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ARTICLE

Ecological succession in two remnants of the Caatinga in the semi-arid tropics of Brazil

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ABSTRACT: (Ecological succession in two remnants of the Caatinga in the semi-arid tropics of Brazil). This study was conducted in two areas of the Caatinga with altitudinal gradients (in a mountain range), in the microregion of the Cariri Oriental Paraibano. It had the goal of characterizing the stages of ecological succession of the plant communities based on the classification of species into ecological groups and comparatively analyzed the phytosociological structure of the two areas, which are influenced by different levels of anthropization. The tree-shrub flora (with diameter ≥ 3 cm and height ≥ 1 m) of the Serra Inácio Pereira was represented by 1043 individuals, 17 families and 42 species and in Serra do Monte by 1264 individuals, 13 families and 29 species. The Shannon diversity index was 2.790 and 2.313 nats.individual^{-1}, respectively. Area I (Serra Inácio Pereira) had a higher diversity of families and species compared to Area II (Serra do Monte); the latter being more influenced by the process of anthropization. In Area I, the species of greatest ecological importance were *Myracrodruon urundeuva* Allem. and *Sapium* sp. In Area II, *Caesalpinia pyramidalis* Tul., *Aspidosperma pyrifolium* Mart. and *Croton sonderianus* Muell. Arg. were the species with the highest importance values (IV). Area I appeared to be in an intermediate stage of succession, where the pioneer species were dominant over the early secondary species, along with late secondary species with high IV. In Area II, 70% of the individuals were pioneer species, characterizing the vegetation as being in the process of regeneration. Area I had heterogeneous vegetation, exhibiting a healthy state of conservation. However, Area II appeared to be homogeneous, demonstrating that the level of disturbance accounted for the differences between the two areas in floristic composition, structural formation and, as a consequence, stage of ecological succession.
Key words: Plant ecology, phytosociology, conservation, anthropization.

RESUMO: (Sucessão ecológica em dois remanescentes de caatinga no trópico semi-árido do Brasil). A pesquisa foi desenvolvida em duas áreas em gradientes altitudinais (serras) pertencentes à Microrregião do Cariri Oriental Paraibano, no intuito de caracterizar os estágios de sucessão ecológica das comunidades vegetais a partir da classificação das espécies em grupos ecológicos e analisar comparativamente a estrutura fitossociológica das duas áreas de Caatinga submetidas a diferentes níveis de antropização. A flora arbóreo-arbustiva (com diâmetro ≥ 3cm e altura ≥ 1m) da Serra de Inácio Pereira foi representada por 1043 indivíduos, 17 famílias e 42 espécies e na Serra do Monte por 1264 indivíduos, 13 famílias e 29 espécies. A diversidade de Shannon foi calculada em 2,790 e 2,313 nats. indivíduo^{-1}, respectivamente. A Área I (Serra de Inácio Pereira) apresentou diversidade em famílias e espécies superior a Área II (Serra do Monte), esta mais fortemente caracterizada pelo processo de antropização. As espécies com maior importância ecológica para Área I foram *Myracrodruon urundeuva* Allem. e *Sapium* sp. Na Área II, *Caesalpinia pyramidalis* Tul., *Aspidosperma pyrifolium* Mart. e *Croton sonderianus* Muell. Arg. foram as espécies com maiores valores de importância (IV). A Área I apresentou-se em estágio intermediário de sucessão, onde as espécies pioneiras dividiram sua dominância com as secundárias iniciais, existindo também espécies secundárias tardias com alto IV. Na Área II, 70% dos indivíduos pertencem a espécies pioneiras, caracterizando uma vegetação em processo de regeneração. Constatou-se que a Área I apresenta uma vegetação heterogênea, exibindo bom estado de conservação; já a Área II revelou-se homogênea, evidenciando que o nível de perturbação gerou diferenças na composição florística, na formação estrutural, e por conseqüência nos estágios de sucessão ecológica entre as áreas.
Palavras-chave: ecologia vegetal, fitossociologia, Cariri Paraibano, antropização.

INTRODUCTION

The poor use of forest resources results in the fragmentation of ecosystems, which leads to the diminution of plant species and the fauna, and alters edaphic conditions. However, the process of forest fragmentation and the consequent formation of remnants are natural consequences of world development and should be seen as a challenge to sustainability (Noss & Csuti 1997).

