

# Floristic analysis in a toposequence of the municipality of Serrinha dos Pintos - Rio Grande do Norte state

## Análise florística em uma topossequência no município de Serrinha dos Pintos - Rio Grande do Norte

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### Abstract

Aiming to contribute to the knowledge of the vegetation of the municipality of Serrinha dos Pintos, Rio Grande do Norte state, a floristic analysis was carried out along a toposequence. Three distinct areas were selected: Plateau (700 m to 720 m altitude), Slope area (410 m to 510 m altitude) and Depression (270 m to 310 m altitude), with allocation of 30 fixed plots of 10 mx 10 m, 10 plots in each area. All individuals with heights greater than or equal to 1 meter and circumference greater than 10 centimeters were sampled. In order to observe the richness and diversity of the study areas, the Shannon-Wiener Diversity Index ( $H'$ ) was calculated. In all, 821 individuals were collected, identified in 35 species and 19 families. The Plateau was the area with the highest diversity of species (21), the families Fabaceae (8 spp.) and Euphorbiaceae (3 spp.) were the most representative; (18 spp.), Slope Area had (18 spp.), also Fabaceae (8 spp.) and Euphorbiaceae (3 spp.) were the families with the highest richness and Depression was the area with the lowest diversity (14 spp.), including Fabaceae (5 spp.) and Euphorbiaceae (3 spp). The most representative species in the three areas were *Croton blanchetianus* (Marmeleiro), *Cenostigma bracteosum* (caatingueira) and *Myracrodruon urundeuva* (Aroeira). The Shannon-Wiener diversity index ( $H'$ ) observed for the Plateau area was 2.42, in Slope Area, it was 2.07 and in Depression, it was 1.91. It is emphasized that the greater the result, the greater the diversity of species in the area in question.

**Keywords:** Caatinga (Scrub forest); Floristic composition; Diversity; Semi-arid

### Resumo

Com o objetivo de contribuir para o conhecimento da vegetação do município de Serrinha dos Pintos-RN, foi realizada a análise florística ao longo de uma topossequência. Foram selecionadas três áreas distintas: Chapada (700 m a 720 m de altitude), Encosta (410 m a 510 m de altitude) e Depressão (270 m a 310 m de altitude), onde foram alocadas 30 parcelas fixas de 10 m x 10 m, sendo 10 parcelas em cada área. Foram amostrados todos os indivíduos com alturas superiores ou iguais a 1 metro e circunferência maior que 10 centímetros. Para observar a riqueza e diversidade das áreas

de estudo, foi calculado o Índice de diversidade de Shannon-Wiener (H). Ao todo, foram coletados 821 indivíduos, identificados em 35 espécies e 19 famílias. A Chapada foi a área com maior diversidade de espécies (21), sendo Fabaceae (8 spp.) e Euphorbiaceae (3 spp.) as mais representativas; a Encosta com (18 spp.), também Fabaceae (8 spp) e Euphorbiaceae (3 spp.) foram as famílias com maior riqueza e Depressão a área de menor diversidade (14 spp.), sendo Fabaceae (5 spp.) e Euphorbiaceae (3 spp). As espécies de maior representação nas três áreas foram a *Croton blanchetianus* (Marmeleiro), *Cenostigma bracteosum* (caatingueira) e a *Myracrodruon urundeuva* (Aroeira). O índice de diversidade de Shannon-Wiener (H') observado para a área de Chapada foi de 2,42, na Encosta foi de 2,07 e na depressão foi de 1,91. Ressalta-se que quanto maior for o resultado, maior será a diversidade de espécies na área em questão.

**Palavras-chave:** Caatinga; Composição florística; Diversidade; Semiárido

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## I. INTRODUCTION

The Caatinga (scrub forest) biome, present in great part of the Brazilian Northeast, has different characteristics at certain times of the year. An example of this is the lack of the green exuberance of the tropical forests and the presence of the dry aspect through its cacti and shrubs, implying that it has a low diversification in its flora. But it is necessary to look closely to unravel the richness of this biome, its high biodiversity, biological relevance and, above all, its peculiar beauty (LEAL; TAMBARELLI; SILVA, 2003).

According to Ab'Sáber (1990, p. 155), the Caatinga biome "in all its regional patterns constitutes a steppe vegetation of hot semi-arid climate, strictly linked to regional climatic and soil conditions". According to Andrade-Lima (1981), the term Caatinga (scrub forest) is a typical name of the Brazilian semi-arid and has indigenous origin, which means white forest. It is constituted of prickly trees and shrubs, xerophilous, deciduous, with presence of succulent plants and seasonal herbaceous stratum. From the same perspective, Rizzini (1997) confirms that this vegetation is formed by small trees and deciduous shrubs during the dry season and often endowed with thorns, cacti, bromeliads, and annual herbs.

