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INFLUENCE OF EDGE IN THE STRUCTURE OF THE VEGETATION OF AN OPEN OMBROPHILOUS FOREST IN ALAGOAS

INFLUÊNCIA DA BORDA NA ESTRUTURA DA VEGETAÇÃO DE UMA FLORESTA OMBRÓFILA ABERTA EM ALAGOAS

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ABSTRACT: Understanding the influence of fragmentation on the behavior of forest essential elements in different vegetation formations is fundamental for the definition of conservation strategies. In this study, the aim was to evaluate the influence of the edge environment on the phytosociological structure of a fragment of Open Ombrophylous Forest, in Rio Largo, Alagoas. Five transects of 10.0 x 100.0 m were subdivided into ten 10.0 x 10.0 m plots to collect the data. All tree individuals with Chest Height Circumference ≥ 15 cm were sampled, measured and later identified in the herbarium of the Institute of the Environment of Alagoas. For the analysis, the phytosociological parameters Shannon-Wiener diversity (H'), Pielou equability (J') were calculated after defined the successional classes and dispersion syndromes of the species sampled. The edge effect was analyzed by comparing the richness, diversity, equability and number of individuals in the interior and at the edge of the fragment, using the Venn diagram technique. There were 581 arboreal individuals, of which 434 were identified as belonging to 20 families, 24 genera and 30 morphospecies. Among the raised species, there were higher occurrences of early secondary (46.67%) and late (23.33%), as well as those of zoocoric dispersion (53.33%). The diversity was 2.89 nats/ind., and the Pielou (J') equability was 0.8497. The edge environment did not influence the establishment of species. This may have occurred due to the environmental characteristics of the open ombrophylous forest.

KEYWORDS: Atlantic forest. Ecological succession. Dispersion syndromes. Edge effect.

INTRODUCTION

In fragmented forest landscapes, as it occurs in the different formations of the Atlantic forest, phytosociological information on forest fragments is essential for the definition of strategies for the conservation of these environments (RODRIGUES; BRANCALION; ISERNHAGEN, 2009; ESTEVAN, VIEIRA; GORENSTEIN, 2016). Such information may contribute to the definition of forest restoration planing measures, interpretation of the successional stage of fragments, predominant dispersion syndromes, definition of species diversity, among others (RODRIGUES; BRANCALION; ISERNHAGEN, 2009; MARTINS, 2012). In Alagoas, the current scenario of Atlantic forest fragmentation is worsened by the scarcity of information on these areas (COSTA; SILVA, 2006), making it difficult to plan silvicultural interventions and decision making, for example.

The Atlantic Forest has been receiving increased attention from researchers, governmental and non-governmental agencies (METZGER, 2009).

This attention is associated with a marked degree of degradation in this domain. According to the Atlas of the Atlantic Forest (CAMPANILI; SCHAFFER, 2010), in Alagoas these formations originally covered 53.22% of the state's territory. Currently, however, only 10.49% of fragments remain, which are equivalent to 155,074 ha (1,550.74 km²) of well-preserved remnants.

According to Campanili and Schaffer (2010), studies indicate that one-third of the trees in the Atlantic forest of Alagoas, Pernambuco, Paraíba and Rio Grande do Norte would be threatened of regional extinction, as a consequence of the interruption of the seed dispersal process caused by fragmentation. Models of tree extinction suggest that this number may be underestimated, and that the forest located north of the São Francisco River is the biogeographic unit of the Atlantic Forest that is more likely to lose species on a regional and global scale (CAMPANILI; SCHAFFER, 2010).

The process of forest fragmentation leads to an increase in edge environments, generating diverse effects on species richness. In general, edge environments tend to cause a decrease in

biodiversity in the original habitat. However, they may also lead to an increase in the abundance of species that are specialized in ecotones. It is important to note that the responses of the different plant populations to the edge environment may also vary between different vegetation formations, as evidenced by a series of studies (HOLANDA et al., 2010; OLIVEIRA et al., 2013; RABELO et al., 2015). In addition, the size and shape of the fragment are also directly related to the effect of the edge environment (MARTINS et al., 2018).

A set of scientific evidence in the field of landscape ecology indicates that the smaller the area and/or the more irregular the shape of a fragment, the greater will be the total border effect (FERNANDES et al., 2017). Therefore, larger fragments and with a format surface tending for circularity are less susceptible to the loss of central area, favoring the maintenance of ecological processes, such as dispersion and ecological succession.

