 | | x | x | 126562 |
| *Terminalia glabrescens* Mart. | 2 | 0.0718 | 0.56 | 1.07 | 0.62 | 2.24 | x | | | 22862 |
| *Eugenia* sp. 2 | 3 | 0.0301 | 0.83 | 0.45 | 0.93 | 2.21 | x | | x | - |
| *Himatanthus lanceifolius* (Müll.Arg.) R.E.Woodson | 3 | 0.0291 | 0.83 | 0.43 | 0.93 | 2.19 | | x | x | 85893 |
| *Bathysa meridionalis* L.B.Sm. & Downs | 2 | 0.0646 | 0.56 | 0.96 | 0.62 | 2.14 | | x | x | 51151 |
| *Ocotea tenuiflora* Mez | 2 | 0.0632 | 0.56 | 0.94 | 0.62 | 2.12 | | | x | 85867 |
| *Virola bicuhyba* Warb. | 3 | 0.0137 | 0.83 | 0.20 | 0.93 | 1.97 | | x | | 88008 |
| *Rollinia dolabripetala* (Raddi) R.E.Fr. | 3 | 0.0126 | 0.83 | 0.19 | 0.93 | 1.95 | | x | x | 45372 |
| *Guatteria villosissima* St. Hil. | 3 | 0.0124 | 0.83 | 0.18 | 0.93 | 1.95 | | x | x | 80267 |
| *Cabralea canjerana* (Vell.) Mart. | 3 | 0.0078 | 0.83 | 0.12 | 0.93 | 1.88 | | x | x | 19671 |
| *Astronium graveolens* Jacq. | 2 | 0.0450 | 0.56 | 0.67 | 0.62 | 1.85 | x | | | 82540 |
| *Esenbeckia febrifuga* A. Juss. | 3 | 0.0228 | 0.83 | 0.34 | 0.62 | 1.79 | | | x | 85879 |
| *Licania cf. octandra* Kuntze | 2 | 0.0373 | 0.56 | 0.56 | 0.62 | 1.73 | x | | | 38193 |
| *Aspidosperma spruceanum* Benth.ex Müll.Arg. | 1 | 0.0757 | 0.28 | 1.13 | 0.31 | 1.71 | x | | | 68789 |
| *Mollinedia argyrogyna* Perkins | 2 | 0.0346 | 0.56 | 0.52 | 0.62 | 1.69 | | x | x | 97026 |
| *Vernonia diffusa* Less. | 2 | 0.0324 | 0.56 | 0.48 | 0.62 | 1.66 | | x | x | 19668 |
| *Machaerium scleroxylon* Tul. | 2 | 0.0311 | 0.56 | 0.46 | 0.62 | 1.64 | x | | | 19114 |
| *Eugenia* sp. 1 | 2 | 0.0228 | 0.56 | 0.34 | 0.62 | 1.51 | | x | | - |
| *Myrcia* sp. | 2 | 0.0175 | 0.56 | 0.26 | 0.62 | 1.43 | | | x | - |
| *Calyptranthes clusiifolia* Berg | 2 | 0.0166 | 0.56 | 0.25 | 0.62 | 1.42 | x | | | 82529 |
| *Abarema obovata* (Benth.) R.C.Barneby & J.W.Grimes | 2 | 0.0153 | 0.56 | 0.23 | 0.62 | 1.40 | | x | x | 66895 |
| *Machaerium floribundum* Benth. | 2 | 0.0124 | 0.56 | 0.18 | 0.62 | 1.36 | | x | x | 49376 |
| *Galipea jasminiflora* Engl. | 2 | 0.0142 | 0.83 | 0.21 | 0.31 | 1.35 | x | | | 36411 |

