

FLORISTIC ASPECTS AND DIVERSITY OF REGENERATED ARBOREAL SPECIES UNDER A STAND OF *Anadenanthera peregrina* SPEG.

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ABSTRACT: This study was conducted at the campus of the Federal University of Lavras, Minas Gerais state, in an area of 7.56 ha which in earlier times was planted with *Anadenanthera peregrina*. It aimed to describe the floristic composition of the site so as to provide a theoretical basis to assist future local management interventions. A total of 81 plots, each measuring 10x10m, were allocated and arranged in such way as to cover as much apparent variation in the physiognomic gradient of the vegetation as possible. All individuals with DBH (diameter at breast height) ≥ 5.0 cm were recorded. Each individual had their DBH and height recorded. Diversity was assessed using Shannon, Pielou and Jentsen indices and compared to adjacent areas and to other areas with similar history of land use. The sampling procedure recorded 1,180 individuals, distributed among 25 families and 66 species. The family presenting the largest number of recorded species was Fabaceae, with 16 species (24.24%). The genera presenting the greatest floristic richness were *Casearia*, with four species, *Machaerium* and *Rollinia*, each with three species, and *Anadenanthera*, *Tapirira*, *Cordia*, *Protium*, *Inga*, *Ocotea*, *Miconia*, *Cedrela* and *Myrcia*, each with two species. The Shannon diversity index (H') was 1.47 nats.ind⁻¹, indicating that the local community has low species diversity.

Key words: Sucession, natural regeneration, shaded coffee.

ASPECTOS FLORÍSTICOS E DIVERSIDADE DAS ESPÉCIES ARBÓREAS REGENERADAS SOB UM POVOAMENTO DE *Anadenanthera peregrina* SPEG.

RESUMO: O presente estudo foi desenvolvido numa antiga área de plantio de *Anadenanthera peregrina*, no Campus da Universidade Federal de Lavras, MG com aproximadamente 7,56 ha. Objetivou-se descrever a diversidade e a composição florística dessa área para subsidiar futuras intervenções de manejo. Foram alocadas 81 parcelas de 10x10m, dispostas de forma a representar a maior variação aparente de gradiente fisionômico da vegetação. Foram registrados todos os indivíduos com DAP (Diâmetro à altura do solo) $\geq 5,0$ cm. Para cada indivíduo, foram anotados valores de DAP e altura. A diversidade foi avaliada por meio dos índices de Shannon, Pielou, Jentsen e comparada com áreas ao entorno e região, bem como áreas com histórico de uso semelhante. Na amostragem realizada foram registrados 1180 indivíduos distribuídos em 25 famílias e 66 espécies. A família com o maior número de espécies foi a Fabaceae, com 16 espécies (24,24%). Os gêneros de maior riqueza florística foram *Casearia*, com quatro espécies, *Machaerium* e *Rollinia*, ambos com três espécies e *Anadenanthera*, *Tapirira*, *Cordia*, *Protium*, *Inga*, *Ocotea*, *Miconia*, *Cedrela* e *Myrcia*, com duas espécies cada. O índice de diversidade de Shannon (H') foi de 1,47 nats.indivíduo⁻¹, o que indica que a comunidade em questão apresenta uma baixa diversidade de espécies.

Palavras-chave: Sucessão, regeneração natural, café sombreado.

1 INTRODUCTION

From the mid 19th century, cultivation of coffee in Minas Gerais state led to a disorderly occupation of land, extending over the entire state and causing devastation of vast stretches of forested areas (MEIRA-NETO et al., 1997). This situation has lingered to this day in the form of environmental and socioeconomic imbalance, as for over a hundred years coffee cultivation had been the driving

force of Brazilian economy, generating a demand for new technologies capable of increasing production.

Within such context, cultivation of shaded coffee came as an improvement endeavor. It failed, however, to produce positive results (MOREIRA, 2003), leading to abandonment of such areas and favoring natural regeneration. On the spatial and temporal scale, this phenomenon can follow any path toward maturity, conditioned by external factors or causes (PICKETT &

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OSTFELD, 1995) that interact to play a key part in local recovery, including precipitation, altitude (EWEL, 1980), previous land use (UHL et al., 1988), soil fertility and proximity to the seed source (MELLO et al., 1989), among others.

Gobbi (2000) argues that the role of trees in the conservation of both land and watercourses is well established, and also that shaded coffee plantations have been cited as biodiversity havens because they can preserve a high diversity of organisms that include birds, arthropods, mammals and orchids.