Martins et al. (2018) observed that, although larger fragments (>100 hectares) presented more irregular forms, their metrics from the central area were still better than the metrics from smaller fragments, even under the effect of greater edge distances. A maximum edge distance of 50 m was suggested by these authors to carry out studies involving metrics from the central area in the Catolé river basin, in the north of Minas Gerais. However, Fernandes et al. (2017) simulated distances of 30, 60 and 90 m from the border to the interior of the fragment, in an area of Atlantic forest in the south region of the state of Sergipe, and recommended a maximum distance of 30 m for the analysis of edge

effects in the region. However, from a phytosociological survey on remainders of Atlantic forest in the Tapacurá River Basin, Pernambuco, Oliveira et al. (2015) concluded that the edge effect on the tree component tends to minimize between 50 and 100 meters towards the interior of the fragment. The results of such studies help to plan and define sample design in researches that seek to evaluate the effect of the edge environment on the vegetation structure.

Considering the above, this study had the objective of evaluating the influence of the edge environment on the phytosociological structure of a fragment of Open Ombrophylous Forest in Alagoas. In this sense, the results of the present study may assist in the planning of future research and evaluations on the potential of this fragment as source of propagules and model for actions of forest restoration and creation of ecological corridors. It is expected that the information generated will give support for the elaboration of conservation and environmental regularization policies in the region.

MATERIAL AND METHODS

Study area

The study was carried out in the forest fragment called "Mata da Frascalli", Rio Largo, located in the Zona da Mata of the state of Alagoas (Figure 1). The climate of the region, according to the Köppen classification, is As (hot and humid, with autumn and winter rains), with annual rainfall ranging from 1,000mm to 1,500mm, and annual average temperature around 25°C (ALAGOAS, 2014).
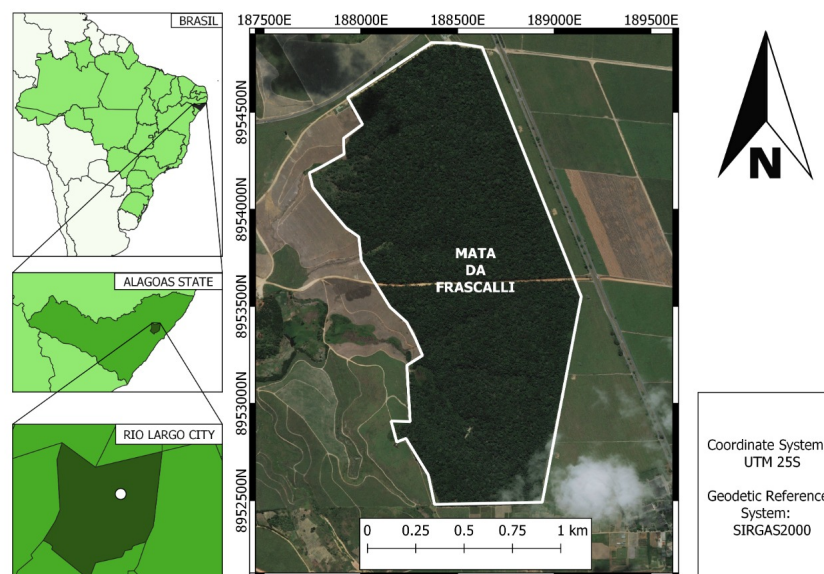

Figure 1. Location map of the "Mata da Frascalli", Rio Largo Municipality, Alagoas, Brazil.

Data collection

Five transects of 10.0 x 100.0 m were allocated from the border to the interior of the fragment, with a distance of approximately 100 meters between them for data collection. Each transect was subdivided into ten plots of 10.0 x 10.0 m, with a total of 50 plots, in a sample area of half a hectare. Using the Software R Vegan package, a curve of species accumulation per plot sampled (Figure 2) was elaborated, through a thousand permutations with random layout of the plots, allowing to verify the sample sufficiency in the studied section.
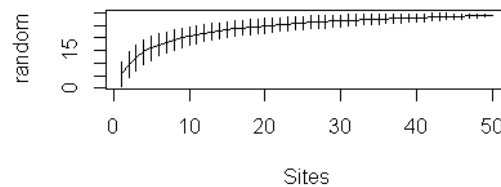

Figure 2. Collection curve of specimens per plot sampled in the Frascalli Forest Fragment, Rio Largo, Alagoas.