The Caatinga is a very fragmented biome unique to Brazil, which occupies an area of 734,478 km^2, corresponding to approximately 12.18% of the country (Brasil 2005). It is the principal biome in the Northeast Region of the country due to the predominant semi-arid climate in this area, is found the states of Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Alagoas, Sergipe and Bahia, and extends to the Southeast Region in northern Minas Gerais (Prado 2003). According to Heywood (1997) *apud* Rodal & Nascimento (2002), the Caatinga, even though fragmented, is an important center of biodiversity in the Americas.

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Forest fragmentation and the formation of forest remnants in the Caatinga result from farming and ranching and from the exploitation of woody products for energy, which have devastated the vegetation cover and led to a drastic diminution of the biological diversity in this region. According to Pereira *et al.* (2001), a large part of the vegetation of tropical areas is constituted by secondary vegetation, due to the intense devastation of primary areas. Araújo-Filho (1996) pointed out that 80% of the vegetation of the Caatinga is completely altered, showing early or intermediate stages of ecological succession, and 40% is unable to develop beyond the pioneer stage.

Studies on the regenerative capacity and recovery of degraded areas revolve around various subjects. It is important to point out that understanding how natural processes occur after environmental alterations should be based on our knowledge of the specific and structural composition of plant communities. In this regard, Lopes *et al.* (2006) affirmed that understanding the natural dynamics and structure of an ecosystem is essential to the development of models of recovery. The type and intensity of a disturbance depend on the nature of the process of land use, which occurs in the different altered regions, and has an influence on the pattern of the natural recuperation of an ecosystem (Santos *et al.* 2004).

This work aimed to provide additional insight into the dynamics of the native flora of the Caatinga, because studies that provide phytoecological knowledge of this exuberant biome are important and compiling information about the impact on areas of the Caatinga helps in the planning of future projects involved with the implementation of conservation units. Thus, the phytosociology of two areas of the Caatinga at different levels of anthropization were comparatively analyzed. In addition, their stages of ecological succession were defined based on the categorization of the species from these regions into ecological groups, in order to determine the consequences of the anthropic activity on the vegetation.

MATERIAL AND METHODS

Study area

The research was conducted in two areas of the Caatinga located in the microregion of the Cariri Oriental in Paraíba, namely Serra Inácio Pereira (Area I), located in the municipality of Barra de Santana (07° 31' 12" S, 35° 59' 59" W), and Serra do Monte (Area II), which is part of the municipality of Boqueirão (07° 25' 12" S, 36º 1' 37" W) and approximately16 km from the first study area. The areas were selected because they are vegetation fragments that are conserved and disturbed (by humans) and because they are near each other (and were in the same municipality until 1985) and are exposed to the same climatic conditions. Both areas are in a mountainous region.

Collection and analysis of data

Phytosociological analysis of the vegetation was carried out utilizing the plot method of Braun-Blanquet (Martins 1989). Fifteen plots per area (fragment), which were 50 x 4 m each, were selected. The plots were distributed in a systematic way, were analyzed, and were located at the base, at the intermediate portion and at the top of the mountain (five plots in each portion of the mountain) in order to obtain a better representation of the vegetation. The elevation difference between the base and top was 266 meters for Area I and 245 meters for area II. All species of the tree-shrub stratum were considered, following the inclusion criteria of diameter at ground level (DGL) $\geq$ 3 cm and height $\geq$ 1 m, by characterizing the plants at the adult stage for the Caatinga (Amorim *et al.* 2005, Rodal *et al.* 1992).

When available, fertile branches were collected from the trees for later taxonomic identification by consulting the literature and botanical collections. All material collected was deposited in the Herbário Jayme Coelho de Moraes / Centro de Ciências Agrárias (CCA) / Universidade Federal da Paraíba (UFPB). The species were classified into families based on the Angiosperm Phylogeny Group II system (Souza & Lorenzi 2005).

To confirm that the composition was adequately sampled, a collector's curve was analyzed for the two sample areas (Pielou 1975). The characterization of the tree-shrub structure was made by calculating the phytosociological parameters of frequency, density, dominance and importance value, using a software package (FITOPAC1/UNICAMP) for phytosociological analyses (Shepherd 1995).

Ecological succession

For the characterization of the successional stages, we divided the species into ecological groups, following the model of Gandolfi *et al.* (1995) for semi-deciduous mesophyllic forests, adapted for the vegetation of the Caatinga, based on field observations, such as dispersal type, life form, density, frequency and dominance. Three distinct groups were considered: Pioneer (PI), Early Secondary (ES) and Late Secondary (LS), where the groups referred to the three categories of succession: early, middle and advanced stages of succession, respectively, according to the following criteria:

Pioneer (PI) – species that develop in open areas, dependent on conditions with greater light, occurring in greater frequency and density in anthropized environments;

Early Secondary (ES) – species that develop in conditions with some shading, generally occurring together with pioneer species;

Late Secondary (LS) – species that develop in conditions with greater shading, generally found in more conserved areas where better environmental conditions promote their development.

