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Articles

Edge effect on floristics and structure in Seasonal Semi-deciduous Forest in the Semi-arid region

Efeito de borda sobre a florística e estrutura em Floresta Estacional Semidecidual no Semiárido

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ABSTRACT

Forest fragmentation is a reality in several Brazilian regions due to high deforestation rates. Studies on these fragments are fundamental, as they enable monitoring and predicting the transformations of populations and isolated plant communities. This work aimed to evaluate the edge effect on the phytosociological and floristic structure of a Montane Seasonal Semi-deciduous Forest fragment in Vitória da Conquista, BA, Brazil. The methodology used is a hierarchical and divisive classification of species (TWINSPAN), which enables identifying groups of species which characterize each sample, but is rarely used in the literature in this context. The studied fragment is influenced by the edge effect, evidenced by the increase in the average height and diameter of individuals towards the fragment interior. The addition to a clear distinction between species compositions, being minimized 90 m away from the edge.

Keywords: Phytosociology; Indicator species; TWINSPAN

RESUMO

A fragmentação florestal é uma realidade em diversas regiões brasileiras em função das altas taxas de desmatamento. Os estudos desses fragmentos são fundamentais, pois permitem monitorar e prever as transformações das populações e das comunidades vegetais isoladas. Este trabalho objetivou avaliar o efeito de borda sobre a estrutura fitossociológica e florística de um fragmento de Floresta Estacional Semidecidual Montana em Vitória da Conquista – BA. A metodologia utilizada se trata de uma classificação hierárquica e divisiva de espécies (TWINSPAN), que permite a identificação de grupos de espécies que caracterizam cada amostra, poucas vezes utilizada na literatura nesse contexto. O fragmento estudado é influenciado pelo efeito de borda, evidenciado pelo aumento da altura média e do diâmetro dos indivíduos em direção ao interior do fragmento, além de clara distinção entre as composições de espécies, minimizado a partir de 90 m de distância da borda.

Palavras-chave: Fitossociologia; Espécies indicadoras; TWINSPAN

1 INTRODUCTION

Seasonal semi-deciduous forests (SSF) occupy just over 5% of the Atlantic Forest biome, being second only to dense ombrophylous forests (Ministry of the Environment - Ministério do Meio Ambiente [MMA], 2020). These are discontinuous formations which can have humid or arid climates and are often located in regions of great agricultural potential, as they usually precede drier inland areas (Paula; Barberena; Soares Filho; Barreto-Garcia; Prata, Medeiros, 2021).

Forest fragmentation is a reality in several tropical regions and is increasing due to high deforestation rates. This process compromises the existing biodiversity in Brazil in its phytophysiognomies with the reduction and isolation of natural vegetation, triggering consequences on the structure and processes of plant communities, in addition to the evident reduction in the original area of habitats (Holanda; Feliciano; Marangon; Santos; Melo; Pessoa, 2010).

There is the formation of edges from fragmentation, which are the border regions of a landscape element where the influences of the surroundings limit the development of interior environmental conditions (Forman; Godron, 1981). Many ecological relationships can be modified or cease to exist by changing the environmental conditions of a forest area, affecting the survival of the local biota.

The edge areas of a forest fragment may not meet the necessary attributes for maintaining some plant species. The distribution area of each species may be related to the physical and biological factors of the environment, as well as the ecological attributes of the species itself, which may limit it to certain locations (Bernardi; Budke, 2010).

One of the main consequences of forest fragmentation is the extinction of species. Variations in wind, humidity and solar radiation patterns occur with microclimatic changes, being important for many organisms, and necessary for species that would be found in an intact ecosystem (Ranta; Blom; Niemela; Joensuu; Siitonen, 1998). Thus, studies in fragmented vegetation areas are extremely important to provide information that can serve as a subsidy for management, aiming at the conservation of these forest remnants.

