# FLORISTIC AND PHYTOOSOCIOLOGICAL SURVEY IN A CAATINGA FRAGMENT UNDER EXTENSIVE GRAZING IN PATOS-PB MUNICIPALITY


## ABSTRACT

**Aims:** The aim of the present study was to evaluate the arboreal-shrub component, analyzing the floristic composition and phytosociology in caatinga area under extensive grazing in the Paraíba hinterland

**Methodology:** The study was carried out at the Research Center for the development of the semi-arid Tropics in the municipality of Patos-PB. The study area extends over 60 ha, and presents open-season shrub-like vegetation. The extraction data were selected using the simple random sample method. Fifteen 20 x 20 m plots were allocated, and all individuals with chest height ≥ 6 cm were measured, as well as total height of the individuals.

**Results and discussion:** There were 1285 individuals belonging to 9 families, 16 species, 15 genera. The Fabaceae family obtained the largest number of individuals and species, with the *Poincianella pyramidalis* species being the most important, with 650 individuals. The first class of diameter, concentrated the largest number of individuals with 627 individuals (48.8%), followed by the second class with 464 individuals (36%) confirming a tendency to reverse in the diameters classes. Regarding height distribution, it was observed that 1154 individuals (89%) are grouped in the first three classes. In relation to floristic diversity, the shannon-wienner index was 3,094 nats / ind, while the furrow index was 0.995, simpson 0.999.

**Conclusion:** The species *Poincianella pyramidalis* presented the highest parameters of horizontal structure, whereas indexes indicated that the study area presents a low diversity, proving that the extensive grazing has been changing the floristic composition of the area.



*Keywords:* Anthropisation, phytosociology, semi-arid, exploration.


## 1. INTRODUCTION

The caatinga occupies an area of 844,453 km ², corresponding to 11% of the Brazilian territory extending through the states of Paraíba, Pernambuco, Bahia, Piauí, Ceará, Alagoas, Rio Grande do Norte, Sergipe, and part of Minas Gerais. The variety of phytophysiognomies determined mainly by climate, geology, topography are results of the interrelationships in the different ecological environments present in the Caatinga biome [20, 31].

The biome is characterized by vegetation highly adapted to adverse conditions such as high temperatures, water scarcity, shallow and stony soils among others with peculiar strategies

such as leaf loss, development of spines, species that store water as cacti, to the maximum advantage of the short rainy season.

Due to the population growth in the semi-arid region, there has been an increase in caatinga exploitation with the emergence of a large number of ceramics, ginseries and bakery industries, which contribute to increase the areas of exploitation of the woody vegetation of the caatinga, where in the great [17, 18, 12].

Therefore the knowledge of the different forest ecosystems, their limitations, capacity of recovery and mainly the floristic composition are essential for the correct management of the forests. In the caatinga, studies are still scarce regarding phytosociology and floristics [7].

Phytosociology provides quantitative and qualitative information on the structure and behavior of a plant population, so the knowledge of the ecosystems through these parameters aims at the best form of management both ecologically and economically, as it provides data on potential use of the forest species, through of information of richness and abundance, relative importance of a certain species, as well as of the volumetric potential, for the appropriate forest management [27, 34].

Sustainable forest management was defined according to the law of the new forest code n ° 12.651 of 05/25/2012 [10], as: administration of vegetation in a natural state for economic, social and environmental benefit, respecting the mechanisms of sustainability of the ecosystems objects of management considering whether cumulative or alternative, the use of multiple timber species or not, as well as the use of other goods.

Sustainable forest management contributes to local socioeconomic development, and assists in the environmental protection of the caatinga biome, also assisting in environmental monitoring. Therefore, forest management aims at providing the raw material (firewood or coal) in a legal way for the functioning of the consumer market for various commercial and industrial activities.