RESULTS AND DISCUSSION

The tree-shrub flora present in the two areas, Serra Inácio Pereira (Area I) and Serra do Monte (Area II), was represented by 2307 individuals, distributed in 18 families, 34 genera and 46 species, where one species was undetermined (Table 1).

Area I showed the greater diversity of families and species, where 1043 individuals were inventoried, belonging to 17 families and 42 species, characterizing it as an area in a better state of conservation. In Area II, 1264 individuals were recorded, belonging to 13 families and 29 species, indicating less diversity and, thus, revealing a greater degree of human disturbance, which was confirmed based on the history of the area.

The most conspicuous families with respect to the number of individuals were Euphorbiaceae, Fabaceae, Cactaceae and Anacardiaceae, which comprised 82.8% of the individuals sampled in Area I; however, for Area II, Euphorbiaceae, Fabaceae and Apocynaceae accounted for 81.6% of the individuals sampled.

With respect to the number of species by family, Fabaceae (11) Euphorbiaceae (six) Cactaceae (four) and Anacardiaceae (three) were the most representative for Area I, which is similar to the findings of Pereira *et al.* (2001), Lemos & Rodal (2002), Nascimento *et al.* (2003), Lacerda *et al.* (2005), Gomes *et al.* (2006) and Lemos & Meguro (2009). As pointed out by Trovão *et al.* (2007), these families, in general, are more common in relation to others, and are always emphasized in studies of the vegetation of the Caatinga.

In Area II, the families with the highest number of species were only the Fabaceae (seven) and Euphorbiaceae (six). This low diversity of species by family in Area II is mainly due to deforestation caused by fires that occurred about four years before the study.

For Area II, it was also observed that only four species accounted for more than 70% of the individuals sampled: *Croton sonderianus* (29.2%), *Caesalpinia pyramidalis* (16.5%), *Aspidosperma pyrifolium* (15.3%) and *Bauhinia cheilantha* (12.3%). According to Sampaio (1996), in the majority of studies carried out in areas of the Caatinga, the first three species are those that stand out the most in relation to the number of individuals. In relation to *A. pyrifolium*, Andrade *et al.* (2005) emphasized that it is a species that thrives in degraded areas of the Caatinga as seen in Area II, which supports the hypothesis that this area is less conserved and provides evidence of the abundance of a few taxa, indicating the effect of a previous perturbation.

The families Combretaceae, Bignoniaceae, Celastraceae, Sapotaceae and Palmae were exclusive to Area I, which demonstrates the greater diversity in this site, as a result of a higher degree of conservation and therefore a more advanced successional stage. The species observed from these families were *Combretum leprosum*, *Tabebuia impetiginosa*, *Maytenus rigida*, *Bumelia sartorium*, and *Syagrus cearensis*, respectively, which are all representatives of the arboreal stratum and of more advanced successional stages. This corroborates that the plant community of Area I is at a higher stage of development and demonstrates that the representatives of these families are not adapted to colonizing areas with the level of anthropization shown in Area II, where none of these taxa were found.

With respect to diversity indices (Table 2) for Area I, the Shannon-Wiener (H') index was similar to values observed by Alcoforado-Filho *et al.* (2003) and Trovão *et al.* (2007), which were both based on conserved areas of the Caatinga. However, in Area II, H' was lower but still similar to levels found in other studies of vegetation of the Caatinga, which according to Andrade *et al.* (2005) vary between 1.91 and 3.09 nats.individual^{-1}. These diversity measures also indicate that Area I has a greater floristic diversity than Area II, which characterizes it as more conserved in accordance with the proposal for such vegetation by Andrade *et al*. (2005).

These diversity indices made it possible to determine the high level of plant diversity in Area I, and these data were similar to those found by Rodal *et al.* (1998), Pereira *et al.* (2002) and Trovão *et al.* (2004), where the authors reported that such values are considered high for areas of the Caatinga. When analyzing the same aspects for Area II, it is noted that diversity is less than that in Area I, but their values are also typical for vegetation of the Caatinga when compared to those of studies by Andrade *et al.* (2005) and Pereira *et al.* (2001).