**Table 2 continued.**

**Table 2.** Species sampled in the three studied areas in RPPN Mata do Jambreiro, Nova Lima, Minas Gerais and their phytosociological parameters, listed in descending order of value of importance (VI). NI = number of individuals; BA ($m^2$) = basal area in square meters; RDe (%) = relative density; RDo (%) = relative dominance; RF (%) = relative frequency; A1 = Area 1; A2 = Area 2; A3 = Area 3; BHCB = number of voucher material in Herbarium BHCB.

| Species | NI | BA | RDe | RDo | RF | VI | A1 | A2 | A3 | BHCH |
|---|---|---|---|---|---|---|---|---|---|---|
| *Schefflera calva* (Cham.) Frodin & Fiaschi | 2 | 0.0120 | 0.56 | 0.18 | 0.62 | 1.35 | | x | x | 126563 |
| *Alchornea glandulosa* Poepp. & Endl. | 2 | 0.0103 | 0.56 | 0.15 | 0.62 | 1.33 | | | x | 19679 |
| *Croton echinocarpus* Müll.Arg. | 2 | 0.0277 | 0.56 | 0.41 | 0.31 | 1.28 | | | x | 126554 |
| *Protium heptaphyllum* March. | 2 | 0.0055 | 0.56 | 0.08 | 0.62 | 1.26 | | x | | 85876 |
| *Miconia tristis* Spring. ex Mart. | 2 | 0.0043 | 0.56 | 0.06 | 0.62 | 1.24 | | x | x | 85902 |
| *Solanum leucodendron* Sendt. | 1 | 0.0390 | 0.28 | 0.58 | 0.31 | 1.17 | | x | | 19538 |
| *Casearia obliqua* Spreng. | 2 | 0.0186 | 0.56 | 0.28 | 0.31 | 1.14 | | | x | 8981 |
| *Dictyoloma vandellianum* A.Juss. | 1 | 0.0368 | 0.28 | 0.55 | 0.31 | 1.14 | | | x | 53368 |
| *Croton urucurana* Baill. | 1 | 0.0326 | 0.28 | 0.49 | 0.31 | 1.07 | x | | | 19666 |
| Lauraceae sp. 3 | 1 | 0.0319 | 0.28 | 0.47 | 0.31 | 1.06 | | x | | - |
| Lauraceae sp. 1 | 1 | 0.0277 | 0.28 | 0.41 | 0.31 | 1.00 | | x | | - |
| *Melanoxylon brauna* Schott | 1 | 0.0224 | 0.28 | 0.33 | 0.31 | 0.92 | | | x | 15178 |
| *Machaerium nyctitans* (Vell.) Benth. | 1 | 0.0199 | 0.28 | 0.30 | 0.31 | 0.88 | x | | | 48711 |
| *Pouteria aff. torta* Radlk. | 1 | 0.0191 | 0.28 | 0.28 | 0.31 | 0.87 | | x | | 74746 |
| *Cyathea phalerata* Mart. | 1 | 0.0161 | 0.28 | 0.24 | 0.31 | 0.83 | | x | x | 30834 |
| Myrtaceae sp. 3 | 1 | 0.0134 | 0.28 | 0.20 | 0.31 | 0.79 | x | | | - |
| *Myrsine umbellata* Mart. | 1 | 0.0115 | 0.28 | 0.17 | 0.31 | 0.76 | x | | | 10455 |
| *Dalbergia nigra* Allem.ex Benth. | 1 | 0.0109 | 0.28 | 0.16 | 0.31 | 0.75 | x | | | 82539 |
| *Siphoneugena densiflora* Berg. | 1 | 0.0109 | 0.28 | 0.16 | 0.31 | 0.75 | x | | | 110375 |
| *Casearia sylvestris* Sw. | 1 | 0.0102 | 0.28 | 0.15 | 0.31 | 0.74 | | | x | 17582 |
| *Solanum cernuum* Vell. | 1 | 0.0092 | 0.28 | 0.14 | 0.31 | 0.72 | | | x | 85896 |
| *Ouratea salicifolia* Engl. | 1 | 0.0092 | 0.28 | 0.14 | 0.31 | 0.72 | x | | | 72009 |
| Fabaceae sp. 2 | 1 | 0.0087 | 0.28 | 0.13 | 0.31 | 0.72 | | x | | - |
| *Piper arboreum* Aubl. | 1 | 0.0074 | 0.28 | 0.11 | 0.31 | 0.70 | | x | | 67011 |