Aiming at this, the objective of this study was to evaluate the arboreal-shrub component and analyzing the floristic and phytosociological composition in the caatinga area under extensive grazing in the Paraíba hinterland

## 2. MATERIAL AND METHODS

The study was carried out at the Research Nucleus for the development of the semi-arid Tropic (NUPEÁRIDO), belonging to the Federal University of Campina Grande (UFCG), located at the geographic coordinates 07º 04 '39.55 "S and 37º 15' 39.17" in the municipality of Patos-PB (Figure 1), inserted in the immediate geographic region of Patos [22].

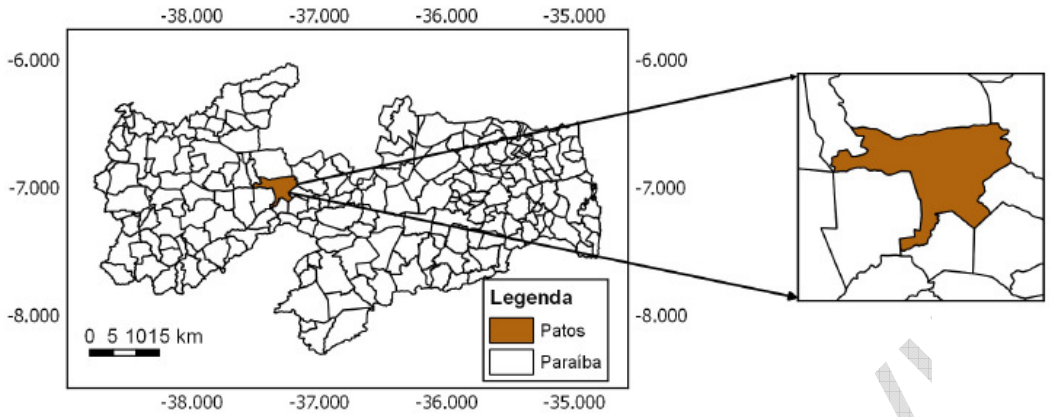


**Figure 1. Map of location, highlighting the municipality of Patos-PB.**

The climate of the region, according to the classification of Alvares et al. [2], is BSh type, semi-arid, with two well defined seasons, one rainy (January to May) and one dry season (June to December) annual rainfall is 600 mm. The average annual temperature is 28º C, minimum 24º C and maximum 35º C. According to EMBRAPA [14], the predominant soil in the study area is Neosol Litólico and Luvissolos Crômico, which is characterized by its high stoniness and small depth.

The study area extends over 60 ha, and shows open-season shrub (CAAA) vegetation, with the presence of specimens of aroeira (*Myracrodruon urundeuva* M. Allemão), Angico (*Anadenanthera colubrina* (Vell.) Brenan), faveleira (*Hyptis suaveolens* (L.) Poit.), And in the herbaceous stratum (*Brachiaria brava*) (*Hyptis suaveolens* (L.) Poit). This area has been maintained with native vegetation cover for about 40 years, however, it has extensive cattle grazing.

The vegetation data were obtained using the simple random sampling method, with plots with a standard size of 20 x 20 m (400 m²), following the Protocol of Measurements of Permanent Parcels (CAATINGA FOREST MANAGEMENT NETWORK - RMFC,[29], being randomly arranged 15 sample units, totaling a sampled area of 6000 m² In each sample unit were measured all living or dead individuals, with Chest Height Circumference (CAP) equal to or greater than six centimeters, measured with a tape measure at 1.30 m from the soil level and total height of each individual was measured with graduated ruler.

The identification of the botanical material was carried out by classical standards used by the taxonomy, based on floral and vegetative morphological characters, using botanical collections, by comparing exsicates collected with material cataloged in the Herbarium of the Federal University of Campina Grande (Campus Patos), and also by consulting the literature and specialists. The species were organized according to the families recognized by the classification of the Angiosperm Philogeny Group [9]

Sampling adequacy was obtained based on the analysis of the collector curve constructed using the nonparametric estimator Jackknife, which is based on the occurrence of species and the number of plots to estimate the total of species in the community.