The criterion of inclusion of the tree individuals sampled was the Circumference at Breast Height (CBH, at 1.30 m from the soil) greater or equal to 15.0 cm. The sampled tree individuals were tagged with aluminum plates (3.0 x 5.0 cm) numbered in ascending order. In the field, all individuals sampled had the estimated height and CAP measured. In addition, all the dendrological information needed for field recognition (PINHEIRO, 2014) and subsequent herbarium identification, such as leaf color, pilosity, exudation, among others, were collected and recorded in a field book. The botanical material was analyzed by the MAC Herbarium of the Environmental Institute of Alagoas (IMA), where approximately 68% of the samples could be identified at the species level. The species were classified according to the APG IV system (2016).

Data analysis

For each species, the phytosociological parameters of density, frequency, dominance, as well as importance value and coverage value (SOUZA; SOARES, 2013) were calculated. Absolute density (AD) was calculated based on the number of individuals per unit area; the relative density (RD) was expressed as the ratio between the number of individuals of a species and the total number of individuals, expressed as a percentage; the absolute frequency (AF) was expressed by the percentage of sample units in which a species occurs in relation to the total number of sample units; the relative frequency (RF) was expressed by the ratio of the AF of a taxon to the total frequency (sum of all absolute frequencies); absolute dominance (ADo) was expressed by the basal area of a species in the sample area; the relative dominance (RDo)

was expressed as the ratio, in percentage, of the total basal area of a species by the total basal area of all species sampled; the value of importance (VI) was expressed through the sum of the values of RD, RF and RDo reached by each species and divided by three; and the coverage value (CV) was expressed by the sum of the values of RD and RDo, divided by two. The diversity index was calculated using the Shannon-Weaver formula and the equability by the Pielou formula (FREITAS; MAGALHÃES, 2012). The similarity between environments (edge and interior) of the fragment was also calculated by means of the Jaccard index (H').

The characterization of the species sampled in terms of successional class and dispersion syndrome followed the criteria adopted by Aquino and Barbosa (2009), with adaptations, covering the following categories: pioneers (Pi); Secondary initial (Si); secondary late (Sl), for the ecological groups; and, autochoric (Aut), anemochoric (An), zoochoric (Zoo), for the dispersion syndromes. The classification of the species sampled in these categories occurred through bibliographical research and field observations.

Comparisons between environments were performed: A1 - the fragment edge (plots 1 to 3 in each transect), A2 - an edge-fragment interior transition (plots 4 to 7 in each transect) and A3 - inside fragment (plots 8 to 10 in each transect) (Figure 3). For this purpose, a Venn Diagram (ZAR, 1999) was used, indicating the richness of species unique and common to each environment, as well as the number of individuals (absolute and relative values), Shannon-Weaver diversity index (H ') and Pielou equability (J '), according to the methodology used by Oliveira et al. (2015).
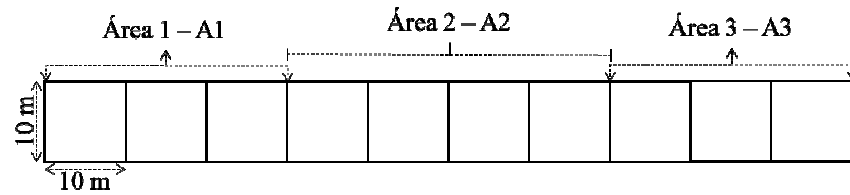
Figure 3. Schematic representation of the subdivisions of the transects in three environments from the edge to the interior of the fragment, where: A1 - edge environment of the fragment, A2 - edge-fragment interior transition; A3 - interior environment of the fragment.

RESULTS AND DISCUSSION

There were 581 tree individuals, of which 434 were identified as belonging to 20 families, 24 genera, and 30 morphospecies (being 20 at the species level, 6 at the genus level) (Table 1).

As to the successional classification (Table 1) of the species recorded in the Mata da Frascalli, a predominance of the initial secondary group was observed, corresponding to 46.67% of the species, followed by the late secondary ones, 23.33% of the species, pioneers, 13.33%. It was not possible to classify the successional group of 16.67% of the morphospecies. This result indicates that, in the sampled portion, the remainder studied is in a successional stage that varies from medium to advanced.

The classification of the dispersion syndromes of the species recorded in the fragment revealed that zoochory is remarkable, corresponding to 53.33% of the species, followed by anemochory, with 16.67%, and autochory, with 13.33%. It was not possible to determine the dispersion syndrome of 16.67% of the morphospecies. Thus, animals can be considered the main responsible agents for the dispersion of propagules of the species that occur in the sampled section of the fragment. This result is in agreement with the literature, which has been reporting the predominance of biotic vectors in the dispersion syndromes in wetlands (SILVA; RODAL, 2009), and reveals the importance of the role of fauna in maintaining the dynamics of the forest fragment Mata da Frascalli.