Rodal *et al.* (1992) points out that this vegetation is characterized primarily by the tropophytism of its components and has as a common feature the water deficit during most of the year. This water shortage is due to low rainfall, high evapotranspiration, poor distribution of rainfall throughout the year and low water holding capacity of soils, which are generally shallow and stony. Thus, it should be noted that:

the semi-arid region exhibits a relatively high environmental variability, especially with regard to geological materials and relief, as well as some important climatic variations. Due to this variability, there are expressive soil differentiations in the environments that integrate the surface occupied by the caatinga biome. (ARAUJO FILHO, 2011, p. 20)

Geologically, the Caatinga (scrub forest) biome predominantly occupies precambrian areas constituted by metamorphosed rocks (ANDRADE-LIMA, 1977), called the *Depressão Sertaneja* (hinterland depression). In addition to these areas, the Caatinga occupies some plateaus and residual reliefs spread through the depressions (NASCIMENTO, 1998, p.13).

Soils of the semi-arid region present physical morphological, chemical, and mineralogical features that allow them to be subdivided into relatively homogeneous classes (EMBRAPA, 2014). According to Rizzini (1997), the soil is predominantly clayey, red, and may also be sandy and most often represented by outcrops of crystalline rocks. According to the author, if it is not stony, the soil is shallow and compact over which the rainwater rushes violently, eroding it with high intensity.

Regarding the study and conservation of the Caatinga biome, this is one of the major challenges of Brazilian science, because this vegetation consists of a large natural region of the country, little protected and goes through an extensive process of environmental change caused mainly by the unsustainable use of its natural resources (LEAL; TAMBARELLI and SILVA, 2003).

In this way, this biome has been drastically devastated. Since the past, man has been using this area for the development of extensive livestock farming, agriculture in the most humid parts, removal of firewood and wood for other purposes of lesser socioeconomic interest. According to Santana (2006), this type of exploration in such a poorly protected environment could lead to an irreversible process of degradation.

Thus, floristic studies are the best way to know an ecosystem, since they contribute to the knowledge of vegetation formations, and later, aim to analyze the distribution of individuals in species and families (Souza, 2009). On the other hand, Chaves *et al.* (2013) emphasizes that the study of floristic composition is of fundamental importance for the knowledge of the vegetation structure, providing qualitative and quantitative information about the area under study and the decision making for the best management of each type of vegetation.

Studies on floristic composition have been intensifying in the Brazilian semi-arid region and several works have been developed, contributing significantly to the understanding of vegetation dynamics and structure.

Ferraz *et al.* (1998) carried out studies on floristic composition in four areas with differentiated orographic factors in the region of Pajeú Valley, Pernambuco state, ranging from 500 m to 1,100 m. They identified 159 species, 101 genera and 45 families. Araújo (2007) analyzed the floristic and phytosociological

composition and the influence of soils on vegetation structure in a caatinga area (scrub forest) in the hinterland of Paraíba state, and identified 1,704 individuals belonging to 27 species, 23 genera and 15 families.

Silva, Lopes and Silva (2012) examined the floristic composition of a caatinga fragment in the municipality of Itapetim, State of Pernambuco. In the study area, the authors recorded 673 individuals belonging to 13 families, 28 genera and 31 species. Lima, Coelho, and Oliveira (2012) studied the floristic characterization of two caatinga areas (Scrub forest) in the Center-South region of the State of Ceará and sampled 256 species, distributed in 169 genera and 62 families.

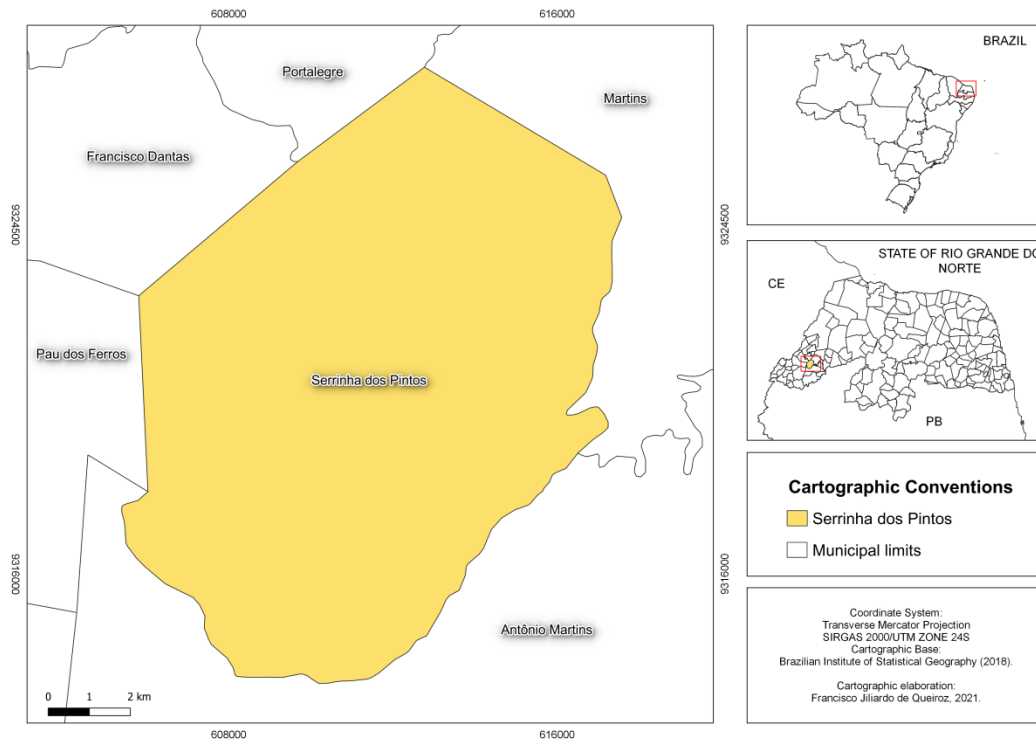
The studies mentioned above were developed in areas that present physiographic similarities to the municipality of Serrinha dos Pintos, Rio Grande do Norte state. Thus, they helped in the design of the present research, since, in the municipality of Serrinha dos Pintos, there are no specific studies regarding its vegetation.