The phytosociological parameters analyzed were relative frequency, absolute frequency; relative dominance, absolute dominance and importance value (VI) were calculated

according to Rodal [30]. Floristic diversity was determined using the Shannon-Weaver index (H '), Simpson dominance (S), Pielou equability (J'). The calculations were performed using the Past program (statistical software) [21].

The classes of diameters were established using class intervals of 3 cm, following the Calixto methodology; Drumond [11], Guedes et al [19], and height classes, were established using classes of 1 m height [11].

The floristic and phytosociological analyzes were performed with the help of Mata Native Software 3.11 [13] and the charts were elaborated in Microsoft Excel 2013.

## 3. RESULTS AND DISCUSSION

Sampling sufficiency, demonstrated by the species accumulation curve (Figure 2), shows that from the 11th plot the number of species stabilized or from that point on, there was a stagnation in the number of species, showing that 100% of the species number of species inventoried had been recorded, indicating that the 15th plots sampled are sufficient to characterize the floristic composition of the fragment studied.

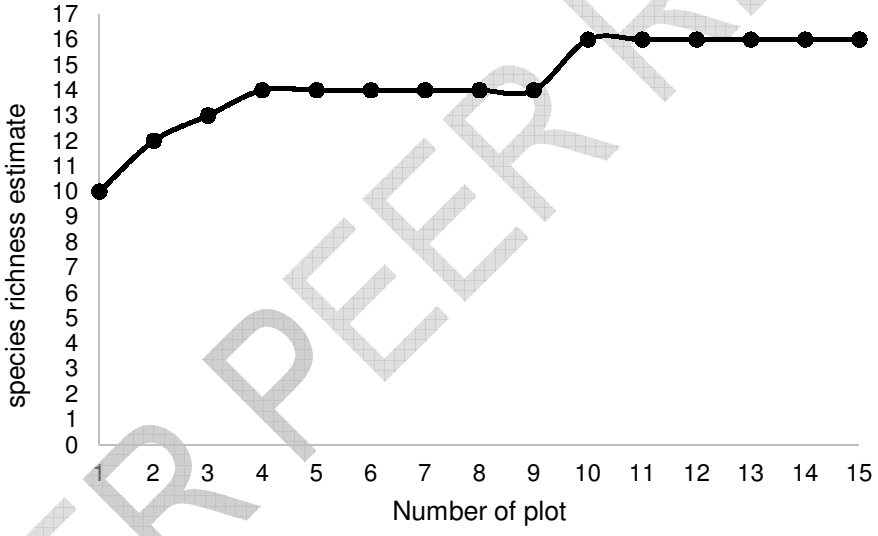


**Figure. 2. Accumulation curve obtained by the non-parametric Jackknife estimator in relation to the sampled area, in the anthropic caatinga, in the municipality of Patos-PB.**

A total of 1,285 individuals belonging to 9 families, 16 species,15 genera were collected. The Fabaceae family obtained the highest number of individuals and species, with *Poincianella pyramidalis* (650) and *Mimosa tenuiflora* (132) being the most abundant among the species, followed by the Euphorbiaceae family, with 162 individuals distributed in 3 species, *Jatropha mollissima* (76), *Croton blanchetianus* (66), *Cnidoscolus quercifolius* (20) (Table 1), thus totaling 89.18% of the species sampled in the community.

**Table 1. Phytosociological parameters of the woody species sampled in an anthropic caatinga area in the municipality of Patos-PB.**