| *Amaioua* sp. | 1 | 0.0072 | 0.28 | 0.11 | 0.31 | 0.69 | | | x | - |
| *Chrysophyllum marginatum* Radlk. | 1 | 0.0067 | 0.28 | 0.10 | 0.31 | 0.69 | | x | | 23320 |
| *Myrsine guianensis* (Aubl.) Kuntze | 1 | 0.0067 | 0.28 | 0.10 | 0.31 | 0.69 | | x | | 71883 |
| *Trichilia pallida* Sw. | 1 | 0.0065 | 0.28 | 0.10 | 0.31 | 0.68 | x | | | 82530 |
| Fabaceae sp. 1 | 1 | 0.0063 | 0.28 | 0.09 | 0.31 | 0.68 | | x | | - |
| *Miconia theazans* (Bonpl.) Cogn. | 1 | 0.0061 | 0.28 | 0.09 | 0.31 | 0.68 | | | x | 73342 |
| *Siparuna bifida* A.DC. | 1 | 0.0059 | 0.28 | 0.09 | 0.31 | 0.68 | | x | | 69483 |
| *Styrax camporum* Pohl | 1 | 0.0058 | 0.28 | 0.09 | 0.31 | 0.67 | | | x | 19704 |
| *Casearia decandra* Jacq. | 1 | 0.0058 | 0.28 | 0.09 | 0.31 | 0.67 | x | | | 56536 |
| *Ilex cf. rivularis* Gardn. | 1 | 0.0058 | 0.28 | 0.09 | 0.31 | 0.67 | | x | | 93680 |
| Fabaceae sp. 3 | 1 | 0.0054 | 0.28 | 0.08 | 0.31 | 0.67 | x | | | - |
| *Myrcia formosiana* DC. | 1 | 0.0050 | 0.28 | 0.07 | 0.31 | 0.66 | x | | | 19957 |
| *Psidium rufum* Mart. ex DC. | 1 | 0.0044 | 0.28 | 0.07 | 0.31 | 0.65 | x | | | 82531 |
| *Euplassa semicostata* V.Plana | 1 | 0.0038 | 0.28 | 0.06 | 0.31 | 0.64 | | x | | 52597 |
| *Vitex sellowiana* Cham. | 1 | 0.0035 | 0.28 | 0.05 | 0.31 | 0.64 | x | | | 79709 |
| *Matayba mollis* Radlk. | 1 | 0.0030 | 0.28 | 0.05 | 0.31 | 0.63 | x | | | 78229 |
| *Myrcia splendens* DC. | 1 | 0.0029 | 0.28 | 0.04 | 0.31 | 0.63 | x | | | 126558 |
| *Hymenolobium janeirense* Kuhlm. | 1 | 0.0029 | 0.28 | 0.04 | 0.31 | 0.63 | x | | | 30729 |
| *Ocotea cf. percoriacea* Kosterm. | 1 | 0.0027 | 0.28 | 0.04 | 0.31 | 0.63 | x | | | 26362 |
| *Miconia petropolitana* Cogn. | 1 | 0.0026 | 0.28 | 0.04 | 0.31 | 0.63 | | | x | 85903 |
| *Miconia cf. valtherii* Naudin | 1 | 0.0026 | 0.28 | 0.04 | 0.31 | 0.63 | | | x | 126566 |
| *Nectandra oppositifolia* Nees & Mart. ex Nees | 1 | 0.0026 | 0.28 | 0.04 | 0.31 | 0.63 | x | | | 82541 |
| Myrtaceae sp. 1 | 1 | 0.0023 | 0.28 | 0.03 | 0.31 | 0.62 | x | | | - |
| *Myrsine venosa* A.DC. | 1 | 0.0023 | 0.28 | 0.03 | 0.31 | 0.62 | | x | | 85892 |
| *Geonoma schottiana* Mart. | 1 | 0.0020 | 0.28 | 0.03 | 0.31 | 0.62 | | x | | 82523 |
| *Psychotria* sp. | 1 | 0.0020 | 0.28 | 0.03 | 0.31 | 0.62 | | x | | - |
| *Guatteria sellowiana* Schltdl. | 1 | 0.0020 | 0.28 | 0.03 | 0.31 | 0.62 | x | | | 26332 |
| *Sorocea bonplandii* (Baill.) W.C.Burger, Lanj. & Boer | 1 | 0.0020 | 0.28 | 0.03 | 0.31 | 0.62 | | | x | 19774 |
| Rubiaceae sp. 2 | 1 | 0.0018 | 0.28 | 0.03 | 0.31 | 0.61 | | x | | - |
| *Ouratea castaneifolia* Engl. | 1 | 0.0018 | 0.28 | 0.03 | 0.31 | 0.61 | x | | | 72009 |
| Myrtaceae sp. 2 | 1 | 0.0018 | 0.28 | 0.03 | 0.31 | 0.61 | x | | | - |
| Total | 36 0 | 6,715 | 100 | 100 | 100 | 300 | - | - | - | - |