Table 1. Families and species recorded in the Mata da Frascalli forest fragment, Rio Largo, AL.

Family Scientific name	Popular name	SC	DS	A1	A2	A3
Anacardiaceae						
Tapirira guianensis Aubl.	Cupiuba	Si	Zoo	17	6	4
Thyrsodium sp.	Camboatá	Sl	Zoo	9	15	5
Apocynaceae						
Aspidosperma discolor A.DC.	Pau-falha	Si	An	2	5	1
Araliaceae						
Schefflera morototoni (Aubl.) Maguire et al.	Sambaqui	Si	Zoo	5	2	2
Bignoniaceae						
Handroanthus impetiginosus (Mart. ex DC.) Mattos	Pau-d'arco	Sl	An	1	1	1
Burseraceae						
Protium sp.	Amescla	Si	Zoo	3	3	4
Cecropiaceae						
Cecropia sp.	Embaúba	Pi	Zoo	0	2	5
Combretaceae						
Morphospecie N.I.3	Mirindiba	-	-	2	1	1
Euphorbiaceae						
Pogonophora sp.	Cocão	-	-	23	34	23
Fabaceae						
Apuleia leiocarpa (Vogel) J.F.Macbr.	Jitaí	Si	Aut	1	0	1
Bowdichia virgilioides Kunth	Sucupira	Pi	An	3	3	5
Chameacrista ensiformis (Vell.) H.S.Irwin & Barneby	Coração-de-nego	Si	Aut	4	3	8
Inga sp.	Ingá	Si	Zoo	0	1	0

Parkia pendula (Willd.) Benth. ex Walp.	Visgueiro	Sl	Zoo	9	19	12
Hypericaceae						
Vismia guianensis (Aubl.) Choisy	Lacre	Pi	Zoo	0	1	0
Lauraceae						
Ocotea glomerata (Nees) Mez	Louro-cagão	Si	Zoo	6	5	1
Lecythidaceae						
Eschweilera ovata (Cambess.) Mart. ex Miers	Embiriba	Sl	Zoo	16	9	7
Lecythis sp.	Sapucaia	Sl	Aut / Zoo	5	6	5
Malpighiaceae						
Byrsonima sericea DC.	Murici	Si	Zoo	4	0	0
Malvaceae						
Apeiba tibourbou Aubl.	Pau-de-jangada	Pi	Aut / Hyd	1	0	0
Luehea divaricata Mart. & Zucc.	Açoita-cavalo	Si	An	9	2	3
Luehea ochrophylla Mart.	Carrapicho	Si	An	2	0	0
Meliaceae						
Trichilia lepidota Mart.	Cedrinho	Sl	Zoo	3	1	0
Moraceae						
Brosimum guianense (Aubl.) Huber	Quiri	Si	Zoo	0	0	2
Myrtaceae						
Morphospecie N.I.2	Batinga	-	-	8	9	4
Peraceae						
Pera glabrata (Schott) Poepp. ex Baill.	Sete-cascas	Si	Zoo	5	5	6
Sapindaceae						
Morphospecie N.I.4		-	-	1	0	0
Sapotaceae						
Pouteria bangii (Rusby) T.D.Penn.	Pitomba-da-mata	Si	Zoo	0	4	4
Pouteria gardneri (Mart. & Miq.) Baehni	Leiteiro	Sl	Zoo	11	17	10
.I						
Morphospecie N.I. 1	Cinzeiro	-	-	1	9	3

With their respective popular names, successional classes (SC) and dispersion syndromes (DS), where: Pi – Pioneer; Si - Secondary initial; Sl - Secondary late; An – anemochoric; Aut - autochoric; Hyd – Hydrochoric; Zoo - zoochoric, and the number of individuals in the areas A1 - edge environment of the fragment, A2 - edge-fragment interior transition; and A3 - interior environment of the fragment

Considering the number of individuals per species, the most remarkable were: *Pogonophora* sp., with 80 individuals; *Parkia pendula* (Willd.) Benth. ex Walp., with 40 individuals; *Pouteria gardneri* (Mart. & Miq.) Baehni, with 38 indivíduals; *Eschweilera ovata* (Cambess.) Mart. ex Miers, with 32 individuals; *Thyrsodium* sp., with 31 individuals *Tapirira guianensis* Aubl., with 28 individuals; *Lecythis* sp., with 16 individuals, *Pera glabrata* (Schott) Poepp. ex Baill. with 16 individuals *Chameacrista ensiformis* (Vell.) H.S.Irwin & Barneby, with 15 individuals; and *Luehea divaricata* Mart. & Zucc., with 14 individuals.

