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POPULATION STRUCTURE AND SPATIAL DISTRIBUTION OF *Bauhinia cheilantha* (Bong.) Steud. IN TWO FRAGMENTS AT DIFFERENT REGENERATION STAGES IN THE CAATINGA, IN SERGIPE, BRAZIL[1]

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ABSTRACT – This study aimed to analyze the vertical and diameter structure and the spatial distribution pattern of *Bauhinia cheilantha* in two Caatinga fragments in Sergipe, Brazil, at different regeneration stages. Thirty plots were demarcated in area I (Canindé de São Francisco and Poço Redondo), which has vegetation regeneration, and 25 plots in area II (Porto da Folha) with preserved vegetation, both having 400 m^2. All *B. cheilantha* individuals had their height and circumference (circumference at breast height > 6 cm) measured. Possible differences in height and diameter at breast height were tested in the two populations by using Student's T-test. The distribution pattern of species was calculated through Payandeh's index. We sampled 154 *B. cheilantha* individuals, equivalent to 33.3% of the plots in area I and in 1,027 individuals in area II, totaling 100% frequency. Height and the diameter of the two populations were statistically different, where AI achieved all values lower than AII. The spatial distribution pattern of *B. cheilantha* found in both areas was aggregate, with values of 11.85 and 9.00, respectively. Thus, it became clear that the population in AII is at a more advanced successional status than AI, due to its longer conservation time.

Keywords: Aggregation; Population density; Mororó.

ESTRUTURA POPULACIONAL E DISTRIBUIÇÃO ESPACIAL DE Bauhinia cheilantha (Bong.) Steud. EM DOIS FRAGMENTOS EM DIFERENTES ESTÁGIOS DE REGENERAÇÃO NA CAATINGA, EM SERGIPE, BRASIL

RESUMO – O objetivo deste estudo foi analisar a estrutura vertical e diamétrica e o padrão de distribuição espacial de ***Bauhinia cheilantha*** *em dois fragmentos de Caatinga em Sergipe, no Brasil, em diferentes estágios de regeneração. Foram demarcadas 30 parcelas na área I (Canindé de São Francisco e Poço Redondo), a qual possui vegetação em regeneração, e 25 parcelas na área II (Porto da Folha), com vegetação conservada, ambas com 400 m^2. Todos os indivíduos de* ***B. cheilantha*** *tiveram a altura e a circunferência (circunferência à altura do peito > 6 cm) mensuradas. Foram testadas possíveis diferenças na altura e no diâmetro à altura do peito entre as duas populações, por meio do teste T de Student. O padrão de distribuição das espécies foi calculado pelo índice de Payandeh. Foram amostrados 154 indivíduos de* ***B. cheilantha****, equivalente a 33,3% das parcelas na área I e 1.027 indivíduos na área II, perfazendo 100% de frequência. A altura e diâmetro das duas populações diferiram estatisticamente, já que na AI todos os valores foram mais baixos do que na AII. O padrão de distribuição espacial de* ***B. cheilantha*** *encontrado nas áreas foi do tipo agregado, com valores respectivos de 11,85 e 9,00. Assim, evidencia-se que a população da AII está em estado sucessional mais avançado do que em AI, devido ao seu maior tempo de conservação.*

Palavras-chave: Agregação; Densidade populacional; Mororó.

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1. INTRODUCTION

Since the early 20th century, most of the Northeastern Brazilian ecosystems are degraded, and their forest remnants consist of secondary formations (GOMES et al., 2006). In Sergipe, Brazil, there is a huge pressure on the original vegetation, since 40% of the municipalities in this state have more pasture land than native plants (GIULIETTI et al., 2003). So, it is impossible to obtain crucial data (PEREIRA et al., 2001), such as the dynamics and functioning of the biological community, and this situation hinders conservation efforts in many biomes, just as the Caatinga (ALVES et al., 2009).

Even with the advances in biological studies, there is a lack of data on the environmental factors that regulate flora abundance and distribution (GIULIETTI et al., 2003). Clarification of essential information, such as the distribution of species in height and diameter, may be used to make clear the structure and dynamics of plant populations (CALIXTO JÚNIOR et al., 2011; SANTANA et al., 2011). Since even within the same population there is distinction regarding the spatial distribution associated with the size and, abundance classes and/or development stages (SILVA et al., 2009).