This study was performed in an experimental area of shaded coffee plantation under a stand of *Anadenanthera peregrina*, which had been abandoned some thirty-five years ago and gave rise to a regeneration process. It aimed to assess the biological diversity and floristic composition of locally regenerated arboreal species, in an attempt to provide a theoretical basis on which to assist future management and conservation interventions in the area as well as in other similar areas.

2 MATERIAL AND METHODS

A part of the Institute of Agricultural Research of the West Central Region (IPEACO) up until 1943 and now

incorporated into the Agricultural Research Company of Minas Gerais (EPAMIG), the study site lies on the Campus of the Federal University of Lavras, southern Minas Gerais state, at geographical coordinates 21° 13' 17" S and 44° 57' 47" W (Figure 1). The area has well defined boundaries and is surrounded by eucalyptus plantations, a public road, and built facilities which include a forest nursery and the Coffee Studies Center of the Federal University of Lavras (NECAF).

In 1943, the above area was used in an experiment designed to investigate the effects of shade on coffee crops under frost conditions. To that end, two types of experiment were performed: one under full sunlight and the other under the shade, using species *Anadenanthera peregrina* as shading agent. The experiment took place in Lavras Experimental Substation, which is what the area became known as after being incorporated into EPAMIG. About thirty-five years ago, after the realization that coffee crops exposed to full sunlight yielded around 40% more than shaded crops, the experimental area was abandoned.

According to Koppen classification, the local climate is Cwb type (mesothermal with mild summers and dry winters), with average annual precipitation of 1,493.2



Figure 1 – Image of the studied area - an abandoned experimental coffee plantation colonized by *Anadenanthera peregrina* (Benth.) Speg. Lavras, MG. Source: Google Earth © 2006 Europe Technology - Image © 2006 DigitalGlobe.

Figura 1 – Imagem da área de estudo, um plantio experimental de café abandonado e colonizado por *Anadenanthera peregrina* (Benth.) Speg. Lavras, MG. Fonte: Google Earth © 2006 Europa Tecnologie - Image © 2006 DigitalGlobe.

mm and temperature of 19.3°C, noting that 66% of the precipitation occurs between November and February (VILELA & RAMALHO, 1979).

The floristic survey of the arboreal component corresponds to the specimens determined in the phytosociological study of that community (NASCIMENTO, 2006). All individuals with DBH (diameter at breast height) ≥ 5.0 cm were sampled, except those branching out above the ground and below breast height (1.30 m). For the latter we used procedures recommended by Scolforo & Mello (1997).

Individuals were identified in the field whenever species were known, while unknown species had botanical samples collected for later identification. In order to perform a more thorough floristic survey of the local tree species, additional botanical material was collected outside the plots in random walks across the entire region. Species were grouped into families according to the APG II system (2003) and the material was cataloged and deposited in the Herbarium of the Federal University of Lavras.

For determination of species diversity, we used the Shannon diversity index (H') (SHANNON, 1948), the Pielou evenness index (J') (BROWER & ZAR, 1984) and the Simpson dominance index (D_s) (SIMPSON, 1949). The Jentsch mixture quotient and the Sorensen similarity quotient (1948) were also used and their values compared to surveys in adjacent fragments.

To derive the Shannon and Pielou indices, the Sorensen similarity quotient, and the Jentsch mixture quotient, we processed the data in the software Microsoft Visual Basic 5.0 Professional Edition. To derive the Simpson dominance index we used software DivEs 2.0 (Species Diversity).

3 RESULTS AND DISCUSSION

The total sampled area of 0.81 hectares corresponds to 11.57% of the grand total. The floristic survey detected 25 families distributed among 66 species, as illustrated in Table 1.

The family with the largest number of species is Fabaceae, with 16 species (24.24 % of the total species richness), followed by families Anacardiaceae, Annonaceae and Salicaceae, each with five species (7.58 % each). The genera presenting greatest floristic richness were *Casearia*, with four species; *Machaerium* and *Rollinia*, each with three species.

The greatest species richness, which in this work is represented by family Fabaceae (16 in total), coincides

with results obtained by Silva et al. (2000) in an inventory of a fragment of semideciduous forest in Ibituruna, Minas Gerais, and with results obtained by Ribas et al. (2003) in the woods of Sítio Palmital, in Viçosa, and with results obtained by Nunes et al. (2003) in the woods of UFLA Forest Reserve, and also with results obtained by Espírito-Santo et al. (2002) in Mata da Subestação, in Lavras.