The species *Pogonophora* sp., *Parkia pendula* (Willd.) Benth. ex Walp. and *Pouteria gardneri* (Mart. & Miq.) Baehni, *Eschweilera ovata* (Cambess.) Mart. ex Miers and *Thyrsodium* sp

totaled 50,92% of the sampled and identified individuals.

The Fabaceae family was characterized by the highest species richness (five in total) in the sampled area, corresponding to 15.90% of the identified individuals. However, the Euphorbiaceae family was classified as the highest density represented by only one species, corresponding to 18.43% of the individuals identified. It should be noted that Fabaceae also excelled in the studies of Moura, Duart and Lemos (2011) and Machado et al. (2012), both carried out in open forest formations in the Atlantic Forest of Alagoas. These results serve as evidence of the ecological importance of this botanical family in the Atlantic Forest fragments of the state.

The ten species that presented the highest value of importance (VI) were: *Parkia pendula* (Willd.) Benth. ex Walp., *Pogonophora* sp.,

Tapirira guianensis Aubl., *Chameacrista ensiformis* (Vell.) H.S.Irwin & Barneby, *Pouteria gardneri* (Mart. & Miq.) Baehni, *Thyrsodium* sp., *Eschweilera ovata* (Cambess.) Mart. ex Miers, *Bowdichia virgilioides* Kunth, Morphospecie N.I. 2 (Myrtaceae), and Morphospecie N.I. 3 (Combretaceae).

In the structure of the studied fragment, the following species excelled: *Parkia pendula*., with a relative density (RD) of 9.22%, relative frequency (RF) of 9.39%, and relative dominance (RDo) of 20.77%. Their importance (IV) and coverage (CV) values were 13.13% and 14.99%, respectively (Table 2).

Table 2. Species sampled in the forest fragment Mata da Frascalli, Rio Largo, AL, and its phytosociological parameters, in descending order by the value of importance index by species (VII).

Scientific name	AD	RD	AF	RF	ADo	RDo	CV	IV
Parkia pendula (Willd.) Benth. ex Walp.	80,00	9,22	52,00	9,39	6,32	20,77	14,99	13,13
Pogonophora sp.	160,00	18,43	66,00	11,91	1,88	6,18	12,31	12,18
Tapirira guianensis Aubl.	56,00	6,45	38,00	6,86	2,87	9,43	7,94	7,58
Chameacrista ensiformis (Vell.) H.S.Irwin & Barneby	30,00	3,46	24,00	4,33	4,47	14,68	9,07	7,49
Pouteria gardneri (Mart. & Miq.) Baehni	76,00	8,76	38,00	6,86	0,68	2,25	5,50	5,95
Thyrsodium sp.	62,00	7,14	38,00	6,86	0,90	2,96	5,05	5,66
Eschweilera ovata (Cambess.) Mart. ex Miers	64,00	7,37	40,00	7,22	0,68	2,22	4,80	5,60
Bowdichia virgilioides Kunth	22,00	2,53	22,00	3,97	2,12	6,97	4,75	4,49
Morphospecie N.I. 2	42,00	4,84	24,00	4,33	0,60	1,96	3,40	3,71
Morphospecie N.I. 3	8,00	0,92	8,00	1,44	2,58	8,48	4,70	3,61
Pera glabrata (Schott) Poepp. ex Baill.	32,00	3,69	28,00	5,05	0,64	2,10	2,89	3,61
Lecythis sp.	32,00	3,69	26,00	4,69	0,61	2,00	2,84	3,46
Luehea divaricata Mart. & Zucc.	28,00	3,23	20,00	3,61	0,67	2,21	2,72	3,02
Schefflera morototoni (Aubl.) Maguire et al.	18,00	2,07	14,00	2,53	1,34	4,39	3,23	3,00
Morphospecie N.I. 1	26,00	3,00	18,00	3,25	0,29	0,97	1,98	2,40
Ocotea glomerata (Nees) Mez	24,00	2,76	16,00	2,89	0,47	1,55	2,16	2,40
Aspidosperma discolor A.DC.	16,00	1,84	12,00	2,17	0,65	2,12	1,98	2,04
Protium sp.	20,00	2,30	16,00	2,89	0,27	0,88	1,59	2,03
Pouteria bangii (Rusby) T.D.Penn.	16,00	1,84	12,00	2,17	0,50	1,65	1,75	1,89
Handroanthus impetiginosus (Mart. ex DC.) Mattos	6,00	0,69	6,00	1,08	0,85	2,80	1,75	1,53
Cecropia sp.	14,00	1,61	6,00	1,08	0,23	0,77	1,19	1,15
Trichilia lepidota Mart.	8,00	0,92	6,00	1,08	0,20	0,66	0,79	0,89
Byrsonima sericea DC.	8,00	0,92	6,00	1,08	0,19	0,62	0,77	0,88
Apuleia leiocarpa (Vogel) J.F.Macbr.	4,00	0,46	4,00	0,72	0,33	1,08	0,77	0,76
Brosimum guianense (Aubl.) Huber	4,00	0,46	4,00	0,72	0,02	0,07	0,26	0,42
Luehea ochrophylla Mart.	4,00	0,46	2,00	0,36	0,02	0,06	0,26	0,30
Morphospecie N.I. 4	2,00	0,23	2,00	0,36	0,02	0,07	0,15	0,22
Vismia guianensis (Aubl.) Choisy	2,00	0,23	2,00	0,36	0,01	0,04	0,13	0,21
Inga sp.	2,00	0,23	2,00	0,36	0,01	0,02	0,13	0,20
Apeiba tibourbou Aubl.	2,00	0,23	2,00	0,36	0,01	0,02	0,12	0,20
Total Geral	868,00	100,00	554,00	100,00	30,44	100,00	100,00	100,00