The forest examined in this study presented a high value for the index of diversity (H'), 4.22, and 0.894 for Pielou (J) equability. Another portion of the same continuum in Mata do Jambreiro was studied using the same methodology by Spósito and Stehmann (2006), that found H'= 3.53 and J= 0.898. In the same study, other forest remnants of the Iron Quadrangle were surveyed, and the values of H' and J ranged from 3.11 to 4.04, and from 0.849 to 0.962, respectively. According to Felfili and Rezende (2003), the values of H' generally range between 1.3 and 3.5, and may exceed 4.0 or 4.5 in tropical forest environments. It was concluded therefore that in the studied forests of Iron Quadrangle, species with similar abundances resulted in high values for H'.

In general, the RPPN Mata do Jambreiro forest has a predominance of small diameter individuals with an average height around 10 m, sometimes forming discontinuous canopies. In several forest patches, mainly close to clearings or places of high degree inclination, there are grasses, such as *Lithachne horizontalis* Chase (Poaceae), an endemic species, that presents the highest coverage value in Andrade's (1992) survey. *Chusquea* spp., *Ichnanthus* spp. and *Parodiolyra micrantha* (Kunth) Davidse & Zuloaga, are other common grasses that can dominate the entire understory. Consequently the forest presents a heterogeneous physiognomy, which indicates that the vegetation has suffered several types of changes in the recent past. In addition the presence and abundance of *Anadenanthera colubrina*, *Cecropia glaziovi* and *Cecropia hololeuca* that are pioneer species (LORENZI, 2002a, 2002b), together with the isolated populations of individuals of large size of important timbers resource in the past, such as *Cariniana legalis,* and *Melanoxylon brauna*, the grass dominance in some areas and the scarcity of epiphytes are all evidence of selective wood exploitation in certain tracks of the forest, as was observed by this study and by Andrade (1992).