Fabaceae is the third largest family of angiosperms, it has about 630 genera and 18,000 species and occurs in a wide range of habitats (JUDD et al., 2009). One of the species belonging to this family is *Bauhinia cheilantha* (Bong.) Steud., which occurs in Northeastern Brazil and Minas Gerais. It is native to the Caatinga, where it occurs mainly in open formations, on soils poor in nutrients and stony, at altitudes from 350 to 560 m (QUEIROZ, 2009). It is easily recognized in the field because it is a shrub or small tree with simple, alternate, leaves split at the apex up to the middle (similar to a cow's paw), with white petals and legume-type fruits, linear, flat, and brown.

This species has economic and cultural importance, as its wood has many uses, it is medicinal, forage (LIMA, 1996; ALBUQUERQUE; ANDRADE, 2002; SILVA; CECHINEL FILHO, 2002; AGRA et al., 2007; QUEIROZ, 2009) and it also has the potential to enrich the soil with nitrogen (MAIA, 2004). However, currently, it suffers exploitation pressure (ALCOFORADO-FILHO et al., 2003). Further, it is regarded as a pioneer (MAIA, 2004), so it is suitable to occupy anthropically disturbed areas, as it improves soil structure, fostering ecological succession (SANTANA et al., 2011).

This study analyzed the vertical and diameter structure and the spatial distribution pattern of *Bauhinia cheilantha* individuals in two Caatinga fragments in Sergipe, at different regeneration stages. Specifically, it sought to answer the following questions: i) Is there a difference in height and diameter between individuals of the two populations?; ii) What is the spatial distribution pattern of the two populations of *B. cheilantha* in the areas under study?; and iii) Are the differences found related to the conservation time in these areas?

2. MATERIAL AND METHODS

The study was conducted in two Caatinga fragments in the high Sergipe state backcountry region, at different regeneration stages. According to Köepen's climatic classification, the climate in the region is Bsh, megathermal semiarid.

Area I (AI; 09°39'S and 37°40'W) is located in the conservation area "Monumento Natural Grota do Angico", which has a total area of 2,183 ha and it is located in the municipalities of Canindé de São Francisco and Poço Redondo, whose northern boundary is the São Francisco river (SEMARH, 2010). The vegetation cover corresponds to hyperxerophilic Caatinga, undergoing a regeneration process with ecological dominance of *Poincianella pyramidalis* (Tul.) L.P.Queiroz (SILVA et al., unpublished data). The location has undergone a strong anthropic impact, with a history of fires, removal of timber, and livestock, such as cattle and horses (SILVA et al., 2013). After the creation and deployment of this protected area, in 2007, there was a decrease in these practices (SILVA et al., 2013). The region has an average altitude of 104 m, a mostly wavy soft relief, cut by narrow valleys with dissected slopes (SÁ et al., 2003) and non-calcic brown and litholic soils (JACOMINE et al., 1975). The average annual rainfall precipitation is 600 mm and the average annual temperature is 26ºC (SERGIPE, 2011).

Area II (AII; 10°01'S e 37°24'W) is located at "Fazenda São Pedro", which has a total area of 50 ha within Lagoa Grande village, in the municipality of Porto da Folha. The vegetation consists of Caatinga trees, which have been preserved since the 1960s. The average altitude is 168 m, with reliefs dissected on hills and ridges with tabular interfluves and eutrophic litholic neosols, planosols, dystrophic regosols, and eutrophic equivalent red-yellow acrisol (SERGIPE, 2011). The average annual rainfall is 548.9 mm and the average annual temperature is 26.2°C (SERGIPE, 2011).

To study the population structure and spatial distribution pattern of *Bauhinia cheilantha*, we adopted a method of permanent plots (PÉLLICO NETO; BRENA, 1997; RMFC, 2005). In area I, thirty 20 x 20 m plots (400 m^2) were demarcated, 289 m away from each other, and area II had twenty-five 20 x 20m plots, 141 m away from each other. In each plot, we counted and measured the height and circumference of all living *B. cheilantha* individuals with circumference at breast height (CBH - 1.30 m) > 6 cm (RMFC, 2005).