Besides *Parkia pendula* (Willd.) Benth. ex Walp., the species that presented the highest values of importance (VI) and value of cover (VC) were distributed as follows: *Pogonophora* sp., *Tapirira guianensis* Aubl., *Chameacrista ensiformis* (Vell.) H.S.Irwin & Barneby, *Pouteria gardneri* (Mart. & Miq.) Baehni, *Thyrsodium* sp., *Eschweilera ovata* (Cambess.) Mart. ex Miers, *Bowdichia virgilioides* Kunth, Morphospecie N.I. 2 (Myrtaceae), and Morphospecie N.I. 3 (Combretaceae). and *Pera glabrata* (Schott) Poepp. ex Baill (Figure 4).
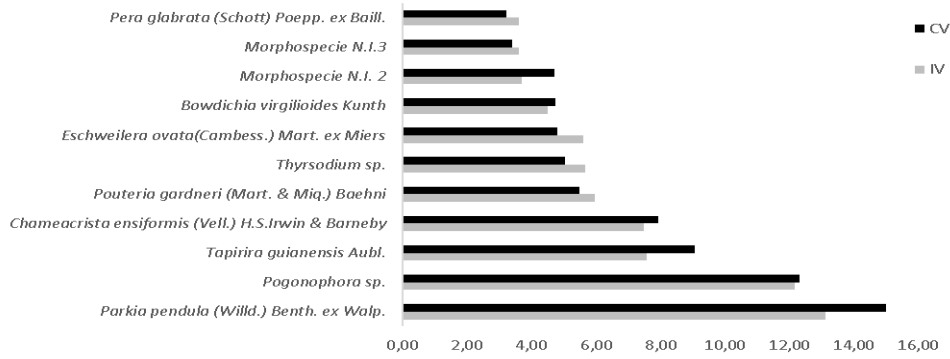
Figure 4. List of the 10 main species in relation to the importance value (IV) and cover value (CV) in the fragment called Mata da Frascalli, Rio Largo, AL.