The total density found in this study was 3476 individuals.ha^{-1} in Area I and 4213 individuals.ha^{-1} in Area II. According to Sampaio (1996), these values are in the expected range for spiny deciduous vegetation, due to the large variations that exist in topography, soil type and rainfall.

Ten species corresponded to 60% of the importance value (IV) in Area I (Table 3), where these species represented pioneer (e.g., *C. sonderianus*), early successional (*Sapium* sp., *M. glaziovii* and *B. cheilantha)* and more advanced successional stages (*M. urundeuva* and *C. leptophloeos*).

Of the species with the highest IV for Area I, *C. sonderianus,* often stands out among the others in studies of the Caatinga (Sampaio 1996), mainly in relation to density and frequency, indicating that this species, besides being abundant in the area, also has a widespread distribution. The elevated IV of *C. sonderianus* in Area I (more conserved) demonstrates that the vegetation tends to be open shrub, as opposed to the idea of an anthropic environment in early stages of development.

According to Alcoforado-Filho *et al.* (2003), *M. urundeuva* and *C. leptophloeos* stand out in IV, even when showing a low relative density in relation to the others, because individuals of these arboreal species are large. This contrasts with *O. palmadora, M. glaziovii,*

Table 1. List of the plant species and respective families, and ecological groups (EG): Pioneer (PI), Early Secondary (ES) and Late Secondary (LS) catalogued in Serra Inácio Pereira (Area I) and Serra do Monte (Area II), located in the municipalities of Barra de Santana and Boqueirão, Cariri Paraibano.

Family	Species	No. of individuals		Habit	EG
		Area I	Area II		
Anacardiaceae					
	Myracrodruon urundeuva Allem.	56	19	Tree	LS
	Schinopsis brasiliensis Engl.	20	3	Tree	LS
	Spondias tuberosa Arruda	14	-	Tree	LS
Apocynaceae					
	Aspidosperma pyrifolium Mart.	18	193	Tree	PI
Bignoniaceae					
	Tabebuia impetiginosa (Mart. ex DC) Standl.	2	-	Tree	LS
Boraginaceae					
	Cordia salzmanni DC	8	11	Shrub	PI
	Cordia trichotoma (Vell.) Arrab. Ex Steud.	1	-	Shrub	PI
Burseraceae					
	Commiphora leptophloeos (Mart.) J.B. Gillet	26	6	Tree	LS
Cactaceae					
	Cereus jamacaru DC.	6	13	Tree	ES
	Pilosocereus glaucescens (Labour) Byles	10	-	Tree	ES
	Pilosocereus gounellei (F.A.C. Weber) Byles & Rowley	1	-	Shrub	PI
	Opuntia palmadora Britton & Rose	103	27	Shrub	PI
Capparaceae					
	Capparis cynophallophora L.	16	4	Tree	ES
	Capparis jacobinae Moric. ex Eich.	8	13	Tree	ES
Celastraceae					
	Maytenus rigida Mart..	4	-	Tree	LS
Combretaceae					
	Combretum leprosum Mart..	5	-	Tree	ES
Euphorbiaceae					
	Cnidoscolus urens (L.) Arthur	2	-	Shrub	PI
	Croton jacobinensis Baill.	3	2	Shrub	PI
	Croton moritibensis Baill.	-	21	Shrub	PI
	Croton rhamnifolius Kunth.	-	1	Shrub	PI
	Croton sonderianus Muell. Arg.	274	367	Shrub	PI
	Jatropha pohliana Muell. Arg.	28	7	Shrub	PI
	Manihot glaziovii Muell. Arg.	86	12	Tree	ES
	Sapium sp.	90	-	Tree	ES
Fabaceae					
	Amburana cearensis (Allem.) A. C. Smith	2	-	Tree	LS
	Anadenanthera macrocarpa (Benth) Ducke	7	9	Tree	ES
	Bauhinia cheilantha (Bong.) Steud.	57	156	Tree	ES
	Caesalpinia ferea Mart. et Tul.	1	-	Tree	ES
	Caesalpinia pyramidalis Tul.	7	208	Tree	PI
	Erythrina velutina Willd.	5	-	Tree	LS
	Mimosa sp.	43	19	Tree	ES
	Mimosa tenuiflora Benth	-	6	Shrub	ES
	Piptadenia stipulacea (Benth.) Ducke	37	30	Tree	ES
	Senna spectabilis (DC) Irwin & Barneby	2	-	Tree	ES
	Leucaena leucocephala Lem. Witt.	2	-	Tree	IND
	Undetermined I	8	1	Tree	ES
Flacourtiaceae					
	Casearia guianensis Urb.	-	3	Shrub	ES
Malvaceae					
	Ceiba glaziovii (Kuntze) K. Schum.	5	3	Tree	LS
	Pseudobombax sp.	5	3	Tree	LS
Nyctaginaceae					
	Pisonia sp.	12	31	Tree	ES
Palmae					
	Syagrus cearenses Noblick.	2	-	Tree	IND
Sapindaceae					
	Allophylus sp.	45	47	Shrub	ES
Sapotaceae					
	Bumelia sartorium Mart.	1	-	Tree	ES
Verbenaceae					
	Lantana camara L.	2	7	Shrub	PI
	Lantana sp.	17	42	Shrub	PI
	Lippia gracilis Schauer	2	-	Shrub	PI