In this sense, the present study aimed to conduct a floristic analysis along a toposequence in the mentioned municipality, in order to know the predominant flora and under what conditions it is found, as well as to check for floristic variations of the vegetation regarding the topography, in a way to make possible a greater knowledge about existing socioenvironmental problems, as well as in the support to the development of preservation environmental policies for the systemic balance of the space studied.

## II. MATERIAL AND METHODS

### Geographical location and characterization of the study area

The floristic composition was analyzed in the municipality of Serrinha dos Pintos, Rio Grande do Norte state, whose area corresponds to 122,375 km<sup>2</sup> and is inserted in the Western Mesoregion of the Rio Grande do Norte and the Umarizal Microregion (IBGE, 2013), is limited to the north with the municipality of Portalegre and Francisco Dantas, to the south with Antônio Martins, to the east Martins and Antônio Martins and to the west with Pau dos Ferros and Francisco Dantas (Figure 1).



**Figure 1: Map of Serrinha dos Pintos, State of Rio Grande do Norte.**

**Source:** Prepared by the authors (2018).

The predominant climate is Sub-humid Rainy, with occurrences of rains in the first five months of the year. It has an average rainfall of 903 mm/year, with an average annual temperature of 23°C (QUEIROZ; MEDEIROS; QUEIROZ, 2017).

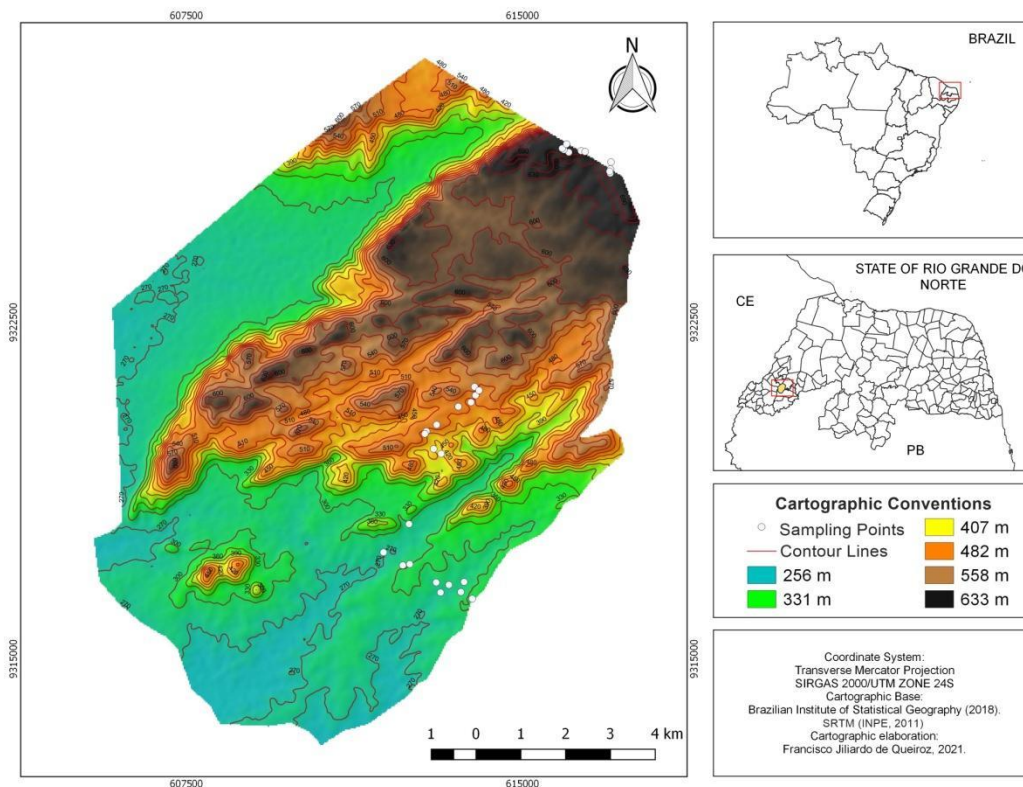
The study area consists of the following lithostratigraphic units: Caicó complex, Poço da Cruz suit, Colluvium-eluvial deposits, Itaporanga suit, formation of Serra de Martins mountain ranges and Indiscriminate Granitoids (CPRM, 2005).

The municipality is located geologically in the Borborema Province, in crystalline basement terrains, except for a small portion to the north that presents sedimentary terrain, represented by the formation of Serra de Martins mountain ranges.

