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Phytosociology of an open arboreal caatinga with high basal area in the Seridó desertification region, Brazil

Fitossociologia de caatinga arbórea aberta de elevada área basal em núcleo de desertificação do Seridó

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ABSTRACT - Seridó is one of the driest regions in the Caatinga biome, Northeastern Brazil, affected by a long history of anthropogenic impact, and today it is considered a desertification region. A phytosociological survey of woody species was carried out in an area at Morada das Jandairas Farm (MJF), in Santana do Seridó, Rio Grande do Norte, which still has a significant arboreal component despite maintaining an extensive cattle production, and compared it with data from other five inventories carried out in the region. Seventeen species from ten botanical families were found, with Fabaceae and Euphorbiaceae being the most diversified. *Commiphora leptophloeos* and *Croton blanchetianus* stood out as the most important species. The high floristic composition similarity among the six compared studies indicates that the different phytophysiognomies may be result of anthropogenic action and regeneration processes. The relatively high Basal Area in the MJF (26.8 m^2 ha^{-1}) stands out even considering inventories carried out throughout the Caatinga region, which is largely due to the presence of many large trees (*C. leptophloeos*). Considerations about the ecological importance of large and old trees are made, with recommendations for the methodology of phytosociological inventories.

Keywords: Dry forests. Seasonally dry tropical forests. Semiarid. Quartzarenic soils. Old trees.

RESUMO - A região do Seridó é uma das mais áridas do bioma caatinga, região Nordeste do Brasil, sendo afetada por uma longa história de impacto antrópico, e hoje considerada um núcleo de desertificação. Realizamos um levantamento fitossociológico das espécies arbustivo-arbóreas de uma área ainda com um componente arbóreo significativo, apesar de ainda ser utilizada para criação extensiva de gado, Fazenda Morada das Jandaíras (FMJ), e comparamos com dados de outros inventários realizados na região. Foram registradas 17 espécies pertencentes a 10 famílias botânicas, sendo Fabaceae e Euphorbiaceae as mais diversificadas. *Commiphora leptophloeos* e *Croton blanchetianus* se destacaram como as espécies de maiores valores de importância. A alta similaridade na composição florística entre os seis estudos comparados foi interpretada como indicador de que as diferentes fitofisionomias podem ser resultado de ação antrópica e processos de regeneração. A relativamente elevada Dominância Basal na FMJ, da ordem de 26,8 m^2 ha^{-1}, se destaca mesmo considerando inventários realizados em toda a região de caatinga, sendo em grande parte devida à presença de muitas árvores de grande porte de *C. leptophloeos*. Considerações sobre a importância ecológica de árvores grandes e antigas são feitas, com recomendações para a metodologia de inventários fitossociológicos.

Palavras-chave: Floresta seca. Florestas tropicais sazonalmente secas. Semiárido. Solo Quartzarênico. Árvores velhas.

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INTRODUCTION

Desertification is one of the main challenges for the conservation of dry ecosystems all over the world; it is a process caused by overexploitation of ecosystems by different land uses, such as extensive extraction of plant resources (extractivism) and livestock production, and anthropogenic climate changes (VIEIRA et al., 2021). Seridó is a region among the four desertification poles in the semiarid region of Northeastern Brazil, extending from the south of the state of Rio Grande do Norte to the center of the state of Paraiba. The Caatinga xerophilous vegetation in this region has been undergoing a long historical process of degradation, which began with colonization, mainly that focused on extensive cattle farming (SILVA et al., 2017). Its current situation of environmental degradation is severe, making the recovery of its soils and forest cover difficult (TOMASELLA et al., 2018).

The Seridó vegetation has been characterized by the presence of open areas with predominance of grasses, a landscape that distinguishes it from other regions of the Caatinga biome, which are predominantly forested (ANDRADE-LIMA,

1981; FERREIRA et al., 2009). However, Coimbra-Filho and Câmara (1996) reported that this predominant open vegetation in the Seridó region is not a natural feature, but the result of at least 300 years of anthropogenic impact by burning and cutting of vegetation, mainly for formation of pastures and agriculture areas, and overgrazing (COSTA et al., 2009). In addition, its woody forest vegetation, which occurs in a mosaic of formations of different sizes and densities, has traditionally been classified as arboreal, dense-shrubby, and open-shrubby, which are facies that may predominantly be the result of different processes of anthropogenic degradation and regeneration. According to Moro et al. (2015b), this interpretation is supported by a high floristic similarity among areas with woody vegetations of different sizes and densities.

Thus, the study and characterization of the phytosociology of woody vegetation in different areas of the Caatinga biome, especially those with higher basal area (biomass and size), under different soil, climate, and topography conditions allow for a better approximation to the possible original conditions of the dry forests in this region. Moreover, areas with well-developed forests can contribute to the conservation of some faunal elements and ecological processes (LINDENMAYER; LAURANCE; FRANKLIN, 2012; LINDENMAYER; LAURANCE, 2016).