Implications for conservation - According to Machado et al. (2004), evaluating floristic changes in some regions can help guide management measures aimed to preserving the forest fragments of a particular region. The RPPN Mata do Jambreiro presents five species that are listed under the International Union for the Conservation of Nature (IUCN) threats categories for the the Red List of the Flora of Minas Gerais (MENDONÇA; LINS, 2000): *Dalbergia nigra*, *Guatteria sellowiana* and *Melanoxylon brauna* are considered Vulnerable, while *Ocotea odorifera* and *Ocotea percoriacea* are considered Endangered. Most of these trees are important timber sources. In view of the low similarity found for these three close areas, a conservation concern is raised here. As a legal requirement in Brazil, any project that suppresses vegetation must be preceded by a study of environmental impact and by a floristic inventory that are usually done by environmental consultants. Many of these studies are done superficially, based on a quick inventory and on bibliographic data compilation. Based in our results we observed that neighboring areas may be strongly divergent in their floristic composition and this may affect many conclusions about biodiversity and its conservation. Usually, such kind of inventory is accepted by governmental agencies when dealing with authorizations for the establishment of new enterprising projects, such as new mines and hydropower plant dams. So, environmental agencies may demand more thoroughly prepared reports, which pay attention to this kind of floristic variation.

# CONCLUSIONS

The present study concluded that the RPPN Mata do Jambreiro is an important forest fragment very close to Belo Horizonte city perimeter. It harbors 111 tree species and can be considered floristic and spatially heterogeneous. The most representative families inventoried in this work were Fabaceae, Myrtaceae, Lauraceae and Rubiaceae. Floristic differences were found among neighboring sampling areas, and diverse agents such as soil composition and human disturbance historic may have played distinct roles to raise such differences. Therefore we conclude that as important as the sample area size is, so it is the distribution of the sampling places along the different stretches of the studied forest fragment. Ignoring such variables may lead to superficially inventoried areas, which may be now loosing important, rare or under collected species. The number of samples taken may influence the overall characterization of the structure of a complex forest, as is the case of the Jambreiro. This is particularly important for the Environmental Consultants that frequently employ the point-quadrat method using a limited number of sampling points. This practice when done inside complex forests as seen along the Espinhaço range may lead to biased and underestimated results.

# ACKNOWLEDGEMENTS

We thank the various specialists consulted who helped in plant identifications, especially Dr. Marcos Sobral, Dr. Julio Lombardi, Dr. Alexandre Salino, Dr. Alexandre Quinet, Dr. Ariane Peixoto, Dr. Maria Candida Mamede, Dr. Renato Goldenberg, Dr. Maria de Fátima Freitas, and Dr. Beatriz Caruzo. Jeffrey Joseph from Royal Botanic Gardens, Kew gave linguistic advice. Dr. Priscila Moreira Andrade helped with the choice of the areas to be sampled and Carlos Alberto Versieux, Henrique Versieux, Pedro Viana, Isabela Garrido, Thiago Gelape, Cecília Calhau, and Daniel Souza provided assistance during the fieldwork.

## REFERENCES

ANDRADE, P. M. **Estrutura do estrato herbáceo de trechos da Reserva Biológica Mata do Jambreiro, Nova Lima, MG**. 1992. 90 f. Dissertação (Mestrado em Biologia Vegetal) - Universidade Estadual de Campinas, Campinas, 1992.

APG (ANGIOSPERM PHYLOGENY GROUP) III. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. **Botanical Journal of the Linnaean Society**, v. 161, n. 2, p. 105-121, 2009.

ARAUJO, K. D. et al. Levantamento florístico do estrato arbustivo-arbóreo em áreas contíguas de Caatinga no Cariri Paraibano. **Revista Caatinga**, Mossoró, v. 23, n. 1, p. 63-70, 2010.

BOTREL, R. T. et al. Influência do solo e topografia sobre as variações da composição florística e estrutura da comunidade arbórea-arbustiva de uma floresta estacional semidecidual em Ingaí, MG. **Revista Brasileira de Botânica**, São Paulo, v. 25, n. 2, p. 195-213, 2002.

CARVALHO, D. A. et al. Variações florísticas e estruturais do componente arbóreo de uma floresta ombrófila alto-montana às margens do rio Grande, Bocaina de Minas, MG, Brasil. **Acta Botanica Brasilica**, São Paulo, v. 19, n. 1, p. 91-109, 2005.