In a survey conducted in a adjacent fragment of the sampled area, Mata da Subestação, covering 8.5 hectares and following the same diameter inclusion parameter, 3,120 trees were sampled and 175 arboreal species were recorded, being distributed among 115 genera and 49 botanical families (ESPÍRITO-SANTO et al., 2002).

In another adjacent fragment, UFLA Forest Reserve, covering 5.04 hectares, Oliveira-Filho et al. (1994, 1997) found 197 species in their global floristic survey, yet it should be said that their sampling was painstakingly accurate, which surely brings species richness close to the actual existing numbers. In that same Reserve, Nunes et al. (2003) recorded 153 arboreal species.

In a survey conducted in Mata da Subestação, the Sorensen similarity coefficient derived by Espírito-Santo et al. (2002) was 41.4 %, while in another survey conducted in UFLA Forest Reserve, Nunes et al. (2003) obtained 32.8 % for the same coefficient, both low values. According to Matteucci & Colma (1982), however, values above 25 % indicate similarity between the relevant elements. Out of 66 species found in this survey, 55 are present in at least one of these two areas, reinforcing their importance as propagule sources.

In other studies with seasonal forests of Zona da Mata, in Minas Gerais, Mariscal-Flores (1993) found 91 species; Almeida & Souza (1997) found 78; Meira-Neto et al. (1997) found 89; Soares-Júnior (2000) found 83, and Silva et al. (2000) found 91. Similarly to this study, these numbers are relatively low. Yet it should be noted that the use of different inclusion criteria and sampling efforts in surveys potentially limit comparisons, therefore any comparison should be done very thoughtfully. It should be also noted that studies done in tropical forests suggest that both successional stage and disturbances history may influence the number of species found in a community (LEITÃO-FILHO et al., 1993; TABARELLI & MANTOVANI, 1999; WERNECK et al., 2000).

The Shannon diversity index (H') was 1.47 nats.ind⁻¹. This result indicates that the community in question has low species diversity, and is reinforced by comparisons to results obtained in other surveys across the region:

Table 1 – Inventory of sampled species with their respective family and common names.**Tabela 1** – Listagem das espécies amostradas com suas respectivas famílias e nomes vulgares.

Family	Species	Common Names
Anacardiaceae	<i>Astronium fraxinifolium</i> Schott	Gonçaleiro
	<i>Lithraea molleoides</i> (Vell.) Engler	Aroeira-brava
	<i>Schinus terebinthifolius</i> Raddi	Aroeira-vermelha
	<i>Tapirira guianensis</i> Aublet	Pau-pombo
	<i>Tapirira obtusa</i> (Benth.) Mitchell	Pombeiro-branco
Annonaceae	<i>Guatteria australis</i> St. Hil.	Cortiça
	<i>Rollinia dolabripetala</i> (Raddi) R. E. Fr.	Araticum-do-mato
	<i>Rollinia sylvatica</i> (A. St.-Hill) Mart.	Araticum
	<i>Rollinia laurifolia</i> Schldtl.	Araticum-bravo
	<i>Xylopia brasiliensis</i> Sprengel	Pindaíba
Araliaceae	<i>Aralia warmingiana</i> (Marchal) J. Wen	
Arecaceae	<i>Syagrus romanzoffiana</i> (Cham.) Glassman	Côco-babão
Bignoniaceae	<i>Tabebuia impetiginosa</i> (Mart. Ex DC.)	Ipê-rosa
Boraginaceae	<i>Cordia ecalyculata</i> Vell.	Café-de-bugre
	<i>Cordia sellowiana</i> Cham.	Chá-de-bugre
Bursaceae	<i>Protium heptaphyllum</i> March.	Breu-branco-verdadeiro
	<i>Protium spruceanum</i> (Benth.) Engl.	Breu-preto
Canellaceae	<i>Cinnamodendron dinisii</i> Schwacke	Casca-d'anta
Cannabaceae	<i>Celtis iguanaea</i> (Jacq.) Sarg.	Esporão-de-galo
Erythroxylaceae	<i>Erythroxylum citrifolium</i> A. ST.-Hill.	Fruta-de-pombo
Euphorbiaceae	<i>Alchornea triplinervea</i> (Sprengel) Mull. Arg.	Tapiá-vermelho
	<i>Sapium glandulosum</i> (L.) Morong	Leiteiro
Fabaceae	<i>Cassia ferruginea</i> (Schrad.) Schrad.	Canafístula
	<i>Copaifera langsdorffii</i> Desf.	Óleo-de-copaíba
	<i>Andira fraxinifolia</i> Benth.	Angelim
	<i>Dalbergia villosa</i> (Benth.) Benth.	Milho-torrado
	<i>Lanchocarpus cultratus</i> (Vell.)	Embira-de-sapo
	<i>Machaerium hirtum</i> (Vell.) Stellfeld	Jacaranda-bico-de-pato
	<i>Machaerium nictitans</i> (Vell.) Benth.	Jacaranda-bico-de-pato
	<i>Machaerium villosum</i> Vogel	Jacarandá
	<i>Platycyamus regnellii</i> Benth.	Pau-pereira
	<i>Platyodium elegans</i> Vogel	Jacaranda-canzil