| Nome cientifico/família | NI | FA | FR (%) | DA | DR (%) | DoA | DoR (%) | IVI |
|---|---|---|---|---|---|---|---|---|
| **Anarcadiaceae** | | | | | | | | |
| *Myracrodruon urundeuva Allemão* | 3 | 13,33 | 1,754 | 5,00 | 0,234 | 1,346 | 0,248 | 3,334 |
| **Apocynaceae** | | | | | | | | |
| *Aspidosperma pyrifolium* Mart | 149 | 93,33 | 12,281 | 248,333 | 11,082 | 11,082 | 2,043 | 34,958 |
| **Burseraceae** | | | | | | | | |
| *Commiphora leptophloeos* (Mart.) J. B. Gillett | 11 | 40 | 5,263 | 18,333 | 0,234 | 0,341 | 0,063 | 10,077 |
| **Capparaceae** | | | | | | | | |
| *Cynophalla flexuosa* (L.) J. Presl | 2 | 13,33 | 1,754 | 3,333 | 0,156 | 0,123 | 0,023 | 2,033 |
| **Combretaceae** | | | | | | | | |
| *Combretum leprosum* Mart | 60 | 86,67 | 11,403 | 100 | 4,669 | 1,546 | 0,285 | 17,619 |
| **Euphorbiaceae** | | | | | | | | |
| *Cnidoscolus quercifolius* Pohl | 20 | 33,33 | 4,386 | 33,333 | 1,556 | 13,122 | 2,419 | 19,064 |
| *Croton blanchetianus Baill.* | 66 | 66,67 | 8,772 | 110,00 | 5,136 | 1,580 | 0,291 | 15,489 |
| *Jatropha mollissima (Pohl) Baill* | 76 | 86,67 | 11,403 | 126,667 | 5,914 | 3,110 | 0,573 | 20,428 |
| **Fabaceae** | | | | | | | | |
| *Bauhinia sp* | 94 | 60 | 7,895 | 156,667 | 7,315 | 3,666 | 0,676 | 18,876 |
| *Poincianella pyramidalis (Tul.) L. P. Queiroz var* | 650 | 100 | 13,158 | 1083,333 | 50,584 | 42,770 | 7,886 | 106,51 |
| *Libidibia ferrea* (Mart. ex Tul.) L. P. Queiroz* | 1 | 6,67 | 0,877 | 1,667 | 0,078 | 0,037 | 0,007 | 0,992 |
| *Anadenanthera colubrina (Vell.) Brenan* | 7 | 13,33 | 1,754 | 11,667 | 0,545 | 4,975 | 0,917 | 7,247 |
| *Mimosa ophthalmocentra* Mart. ex Benth. | 6 | 20 | 2,632 | 10,00 | 0,467 | 0,175 | 0,032 | 3,274 |
| *Mimosa tenuiflora (Willd.) Poir* | 132 | 93,33 | 12,281 | 220,00 | 10,272 | 10,733 | 1,979 | 33,286 |
| **Malvaceae** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Pseudobombax marginatum* (A. St.-Hil.) A. Robyns | 3 | 20 | 2,632 | 5,000 | 0,234 | 0,341 | 0,063 | 10,077 |
| **Rhamnaceae** | | | | | | | | |
| *Ziziphus joazeiro* Mart | 5 | 13,33 | 1,754 | 8,333 | 0,389 | 1,437 | 0,265 | 3,580 |
| Total | 1285 | 760 | 100 | 2141,67 | 100 | 18,44 | 100 | 300 |

Ni; number of individuals FA: absolute frequency; FR: relative frequency; DA: absolute density; DR: relative density; DoA: absolute dominance; Pain; relative dominance; I SAW; Index of importance valu

Catingueira (*Poincianella pyramidalis*) species with the highest values in all the parameters studied with absolute frequency (93.3) and relative (13.158%), Absolute density (1083.33) were the most representative values for the species ) and relative (50.58%), absolute dominance (42,770) and relative (7.886%); and Importance value index (106.51) respectively, followed by Pereiro (*Aspidosperma pyrifolium*) with absolute frequency (93,33) and relative (12,58%), absolute (248,333) and relative (11,082%) density, and (12) and (12,28%), absolute density (220,000) and relative density (10,272%), and value of importance value (34,958) and black jurema (*Mimosa tenuiflora*) with absolute frequency (93,33) and relative frequency (33,28). The highest results for IVI of the species *Poincianella pyramidalis, Aspidosperma pyrifolium* and *Mimosa tenuiflor*a were mainly contributed by the high number of individuals, frequency, and density, since they together obtained 72.45% of the total trees sampled.

