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Articles

Edge effect in Cerrado Seasonal Semideciduous Forests

Efeito de borda em Florestas Estacionais Semideciduais do Cerrado

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ABSTRACT

Edge effects are changes in vegetation, microclimate conditions and soil in transition bands between the edge and interior of the forest. The objective of this study was to verify for how many meters it is possible to perceive structural floristic variations caused by the Edge Effect by analyzing the tree and regenerative strata of four seasonal semi-deciduous forests located in the Cerrado Biome, Brazil. Samples were taken from four fragments of semi-deciduous forests in the Cerrado and analyzed by dendrograms and regressions for structural parameters that could distinguish edge and interior regions. In the Bray-Curtis Index and in the Sørensen Coefficient, for the tree stratum, the fragments presented groups with plots close to 40 meters from the edge. For the regenerative stratum the groups were more difficult to distinguish, even with a tendency to floristic dissimilarity of 15 to 20 meters. The groups were statistically confirmed by the Similarity Analysis (ANOSIM). The similarity percentage (SIMPER) can relate the species according to their contribution to the division into groups and to the areas of greatest interest. In the analysis of the structural data, the relationships between the number of trees, species and basal area as a function of the edge were not proven. Similarity analyzes distinguished the interior from the edge and measured the distance covered in the studied fragments, demonstrating that the composition of the first 40 meters of forest can be considered edges.

Keywords: Anthropization; Dendrogram of similarity; Edge distance; Forest fragmentation

RESUMO

Os efeitos de borda são modificações na vegetação, nas condições microclimáticas e no solo na transição entre o meio exterior e o interior da floresta. O objetivo deste estudo foi verificar até quantos metros é perceptível variações florístico estruturais ocasionadas pelo Efeito de Borda, analisando-se o estrato arbóreo e regenerativo de quatro fragmentos de Floresta Estacional Semidecidual localizados no bioma Cerrado. A partir da amostragem realizada nestes quatro fragmentos, foram analisadas, por meio de dendrogramas e regressões, se os parâmetros estruturais podem distinguir regiões de borda e de interior. Para o estrato arbóreo, nos dendrogramas de similaridade (Bray-Curtis e Sørensen), os fragmentos apresentaram grupos com parcelas semelhantes até os 40 metros de borda. Para o estrato regenerativo, os grupos foram mais difíceis em distinguir, mesmo com tendência, a dissimilaridade florística de 15 a 20 m. A partir da Análise de Similaridade (ANOSIM), os grupos foram confirmados estatisticamente. A porcentagem de similaridade (SIMPER) pode relacionar as espécies em função da sua contribuição para a divisão dos grupos e para as áreas de maior interesse. Nas análises dos dados estruturais, não foram comprovadas as relações do n° de árvores, espécies e área basal em função da borda. As análises de similaridade foram capazes de distinguir o interior da borda e mensurar a distância percorrida nos fragmentos estudados, demonstrando que a composição dos primeiros 40 m de floresta pode ser considerada borda.

Palavras-chave: Antropização; Dendrograma de similaridade; Distância da borda; Fragmentação florestal

1 INTRODUCTION

Edge effects are changes that take place in the forest exterior boundary, such as variation in microclimate conditions including wind and light incidence, increase in pressure due to evapotranspiration and tree fall (Laurance; Vasconcelos, 2009). The edge effect can thus be considered as modification in the transition band between the forest interior and the matrix (highways, monocultures and pasture) (D'abadia *et al*., 2020). There are borders in any forest, but they can be the result of fragmentation of native areas that causes thinning of part of the forest, forming a new border area in a previously protected area (Ferreira *et al*., 2017). Therefore, there is habitat isolation and reduction in properly protected forest areas (Pereira *et al*., 2021).

Changes triggered by the abrupt contact between forest and matrix are responsible for damage to the local fauna and flora. Due to this contact, there may be changes in the light and moisture regimen in the habitat that sheltered organisms adapted to the forest interior (Bolt *et al.*, 2020). The reasons for the thinning that causes edges are usually linked to wood material extraction for land conversion to agriculture, cattle raising, mining or for lumber use (Coelho *et al*., 2020).

Increased light and wind incidence are more prominent in the edge areas, and also raise wild fire frequency and consequently increase tree mortality rates (Brinck *et al*., 2017). The result of these phenomena daily affects the forest structure and composition in the edge zones, differentiating them from the interior areas (Silva *et al*., 2021). This change in structure, resulting from decrease in species richness and abundance, is present in vegetation in regions that have been modified by timber extraction, such as in forests in the Cerrado, Atlantic Rainforest and the Amazon, Brazil (Medonça *et al*., 2015).

In the Cerrado, recent studies have shown the edge effect as influencer in the dynamic of the forest ecosystem, especially regarding the soil-vegetation interaction, that affects carbon incorporation by microorganisms (D'abadia *et al*., 2020). A study carried out in Southeastern Goiás state, Brazil, in areas affected by the edge effect, showed there was tree species loss and structural differentiation of organisms present in the natural vegetations in the different Cerrado formations analyzed (Palharini *et al*., 2020).