Geomorphologically, the municipality has the following relief units: Flattened or Degraded Surfaces, Tableland and Plateaus, High Plateaus, Fluvial Plains, Serrana Escarpments, Inselbergs, and other residuals reliefs (MEDEIROS AND QUEIROZ, 2016). There is predominance of soils Red yellow Latosols, Neosols, Luvisols and Argisols (JACOMINE, 1971).

### Sampling and data collection

For the collection of botanical material in the toposequence, three geomorphologically distinct areas were delimited in transects within the municipality of Serrinha dos Pintos, State of Rio Grande do Norte. The first area was characterized by plateau, with altitudes varying from 700 m to 720 m. The Slope Area with altimetric heights between 410 m and 510 m; and finally, the depression area ranging from 270 m to 310 m altitude (Figure 2).



**Figure 2:** Hypsometric classes of the municipality of Serrinha dos Pintos, State of Rio Grande do Norte.

**Fonte:** Prepared by the authors (2018).

Thus, 30 plots of 10m x 10m were allocated, 10 of which were randomly distributed in each toposequence area (Plateau, Slopes and Depression). As inclusion criterion, only species with heights greater than or equal to 1 meter and circumference greater than 10 cm at base height (ARAÚJO, 2007) were considered within each plot.

Identification of the species was carried out through specialized literature. Subsequently, the species and their respective families were checked through consultation with experts and the virtual herbarium speciesLink (<http://splink.cria.org.br>). According to Medeiros (2016, p. 141), this virtual herbarium “is characterized as a distributed information system that integrates in real time, primary data of scientific

collections from various parts of Brazil”. In turn, for the classification of the habit of the species into arboreal and shrub, we used the Technical Manual of the Brazilian vegetation (IBGE, 2012).

From the data obtained in the field, the diversity index of Shannon-Wiener (1963) was calculated. This index was introduced to calculate information about a particular plant community, the higher its value, the higher the diversity and richness (MEGURO, 2000), being calculated by the following equation:

$$H' = \frac{\left[ N \ln(N) - \sum_{i=1}^s n_i \ln(n_i) \right]}{N}$$

Where:

H' = Shannon-Wiener diversity index

ni=Number of individuals sampled from species i;

N=total number of individuals sampled;

S= total number of species sampled;

ln=Napierian logarithm.

### III. RESULTS AND DISCUSSION

#### Analyses of the three areas: Plateau, Slope area and Depression

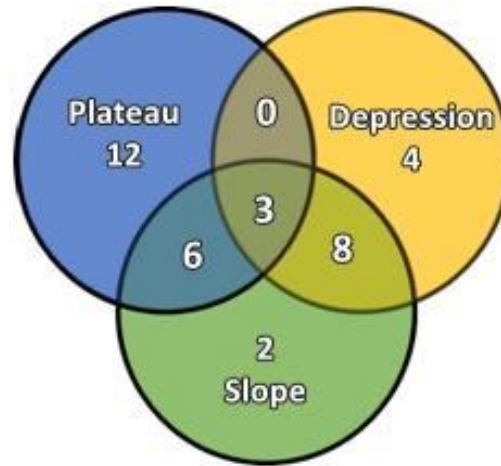
In all, 821 individuals were sampled in the three areas, belonging to 34 species, 29 genera and 16 families (Table 1). The most species-rich families were Fabaceae (13 spp.), Euphorbiaceae (4 spp.), Anacardiaceae, Apocynaceae and Combretaceae (2 spp.), respectively, and the others with only one species each. The most representative genera were *Aspidosperma*, *Combretum*, *Croton*, *Mimosa* and *Senegalia* with two species each. Considering the habit of the species, 62% were arboreal and 38% were shrub, with no liana. According to Queiroz (2009), *Dahlstedtia araripensis* (Benth.) M.J. Silva & A.M.G. Azevedo, *Libidibia ferrea* (Mart. ex Tul.) L.P. Queiroz., *Senegalia polyphylla* (DC.) Britton & Rose. are arboreal species, however, were found with shrub habit in the area, as well as *Talisia esculenta* (A. St.-Hil.) Radlk. a Sapindaceae. Gomes *et al.* (2005) report *Dahlstedtia araripensis* and *Libidibia ferrea* with arboreal size in Serra de São José, corroborating Queiroz (2009). Individuals of these species were observed on road barriers over 3 m in length. The presence of deep roots is a characteristic that makes individuals resistant to anthropization. Thus, whenever we find these plants with shrub size they may be plants that had their trunks cut and this character is a reflection of possibly disturbed environments.

The areas of Plateau, Slope Area and Depression are physically heterogeneous, and this can be observed by the vegetation that responds to these characteristics through the density of individuals and distribution of species. In these environments, the only species that occurred in the three areas were *Croton blanchetianus* Baill., *Cynophalla flexuosa* (L.) J. Presl e a *Mimosa tenuiflora* (Willd.) Poir. According to Flora do Brasil (2020), *Cynophalla flexuosa* is widely distributed in Brazil and has perennial leaves, arboreal size and small populations; while *Croton blanchetianus* and *Mimosa tenuiflora* are endemic to the Caatinga (scrub forest) and have adaptations such as deciduous, shrub habit and dense populations. In addition, these species can be able to reproduce in very scarce years. Sabino et al. (2016) studied two anthropic areas and found *Croton blanchetianus* and *Mimosa tenuiflora* among the most abundant species. When evaluating plant species as bioindicators of degraded areas in the Caatinga, Santos, Luz and El-Deir (2016) noted that these are important for the ecological balance of the Caatinga.