However, for absolute (13,122) and relative (2,419) dominance the favela species (*Cnidoscolus quercifolius*) obtained the highest results only of the species *P. pyramidalis*. This fact shows that although the species obtained few individuals (29) in the survey in relation to other species, its occupation in the environment per unit area was larger in relation to the area occupied by the other species, which can be explained by the larger size of the same individuals present in the area.

In a similar study, Sabino et al. [32] found similar results, where the species *P. pyramidalis* had the highest number of individuals (678), relative density (30.45%), relative dominance (43,58), relative frequency 13,158) and IVI (29,066), making it clear that the species does not have higher environmental requirements. Guedes et al. [19] , also in a study of caatinga fragment in the municipality of Santa Terezinha, PB, showed high IVI values (21.58%), frequency (8.55%), density (387.5), dominance 32.30%) for *P. pyramidalis*. The abundance of the species can be observed in surveys in the caatinga area in different states of the northeast region [3].

As for the superiority of these species in the phytosociological parameters studied in the area can be explained by the fact that they have beneficial characteristics the secondary succession communities preparing the environment, especially in areas that had anthropic intervention with use in agriculture and pasture and that were naturally recomposed [31,6], as the case of the area under study or because they have great regrowth power after periods of disturbance in the environment by the action of man [28] with most of the Caatinga studies in which the families Fabaceae and Euphorbiaceae cover the majority of the tree species raised in the Caatinga biome according to the majority of the studies [12, 34]

In a study in the Seridó, Rio Grande do Norte, Santana [33], observe the species *P.pyramidalis* and A. *pyrifolium*, together with the species *C. sonderianus* obtained 58.66% of the total sampled individuals.

Already in the cerrado-caatinga transition area in Piauí, Amaral et al [8] surveyed the species *Campomanesia xanthocarpa* Berg (616) *Bauhinia. ungulata* L. (507), *Mimosa caesalpinifolia* Benth. (457), as the largest number of individuals, with higher IVI for *B. ungulata* (31.91%) differing from the results of this study.

In relation to the dead individuals, 352 were identified, totaling 27.39% of the species sampled in the study area. In a survey in 2013 Sabino et al [33] observed 10.69% of individuals dead. According to the AESA [1], the average annual precipitation of the last seven years was below the average for the municipality of Patos, PB. Some factors may explain this behavior in the six-year period that contributed to the increase of this index, such as the prolonged periods of drought, in addition the edaphoclimatic factors also contribute to the high mortality, since the existing soils in the region are shallow and stony, not favoring the conservation of the humidity in the same damaging the survival of the species. A similar result was found by Araújo [4], in a survey in a municipality near the study area, also observed a high mortality rate (24%).

The first diameter class (Figure 3), concentrated the largest number with 627 individuals (48.8%), followed by the second class with 464 individuals (36%). These two classes represent 84% of the individuals raised in the study. It is observed a tendency to reverse J in the diameters classes, with a larger number of individuals in the classes with smaller diameters, thus showing a typical characteristic of unequal forest. Apparently this pattern was basically due to the behavior of three species of highest value (*Poincianella pyramidalis, Aspidosperma pyrifolium, Mimosa tenuiflora*), both of which presented high numbers of individuals in the lowest classes. According to Machado et al. [24], most of the forest tree-shrub component inventories of secondary forests have a larger distribution in smaller diameter classes, following the reverse or exponential negative J model.