CAVASSAN, O.; CÉSAR, O.; MARTINS, F. R. Fitossociologia da vegetação arbórea da Reserva Estadual de Bauru, Estado de São Paulo. **Revista Brasileira de Botânica,** São Paulo, v. 7, n. 2, p. 91-106, 1984.

CETEC. **Diagnóstico ambiental do estado de Minas Gerais**. Belo Horizonte: Centro Tecnológico de Minas Gerais, 1983. 158 p. (Comissão de Política Ambiental).

COTTAM, G.; CURTIS, J. T. The use of distance measures in phytossociological sampling. **Ecology,** v. 37, n. 3, p. 451-460, 1956.

DRUMMOND, G. M. et al. (Ed.). **Biodiversidade em Minas Gerais:** um atlas para sua conservação. 2. ed. Belo Horizonte: Fundação Biodiversitas, 2005. 222 p.

ENGELBRECHT, B. M. J. et al. Drought sensitivity shapes species distribution patterns in tropical forests. **Nature,** v. 447, n. 7140, p. 80-83, 2007.

ESPÍRITO-SANTO, F. D. B. et al. Variáveis ambientais e a distribuição de espécies arbóreas em um remanescente de floresta estacional semidecídua montana no campus da Universidade Federal de Lavras, MG. **Acta Botanica Brasilica**, São Paulo, v. 16, n. 3, p. 331-356, 2002.

FELFILI, J. M.; REZENDE, R. P. **Conceitos e métodos em fitossociologia**. Brasília: Universidade de Brasília, 2003. 68 p. (Comunicações técnicas florestais, 5).

FIGUEIREDO, J. B.; SALINO, A. Pteridófitas de quatro reservas particulares do patrimônio natural ao sul da região metropolitana de Belo Horizonte, Minas Gerais, Brasil. **Lundiana**, Belo Horizonte, v. 6, n. 2, p. 83-94, 2005.

GIRALDO-CAÑAS, D. Variación de la diversidad florística en un mosaico sucesional en la cordillera central andina (Antioquia, Colombia). **Darwiniana**, v. 38, n. 1-2, p. 33-42, 2000.

GIULIETTI, A. M.; PIRANI, J. R.; HARLEY, R. M. Espinhaço Range Region, Eastern Brazil. In: DAVIS, V. H. et al. (Ed.). **Centres of plant dbversity:** a guide and strategy for their conservation. Cambridge: World Wildlife Fund & World Conservation Union, 1997. p. 397-404.

IGA-INSTITUTO DE GEOCIÊNCIAS APLICADAS (Belo Horizonte, MG). **Mapas municipais com monografia:** mapa do município de Nova Lima, MG. Belo Horizonte: IGA, 1980. Escala 1: 75.000.

JACOBI, C. M. et al. Plant communities on ironstone outcrops: a diverse and endangered Brazilian ecosystem. **Biodiversity and Conservation**, v. 16, n. 7, p. 2185-2200, 2007.

KOTCHETKOFF-HENRIQUES, O.; JOLY, C. A.; BERNACCI, L. C. Relação entre o solo e a composição florística de remanescentes de vegetação natural no município de Ribeirão Preto, SP. **Revista Brasileira de Botânica**, São Paulo, v. 28, n. 3, p. 541-562, 2005.

LORENZI, H. **Árvores brasileiras**: manual de identificação e cultivo de plantas arbóreas nativas do Brasil. 4. ed. Nova Odessa: Instituto Plantarum, 2002a. v. 1, 368 p.

LORENZI, H. **Árvores brasileiras**: manual de identificação e cultivo de plantas arbóreas nativas do Brasil. 2. ed. Nova Odessa: Instituto Plantarum, 2002b. v. 2, 384 p.

LOURES, L. et al. Florística, estrutura e características do solo de um fragmento de floresta paludosa no sudeste do Brasil. **Acta Botanica Brasilica**, São Paulo, v. 21, n. 4, p. 885-896, 2007.