#### **Floristic survey of the Plateau area**

Plateau was the area that presented the smallest number of individuals, 212 in total. However, it was the environment with the highest plant diversity with 21 species, 18 genera and 12 families. Fabaceae (8 spp.) and Euphorbiaceae (3 spp.) were the most diverse families. When comparing this study (Ferraz et al., 1998) with materials collected in altitudes between 500 and 700 m, we observed that the number of species here is lower, but the most representative families are the same. In addition, both in (Ferraz et al. 1998) and (Nascimento & Rodal 2008), *Albizia polycephala*, *Dahlstedtia araripensis*, *Croton argyrophyloides* and the genera *Copaifera*, *Syagros*, *Myrcia* and *Guappira* were found in altitudes equal to or higher than 900 m altitude. The data of the present study are relevant, since they extend the distribution area of these taxa, which are mostly from forest environments. According to the Flora do Brasil 2020, species such as *Dahlstedtia araripensis* and *Croton argyrophyloides* occur only in sedimentary formations and because they are more restricted areas, they are areas of great ecological importance.





**Diagram 1.** Comparison of species diversity between the studied areas

Comparing the three areas of this study, Plateau, besides being the most diverse, was also the most important from the floristic point of view, since more than half of the species are unique there (Table 1) and six shared with slope area. The presence of these taxa is conditioned by physical factors such as high altitude, milder temperatures, and deep soils. As a result of these characteristics, these areas were intensively used for cashew and cassava plantations. As for the lower density, it may be related to the low recruitment rate and to the size of the vegetation that consists of arboreal individuals (57%) and shrubs (43%).

**Table 1.** List of the woody families and species recorded in Plateau (A), Slope Area (B), Depression (C) in Serrinha dos Pintos, State of Rio Grande do Norte.

FAMILY	SPECIES	Vernacular name	Habit	Location		
				A	B	C
<b>ANACARDIACEAE</b>						
	<i>Myracrodruon urundeuva</i> Allemão	Aroeira	Arboreal	X	X	
	<i>Astronium fraxinifolium</i> Schott	Gonçalo	Arboreal	X		
<b>APOCYNACEAE</b>						
	<i>Aspidosperma pyriforme</i> Mart.	Pereiro	Arboreal			X
	<i>Aspidosperma riedelii</i> Müll. Arg.	Pitiá	Arboreal	X		
<b>ARECACEAE</b>						
	<i>Syagrus cearensis</i> Noblick.	Coqueiro catolé	Arboreal	X		
<b>BORAGINACEAE</b>						
	<i>Cordia trichotoma</i> (Vell.) Arráb. ex Steud.	Freijó	Arboreal			X
<b>BURSERACEAE</b>						
	<i>Commiphora leptophloeos</i> (Mart.) J.B.Gillett *	Imburana	Arboreal		X	X
<b>CACTACEAE</b>						
	<i>Pilosocereus gounellei</i> *	xique-xique	Shrub		X	X
<b>CAPPARACEAE</b>						