To be continued...
 Continua...

Table 1 – Continued...

Tabela 1 – Continua...

Family	Species	Common Names
	<i>Albizia polycephala</i> (Benth.) Killip	Farinha-seca
	<i>Anadenanthera colubrina</i> (Vell.) Brenan	Angico-liso
	<i>Anadenanthera peregrina</i> Speg	Angico-vermelho
	<i>Inga marginata</i> Willd.	Ingá
	<i>Inga vera</i> Willd.	Ingá
	<i>Piptadenia gonoacantha</i> (Mart.) JF Macbr.	Pau-jacare
Lauraceae	<i>Nectandra oppositifolia</i> Ness	Canela-ferrugem
	<i>Ocotea corymbosa</i> (Meisner) Mez	Canela-bosta
	<i>Ocotea villosa</i> Kosterm.	Canela
	<i>Persea pyrifolia</i> Ness & Mart	Maçaranduba
Malvaceae	<i>Chorisia speciosa</i> A. St.-Hil.	Paineira-rosa
	<i>Luehea grandiflora</i> Mart & Zucc	Açoita-cavalo
Melastomataceae	<i>Miconia argyrophylla</i> DC.	Casca-de-arroz
	<i>Miconia chartacea</i> Triana	Pexiriquinha
Meliaceae	<i>Cabralea canjerana</i> (Vell.) Mart.	Cangerana
	<i>Cedrela fissilis</i> Vell.	Cedro
	<i>Cedrela odorata</i> L.	Cedro-rosa
	<i>Trichillia pallida</i> Swartz	Catiguá
Moraceae	<i>Ficus enormis</i> (Mart. ex Miq.) Mart.	Figueira-mata-pau
	<i>Maclura tinctoria</i> (L.) D. Don	Amoreira
Myrtaceae	<i>Calyptanthes clusiifolia</i> (Miq.) O. Berg	Orelha-de-burro
	<i>Myrcia splendens</i> (Sw.) DC.	Guamirim
	<i>Myrcia tomentosa</i> (Aublet) DC.	Goiabão, goiaba-brava
	<i>Myrciaria floribunda</i> (West) O. Berg	Jaboticaba-do-mato
Rubiaceae	<i>Coffea arabica</i> L.	Café
Rutaceae	<i>Zanthoxylum rhoifolium</i> Lam.	Mamica-de-porca
Salicaceae	<i>Casearia arborea</i> (L. C. Rich.) Urban	Cambroé
	<i>Casearia decandra</i> Jacquin	Guaçatunga
	<i>Casearia lasiophylla</i> (Eichler)	Erva-de-lagarto
	<i>Casearia sylvestris</i> Swartz	Guaçatonga
	<i>Xylosma prockia</i> (Turcz.) Turcz.	Espinheiro
Sapindaceae	<i>Cupania vernalis</i> Cambess.	Camboatá
Siparunaceae	<i>Siparuna guianensis</i> Aublet	Capitu
Urticaceae	<i>Cecropia pachystachya</i> Trécul	Embaúba

Espírito-Santo et al. (2002) in Mata da Subestação - Lavras ($H' = 4.19 \text{ nats.ind}^{-1}$); Oliveira-Filho et al. (1994) in UFLA Forest Reserve ($H' = 3.605 \text{ nats.ind}^{-1}$); Silva et al. (2000) in Ibituruna; Rondon-Neto et al. (2000) in Parque Florestal Quedas do Rio Bonito - Lavras; Souza (2001) on the banks of Capivari river - Lavras; and Daniel & Arruda (2005) in Mata da Silvicultura - Viçosa.