Many studies have evaluated the edge effects on the vegetation of forest fragments in different regions of Brazil (Holanda; Feliciano; Marangon; Santos; Melo; Pessoa, 2010; Ferreira; Marcon; Salami; Rech; Mendes; Carvalho; Missio; Pscheidt; Guidini; Dornelles; Silva; Higuchi, 2016; Rocha, Torres; Jacovine; Schettini; Villanova; Rufino; Viana, 2019; Hentz; Dalla Corte; Sanqueta; Blum; Netto, 2017; Silva; Avila; Bica; Dalzochio; Rempel; Barros; Almeida, 2019). However, there are no works in the literature that portray the edge effect using the Two-Way Indicator Species Analysis (TWINSPAN) method, a hierarchical and divisive species classification methodology which enables identifying groups of species that characterize each sample.

In view of the above, the present study aimed to evaluate the edge effect on the phytosociological and floristic structure of a montane seasonal semi-deciduous forest fragment using the TWINSPAN method.

2 MATERIALS AND METHODS

The study was carried out in a forest fragment located on the campus of the Universidade Estadual do Sudoeste da Bahia (UESB), in the municipality of Vitória da Conquista, BA, Brazil, classified as Montane Seasonal Semi-deciduous Forest (MSSF) (Instituto Brasileiro de Geografia e Estatística [IBGE], 2012) and known regionally as Mata de Cipó. The area is located in the Planalto da Conquista at an altitude of 891 m, at the geographical coordinates: 14°52'46" South latitude and 40°47'34" West longitude. The area around this forest fragment is mostly composed of degraded pasture.

The region's climate is Cwb according to the Köppen classification, an altitude tropical climate (Alvares; Stape; Sentelhas; Gonçalves; Sparovek, 2013) with an average annual temperature of around 25°C and an average annual precipitation of around 850 mm (Barbosa; Barreto-Garcia; Gama-Rodrigues; Paula, 2017). The soil in the region is classified as Dystrophic Yellow Latosol (Solos EMBRAPA, 2013).

First, four sampling strips were defined in the forest fragment: strip 1 (S1) set immediately at the edge of the fragment (0-10 m); strip 2 (S2) at a distance of 40-50 m from the edge; strip 3 (S3) at a distance of 80-90 m from the edge; and strip 4 (S4), which represents the fragment matrix at 400 m from the edge. These distances are in accordance with Santos, Barreto-Garcia and Scoriza (2018), Barreto-Garcia, Oliveira, Oliveira and Lacerda (2019a) and Barreto-Garcia, Scoriza and Paula (2019b), who also carried out studies regarding the edge effect in the same ranges considered in this work. Next, 10 plots of 10m x 10m were outlined in each of the strips, totaling 40 plots in the fragment.

All trees with CBH (circumference at breast height at 1.30 m from the ground) greater than 15 cm were included in this study. All trees considered suitable for entering the survey were marked with aluminum plates numbered in increments.

Fertile or sterile samples were collected (according to availability) from the sampled individuals. The species were identified using the collection of the UESB Herbarium of Vitória da Conquista (HUESBVC), specialized bibliography such as Flora da Bahia, Barroso (1992), Lorenzi (1992, 2009) and Queiroz (2009) and access to virtual herbaria (tropical.org, fm1.fieldmuseum.org; reflora.jbrj.gov.br). The APG IV taxonomic system was used (Chase; Christenhusz; Fay; Byng; Judd; Soltis; Mabberley; Sennikov; Soltis; Stevens, 2016).

The ecological groups of the species were defined based on the work of Macedo, Silva, Alves and Martins (2019), Silva, Oliveira, Santos and Paula (2003) and Meira Júnior, Pereira, Machado, Mota and Otoni (2015). The importance value (IV) was subsequently calculated for the phytosociological analysis (Mueller-Dombois; Ellenberg, 1974). The Shannon-Weaver diversity (H') (Shannon; Weaver, 1964) and the Pielou evenness (J') (Pielou, 1966) indices were also defined. The calculations were performed using the FITOPAC 2.1 software program (Shepherd, 2010).

The floristic composition and phytosociological structure were compared and classified using the TWINSPAN method (Hill, 1979), and the cut-off levels for the pseudospecies were 0; 2; 5; 10 and 20. The TWINSPAN method considers that each grouping is different from the other through the species that compose it, based on the presence and absence of pseudospecies in the plot (Kent; Coker, 1992). In turn, the pseudospecies represents the different density amplitudes of the species in question. Thus, the vegetation classification by TWINSPAN makes it possible to identify groups and their respective indicator species, which are restricted to the group (Avila; Araújo; Longhi; Gasparin, 2011).