The objective of the present work was to characterize the phytosociology of an open arboreal area in the Caatinga biome in the Seridó region and compare it with other phytosociological studies carried out in areas preserved for at least 30 years in the region. According to Rodal, Sampaio, and Figueiredo (2013), despite the existence of several phytosociological studies on the Caatinga biome, more studies are needed to understand these dry forests, with phytosociological surveys in areas of different characteristics to develop a complete floristic list based on quantitative data and understand the different types of Caatinga biome vegetations and their floristic connections.

MATERIAL AND METHODS

Study area

A phytosociological survey was carried out in the Morada das Jandairas Farm (MJF), Santana do Seridó, Rio Grande do Norte (RN), Brazil (-6.73083, -36.75361) (Figure 1). Its forest area was approximately 179 ha.

Seridó is one of the driest regions in the semiarid region of Northeastern Brazil, with an altitude of approximately 300 m and average annual rainfall of up to 600 mm (JESUS; MATTOS; JESUS, 2014). It has a typically open shrubby-arboreous xerophilous and deciduous Caatinga vegetation (ANDRADE-LIMA, 1981; QUEIROZ et al., 2017). The MJF presents a mosaic of different phytophysiognomies typical of the region, from areas with predominant herbaceous stratum and isolated trees or shrubs (Figure 2C) to areas with relatively large trees and sparse understory (Figures 2A, B, D). According to the person responsible for the farm (Mr. Ezequiel Macedo), the vegetation was thinned in the past to favor the formation of pasture for extensive cattle raising.

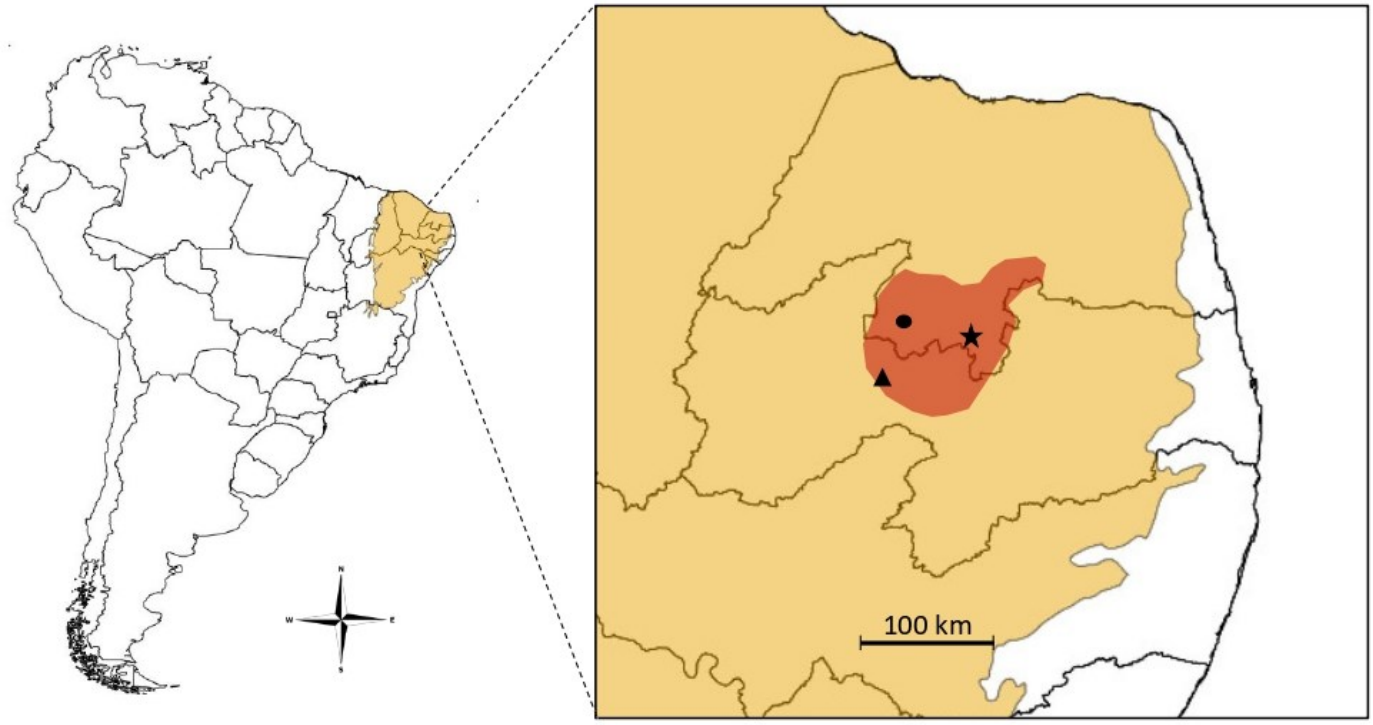

Figure 1. South America and boundaries of the Caatinga biome in Northeastern Brazil (orange). Boundaries of Seridó within the Caatinga biome region (red), in the states of Rio Grande do Norte and Paraiba, Brazil. Morada das Jandairas Farm (star), Seridó Ecological Station (circle), and Tamandua Farm (triangle).