Table 2. Shannon-Wiener (H') index, Simpson index (D), equability (J), richness of species (RE) and richness of families (RF) for Areas I and II.

Indexs	Serra Inácio Pereira (Área I)	Serra do Monte (Área II)
H'	2.790	2.313
D	0.106	0.155
J	0.747	0.687
RE	6.05	4.06
RF	2.44	1.82

B. cheilantha, Mimosa sp. and *P. stipulacea,* which are small species that grow at greater relative densities.

To the detriment of the already demonstrated greater stage of conservation in this area, it is necessary to point out that *Leucaena leucocephala* grows in this environment, which is an exotic species in areas of the Caatinga. It is not possible to determine from the data obtained in this work if this was caused by a biological invasion or is a beneficial coexistence resulting from the impact of animal herds, which spread this species. It is necessary to explain that this species is only an invasive if it hinders the normal development of native species.

For Area II, seven species, *C. pyramidalis, A. pyrifolium, C. sonderianus, B. cheilantha, Pisonia* sp.*, Allophylus* sp. and *Lantana* sp.*,* represented 70% of the total sum of the IV, which are all species of the early successional stages, pioneer and early secondary (Table 3). These values denote Caatinga vegetation in the process of regeneration, confirming that the area had undergone alterations of anthropic nature.

The species *C. pyramidalis, C. sonderianus* and *A. pyrifolium* stood out with regard to IV mainly due to the high number of individuals inventoried, but *C. pyramidalis* and *A. pyrifolium* showed a greater relative dominance because of their larger size in height and diameter, and because they are the first arboreal species to colonize areas in the process of regeneration (Pereita *et al.* 2001, Andrade *et al.* 2005).

Ecological succession

In the general floristic composition of the two areas, 15 pioneer species, 19 early secondary species and 10 late secondary species were recorded (Table 1). *Syagrus cearenses* and *L. leucocephala* were the only indifferent species (IND), because according to Trovão *et al.* (2004) the incidence of the first species in areas of the Caatinga is restricted to high altitudinal zones such as mountains. However, *L. leucocephala* is an exotic species in the Caatinga.

Based on the classification of Gandolfi *et al.* (1995), the pioneer species that stand out among those described are *C. sonderianus*, *A. pyrifolium, O. palmadora* and *C. pyramidalis*, while the early secondary group includes *A. macrocarpa, B. cheilantha, P. stipulacea, Pisonia* sp. and *Allophylus* sp. The group of late secondary plants includes *M. urundeuva, S. tuberosa, S. brasiliensis, T. impetiginosa, M. rigida* and *C. glaziovii.* All of these species are unique to the Caatinga and are always listed in floristic studies carried out on this type of vegetation (Alcoforado-Filho *et al.* 2003; Cestaro & Soares 2004).

In Area I, there were 13 pioneer, 17 early secondary, 10 late secondary and two indifferent species (Table 1). Thus, the community found in Area I was in an intermediate stage of succession, where the pioneer species were beginning to lose their dominance to the early secondary species. It is important to note that the late secondary species were present in the area and were relatively important.

In analyzing the number of individuals of each ecological group (Table 4), Area I appeared to have an even distribution between the pioneer and early secondary

Table 3. Phytosociological parameters of importance value (IV) and cover value (CV) of the most common species in each area.