As for the diametric distribution, a pattern similar to a J-inverted was observed (Figure 5). In this sense, it can be observed that the fragment of Mata do Frascalli presented a larger number of individuals in the smaller diameter classes. This is the expected pattern for unequal forests (SOUZA; SOARES, 2013), and indicates that the studied forest community has been able to sustain the individuals that form their growing stock, although not all will survive until reaching the largest diameter classes.
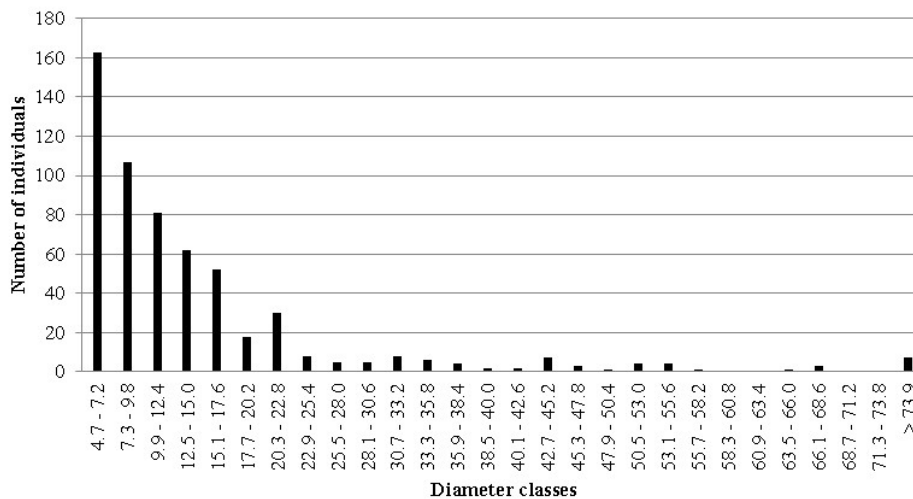

Figure 5. Diametric distribution of individuals sampled in the Mata da Frascalli, Rio Largo, Alagoas, Brazil.

Regarding the fragment diversity, the Shannon-Weaver Index (H') was found to be 2.89 nats/ind. It should be pointed out that, according to Freitas and Magalhães (2012), a comparative basis is needed for a proper interpretation of the Shannon index result, which requires other studies that have employed similar methodological procedures (such as the same inclusion criterion, size and shape of sample units, similar forest formations, among others). This comparative basis is not yet available for the studied region. Therefore, it is opportune to discuss the result obtained by the Shannon index together with the value of the Pielou equability (J') for the studied area, which was 0.8497. In this sense, Arruda and Daniel (2007) point out that, in the interpretation of the Pielou index, the minimum value is zero and the maximum value is one, representing low and high equability, respectively. When multiplied by 100, the resulting value represents, in percentage terms, the current diversity in relation to the maximum possible. Therefore, theoretically, the result of the present study reveals that an increase of more 15.03% of species would be necessary to reach the maximum diversity of the plant community of the Mata da Frascalli. This result allows considering that the fragment studied presented a reasonable diversity. However, it is worth mentioning that, theoretically, this maximum diversity would occur not only because of the increase in the number of species (increase in

wealth), but also because of the increase in equitability (distribution of the average number of individuals among species).

In the comparison between border, transition and interior environments of the fragment (A1, A2 and A3, respectively) it was observed that 19 of the 30 species are common to the three environments and that the values of H' and J' were similar regardless of the distance from the edge (Figure 6). It was also verified that A2 presented the

highest number of individuals. However, this result was influenced by the greater number of parcels that exist in it, which justifies in parts the increment in relation to the other environments. In general, the results suggest that the edge environment did not influence the establishment of species. One of the evidences, in this sense, can be verified by the similarity of species in the edge and in the interior of the fragment.
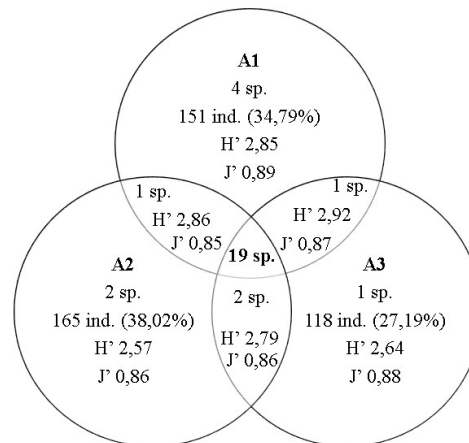

Figure 6. Venn diagrams containing unique and common species to each environment, as well as the number of individuals, diversity index of Shannon-Weaver (H') and Pielou equability (J'), sampled in the Mata da Frascalli, Rio Largo, Alagoas, Brazil (A1 - fragment edge, A2 - 30m from the edge and A3 - 70m from the margin).

Although there is a consensus in the literature that edge environments present abiotic characteristics that are generally adverse to the development of species adapted to the interior of the forest, when compared to the interior of the fragments, such as: higher temperature, luminosity, wind speed and low relative humidity (HOLANDA et al., 2010). In addition, a number of phytosociological studies have shown that there are no significant differences between the internal and external environments (OLIVEIRA et al., 2013; RABELO et al., 2015).