<i>Cynophalla flexuosa</i> (L.) J. Presl	Feijão bravo	Arboreal	X	X	X
<b>COMBRETACEAE</b>					
<i>Combretum leprosum</i> Mart.	Mofumbo	Shrub		X	X
<i>Combretum glaucocarpum</i> Mart.	Sipaúba	Arboreal	X	X	
<b>EUPHORBIACEAE</b>					
<i>Croton blanchetianus</i> Baill.	Marmeleiro	Shrub	X	X	X
<i>Croton argyrophyloides</i> Müll. Arg.	Marmeleiro branco	Shrub	X		
<i>Jatropha mollissima</i> (Pohl) Baill.	pinhão	Shrub		X	X
<i>Manihot glaziovii</i> Müll.Arg..	Mama cachorro	Arboreal	X	X	
<b>FABACEAE</b>					
<i>Albizia polycephala</i> (Benth.) Killip ex Record.	Camunzé	Arboreal	X		
<i>Amburana cearensis</i> (Allemão) A. C. Sm.	Cumarú	Arboreal			X
<i>Bauhinia cheilantha</i> (Bong.) Steud..	Mororó			X	
<i>Anadenanthera colubrina</i> Vell.	Angico	Arboreal		X	X
<i>Cenostigma bracteosum</i> (Tul.) Gagnon & G.P. Lewis.	Catingueira	Shrub		X	X
<i>Copaifera duckei</i> Dwyer.	Pau dóia	Arboreal	X		
<i>Dahlstedtia araripensis</i> (Benth.) M.J. Silva & A.M.G. Azevedo	Sucupira	Shrub	X		
<i>Libidibia ferrea</i> (Mart. ex Tul.) L.P. Queiroz.	Jucazeiro	Shrub		X	X
<i>Luetzelburgia auriculata</i> (Allemão) Ducke.	pau mocó			X	
<i>Mimosa tenuiflora</i> (Willd.) Poir. *	Jurema Preta	Shrub	X	X	X
<i>Mimosa arenosa</i> (Willd.) Poir. *	Calumbi	Shrub	X	X	
<i>Piptadenia stipulacea</i> (Benth.) Ducke *	Jurema branca	Shrub	X	X	
<i>Senegalia polyphylla</i> (DC.) Britton & Rose. *	Espinheiro	Shrub	X		
<i>Senegalia riparia</i> (Kunth) Britton & Rose ex Britton & Killip. *	Unha de gato	Shrub	X		
<b>MALVACEAE</b>					
<i>Pseudobombax marginatum</i> (St. Hill.) A.Robyns	Embiratanha	Arboreal			X
<b>MORACEAE</b>					
<i>Brosimum gaudichaudii</i> Trécul.	Inharé	Arboreal	X		
<b>MYRTACEAE</b>					
<i>Myrcia</i> DC..	Goiabinha	Shrub	X		
<b>NYCTAGINACEAE</b>					
<i>Guapira laxa</i> (Netto) Furlan	João Mole	Arboreal	X	X	
<b>RHAMNACEAE</b>					
<i>Ziziphus joazeiro</i> Mart. *	Joazeiro	Arboreal		X	X
<b>SAPINDACEAE</b>					
<i>Talisia esculenta</i> (A. St.-Hil.) Radlk.	Pitombeira brava	Shrub	X		

Source: prepared by the authors from field data (2018)

Among the species identified, those with a large number of individuals were *Senegalia polyphylla* (17.5%), *Copaifera duckei* (17.5%), *Combretum glaucocarpum* (7.5%), *Croton argyrophyloides* (5.2%) and *Aspidosperma riedelii* (5.2%).

In floristic studies in Serra de Martins, State of Rio Grande do Norte, Medeiros (2016) observed that the species sampled in the study area are typical of the semideciduous seasonal forest and are found in several geographic areas of Brazil with peculiar characteristics regarding altitude, relief and climatic elements.

As the study area is bordered by Serra de Martins, it presents similar physical aspects regarding altitude, types of soils and rocks and relief. It is possible to observe the presence of some species that were found by Medeiros (2016): *Cynophalla flexuosa* (Capparaceae), *Copaifera duckei* (Fabaceae), *Senegalia polyphylla* (Fabaceae) and *Myrcia* (Myrtaceae).

Although this area presents a high diversity of species and families, it was the one with the lowest number of individuals. One of the reasons for this low frequency of individuals is when a particular species is considered rare. Rarity is a peculiar phenomenon defined for some species because they present low reproduction rate, succession of few individuals, long growth, low dissemination capacity, low ecological amplitude, and specific environmental requirements (MARTINELLI; MESSINA; SANTOS FILHO, 2014).

Regarding the size of the vegetation in the area, *Copaifera duckei* presented an average of 16.47 m height in relation to the other species. This is also one of the fundamental factors for the presence of few individuals in the study area since it presents a marked dominance.

Among the three studied areas, Plateau, being located at 720 m altitude and located in sedimentary terrains of the Serra do Martins geological formation, presented the highest diversity of species, resulting from the diverse conditions in which this vegetation is found. For Ferraz *et al.* (1998), the large number of species present in high altitudes is the response of higher rainfall rates, high relative humidity, and low temperatures, which lead to greater soil fertility.

Despite the data presented, it is verified that the area of the Plateau constantly suffers from degradation, from the presence of agriculture, livestock, as well as cashew culture. Both have contributed to the transformation of the area in question.

### **Floristic survey of the Slope Area**

In the Slope area, 266 individuals were found, composed of 19 species, 16 genera and 10 families. The positioning of the Slope area between the Plateau and Depression makes this area naturally intermediate and

causes it to be influenced by both, easily observed in (Table 1). Where both the number of individuals and the diversity of taxa are reflected by the data. The families with a high number of species were: Fabaceae (8 spp.), Euphorbiaceae (3 spp.) and Combretaceae (2 spp.) and the others presented only one species each. In the study carried out by Serafim Filho (2014) in caatinga areas (scrub forest) in the municipality of Buíque, State of Pernambuco, it is noted that the main families were Fabaceae and Euphorbiaceae.

Similar data in border municipalities were evidenced by Dantas (2016) in a phytosociological survey in forest enclaves in the mountainous regions of Portalegre and Martins, State of Rio Grande do Norte, where the main families were Combretaceae (55%) and Fabaceae (10%).

*Myracrodruon urundeuva* (35%), *Manihot glaziovii* (18.4%), *Bauhinia cheilantha* (13.5%), *Cenostigma bracteosum* (7.1%), *Croton blanchetianus* (4.5%) and *Combretum leprosum* (4.5%) had the highest number of individuals sampled.