Figure 2. Different phytophysiognomies in the Morada das Jandaíras Farm, Santana do Seridó, Rio Grande do Norte, Brazil. A. *Commiphora leptopholeos* (highlighted). B. *Pseudobombax marginatum* (highlighted). C. Open vegetation. D. Shrubby vegetation area with predominance of *Croton blanchetianus*.

The soils of the Seridó region where the MJF is located are originated from crystalline rocks and usually have small water retention capacity and susceptibility to erosion. The most common soils are Chromic Luvisols (non-calcic brown), with a high fertility, and shallow Lithic Neosols and Vertisols (FERREIRA et al., 2009; SANTANA; SOUTO, 2006). The soil in the MJF study area presented coarse grain and quartz particles (Figures 3 A and B) and was very permeable and deep, with practically no surface water, as the water infiltrates quickly, even in the rainy season. Few sectors had presence of more weathered soils (Figure 3C) and rock outcrops were scarce, differing from the general pattern of the Seridó region.

Figure 3. Soils with coarse grain and quartz particles commonly observed in the Morada das Jandaíras Farm, Santana do Seridó, Rio Grande do Norte, Brazil.

The results found for the MJF were compared to three other phytosociological studies carried out in two other relatively preserved areas of forested Caatinga in the Seridó region, which have been without significant anthropogenic impact for at least 30 years: Seridó Ecological Station (SEC), in Serra Negra do Norte, Rio Grande do Norte (AMORIM; SAMPAIO; ARAÚJO, 2005; SANTANA et al., 2016) and Tamandua Natural Heritage Private Reserve Farm (TF), in Santa Terezinha, Paraíba (GUEDES et al., 2012). The approximate distances between the areas were 57 km between MJF and SEC, 78 km between MJF and FT, and 52 km between SEC and TF (Figure 1).

The predominant soils in SEC were characterized as Chromic Luvisols, with deep and shallow depths, with localized occurrences of Litholic Neosols and Vertisols (SANTANA et al., 2009). TF is characterized as an extensive lowland plain, with residual elevations. Its soils are usually shallow and stony with medium to high fertility, but very susceptible to erosion, predominantly classified as Chromic and Podzolic Luvisols, Lithic Neosols, and Planosols (GUEDES et al., 2012).

Data collection

Field survey was carried out in April 2010 using the systematic sampling method with fixed plots. Ten transects with 200 meters in length each were established and then distributed from the dirt road that crosses the most forested area of the farm. The transects were at distances of approximately 400 m from each other. Two sample plots of 10×20 m spaced 100 m apart were defined on each trail; the first at 30 meters from the beginning of the trail. Twenty 200-m^2 plots were stablished, resulting in a total sampling area of 0.4 ha. The transects were stablished in sectors with no fully open herbaceous vegetation.

All shrubs and trees, living or dead, still standing, and whose perimeter at 1.30 m in height was larger than 6 cm were identified and measured in each sampling unit, following the Permanent Plot Measurement Protocol. Many species in the Caatinga biome have ramifications at their bases, therefore, measurements of all shafts of an individual were grouped to verify if it met the inclusion criteria.

The botanical identification was preliminarily carried out in the field, with the help of a local specialist, who lives in the region and has great knowledge of the local vegetation. Exsiccates were collected and deposited in the Herbarium Rita Baltazar de Lima (UFCG Patos). The floristic list follows the classification system of APG IV (2016) and the Flora Brasil 2020 database.

Data analysis

The horizontal and vertical structures of the community were studied: the horizontal corresponded to the form of distribution and occupation of woody plants in the area, in which the individuals were analyzed as units or by their basal area; and the vertical structure considered the maximum height and strata formation (CIENTEC, 2014). The height of the larger shaft was considered.

The sufficiency of sampling in the study area was analyzed based on a collector curve, which shows the appearance of new species during the survey. Floristic diversity was analyzed by the Shannon-Weaver diversity index (H'), and parameters of horizontal and vertical structures and species diversity of the phytosociological analysis were calculated using the software Mata Nativa (CIENTEC, 2014). The species composition was compared with other similar studies in the Seridó region, using the Sorensen-Dice similarity index (SD): $SD = 2a / (2a + b + c)$, where a = number of species common to both areas; b = number of species exclusive to one area; and c = number of species exclusive to other area. The SD varies from 1 (total similarity) to zero (no similarity).