In a study of a secondary fragment in the west zone of Rio de Janeiro with disturbance history, known as Serra da Barata, Santana et al. (2004) obtained $H' = 0.85 \text{ nats.ind}^{-1}$; in two disturbed forests within Rio de Janeiro state, Guedes (1998) obtained 1.89 and 1.69 nats.ind^{-1} , numbers closer to the findings in this work, indicating that different land use patterns potentially exerts influence on the development of the local vegetation.

The Simpson dominance index was 0.46, noting that this index is constrained between 0 and 1, so the closer to 1 the poorer the diversity. Thus the value obtained reinforces what has already been detected by the Shannon index. The Jentsch mixture quotient was 0.05169, or 1/19 approximately, indicating that for every 19 individuals sampled a new species was found. In equatorial forests, Finol-Urdaneta (1972) considers values from 1/10 to 1/5 to denote an intense mixture. In Mata da Silvicultura - Viçosa, Daniel & Arruda (2005) obtained 1/12.96 for the mixture quotient. The result obtained in this study indicates low heterogeneity, possibly explained by the local history of land use, and as verified by the Shannon and Simpson indices.

The Pielou evenness index (J') was 0.353, using a natural logarithm. As this index compares current diversity with maximum estimated diversity, it can be said that the current estimated diversity represents 35.16% of the maximum estimated diversity. According to a classification proposal by Daniel & Arruda (2005) for development stages in a vegetal community based on the evenness index, the obtained result places the area in an intermediate succession stage. Yet it should be noted that, comparatively to other surveys in the region, this index is still very low.

As the sampled area is planted with *Anadenanthera peregrina* and this species is widely scattered across the entire area, the low evenness numbers indicate that there is indeed inequality in the density of this species in relation to other species, suggesting that the local dominance of this species is high.

Carvalho (1994) affirmed that the fast growth rate of *Anadenanthera peregrina* expanded its use to reforestation programs. According to Abreu (1997), field

observations have demonstrated that the good performance of this species is associated to its allelopathic potential that assumedly inhibits growth and/or development of other plants, ensuring its success in competitive environments.

The local canopy is rather homogeneous, with species *Anadenanthera peregrina* being dominant. The high population density associated with the deciduous behavior of this species allows the undergrowth to receive intense light. These and the allelopathic properties of *A. peregrina*, with its high concentrations of tannin in the fruit and stem bark (CARVALHO, 1994) as well as alkaloid bufotenine in the seeds and vegetative parts (FELLOWS & BELL, 1971), could be having a selective effect on the seed and regenerant bank. Fellows & Bell (1971) argue that the presence of bufotenine plays a major part in plant survival, helping protect them against animal or insect predators.

Another distinctive characteristic of this area is the presence of lianas, particularly cipó-prata liana. According to Schnitzer (2000), lianas can proliferate to a point where branches of host plants will break due to weight and possibly become a part of their structure for a long time. The presence of these lianas helps restrict recruitment of new species locally. The above facts, in association with local history, may explain the strong presence of this species in the sampled plots.

Despite species *Anadenanthera peregrina* occurring in all plots, species *Machaerium villosum*, *Casearia lasiophylla*, *Myrciaria floribunda*, *Maclura tinctoria*, *Casearia sylvestris*, *Copaifera langsdorffii* and *Casearia arborea* were found to be the most frequent species to occur concurrently with *Anadenanthera peregrina*. In many plots, *Anadenanthera peregrina* was the only species found, while in other plots it occurred most of the time concurrently with three or four different species.

On the note of environmental benefits, Moreira (2003) argues that the more diversified systems presented greater concentrations of organic matter than their counterparts, probably a reflection of their different species composition with different phenologies and variable decomposition rates, allowing greater accumulation of organic matter.

Given the above facts, even where diversity indexes detected low values, this work demonstrates that the local mechanism for species replacement is still very operative, especially in relation to a survey done by Andrade (1997) in the same area.

Additionally, species *Anadenanthera peregrina* could be recommended for reforestation programs in degraded areas as a way of reducing local impact, only observing its allelopathic properties. Ideally it should be planted in conjunction with tolerating species. Data indicate that *Machaerium villosum*, *Casearia lasiophylla*, *Myrciaria floribunda*, *Maclura tinctoria*, *Casearia sylvestris*, *Copaifera langsdorffii* and *Casearia arborea* manage well in the presence of *Anadenanthera peregrina*.

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