Similar results were presented by Araújo (2007) in studies of floristic composition in areas of caatinga (scrub forests) in the semi-arid region of the State of Paraíba. Queiroz *et al.* (2006), when analyzing Serra do Monte in Boqueirão, State of Paraíba, recorded the same species mentioned above in their study area, although they did not present the same sequence, they were also those with the largest number of individuals.

*Myracrodruon urundeuva* presented the largest size, with an average of 12.5 m height in relation to the others. This occurrence can be evidenced by the fact that it shows a significant number of individuals in the study area.

The slope area, due to the fact that it is situated on the mountain escarpment, presents a high degree of slope and shows rocky outcrops, makes it difficult to access and use the area for agricultural activities, thus helping in a positive way for the preservation of this vegetation.

Among the analyzed areas, the slope area was the one with the lowest number of unique species, only two *Luetzelburgia auriculate* and *Bauhinia cheilantha* (Diagram 1), influenced by both Plateau with six shared species and Depression, with eight species. These data show that the species of Slope area have a greater influence from Depression. According to Queiroz (2009), *Luetzelburgia auriculate* and *Bauhinia cheilantha* are found in open environments and sandy and rocky soils, being the first plant more characteristic of the Hinterland Depression, which diverges from the present study, while the second presents distribution between 350 and 560 m that corresponds precisely the height of the studied area.

Regarding the species habit, 72% were considered arboreal and 28% shrub. It is evidenced that there was a predominance of arboreal species that is superior to both Plateau and Depression; perhaps the difficulty of access allows a greater preservation of this environment.

It was possible to perceive, through the field work, that most of the sampling areas contained leaf litter. According to Andrade, Tavares and Coutinho (2003), the leaf litter assumes an especially important role, since it protects soils from erosive agents, provides retention of moisture and nutrients for both soil organisms and plants, helping to improve the physical, chemical and biological properties of the soil, therefore, in the vegetation production.

#### **Floristic survey of the area of Hinterland Depression of Serrinha dos Pintos, Rio Grande do Norte state.**

A floristic survey was carried out in the area of Depression, where 343 individuals were sampled, distributed into 15 species, 15 genres and 10 families, with Fabaceae (5 spp.) and Euphorbiaceae (2 spp.) being the most representative. In studies in similar areas, Fabaceae and Euphorbiaceae were the ones that appear the most in floristic compositions in areas of Caatinga (scrub forest). Silva, Lopes e Silva (2012) analyzed the floristic composition of a Caatinga (scrub forest) fragment in the municipality of Itapetim, State of Pernambuco, and verified that the families sampled represented 52.82% of the species. Similar results were also reported by Souza and Medeiros (2013), analyzing the floristic composition in caatinga areas (scrub forests) in the microbasin of the Cajazeiras Stream, State of Rio Grande do Norte, which showed a greater abundance of the families Fabaceae and Euphorbiaceae.

The families Apocynaceae, Combretaceae and Burseraceae, although they did not present a great diversity of species, presented a greater number of individuals, being represented by *Combretum leprosum* (20%), *Aspidosperma pyriforme* (8%) *Commiphora leptophloeos* (2%), respectively. Similar results were presented by Sabino, Cunha and Santana (2016), where they appeared in abundance in studies on the structure of two fragments of anthropized caatinga (scrub forest) in the State of Paraíba.

*Croton blanchetianus* (27%), *Cenostigma bracteosum* (27%), *Combretum leprosum* (20%), *Aspidosperma pyriforme* (8%) and *Jatropha mollissima* (4%) were the species with the largest number of individuals sampled.

These species, with the exception of *Combretum leprosum*, were also recorded by Pereira *et al.* (2002) in studies on the floristic composition and phytosociological analysis of the shrub-arboreal component of a forest remnant in the harsh area of the State of Paraíba.

In studies of floristic composition, phytosociology and soil influence on vegetation structure in a caatinga area (scrub forests) in the State of Paraíba semi-arid region, Araújo (2007) verified that *Croton blanchetianus*, *Cenostigma bracteosum* and *Combretum leprosum* presented the largest number of individuals.

Although there were few individuals, *Anadenanthera colubrina* showed the largest size among species, its average height was 7 m. This same species was also reported in Sabino, Cunha and Santana (2016) for showing the largest size with 7 m height.

The area of Depression presented the largest number of individuals and the lowest diversity of species; this was due to the presence of rock outcrops and stony soils, as well as the anthropic action through agriculture, livestock and firewood removal.

Depression surpassed the slope area in number of exclusive species, *Aspidosperma pyriformium*, *Cordia trichotoma*, *Amburana cearensis* and *Pseudobombax marginatum* (diagram 1). There are few ecological features that group these species, among them tropophytism and the anemochory dispersal.

Considering the habit of the 15 species recorded, 46% were classified as arboreal and 64% as shrubs (Table 1). These data show that there is a trend that relates the number of individuals to the type of habit, since in the area of Depression, the number of individuals was higher than in the other areas. Although the slope area surpassed Plateau in terms of number of individuals and percentage of habit, it is important to point out that the former suffers more influence from the Depression than from the Plateau. Probably the predominance of shrub plants is mainly related to the high temperatures and low availability of water in the soil of Depression. At this point, we believe that groups in the area of Depression are much more adapted to scarcity and can reach the plateau, as was seen with the three species; however, the species of Plateau cannot survive in Depression.