The consequences of the edge effect, such as fire, daily affect the resilience of forests due to the gradual decrease in vegetation regeneration, increase in mortality rate and decreasing germination of new individuals (Christianini; Oliveira, 2013). In order to conserve and preserve forest resources and the functioning of the diversity of all the ecosystem, it is important to study the consequences of the formation of edge regions (Paula *et al*., 2016).

One of the necessary questions is to define how many meters into the forest the edge effect reaches until it modifies the species structure and composition in different forest formations. Even with the importance of protecting natural areas fragmented for various purposes (in the most part for agriculture and cattle raising) discussed in several reports, studies still fail to measure in meters the zones of the edges present in the forests.

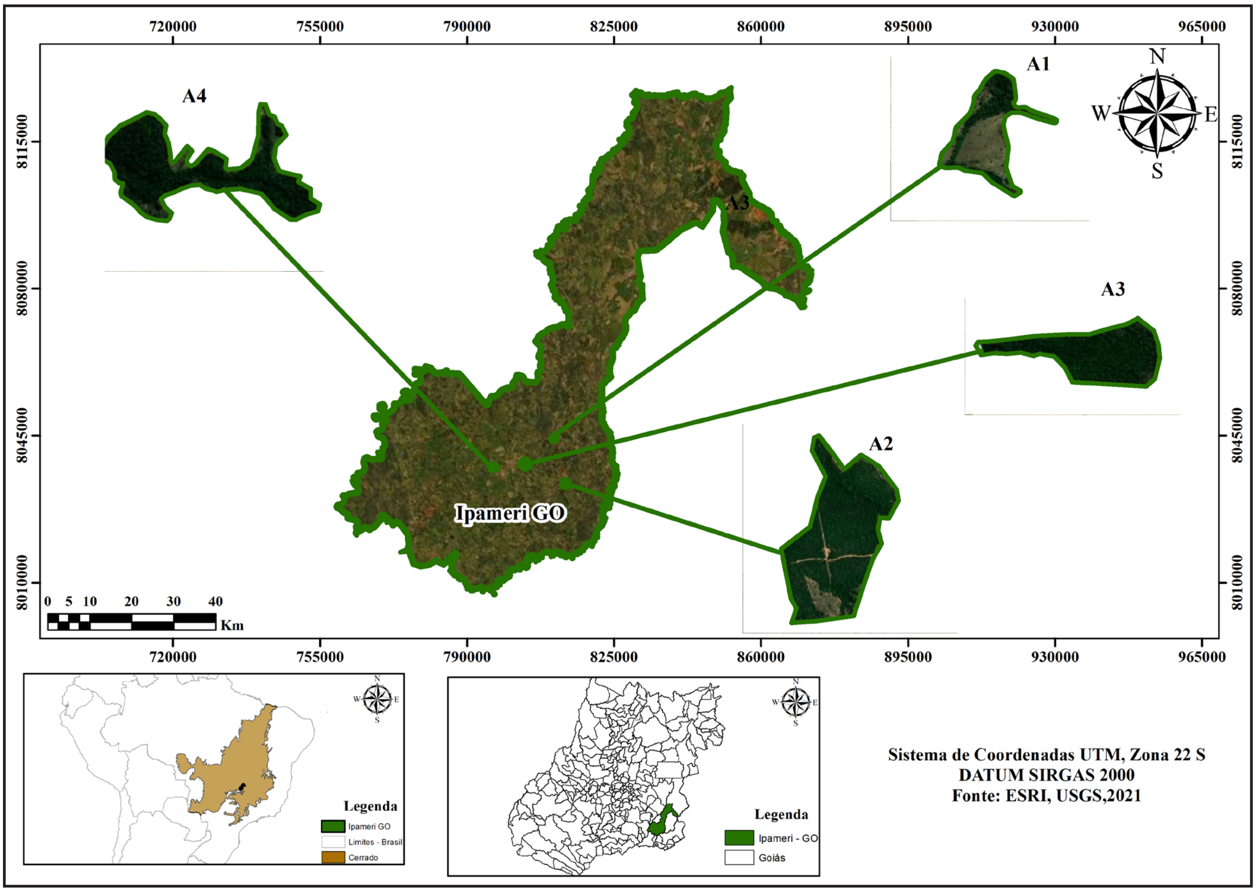
The size (distance) of the areas of the edge effect can be understood as the calculation in meters of the vegetation cover from the edge area to the forest interior that is influenced and thus differentiated (composition and structure) due to factors such as area size, fragment age, type of fragmentation and also the flora present. (Guanier *et al*., 2020; Pscheidt *et al*., 2018).