A comparison of the averages of height, diameter (circumference divided by Pi), basal area, number of individuals and of species was performed by applying the F test through the Duncan test at 5% of probability using the R version 4.1.2 software program (R CORE TEAM, 2021). The Past software program was used to compare the diversity values (H') (Test of diversity) (Hammer, 2001).

3 RESULTS

A total of 63 species distributed in 25 families were sampled (Table 1). Only three taxa could not be identified and two individuals were defined at the family level.

Table 1 – List of species sampled in the survey carried out in a montane seasonal semi-deciduous forest fragment in Vitória da Conquista, BA, Brazil, organized in alphabetical order of family and species

Family	Species	EG	S1	S2	S3	S4
Anacardiaceae	*Astronium graveolens* Jacq.	LS	X	X	X	X
Annonaceae	*Annona sylvatica* A.St.-Hil.	P	X	X	X	X
Apocynaceae	*Aspidosperma parvifolium* A.DC.	LS	X			
Bignoniaceae	*Anemopaegma album* Mart. ex DC.		X	X	X	
Bignoniaceae	*Handroanthus impetiginosus* (Mart. ex DC.) Mattos	LS	X			
Bignoniaceae	*Handroanthus serratifolius* (Vahl) S.Grose	LS			X	
Boraginaceae	*Cordia incognita* Gottschling & J.S.Mill.		X	X	X	
Celastraceae	*Monteverdia distichophylla* (Mart. ex Reissek) Biral		X	X	X	X
Chrysobalanaceae	*Licania kunthiana* Hook.f.	LS			X	X
Combretaceae	*Terminalia glabrescens* Mart.	P			X	X
Erythroxylaceae	*Erythroxylum daphnites* Mart.			X	X	X
Euphorbiaceae	*Croton piptocalyx* Müll.Arg.	P	X	X	X	
Euphorbiaceae	*Sapium glandulosum* (L.) Morong	P	X	X	X	X
Fabaceae	*Albizia inundata* (Mart.) Barneby & J. W. Grimes	P	X	X	X	X

To be continued ...

Table 1 – Continuation

Family	Species	EG	S1	S2	S3	S4
Fabaceae	*Anadenanthera colubrina* var. cebil (Griseb.) Altschul	P	X	X		
Fabaceae	*Andira inermis* (W.Wright) DC.	C				X
Fabaceae	*Bowdichia virgilioides* Kunth	P	X	X		
Fabaceae	*Chloroleucon foliolosum* (Benth.) G. P. Lewis	ES	X			
Fabaceae	*Dalbergia decipularis* Rizzini & A. Mattos	ES	X		X	
Fabaceae	Fabaceae 1				X	
Fabaceae	Fabaceae 2				X	
Fabaceae	*Hymenaea courbaril* L.	LS		X	X	
Fabaceae	*Hymenaea eriogyne* Benth.					X
Fabaceae	*Machaerium acutifolium* Vogel	LS	X	X	X	
Fabaceae	*Machaerium brasiliense* Vogel	ES	X	X	X	X
Fabaceae	*Machaerium fulvovenosum* Lima	LS	X	X	X	
Fabaceae	*Machaerium hirtum* (Vell.) Stellfeld	P	X		X	X
Fabaceae	*Machaerium lanceolatum* (Vell.) J. F. Macbr.		X			
Fabaceae	*Machaerium nyctitans* (Vell.) Benth.	P	X	X	X	X
Fabaceae	*Peltophorum dubium* (Spreng.) Taub.	P	X	X		
Fabaceae	*Platymiscium floribundum* Vogel	LS	X			
Fabaceae	*Platypodium elegans* Vogel	LS	X	X		
Fabaceae	*Pseudopiptadenia contorta* (DC.) G. P. Lewis & M.P. Lima	ES	X	X	X	X
Fabaceae	*Pterocarpus villosus* (Mart. ex Benth.) Benth.				X	X
Fabaceae	*Pterogyne nitens* Tul.	ES	X			
Fabaceae	*Sweetia fruticosa* Spreng.	P	X	X		
Fabaceae	*Swartzia flaemingii* Raddi	LS	X	X		
Indeterminada	Indet 1			X	X	X
Indeterminada	Indet 2					X
Indeterminada	Indet 3		X	X	X	X
Lauraceae	*Ocotea odorifera* Rohwer	LS			X	X
Malvaceae	*Luehea* sp.		X	X	X	X
Meliaceae	*Trichilia emarginata* (Turcz.) C.DC.	LS	X		X	
Meliaceae	*Trichilia hirta* L.	ES	X	X	X	X
Meliaceae	*Trichilia lepidota* Mart.	LS	X			
Myrtaceae	*Blepharocalyx salicifolius* (Kunth) O.Berg	ES			X	X
Myrtaceae	*Eugenia itapemirimensis* Cambess.	LS			X	
Myrtaceae	*Eugenia ligustrina* (Sw.) Willd.	LS		X	X	X
Myrtaceae	*Eugenia punicifolia* (Kunth) DC.	P			X	X
Myrtaceae	*Myrcia guianensis* (Aubl.) DC.	ES			X	
Nyctaginaceae	*Guapira noxia* (Netto) Lundell	ES		X		
Ochnaceae	*Ouratea spectabilis* (Mart.) Engl.	ES				X
Proteaceae	*Roupala montana* Aubl.	C				X
Rhamnaceae	*Ziziphus joazeiro* Mart.	ES	X			