### 3.5 Shannon-Wiener diversity index (H')

The Shannon-Wiener diversity index calculated for the three areas is listed in Table 2. The data show the diversity of species found in each study area. It is worth mentioning that the higher the result, the higher the diversity and species richness in a given location.

Table 2 - Shannon-Wiener diversity index ( $H'$ ) in distinct areas in the municipality of Serrinha dos Pintos, State of Rio Grande do Norte.

Areas	Shannon-Wiener Diversity index( $H'$ )
Plateau	2.42
Slope	2.07
Backcountry depression	1.91

Source: prepared by the authors from field data (2018)

The Shannon-Wiener diversity index for the Plateau area was  $H' = 2.42$ . The value detected is close to the result found by Silva (2017), in studies on the diversity index of Caiçara mountain range in Maravilha, State of Alagoas, with  $H' = 2.80$ . When comparing with values obtained in similar areas, such as Pinto, Sampaio and Nascimento (2012), who evaluated a Swamp of altitude in Pesqueira, State of Pernambuco, and found a higher diversity index with  $H' = 3.31$ . In turn, Bezerra and Pereira (2017), analyzing the vegetation in Monteiro, State of Paraíba, showed a lower diversity index,  $H' = 1.48$ . Dário (2017), in studies carried out in the vegetation of Campina Grande, State of Paraíba, verified a lower index,  $H' = 1.89$ . However, it can be seen that the result found in the Plateau, when compared to the studies cited above, is on average.

The diversity index of Shannon-Wiener in the Slope area was  $H' = 2.07$ . When comparing with relatively similar areas, the index obtained is relatively low. Lemos and Meguro (2015) analyzed the vegetation of a Caatinga area at the Aiuaba Ecological Station, State of Ceará, and obtained a diversity index of  $H' = 3,11$ . Alcoforado-Filho, Sampaio and Rodal (2002) calculated the diversity index of the Caruaru vegetation and obtained  $H' = 3.09$ . Rodal *et al.* (1998) found in National park of Catimbau, in Buíque, State of Pernambuco, a Shannon index of  $H' = 2.73$ .

In the Depression area of the town of Serrinha dos Pintos, State of Rio Grande do Norte, the diversity index was  $H' = 1.91$ . This value was also compared with those of other studies in the Caatinga (Scrub forest) areas. In the municipality of São Francisco, in the State of Piauí, the diversity index found by Vasconcelos *et al.* (2017) was  $H' = 3.08$ . Comparing with values obtained by Araújo (2007) in a Caatinga (scrub forest) area in the municipality of Santa Terezinha, State of Paraíba, it is verified that the diversity index was  $H' = 2.37$ . Maracajá *et al.* (2003), in their views, performed a floristic survey in two environments in Serra do Mel, State of Rio Grande do Norte, and obtained diversity indices of  $H' = 1.18$  and  $H' = 0.78$ .

In view of the above, the Shannon-Wiener diversity presented different results in the study areas, and Plateau and Slope obtained superior results in relation to the area of Depression. For Meguro (2000), values above 5.0 are extremely rare.

The results obtained in the municipality of Serrinha do Pintos, State of Rio Grande do Norte, can be related to the different environmental and physiognomic factors existing in each locality, including the altitude, types of soils and, mainly, the way man uses each area, with the firewood removal, agriculture and livestock.

#### IV. FINAL CONSIDERATIONS

In general, each study area delimited in the municipality of Serrinha dos Pintos, State of Rio Grande do Norte, presented floristic composition similar to studies carried out in the Northeast region, in similar areas.

It can be concluded that areas with higher altitudes revealed a greater diversity of species and families. Most of the individuals identified in Plateau occur in areas characterized as Swamps of altitude, mountainous or humid forests. Generally, these geographical locations are influenced by high rainfall, lower temperatures, fertile soils and high altitudes. The other areas, slopes and Depression, presented endemic species to the scrub forest ecosystem.

The most important families in the three study areas in the municipality of Serrinha dos Pintos, State of Rio Grande do Norte, were Fabaceae, Euphorbiaceae and Capparaceae. These families were also the most cited in floristic studies carried out in the Caatinga (scrub forest) ecosystem.

The species with the highest number of individuals in the three areas were *Croton blanchetianus* (Marmeleiro), *Cenostigma bracteosum* (Caatingueira) and *Myracrodruon urundeuva* (Aroeira).

The Shannon-Wiener diversity index ( $H'$ ) was 2.42 in the Plateau area, 2.07 in Slope and 1.91 in the Depression area. When compared with similar areas, the results obtained are considered low; this partly reflects the natural and anthropic action.

In general, this study on the floristic composition and diversity produced information about the vegetation of the municipality of Serrinha dos Pintos, State of Rio Grande do Norte, contributing in a significant way to develop strategies of preservation, conservation and mainly in the development of the forest management plan. Regarding the data obtained and the methodology adopted in this research, it is indicated that these could serve as a basis for other studies on vegetation in similar areas.



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