Thus, Rabelo et al. (2015) showed that there was no significant edge effect in a dense ombrophilous forest fragment in Pernambuco. However, although they did not identify differences in species richness between the edge and internal environments, these authors identified an expressive variation in floristic composition between the two environments. In our study, the edge and interior environments presented high species similarity. Possibly, the difference between the results found by Rabelo et al. (2015) and those obtained in this study, in terms of similarity of border and inland species, can be attributed to the environmental

differences of the forest formations studied in each case. In this sense, it is possible to suppose that, due to the fact that open forest formations present a discontinuous canopy (natural clearings), the species found inside fragments of these formations are better adapted to withstand the environmental conditions found at the edges. A similar trend has been identified in forest formations of semi-arid environments (OLIVEIRA et al. 2013). However, this pattern would not be expected to occur in forest formations with a more continuous (closed) canopy, such as the dense ombrophilous forest.

We can consider that different environmental factors can influence the pattern of distribution observed in the present study. Thus, we can raise the following hypotheses that can guide future research: (1) Canopy discontinuity, characteristic of the vegetation formation of the (open forest), provided less variation in terms of environmental conditions (such as luminosity, temperature, humidity, for example) from the border to the interior of the fragment; (2) The entire sampled section (from zero to 100 meters from the edge, towards the internal area of the fragment) is under the influence of the edge environment. Let us

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consider that, in the present study, hypothesis 1 explains better the results obtained. Such consideration is based on the apparent good state of conservation of the fragment.

CONCLUSIONS

No evidence was found that the border environment influences the structure of the fragment studied. This may have occurred due to the environmental characteristics of the open ombrophylous forest, as a consequence of the canopy discontinuity. However, it may also be a consequence of an advancement of environmental conditions from the edge into the fragment.

The most representative species of the Frascalli forest fragment were *Pogonophora* sp., *Parkia pendula*, *Tapirira guianensis*, *Chameacrista ensiformis*, *Pouteria gardneri*, *Thyrsodium* sp., *Eschweilera ovata*, *Bowdichia virgilioides*, *Lecythis* sp. and *Luehea divaricata*. Therefore, we recommend that these species should be considered for restoration and restoration of degraded areas in the region.

Despite the difficulties to identify part of the raised species, the results demonstrated that the fragment presents a considerable richness of species, with high equability. Considering this, we suggest that continuous research efforts should be made in order to overcome the current lack of phytosociological information about the open forest in the region. In this context, we consider that the present study may contribute to the planning of future research and to the elaboration of forest conservation and restoration actions.

RESUMO: Compreender a influência da fragmentação sobre o comportamento das essências florestais em diferentes formações vegetacionais é fundamental para que se possa definir estratégias de conservação. Neste trabalho, objetivou-se de avaliar a influência do ambiente de borda sobre estrutura fitossociológica de um fragmento de Floresta Ombrófila Aberta, em Rio Largo, Alagoas. Para a coleta dos dados foram alocados cinco transectos de 10,0 x 100,0 m, subdivididos em dez parcelas de 10,0 x 10,0 m. Foram amostrados todos os indivíduos arbóreos com Circunferência à Altura do Peito ≥ 15 cm, que foram mensurados e posteriormente identificados no herbário do Instituto do Meio Ambiente de Alagoas. Para a análise foram calculados os parâmetros fitossociológicos, a diversidade de Shannon-Wiener (H'), a equabilidade de Pielou (J'), definidas as classes sucessionais e síndromes de dispersão das espécies amostradas. O efeito de borda foi analisado por meio de comparação da riqueza, diversidade, equabilidade e número de indivíduos no interior e na borda do fragmento, empregando-se a técnica diagrama de Venn. Foram registrados 581 indivíduos arbóreos, dos quais 434 foram identificados como pertencentes a 20 famílias, 24 gêneros e 30 morfoespécies. Entre as espécies levantadas, houve maior ocorrência de secundárias iniciais (46,67%) e tardias (23,33%), assim como de dispersão zoocórica (53,33%). A diversidade foi de 2,89 nats/ind., e a equabilidade de Pielou (J') foi de 0,8497. O ambiente de borda não influenciou no estabelecimento de espécies. Isso pode ter ocorrido em virtude das características da floresta ombrófila aberta.

PALAVRAS-CHAVE: Mata atlântica. Sucessão ecológica. Síndromes de dispersão. Efeito de borda.

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