Phytosociological analysis was performed by using the software *Mata Nativa 2* (CIENTEC, 2006). An analysis of the distribution of individuals sampled in relation to height and diameter classes was performed by preparing frequency histograms with an interval of 1 m and 3 cm, respectively (ALMEIDA NETO et al., 2009; CALIXTO JÚNIOR et al., 2011). In the case of plants with forked stems below the breast height, we measured all branches that were within the inclusion criteria (AMORIM et al.; 2005). However, to establish the diameter classes, we considered only the diameter at breast height (DBH - 1.30 m) of each individual. Subsequently, we tested possible differences in the structure of the two populations studied by using Student's T-test (ZAR, 1999) for independent samples.

The distribution pattern of the species was calculated through the Payandeh (1970) index. When $Pi < 1.0$, there is a non-random clustering; when $1.0 \leq Pi < 1.5$, it indicates a tendency to clustering and when $Pi \geq 1.5$, it indicates clustering or aggregation.

3. RESULTS

A total of 1,181 *Bauhinia cheilantha* individuals were sampled in the two areas, 154 of them were observed in 10 out of the 30 plots in area I, and 1,027 individuals in 100% of the 25 plots in area II.

In general, the population of *B. cheilantha* may be regarded as medium-sized. The height distribution was unimodal, since there were a higher number of individuals in the intermediate height classes, from 4.0 to 5.9 m in area I and from 5.0 to 6.9 m in area II (Figure 1). The minimum heights found in areas I and II were, respectively, 2.2 and 2.4 m and the maximum were 7.5 and 10.4 m, with an average height of 4.5 and 5.9 m, statistically different ($t = -16,15$; $df = 263,47$; $p < 0.0001$).

The distribution of subjects by diameter class is represented in area I as an inverted and inclined J-shape, concentrated on the first two classes with a smaller diameter, up to 5.9 cm (Figure 2). In turn, area II showed a unimodal distribution, where the individuals are mainly at the second and third diameter classes, from 3,0 to 8.9 cm (Figure 2). The average diameter

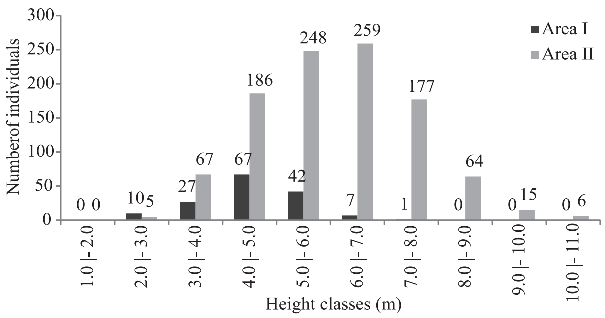

Figure 1 – Distribution of height classes *of Bauhinia cheilantha* (Bong.) Steud. In two Caatinga fragments in Sergipe, Brazil. Area I: regenerating vegetation (n = 154). Area II: preserved vegetation (n = 1,027).

Figura 1 –*Distribuição das classes de altura de* ***Bauhinia cheilantha*** *(Bong.) Steud. em dois fragmentos de Caatinga, em Sergipe. Área I: vegetação em regeneração (n = 154). Área II: vegetação conservada (n = 1027).*

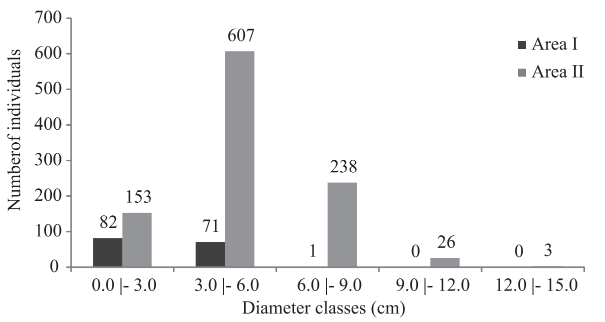

Figure 2 – Distribution in diameter classes of *Bauhinia cheilantha* (Bong.) Steud. two Caatinga fragments in Sergipe, Brazil. Area I: regenerating vegetation (n = 154). Area II: preserved vegetation (n = 1,027).

Figura 2 – *Distribuição em classes diamétricas de* ***Bauhinia cheilantha*** *(Bong.) Steud. em dois fragmentos de Caatinga, em Sergipe. Área I: vegetação em regeneração (n = 154). Área II: vegetação conservada (n = 1027).*

was 3.1 cm (AI) and 4.9 cm (AII) and the maximum diameter was 6.9 cm (AI) and 13.5 cm (AII), statistically different ($t = -19,14$; $df = 402,47$; $p < 0.0001$).