To be continued ...

Table 1 – Conclusion

Family	Species	EG	S1	S2	S3	S4
Rubiaceae	*Amaioua guianensis* Aubl.	ES	X	X	X	
Rubiaceae	*Randia armata* (Sw.) DC.	ES			X	X
Rubiaceae	*Guettarda viburnoides* Cham. & Schltdl.	ES			X	
Rutaceae	*Esenbeckia febrifuga* A.Juss	ES			X	
Rutaceae	*Metrodorea mollis* Caub.			X	X	X
Rutaceae	*Zanthoxylum rhoifolium* Lam.	P		X		X
Salicaceae	*Casearia decandra* Jacq.	ES				X
Salicaceae	*Casearia sylvestris Sw.*	ES				X
Sapotaceae	*Pouteria gardneri* (Mart. & Miq.) Baehni	ES				X

Source: Authors (2022)

In where: EG – ecological groups; LS – late secondary; C – climax; P – pioneer; ES – early secondary; S1 – strip 1; S2 – strip 2; S3 – strip 3; S4 – strip 4.

The family that presented the greatest richness in terms of the number of species and genera was Fabaceae, with 23 species distributed in 15 genera, and two unidentified taxa.

A total of 563 individuals were sampled. The total H' index was 3.379 nats ind-1; this value represents a relatively high diversity, favored by a high evenness index (J' = 0.82), showing a great balance in the distribution of individuals by species.

The maximum diameter found was 42.33 cm and the estimated maximum height was 16 m. The total basal area found in this study was 5.283 m^2/ha, and the values per range are described in Table 2.

Table 2 – Mean parameters per strip of a forest fragment at the Universidade Estadual do Sudoeste da Bahia (UESB), Vitória da Conquista (BA, Brazil), campus

Strip	BA	NI	H'	NS	Height	sd	Diameter	sd
1	0.116 a	16.5 a	2.9178 b	8.1 a	7.384 a	1.630	8.890 b	3.987
2	0.136 a	15.5 ab	2.9406 b	8.7 a	7.723 a	1.712	9.605 b	4.495
3	0.138 a	13.7 ab	2.8705 b	7.7 a	8.113 a	1.820	10.583 ab	5.391
4	0.137 a	10.6 b	3.1751 a	7.5 a	7.921 a	2.509	11.538 a	6.026

Source: Authors (2022)

In where: BA = basal area (m^2/ha); NI = number of individuals; H'= Shannon-Weaver diversity index; NS = number of species; Mean height (m); Mean diameter (cm); sd = standard deviation; *Means followed by the same letter in the column do not differ statistically from each other by the t-test for H' and Duncan's test for the other parameters, at 5% probability.