RESULTS AND DISCUSSION

Sufficiency of sampling

The collector curve indicates that the sampling was sufficient to represent the diversity of species in the area, as the number of species sampled showed a strong tendency to increase up to the fifth plot, and two new species emerged only in the last two plots (Figure 4). These species were represented by only one individual each.

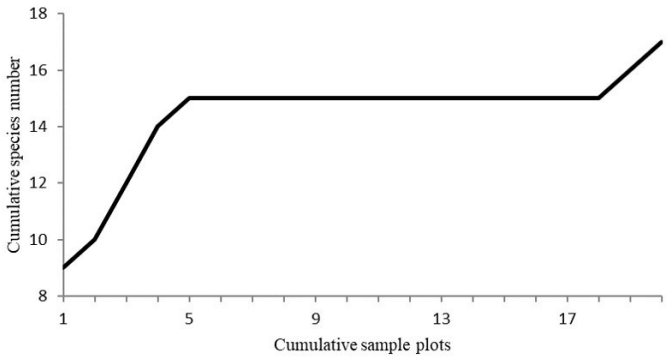

Figure 4. Cumulative species number (collector curve) in relation to cumulative sample plots at Morada das Jandaíras Farm, Santana do Seridó, RN, Brazil.

Floristic Composition and Community Structure

Only seventeen woody species were found in MJF, which denotes a low richness, even when compared to other sampled areas in the Seridó region (Tables 1, 2). Families with the highest numbers of species were the same observed in other areas: Fabaceae (6 spp.) and Euphorbiaceae (4 spp.).

Only the SEC 1 area, sampled by Amorim, Sampaio, and Araújo (2005), had a lower number of species; their study was carried out using the most inclusive criterion among the studies analyzed, and an area 2.5-fold larger was inventoried when compared to that in MJF (Table 2). The higher number of individuals observed in SEC 1 (Table 2) should result in a higher number of species, as Moro et al. (2015a) conducted a review on phytosociological studies in a Caatinga region and found a positive correlation between number of individuals and number of species. However, when analyzing only the four phytosociological studies cited for the Seridó region, no positive correlation is found between numbers of individuals and species.

Table 1. Woody shrub and tree species found in four phytosociological studies in the Seridó region, Brazil: Morada das Jandaíras Farm (MJF), Santana do Seridó, RN; Tamandua Farm (TF), Santa Terezinha, PB; and SEC Seridó (E1 and E2), Serra Negra do Norte, RN.

Family / Species	Common Name	Habit	MJF	TF[1]	E1[2]	E2[3]
Anacardiaceae						
Astronium urundeuva (M. Allemão) Engl.	Aroeira	Arboreal	x	x		
Apocynaceae						
Allamanda blanchetii A. DC.	Pente-de- macaco	Liana		x		
Aspidosperma pyrifolium Mart. & Zucc.	Pereiro	Arboreal	x	x	x	x
Bignoniaceae						
Handroanthus impetiginosus (Mart. ex DC.) Mattos	Pau d`arco roxo	Arboreal			x	x
Dolichandra unguis-cati (L.) L.G.Lohmann	Unha de gato	Liana				x[4]
Bixaceae						
Cochlospermum vitifolium (Willd.) Spreng.	Algodão bravo	Arboreal	x	x[4]		
Boraginaceae						
Varronia globosa Jacq.	Maria-preta	Shrubby			x[4]	
Burseraceae						
Commiphora leptophloeos (Mart) J.B. Gillet	Imburana	Arboreal	x	x	x	x
Cactaceae						
Cereus jamacaru DC.	Mandacaru	Shrubby		x		x
Capparaceae						
Cynophalla flexuosa (L.) J. Presl	Feijão-bravo	Shrubby		x	x	x
Combretaceae						
Combretum leprosum Mart.	Mofumbo	Shrubby	x	x	x	x
Erythroxylaceae						
Erythroxylum pungens O. E. Schulz	Rompe-gibão	Shrubby		x	x	x
Euphorbiaceae						
Cnidoscolus quercifolius Pohl	Favela	Arboreal	x	x		x
Croton blanchetianus Baill	Marmeleiro	Shrubby	x	x	x	x
Croton campestris A.St.-Hil.	Velame	Shrubby				x
Jatropha mollissima (Pohl) Baill	Pinhão-bravo	Shrubby	x	x	x	x
Manihot carthagenensis (Jacq.) Müll.Arg	Maniçoba	Shrubby	x			
Fabaceae						
Amburana cearensis (Allemão) A.C. Sm.	Cumaru	Arboreal		x	x	x
Anadenanthera colubrina (Vell.) Brenan	Angico	Arboreal	x	x	x	x

1. TF1= Guedes et al. (2012); 2. E1- SEC1 = Amorim, Sampaio, and Araújo (2005); 3. E2- SEC2 = Santana et al. (2016). 4. Cited with a synonymous.

Table 1. Continuation.