MACHADO, E. L. M. et al. Análise comparativa da estrutura e flora do compartimento arbóreo-arbustivo de um remanescente florestal na Fazenda Beira Lago, Lavras, MG. **Revista Árvore**, Viçosa, MG, v. 28, n. 4, p. 499-516, 2004.

MARTINS, F. R. **Estrutura de uma floresta mesófila**. Campinas: Editora da UNICAMP, 1991. 246 p.

MENDONÇA, M. P.; LINS, L. V. (Org.). **Lista vermelha das espécies ameaçadas de extinção da flora de Minas Gerais**. Belo Horizonte: Fundação Biodiversitas e Fundação Zôo-Botânica de Belo Horizonte, 2000. 157 p.

MEYER, S. T. et al. Composição florística da vegetação arbórea de um trecho de floresta de galeria do Parque Estadual do Rola-Moça na Região Metropolitana de Belo Horizonte, MG, Brasil. **Acta Botanica Brasilica**, São Paulo, v. 18, n. 4, p. 701-709, 2004.

OLIVEIRA FILHO, A. T.; CAMISÃO NETO, A. A.; VOLPATO, M. M. Structure and dispersion of four tree populations in an area of montane semideciduous forest in southeastern Brazil. **Biotropica**, v. 28, n. 4b, p. 762-769, 1996.

OLIVEIRA FILHO, A. T.; FONTES, M. A. L. Patterns of floristic differentiation among Atlantic forests in southeastern Brazil and the influence of climate. **Biotropica**, v. 32, n. 4b, p. 793-810, 2000.

PIELOU, E. C. **Ecological diversity**. New York: John Wiley & Sons, 1975. 165 p.

RESENDE, M.; LANI, J. L.; REZENDE, S. B. Pedossistemas da Mata Atlântica: considerações pertinentes sobre a sustentabilidade. **Revista Árvore**, Viçosa, MG, v. 26, n. 3, p. 261-269, 2002.

RIBEIRO, S. T. M. **Florística e estrutura fitossociológica de um trecho de floresta de galeria do Parque Estadual do Rola-Moça na região metropolitana de Belo Horizonte – MG**. 1998. 89 f. Dissertação (Mestrado em Botânica) - Universidade Federal de Viçosa, Viçosa, MG, 1998.

RODRIGUES, L. A. et al. Efeitos de solo e topografia sobre a distribuição de espécies arbóreas em um fragmento de floresta estacional semidecidual, em Luminárias, MG. **Revista Árvore**, Viçosa, MG, v. 31, n. 1, p. 25-35, 2007.

SHEPHERD, G. J. **Fitopac 1**: manual de usuário. Campinas: UNICAMP, 1995. 93 p.

SPÓSITO, T. C.; STEHMANN, J. R. Heterogeneidade florística e estrutural de remanescentes florestais da Área de Proteção Ambiental ao Sul da Região Metropilitana de Belo Horizonte (APA Sul-RMBH), Minas Gerais, Brasil. **Acta Botanica Brasilica**, São Paulo, v. 20, n. 2, p. 347-362, 2006.

VELOSO, H. P.; RANGEL FILHO, A. L. R.; LIMA, J. C. **Classificação da vegetação brasileira adaptada a um sistema universal**. Rio de Janeiro: IBGE, 1991. 124 p.

VERSIEUX, L. M.; WENDT, T. Bromeliaceae diversity and conservation in Minas Gerais, Brazil. **Biodiversity and Conservation**, v. 16, n. 11, p. 2989-3009, 2007.

VIANA, P. L.; LOMBARDI, J. A. Florística e caracterização dos campos rupestres sobre canga na Serra da Calçada, Minas Gerais, Brasil. **Rodriguésia**, Rio de Janeiro, v. 58, n. 1, p. 159-177, 2007.