The number of individuals showed a significant difference between strip 1 and strip 4, revealing a gradual decrease along the strips as you move away from the edge. There was a difference between the edge strips (S1 and 2) and the matrix strip (S4) for the diameter, with an increase in diameter as it moves away from the edge. The Shannon-Weaver index was statistically different and higher in strip 4 compared to the others, revealing an increase in diversity within the fragment.

The *Pseudopiptadenia contorta* and *Sapium glandulosum* species are among the five species with the highest values for IV in all strips, while the *Platypodium elegans* species presents good presence only in strip 1 (Table 3).

Table 3 – List of species sampled in a phytosociological survey carried out in a montane seasonal semi-deciduous forest fragment at the Universidade Estadual do Sudoeste da Bahia (UESB), Vitória da Conquista (BA, Brazil), campus

Species	Strip 1		Strip 2		Strip 3		Strip 4	
	NI	IV	NI	IV	NI	IV	NI	IV
Albizia inundata	7	15.87	4	9.21	1	2.49	4	10.63
Amaioua guianensis	1	2.27	3	6.52	1	2.42		
Anadenanthera colubrina	2	4.38	1	1.93				
Andira inermis							1	2.48
Anemopaegma album	1	2.44	3	9.34	3	19.41		
Annona sylvatica	10	19.56	5	12.87	1	2.48	3	9.07
Aspidosperma parvifulium	1	2.39						
Astronium graveolens	7	18.03	2	6.18	5	15.54	14	30.22
Blepharocalyx salicifolius					1	2.35	1	3.29
Bowdichia virgilioides	1	2.02	1	1.94			1	2.89
Casearia decandra							2	6.33
Casearia sylvestris							1	3.68
Chloroleucon foliolosum	1	2.07						
Cordia incognita	20	25.38	1	2.68	2	4.22		
Croton piptocalyx	1	2.94	4	9.90	3	9.12		
Dalbergia decipularis	1	2.22			3	9.02		
Erythroxylum daphnites			2	4.44	7	13.09	3	10.91
Esenbeckia febrifuga					1	3.23		
Eugenia itapemirimensis					1	2.27		
Eugenia ligustrina			3	6.88	2	4.75	5	10.15
Eugenia punicifolia					1	2.21	5	12.23

To be continued ...

Table 3 – Continuation

Species	Strip 1		Strip 2		Strip 3		Strip 4	
	NI	IV	NI	IV	NI	IV	NI	IV
Fabaceae 1					2	4.93		
Fabaceae 2					1	3.68		
Guapira noxia			1	2.40				
Guettarda viburnoides					1	2.26		
Handroanthus impetiginosus	1	2.39						
Handroanthus serratifolius					1	4.98		
Hymenaea courbaril L.			1	2.02	1	2.28		
Hymenaea eriogyne							1	6.16
Indet 1			4	10.65	2	5.21	3	11.81
Indet 2							5	15.89
Indet 3	2	4.30	4	6.94	2	4.79	3	7.44
Licania kunthiana					2	8.91	2	5.18
Luehea sp.	1	2.07	3	5.26	2	4.85	2	5.20
Machaerium acutifolium	7	13.22	17	25.85	1	2.23		
Machaerium brasiliense	15	19.85	11	18.55	2	7.25	2	5.75
Machaerium fulvovenosum	2	4.32	12	19.35	8	13.77		
Machaerium hirtum	3	7.50			1	2.99	3	10.19
Machaerium lanceolatum	1	2.19						
Machaerium nyctitans	19	26.19	10	20.73	2	4.55	4	12.98
Metrodorea mollis			6	12.47	11	23.20	11	19.25
Monteverdia distichophylla	1	2.01	1	3.29	4	12.46	1	2.41
Myrcia guianensis					1	2.26		
Ocotea odorifera					1	2.37	1	2.49
Ouratea spectabilis							3	6.34
Peltophorum dubium	1	2.72	2	3.99				
Platymiscium floribundum	1	2.10						
Platypodium elegans	15	28.68	4	11.21				
Pouteria gardneri							2	8.47
Pseudopiptadenia contorta	13	27.80	28	41.79	42	57.65	5	14.81
Pterocarpus villosus					1	3.77	2	8.29
Pterogyne nitens	1	3.70						
Randia armata					1	2.18	1	2.49
Roupala montana							1	3.26
Sapium glandulosum	17	27.10	11	23.55	12	20.84	9	34.43
Swartzia flaemingii	1	2.17	1	1.98				
Sweetia fruticosa	4	6.97	7	11.25				
Terminalia glabrescens					1	2.87	1	3.90
Trichilia emarginata	1	2.09			2	4.93		
Trichilia hirta L.	1	2.01	2	3.89	1	2.20	1	2.58