The spatial distribution pattern of *B. cheilantha* found in both areas was aggregate, with respective values of 11.85 (AI) and 9.0 (AII).

4. DISCUSSION

The number of cataloged *Bauhinia cheilantha* individuals in the two areas were higher than those found in other Caatinga areas (PEREIRA et al., 2002; SANTANA; SOUTO, 2006; FABRICANTE; ANDRADE, 2007; RODAL et al., 2008), also in Sergipe (FONSECA, 1991; DÓRIA NETO, 2009; FERREIRA, 2011; MACHADO, 2011), which ranged from 3 to 116 individuals, except for two studies conducted in this biome (ALCOFORADO-FILHO et al., 2003; BARBOSA et al., 2007), whose values were higher than those in area I.

The absence of individuals in the first height class (up to 2 m) in the two areas does not mean that there are no youth individuals and there are recruitment problems for this species. It may be due to the inclusion criteria, i.e. individuals whose CBH was > 6.1 cm, since in many papers the criterion in this regard is different (SILVA et al., 2012), with a circumference value below that adopted herein. In turn, a big difference between the average and maximum heights indicates that the species is still at a regenerative phase. However, it was found that some *B. cheilantha* individuals have already reached a suitable size in the two areas, since the values were equal to or above the maximum height values observed in various Caatinga locations, ranging from 3.8 to 7.8 (SAMPAIO et al., 1998, FONSECA, 1991; LEMOS; RODAL, 2002; AMORIM et al., 2005).

Regarding the diameter class, only in area I the distribution of individuals achieved the inverted and inclined J-shape, something which characterizes a predominance of young or thin-sized adult individuals. Because most individuals in this location were concentrated on the first class diameter, it is believed that the conservation of this area for a longer time will increase the basal area of the population. The average and maximum diameter values in AI and AII were higher than those found in *B. cheilantha* individuals in an open and small-sized Caatinga area in Seridó, Rio Grande do Norte, Brazil (AMORIM et al., 2005), something which suggests that both areas are larger than Seridó.

The high concentration of individuals at the smaller height and diameter classes demonstrates that the population is at a regeneration phase (LEHN, 2007). In turn, the population in AII had individuals at higher height and DBH classes than in Al (Figure 1 and 2), confirming the greater local storage times. Populations with higher DBH classes are at a more advanced succession stage than those with lower DBH (ANTONINI; NUNES-FREITAS, 2004). Deforestation, fires, and herbivory by goats change the number, density, and geographical distribution of species in the Caatinga (SAMPAIO et al., 1998; LEAL et al., 2003). In the case of *Bauhinia cheilantha*, its survival after human disturbance is more affected by the intensity of fires than removal of timber (SAMPAIO et al., 1998).

The spatial distribution values found are far above those observed for other species, such as *Mimosa tenuiflora* (Willd.) (CALIXTO JÚNIOR et al., 2011) and *Poincianella pyramidalis* (SANTANA et al., 2011) in Caatinga regeneration areas. Data also indicated that the population in area I is more aggregate than in area II. This fact was also noticed concerning the irregular distribution of species in the sampling units, since in area I the individuals are concentrated in just 10 out of the 30 plots and in area II they are distributed in all plots.

The spatial distribution pattern of woody species in an environment is influenced by biotic and abiotic variables, which may be clustered due to more favorable conditions in a habitat (SILVA et al., 2009). So, changes can be observed in the population structure of a species in the same ecosystem (MIRANDA-MELO et al., 2007). In the case of *B. cheilantha*, aggregation may be related to autochoric dispersion, which facilitates the deposition of seeds close to the mother plant. Checking this pattern is of paramount importance to understand ecological processes and determine the sampling method suitable for restoration of the areas (PALUDO et al., 2011).

5. CONCLUSION

The population of *Bauhinia cheilantha* in area II showed significantly higher height and diameter values than in area I, something which suggests that it at a more advanced successional stage due to longer conservation time. The spatial distribution pattern of the species studied was aggregate in both areas, with greater value and irregularity in the distribution of area I. This pattern may be related to autochoric dispersion and a history of degradation in the areas.

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