Area	Species	Area I	
		IV (%)	CV(%)
Serra Inacio Pereira (Area I)	*Croton sonderianus*	15.0	19.2
	Myracrodruon urundeuva	7.5	8.1
	Sapium sp.	6.3	6.9
	Opuntia palmadora	5.8	5.8
	Manihot graziovii	5.7	5.7
	Bauhinia cheilantha	4.9	5.4
	Mimosa sp.	4.6	4.9
	Piptadenia stipulacea	3.6	2.5
	Commiphora leptophloeos	3.6	2.9
	Allophylus sp	3.5	3.0
Serra do Monte (Area II)	*Caesalpinia pyramidalis*	19.5	25.4
	Aspidosperma pyrifolium	15.4	19.3
	Croton sonderianus	15.3	19.2
	Bauhinia cheilantha	8.7	9.3
	Pisonia sp.	3.9	3.6
	Allophylus sp	3.6	2.4
	Lantana sp.	3.5	2.2

Table 4. Number (NI) and percentage (%) of individuals in each ecological group, sampled in the survey carried out in Serra Inácio Pereira (Area I) and Serra do Monte (Area II).

Ecological Group	S. Inácio Pereira (Area I)		S. do Monte (Area II)	
	NI	(%)	NI	(%)
Pioneer (PI)	468	44.9	886	70.0
Early Secondary (SI)	439	42.1	344	27.2
Late Secondary (ST)	134	13.0	34	2.8
Total	1041	100%	1264	100%

Table 5. Importance value (IV) and cover value (CV) of the ecological groups in the two areas analyzed: Serra Inácio Pereira (Area I) and Serra do Monte (Area II).

Ecological Group	S. Inácio Pereira (Area I)		S. do Monte (Area II)	
	IV (%)	CV (%)	IV (%)	CV (%)
Pioneer (PI)	33.5	33.6	62.1	70.7
Early Secondary (ES)	42.8	41.9	32.3	26.2
Late Secondary (LS)	23.7	24.5	5.6	3.1
Total	100%	100%	100%	100%

ones. This demonstrated that in this area the vegetation was in an intermediate process of secondary succession, where there was the development of the community in a progressive direction, passing through early pioneer stage towards a greater degree of diversity and complexity. According to Silva *et al.* (2003), these conditions indicate a tendency toward better conditions for the establishment of late species.

In Area II, there were 11 pioneer species, 13 early secondary species and only 5 late secondary species (Table 1). The early secondary species were beginning to become established in the environment, but the dominance of the pioneer species was still obvious, which suggests a plant community in an early stage of development. This was confirmed when analyzing the number of individuals by ecological group (Table 4), which showed that in Area II 70% of the individuals sampled were pioneer species and characterized a vegetation in the process of natural regeneration, where the pioneer species were still very dominant.

Paula *et al.* (2004) affirmed that the simple characterization of the successional stage based only on the flora often does not consider important information and may not be able to express reality in a reliable manner, which makes it necessary to evaluate phytosociological parameters to better understand the developmental stage of a plant community. In this perspective, table 5 exhibits the combination of the phytosociological parameters according to each ecological group.

In Area I, the early pioneer and secondary species showed greater IV and CV, but it is seen that the late species also had high importance and cover values, demonstrating that in this area 11 species of the plant community were in an intermediate phase of succession, and that the late species were beginning to become established. In Area II, the pioneer species showed a greater dominance in relation to the other ecological groups. More than 60% of IV and CV corresponded to the pioneer group. The early secondary species were beginning to develop in this area, but the late species showed very low IV and CV, demonstrating that these species are unable to establish themselves in areas with a high level of degradation.

Although we used the classification proposed by Gandolfi *et al.* (1995), it can be inferred that the emergence of pioneer species at more elevated mountain levels can occur as a result of the peculiar environmental conditions of the Caatinga. For example, consecutive droughts and rains provide conditions, in even more developed environments, for the emergence of pioneer species, since the seed banks of these species are resupplied after every rainy period. In the dry period, in areas where the ground is not shaded, there is a greater incidence of light making it possible for seeds to germinate, which repopulates pioneer species.

CONCLUSIONS

An analysis of the vegetation cover in the two areas, Serra Inácio Pereira, a conserved area (Area I), and Serra do Monte, an anthropized area (Area II), revealed that the former appears to be heterogeneous, exhibiting a good state of conservation and that the latter appears to be more homogeneous, which is characteristic of anthropized environments.

Area I showed greater diversity in families and species compared to Area II, which directly influenced the diversity indices of the area and the development of the vegetation.

Based on the classification of the species into ecological groups, Area I showed a community at an intermediate stage of succession, where the pioneer species were beginning to lose their dominance to the early secondary species, and the late secondary species also appeared relatively important in the area. In Area II, the plant community was in an early stage of development, where the early secondary species were beginning to establish themselves, but the pioneer species were still dominant.

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