To be continued ...

Table 3 – Conclusion

Species	Strip 1		Strip 2		Strip 3		Strip 4	
	NI	IV	NI	IV	NI	IV	NI	IV
Trichilia lepidota	1	2.00						
Zanthoxylum rhoifolium			1	2.93			3	8.82
Ziziphus joazeiro	4	9.03						

Source: Authors (2022)

In where: NI: number of individuals; IV = importance value.

A total of 33% of species were exclusive in strips 3 and 4, revealing a distinction in the species composition of the strips closer to the edge with those of the fragment interior.

The classification for samples produced 24 groups after six levels of division, which indicates great heterogeneity, both in the composition and in the distribution of individuals per species within the plots. Moreover, three clusters were identified when analyzing the third level of division (Figure 1).

Figure 1 – Classification of sampling units into three groups* characterizing the formations in the MSSF fragment in Vitória da Conquista, BA, Brazil

GROUP 1	GROUP 2	GROUP 3
Eigenvalue: 0,336	**Eigenvalue:** 0,447	**Eigenvalue:** 0,539
16 subplots:	11 subplots:	16 subplots:
Indicator species: *Zanthoxylum rhoifolium.*	**Indicator species:** *Monteverdia distichophylla*, *Eugenia punicifolia.*	**Indicator species:** *Luehea sp.*, *Astronium graveolens.*

Source: Authors (2022)

In where: * describing the following for each group: the eigenvalue, the number of subplots, the quantity of subplots representing each range and the indicator species; S1 = strip 1; S2 = strip 2; S3 = strip 3; S4 = strip 4.

It can be seen that group 1 was formed by the majority (14 of 18) of the plots present in strips 1 and 2, and group 2 and 3 is formed by the majority (22 of 27) of the plots present in strips 3 and 4; thus, it can be inferred that strip 3 (located 80-90 m from the edge) is more similar to the matrix strip than the two strips on the edge.

In addition, it is possible to observe that the indicator species in group 1 is a pioneer. The indicator species identified in group 3 is late secondary, revealing the change in the environment when it moves away from the edge.

4 DISCUSSIONS

We found the first indication of the edge effect when analyzing the number of individuals, since it tended to reduce as it got further from the edge. Also, the diameter increased towards the fragment interior (Table 2). This result is in agreement with Zaú (1998), who stated that the vegetation on the edge has a smaller average diameter than that of the interior.

Thus, it can be deduced that there is a greater number of species that can develop at the edge where there is greater solar radiation intensity, less rain interception, and greater incidence of winds. While only a few species manage to adapt and remain inside the fragment where these conditions are not the same, reducing the number of individuals in this space.

Furthermore, it is inferred that the vegetation in the interior has been established for a longer time than the one on the edge, as it is an environment in a more advanced successional stage, with individuals with larger diameters. At the edge where individuals are pioneers and present rapid growth, they may form vegetation with a more advanced successional stage as conditions become more favorable and new vegetation strips are added around the fragment.

The H' index found was higher than that found in surveys carried out in the same phytophysiognomy (Nascimento; Rodal, 2008; Cunha; Silva Junior; Lima, 2013; Freitas; Sampaio, 2013), which obtained values ranging between 2.99 and 3.15 nats ind^{-1}. The increase in diversity within the fragment specifically regarding strip 4 mainly revealed greater evenness (J'), demonstrating that this portion of the fragment is more balanced in relation to the number of individuals per species.