Family / Species	Common Name	Habit	MJF	TF[1]	E1[2]		E2[3]
Bauhinia cheilantha (Bong) Steud	Mororó	Arboreal		x	x	x	X
Cenostigma pyramidale (Tul.) E. Gagnon & G.P. Lewis	Catingueira	Arboreal		x	x	x	x
Chamaecrista hispidula (Vahl) H.S.Irwin & Barneby	-	Shrubby					x[4]
Chloroleucon foliolosum (Benth.) G. P. Lewis	-	Shrubby			x		
Libidibia ferrea (Mart. ex Tul.) L.P.Queiroz	Jucá	Arboreal					x
Mimosa arenosa (Willd.) Poir	Jurema vermelha	Arboreal		x			
Mimosa tenuiflora (Willd.) Poir	Jurema-preta	Arboreal		x	x	x	x
Piptadenia retusa (Jacq.) P.G.Ribeiro, Seigler & Ebinger[4]	Jurema-branca	Arboreal		x	x	x	x
Senna macranthera (DC. ex Collad.) H.S. Irwin & Barneby	São João	Arboreal			x		x
Malvaceae							
Pseudobombax marginatum St., Hill., Juss. & Cambess) A. Robyns	Embiratanha	Arboreal		x	x		
Rubiaceae							
Cordiera rigida (K. Schum.) Kuntze	-	Shrubby		x			
Verbenaceae							
Lantana camara L.	Chumbinho	Shrubby					x

1. TF1= Guedes et al. (2012); 2. E1- SEC1 = Amorim, Sampaio, and Araújo (2005); 3. E2- SEC2 = Santana et al. (2016). 4. Cited with a synonymous.

Table 2. Phytosociological and environmental data from four studies in the Seridó region, Brazil: Morada das Jandaíras Farm (MJF), Santana do Seridó, RN; Tamandua Farm (TF), Santa Terezinha, PB; and SEC1 and SEC2, Serra Negra do Norte, RN, ordered from the most inclusive to the least. PBH = perimeter at breast height, DAS = diameter at ground level, PNB30 = perimeter at 30 cm from the ground, PAS = perimeter at ground level, ADo = absolute dominance, Spp = richness of species, SIM = mean of Sorensen-Dice Similarity Index, and Shannon-Wiener (H') diversity index.

Location	Inclusion Criteria	Area (ha)	Altitude (m)	Predominant Soil type	No. ind.	Density (ind. ha^{-1})	ADo (m^2 ha^{-1})	Spp	SIM	H'	Source[2]
SEC1	PBH ≥ 3 cm	1.0	200	Argisol	3247	3.2	6.10	15	0.69	1.94	E1
MJF	PBH > 6 cm	0.4	300	Quartzarenic	833	2.0	26.87	17	0.70	2.02	This work
SEC2	DAS ≥ 3 cm and height ≥ 1 m ([1])	2.0	?	?	1684	1.4	7.70	22	0.67	2.35	E2
TF	PAS ≥ 10 cm and height ≥ 1 m	0.4	300	Luvisol Chromic	649	1.6	9.21	21	0.73	2.54	TF1

[1]Equal to PAS ≥ 9.4; [2] See Table 1.

Therefore, the lower richness of species found by Amorim, Sampaio, and Araújo (2005) cannot be attributed to methodological aspects, such as inclusion criteria and total surveyed area, but to the specific characteristics of the selected plots, which presented many small size individuals from a dominant species, possibly denoting an area under regeneration. In this case, *Aspidosperma pyrifolium* corresponded to 37% of the total density of individuals sampled and to 50% of the total basal area (ADo). The species with the greatest contribution to total density in MJF is *Croton blanchetianus*, representing 40% of the individuals; but this species presented a very small number of individuals and its contribution to the total basal area was only 9.7%.

The relatively small number of species in MJF was connected to the small area surveyed, less inclusion criterion, and a higher absolute dominance in terms of basal area (Table 2), which was mainly due to the most important tree species (Table 3).

The Shannon-Weaver diversity index (H') followed the variation in richness of species between areas; it was higher for MJF only when compared to the SEC studied by Amorim, Sampaio, and Araújo (2005) (Table 2). The comparison found a high proportion of species shared between all surveys evaluated, which resulted in a high Sorensen-Dice similarity index (Table 2).

The use of different sampling parameters, mainly the inclusion criteria, potentially affected the density and number of species found. Four inclusion criteria, among the four phytosociological inventories analyzed for the Seridó region, were used (Table 2): the least inclusive considered only individuals with circumference equal to or larger than 10 cm above ground and height equal to or greater than one meter (GUEDES et al., 2012), and the most inclusive was that from the study of Amorim, Sampaio, and Araújo (2005) described above.

Table 3. Phytosociological parameters of the species sampled in the Morada das Jandairas Farm, Santana do Seridó, RN, Brazil.