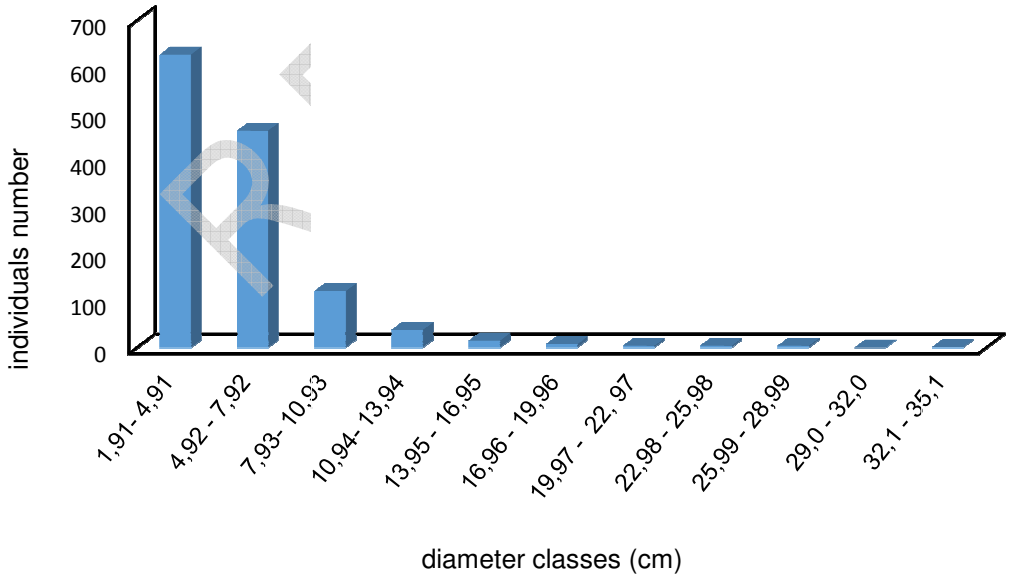


**Figure 3. Distribution of the number of individuals in diameter classes (cm) in a fragment of anthropic caatinga, at the Research Center for the development of the semi-arid Tropics in Patos, PB.**

Calixto Junior et al. [12], studying the phytosociological survey of a caatinga area in the municipality of Petrolina-PE, around 30 years without anthropic intervention, observed that 53.7% of individuals surveyed presented a diameter in the class between 3.0-6.0 cm, this result being similar to this study. Marangor et al. [25], in a phytosociological survey in a caatinga area with a history of disturbance, with logging and pasture of goats in the municipality of Floresta-PE, found a diametric distribution represented in inverted form of J, in which 84% of the individuals were distributed in the first two classes up to 6.4 cm in diameter and then with a sharp drop for the other classes, corroborating the results of this work.

Regarding height distribution (Figure 4), it was observed that 1154 individuals (89%) are grouped in the first three height classes. The maximum height was 8.5 meters, in an individual of *Anandenathera columbrina*. However, the second class presented the highest number of individuals with 496 (38%) of the total sampled individuals. There was a small decrease of individuals in the other height classes, since the majority of the individuals present in the survey are pioneer species of low size. According to Souza and Soares [35], the study of the vertical structure is of paramount importance for the evaluation of the sociological position of each species in relation to its height, because from this it classifies the forest fragment in the upper, middle and lower vertical strata and forest.