It is noteworthy that the percentage of rare species found was similar to that observed by Martins (1991) for SSF of between 25.5 and 29.9%. The phytosociological data found corroborate with Paula, Barberena, Soares Filho, Barreto-Garcia, Prata and Medeiros (2021) who also found most of the species in the work carried out at MSSF located in Vitória da Conquista, BA, Brazil. However, the *Cordia incognita* species defined in the cited article as the second highest species for IV, is only present among the 10 largest in strip 1 in this work. According to Lorenzi (1998), this species is heliophilic, meaning that it needs more illuminated environments, thus corresponding to the outermost edge (strip 1) of the present study.

The Fabaceae family was very present in this work, which is in agreement with other works carried out in seasonal forests in Bahia (Carvalho-Sobrinho; Queiroz, 2005; Rodal; Lucena; Andrade; Melo, 2005; Cardoso; Queiroz, 2008; Paula; Barberena; Soares Filho; Barreto-Garcia; Prata; Medeiros, 2021) who cite the importance of legumes for physiognomy.

The performance of *Pseudopiptadenia contorta* was similar to that found by Paula, Barberena, Soares Filho, Barreto-Garcia, Prata and Medeiros (2021) in their study. This species belonging to the Fabaceae family is often cited in studies in seasonal forests, and has autochoric dispersion syndrome (Lorenzi, 2009), which contributes to its reproduction and consequently its high richness in this type of physiognomy.

Another relevant fact is the presence of *Platypodium elegans* only in the initial strips, as this species is considered an early secondary species (Higuchi; Reis; Reis; Pinheiro; Silva; Oliveira, 2006), showing that it is strongly present in areas with greater luminosity influence. In addition, as it is a species with anemochoric dispersion syndrome (Paula; Barberena; Soares Filho; Barreto-Garcia; Prata; Medeiros, 2021) it is also dependent on the higher occurrence of winds in the strips closest to the edges.

An eigenvalue is calculated in the analysis of samples for each division produced, which indicates how much of the variation in the community data was explained (Mccune; Mefford, 1999). The eigenvalues found are greater than 0.3, which According to Felfili and Venturoli (2000) indicate that the divisions have ecological significance.

With the definition of the groups, it was observed that the edge effect in this forest fragment exerts influence up to the first 90 m. This value is close to that found by Espírito-Santo, Oliveira-Filho, Machado, Souza, Fontes and Marques (2002), who found a radius of 100 m for the edge effect in the MSSF located in Lavras, MG, Brazil.

Other studies have been conducted in the same fragment of the present work (Santos; Barreto-Garcia; Scoriza, 2018; Oliveira; Barreto; Gomes; Guimarães, 2013; Barreto-Garcia; Oliveira; Oliveira; Lacerda, 2019a; Barreto-Garcia; Scoriza; Paula, 2019b; Novais; Ferreira; Barreto, 2016) which have shown the existence of an edge effect on vegetation and other ecosystem attributes. Barreto-Garcia, Oliveira, Oliveira and Lacerda (2019a) observed that the climate interfered with the litter contribution with greater intensity up to 90 m towards the interior of the fragment. Barreto-Garcia, Scoriza and Paula (2019b) found that the edge effect influenced the fertility of the surface layer of the soil up to 90 meters from the edge towards the fragment interior.

5 CONCLUSIONS

The vegetation of the studied forest fragment is influenced by an edge effect, evidenced by the increase in the average diameter of individuals towards its interior and by the increase in the number of individuals in the strips closer to the edge. In addition, it is possible to observe a clear distinction in the floristic composition between the edge/border strips (1 and 2) and the interior strips (3 and 4), which make up a total of 33% of exclusive species.

The diversity index H' was higher in strip 4, mainly due to the increase in evenness (J'), demonstrating that the fragment interior has a greater balance in the number of individuals per species.

According to the multivariate analysis, it was possible to conclude that strip 3 is more similar to strip 4 than to the initial strips, characterizing an edge effect up to 90 m towards the fragment interior.

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