Species	AD (ind./ha)	RD (%)	AF	RF (%)	ADo (m²/ha)	RDo (%)	Cv (%)	IV (%)
C. leptophloeos	285	13.60	95	11.80	11.80	44.20	28.90	23.2
C. blanchetianus	832	39.90	90	11.20	2.59	9.66	24.80	20.3
C. pyramidale	190	9.12	100	12.50	2.00	7.46	8.29	9.69
C. leprosum	210	10.00	90	11.20	0.79	2.95	6.52	8.09
M. tenuiflora	142	6.84	55	6.88	2.57	9.59	8.22	7.77
M. arenosa	102	4.92	70	8.75	0.94	3.50	4.21	5.73
C. quercifolius	25	1.20	30	3.75	2.58	9.61	5.41	4.85
B. cheilantha	110	5.28	50	6.25	0.30	1.13	3.21	4.22
A. pyrifolium	50	2.40	50	6.25	0.95	3.56	2.98	4.07
J. mollissima	32	1.56	45	5.63	0.16	0.60	1.08	2.59
P. retusa	35	1.68	30	3.75	0.26	1.00	1.34	2.14
Dead	25	1.20	35	4.38	0.14	0.52	0.86	2.03
C. vitifolium	15	0.72	10	1.25	1.08	4.03	2.38	2.00
M. carthaginensis	10	0.48	20	2.5	0.02	0.08	0.28	1.02
A. colubrina	7.5	0.36	10	1.25	0.19	0.73	0.54	0.78
P. marginatum	5	0.24	10	1.25	0.10	0.39	0.31	0.63
A. urundeuva	2.5	0.12	5	0.63	0.23	0.88	0.50	0.54
C. rigida	2.5	0.12	5	0.63	0.02	0.10	0.11	0.28
Total	2082	100	800	100	26.8	100	100	100

AD = absolute density, RD = relative density, AF = absolute frequency, RF = relative frequency, ADo = absolute dominance, RDo = relative dominance, Cv = coverage value, Cv% = coverage value in percentage, and IV% = importance value in percentage.

The density of individuals in MJF showed an intermediate value in relation to the surveys carried out in the other areas, but MJF stands out among them regarding absolute dominance, which represents the sum of the basal areas of all species per unit of area (Table 2). It may be a consequence of the presence of bigger trees, possibly older, where a single or a few individuals can occupy a sample plot and limit the occurrence of other individuals under their crown.

The only exclusive species in MJF was *Cordiera rigida*. This is the first record of the genus for the state of Rio Grande do Norte. This species is endemic to Brazil, occurring in the Cerrado and Caatinga biomes, and was recorded before in the state of Paraiba (PESSOA; BARBOSA, 2012), and in the Cariri and Sertão regions, under relatively shallow soils, such as Litholic Neosols and Luvisols. The soils in MJF are apparently deep, but formed by coarse sand, and possibly very poor due to leaching of nutrients.

Horizontal Structure

The highest importance values, above 20%, was found for *Commiphora leptophloeos* and *Croton blanchetianus*, but the first is a tree that reached 44% of the total basal area and the second is a shrubby that presented the highest number of individuals (Table 3). Despite *Cenostigma pyramidale* was the fourth species in number of individuals, it was represented in all plots, followed by *Commiphora leptophloeos*, *Croton blanchetianus*, and *Combretum leprosum*.

The maximum diameter was found for a specimen of *Cnidoscolus quercifolius* (170 cm), followed by *Commiphora leptophloeos* (163 cm and several individuals with very large diameters, six of them above 100 cm), *Cenostigma pyramidale* (95 cm), and *Cochlospermum vitifolium* (88 cm). The diversity of trees that had dry, thick, and hollow branches stood out, denoting possible aging, which is an important factor for the functioning of the ecosystem and maintenance of the local fauna (LINDENMAYER; LAURANCE; FRANKLIN, 2012; LINDENMAYER; LAURANCE, 2016). Many hollows were found in trunks of *Commiphora leptophloeos* in the MJF area; they are used as shelter by reptiles, small rodents, birds, and insects in general and, more often and permanently, as nests for native bees.

Silva et al. (2017) analyzed phytosociological and growth aspects of *C. leptophloeos* in the Brazilian Semiarid region and compared their data with works carried out in 44 different areas, where its relative dominance (RDo) varied from 0.01% to 19.58%. The maximum RDo found by Silva et al. (2017) was very lower than that found in MJF (44.2%), which stresses the peculiarity and importance of the area surveyed in MJF. They considered that this tree species presents a slow growth and regeneration, and estimated that its annual periodic increment in the Caatinga is 0.14 cm (diameter) year^{-1}, ranging from 0.00 to 0.25.

The presence of many individuals of this species in MJF, large and certainly older, represents a unique feature among the areas already studied in the region and serves as a closer reference, at least for this species, to the possible original structure of these forests before human intervention. This species was considered a late secondary tree by Lima and Barbosa (2018).