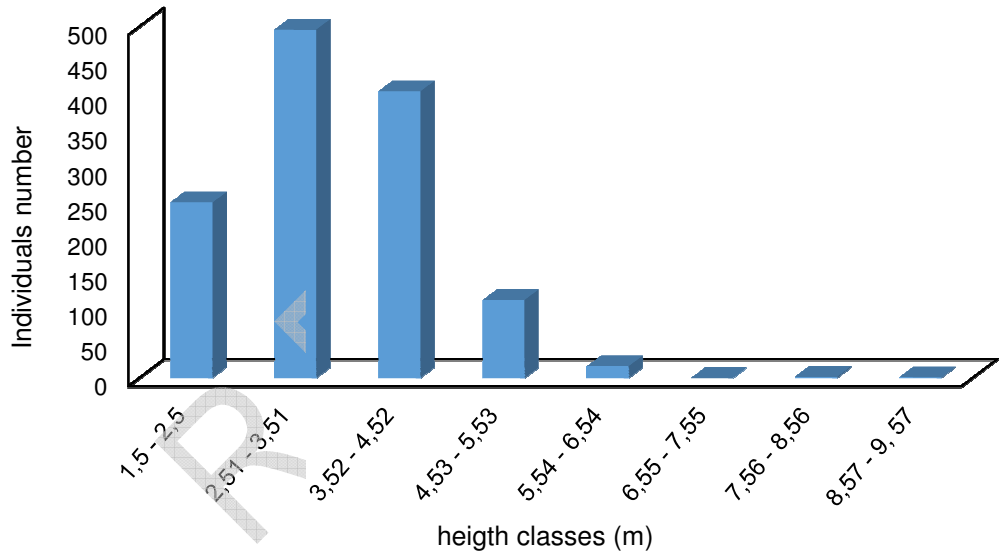


**Figure 4. Distribution of the number of individuals in height classes (m) in a fragment of anthropic caatinga, at the Research Center for the development of the semi-arid Tropics in Patos, PB**

The average height of the individuals inventoried was 3.5 meters, and this value was similar to those verified by Medeiros et al.[26], studying the vertical structure of the caatinga fragment in the municipality of São Mamede-PB, verified an average height of 3.6 meters. Alves et al. [6], analyzing the vegetative structure in an area of Caatinga in the municipality of Bom Jesus, PI and obtained the mean value of 3.44 meters in height, corroborating these results for this study. According to the previous author, the types of anthropic disturbances such as cattle trapping, partial cutting of trees, directly influence the low height of this

species. So the cattle grazing in the area of the present study is a preponderant factor for the low average height for this community.

In relation to floristic diversity, the Shannon-Wienner index was 3,094 nats / ind, while the Pielou index was 0.995, Simpson 0.999.

Guedes et al.[19], studying the remnant component of shrub-tree caatinga that has been maintained with its native vegetation cover for at least 30 years, we found a Shannon index of 2.54 nats / ind, Pielou of 0, 96 and Simpsom of 0.82. It is observed that the index of Shannon and Simpsom of the present study was superior to the work of Guedes et al. [19].

Leite et al.[23], in a quantitative analysis of the Caatinga woody vegetation in the city of Teixeira, PB, presented a diversity index of Shannon-Weaver (H ') for the studied area of 2.69; the Simpson dominance index, 0.99; Pielou equability (J), 0.70. According to Felfili and Resende [16], the shannon-wienner index assumes that individuals are randomly sampled from an infinitely large set, and that all species are represented in the sample, thus basing themselves on the higher the value of Shannon, the greater the diversity of the area, however the values can reach 4.5 but generally are generally between 1.3 and 3.5. The same author reports that the Simpson index indicates the probability that any two individuals, randomly taken from a community, belong to different species, giving more weight to species abundance and being less sensitive to wealth. The values of the index vary in the scale of 0 to 1, values close to 1 indicate lower diversity. In this study, the Simpson index (0.99), indicates that the area where this study was performed presents less diversity.

The Pielou Index represents the distribution of individuals among existing species and the scale ranges from 0 to 1, where the values close to 0 represent a minimum uniformity and the value 1 represents the maximum diversity, that is, all species are equally abundant [30].

It is observed a great variation in the diversity indexes, within the same phytogeographic region, this is related mainly to the different stages of succession, floristic heterogeneity caused by the different types of soil and the anthropic activities that are carried out in an unsustainable way.

## 4. CONCLUSION

The results confirmed that the families Fabaceae and Euphorbiaceae are the most representative floristically, with 7 species and 3 species, respectively.

The species *Poincianella pyramidalis*, presented the highest parameters of horizontal structure, making it clear that it does not have higher environmental demands and it has a great regrowth power after periods of human disturbance.

The first three diameter classes presented the largest numbers of individuals, thus showing a trend of reverse J, which is characteristic of unequal forests and absence of individuals in the last large ones due to anthropic actions.

The average height of the individuals inventoried was 3.5 meters, thus demonstrating that the types of anthropic disturbances such as cattle grazing, partial cutting of trees, directly influence the low height of this species.

In relation to diversity, the indexes indicated that the study area presents a low diversity, proving that the extensive grazing has been changing the floristic composition of the area.

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