Croton blanchetianus is considered a pioneer species; it presented many small individuals, which is in consistent with studies of anthropized open Caatinga vegetations at regeneration stage (SABINO; CUNHA; SANTANA, 2016; SANTANA et al., 2016). Additionally, *Aspidosperma pyrifolium* and *Mimosa tenuiflora* were considered pioneer tree species, and *Combretum leprosum, Anadenanthera colubrina, Bauhinia cheilantha*, and *Cenostigma pyramidale* were considered early secondary species by Lima and Barbosa (2018), reinforcing the importance of early successional species in MJF.

The frequency distribution by diametric classes of individuals for the studied community showed an inverted J-shaped curve (Figure 5). This same distribution pattern has been described for other areas of the Seridó region (GUEDES et al., 2012; SANTANA et al., 2016; AMORIM; SAMPAIO; ARAÚJO, 2005).

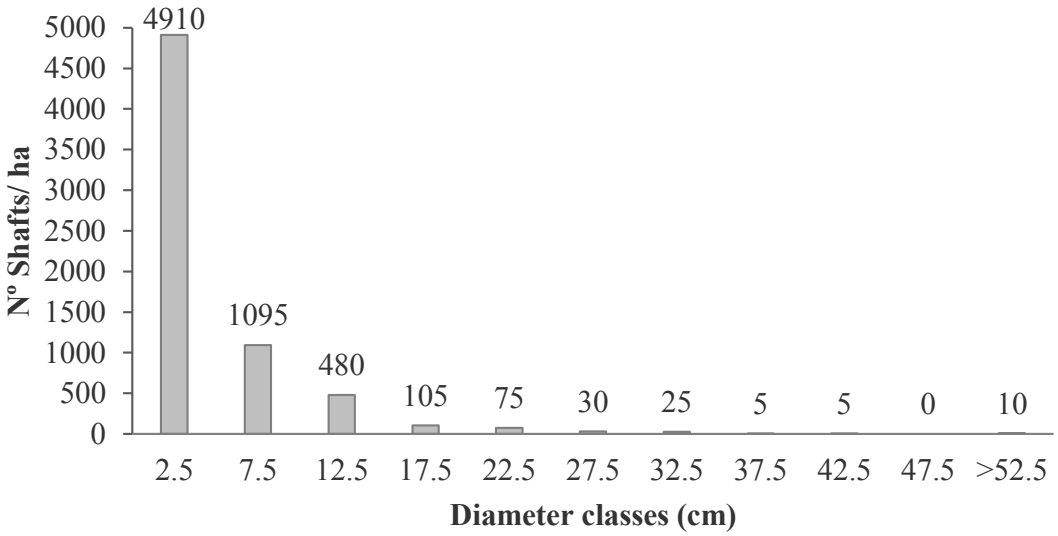

Figure 5. Distribution of shafts by diameter class (middle point), considering each shaft as an individual, in the Morada das Jandairas Farm, Santana do Seridó, RN, Brazil.

Vertical Structure

The maximum height found in the studied community was 10 m and the minimum was 1.5 m (Figure 6). The greatest heights were found for individuals of *Cnidoscolus quercifolius* (10 m), *Aspidosperma pyrifolium*, and *Combretum leprosum* (9 m). *Commiphora leptophloeos* had individuals with 8 m, and *Cochlospermum vitofolium* and *Croton blanchetianus* had individuals with 7 m. Larger trees were found in MJF, but they were not represented in the plots, such as *Cnidoscolus quercifolius*, *Pseudobombax marginatum* (Figure 2B), *Anadenanthera colubrina,* and *Spondias tuberosa*.

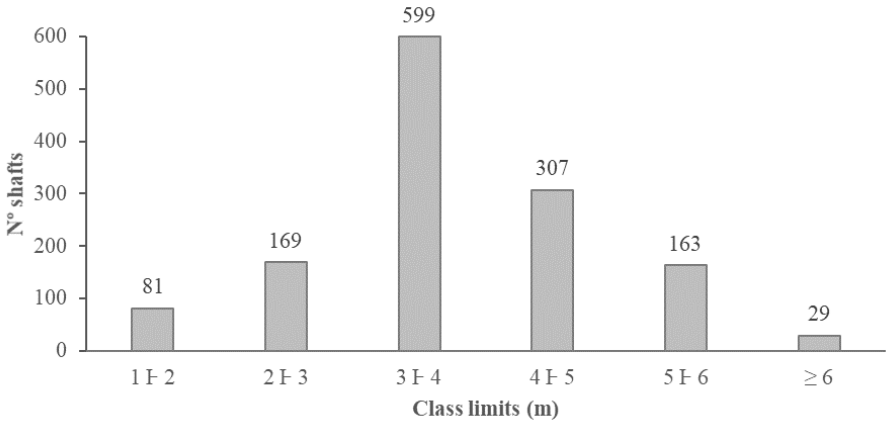

Figure 6. Distribution of shrubby-tree individuals by height class in the Morada das Jandairas Farm, Santana do Seridó, RN, Brazil.

CONCLUSION

Despite the different inclusion criteria used in the evaluated studies and the high variation in phytosociological parameters, such as density of individuals and total basal area, the high floristic similarity found can be interpreted as evidence that the different phytophysiognomies in these relatively preserved areas in the Seridó region can be the result of different histories of anthropogenic degradation and regeneration, following the interpretation of Moro et al. (2015b). Currently, it is not possible to associate any aspect of their woody vegetation with any characteristic of the area, such as soil. The predominant Quartzarenic Neosols in the Morada das Jandairas Farm (MJF) is distinct from the Chromic Luvisols and shallow Lithic Neosols commonly found in the Seridó region.

The small number of species in areas of the Sertaneja Septentrional Depression, particularly in the Seridó region, might be related to an intense and prolonged anthropogenic impact, resulting in a scenario of slow landscape regeneration (MORO et al., 2015b; SILVA et al., 2017). In the case of excessive degradation with soil loss, the process becomes much slower and can reach critical levels of desertification. This is the scenario in a large part of the Seridó desertification region (ALBUQUERQUE et al., 2020).

The high absolute dominance in total basal area per hectare found in MJF, when compared to other relatively preserved areas in the Seridó region, is due almost exclusively to the many large individuals of the species *Commiphora leptophloeos*. The basal area of this species in MJF was higher than the total basal area found for all species by the studies carried out in the Seridó Ecological Station (SEC) and Tamandua Natural Heritage Private Reserve Farm (TF), characterizing MJF as an exceptional area in the context of the Seridó region. The high number of large individuals of *C. leptophloeos* found is probably the result of selective cutting of other species. The presence of isolated specimens of large tree of the other species mentioned in the vertical structure section may also be remnants of selective cutting in the area. However, the great abundance of *Croton branchetianus*, which is a pioneer shrubby species (SABINO; CUNHA; SANTANA, 2016), and other pioneer early successional species might correspond to sectors that were cleared for formation of pastures for cattle breeding, which is a traditional activity in the region and still practiced in MJF.

C. leptophloes trees with larger diameters must be very old. Considering an estimated annual average growth of 1.5 cm (SILVA et al., 2017), the individual with the largest diameter had an estimated age of 106 years, and the several individuals with more than one meter in diameter were at least 67 years old. Another qualitative indicator of the age of these trees is the large number of hollows evidenced by eusocial nests of stingless bees (Meliponini) that occupy them (original observation at field). This tree species has also great social and ecological importance (PAREYN; ARAÚJO; DRUMOND, 2018) as well as *Cenostigma pyramidale* and *Astronium urundeuva*, since they usually have hollows that are important for social bees and other organisms, including wasps, mammals, and birds in the Caatinga biome (MAIA-SILVA; HRNCIR; IMPERATRIZ-FONSECA, 2017).

The study and conservation of old-growth forest areas in several regions of the world are matter of great concern (LINDENMAYER; LAURANCE; FRANKLIN, 2012). The occurrence of large trees with high basal area, presumably old, in xerophilous deciduous forests in the Caatinga region has been very little reported. The only area with an absolute dominance higher than that observed in MJF was Serra Talhada, in the state of Pernambuco, with 56.81 m^2 ha^{-1} (SOBRINHO et al., 2016), which is more than double that found in MJF; it was not expected, considering the large number of phytosociological surveys listed by Moro et al. (2015a) for xerophilous Caatinga vegetation (88). Nevertheless, fragments of forests with high density of large trees are rare, even when represented by few species; thus, recognizing and preserving those that have this characteristic and studying their possible effect on the maintenance of the biodiversity in general and on the functioning of ecosystems are increasingly important.

Andrade-Lima (1981) described the difficulty in recognizing the original phytophysiognomy of each area in the Caatinga region due to a historical context of intense and continuous anthropogenic impact on the vegetation, which was recently reinforced by Menezes et al. (2012) and Moro et al. (2015b). This situation does not diminish, but highlights the importance of searching for areas with presumably more preserved characteristics.

The presence of large trees is assumed to be older remnants of vegetation, at least for the arboreal Caatinga vegetation. The documentation of the presence of old and large trees has an intrinsic value due to their great ecological importance for the stability of the cycling of water and nutrients and for the fauna, providing microhabitats and cavities for protection and nesting of animals, minimizing the direct sunlight on the soil, increasing the abundance of fungi, providing resources, such as leaves, flowers, and fruits, more constantly throughout the year, and expanding the spatial and vertical heterogeneity (LINDENMAYER; LAURANCE; FRANKLIN, 2012).

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