The Seasonal Semideciduous Forests of the Cerrado, Brazil, are present in regions where agriculture and cattle raising predominate, that raises the anthropization incidence due to factors such as the edge effect and natural disasters that result in alteration in the forest composition and structure. Thus, these forests become good study objects to assess the edge effect (Gusson *et al*., 2009). *T*he objective of the present study was to verify whether the edge could be distinguished from the forest interior by the forest structure in comparisons between these forest sectors and, mainly, to measure the distance occupied by the edge zone in semideciduous forests in the Cerrado, for the tree and vegetation regeneration strata.

2 MATERIALS AND METHODS

The study was carried out in four areas (A1. A2. A3 and A4) in the municipality of Ipameri, Goiás state, Brazil (Figure 1), all with a predominantly agricultural matrix (Table 1). The climate in the region is type Aw with two well-defined periods, one dry and cool (April to September) and 214 mm average rainfall while the other is warm with rain (October to March) and 1317 mm average rainfall. The mean annual temperature is 21.6°C, with minimums of 22.9°C in the wet season and 20.2°C in the dry season (Alvares *et al*., 2014).

Figure 1 – Location of the four fragments of semideciduous forests present in the agricultural matrix and located in the southeast of Goiás state, Brazil, which were used in the study



Source: Authors (2021)

Table 1 – Characterization with location and dimension of the four fragments belonging to the phytophysiognomy of a seasonal semideciduous forest in the municipality of Ipameri, Goiás state, Brazil

Frag.	Latitude	Longitude	Area (ha[-1])	Per. (km)	Comp. (km)	Larg. (km)	TB (years)
A1	17°39’55.12”S	48° 4’19.60”O	5.37	0.91	0.21	0.43	14
A2	17°45’40.35”S	48° 2’42.80”O	21.6	1.49	0.59	0.30	16
A3	17°43’08.30”S	48° 8’10.16”O	15.6	2.23	0.47	0.72	14
A4	17°43’48.71”S	48°12’17.48”O	21.3	2.79	0.70	0.51	20

Source: Authors (2021)

In where: Frag = fragment name; Per. = fragment perimeter; Comp. = fragment length; Larg. = fragment width; TB = edge lifetime.

Regarding sampling, the individuals were surveyed after plotting three transects in each forest, with 10 plots in each transect. Ten x 10 m plots were used to sample the tree individuals using the criteria of diameter at chest height (D1.30) greater than 5 cm (15.7 cm circumference). The plot size was chosen because it was considered that the modifications are harder to detect in bigger plots (for example, 20x20 m, 20x50 m). In all, considering the four fragments, 1.2 ha were sampled.

The criteria adopted for the regenerative individuals was diameter at chest height less than 5 cm and 1m minimum height, diameter measured at 0.30 m from the soil (D0.30), in 5x5 m plots set inside in the 10x10 m plots. Each fragment consisted of three transects containing 10 plots that started at the edge, thus reaching 100 (tree stratum) and 50 m (regenerative stratum) entering the forest (Figure 2).

There were the following exceptions in the sampling: in A4. 10 x 10 m plots were adopted for the regenerative stratum and 10 x 20 m plots for the tree stratum because of previous sampling in the area, and because the fragment did not reach the maximum of 100 m, due to water courses or craters opened in the fragment. In A3. four plots were lost due to natural disasters and human interference.

In order to analyze the fragments in function of the other parameters, plots were grouped at the same distance from the edge, with 0 from the edge to a maximum distance of 100 m. To verify whether differences could be detected between the plots along the forest edge, using the total of individuals for each species sampled at the different distances from the edge, similarity analyzes were performed using the Sørensen Coefficient (after converting the data in presence-absence) and the Bray-Curtis Index using the total number of individuals per species (Chen *et al*., 2021). Then similarity dendrograms were generated from the similarity results, with the mean distance grouping technique (UPGMA – Hua *et al*., 2017). After verifying the dendrograms, different forest groups were determined among plots closer and farther from the edge.

Figure 2 – Representative illustration of the plot of transects composed of 10x10 m and 5x5 m plots from the edge entering along the forest fragments

Source: Authors (2021)

To verify whether the groups of plots closer and farther from the edge that were formed by the dendrograms really were distant from one another, a similarity analysis was made with the Bray-Curtis index as distance measurement (Analysis of Similarities – ANOSIM – Anderson; Walsh, 2013). Then, to verify which were the most important species to define the forest edge and interior groups, the Similarity Percentage analysis was performed (Similarity Percentage – SIMPER) using the Bray-Curtis index as distance measurement. These analyses (similarity, dendrograms, ANOSIM and SIMPER) were made on the free software, PAST 4.0 (Hammer *et al*., 2001).

To verify whether the structural parameters showed differences in the direction from the forest edge to the interior, for each fragment of semideciduous forest, linear regressions were made between the total number of trees, number of species and basal area per individual for the distances in relation to the edge.

3 RESULTS

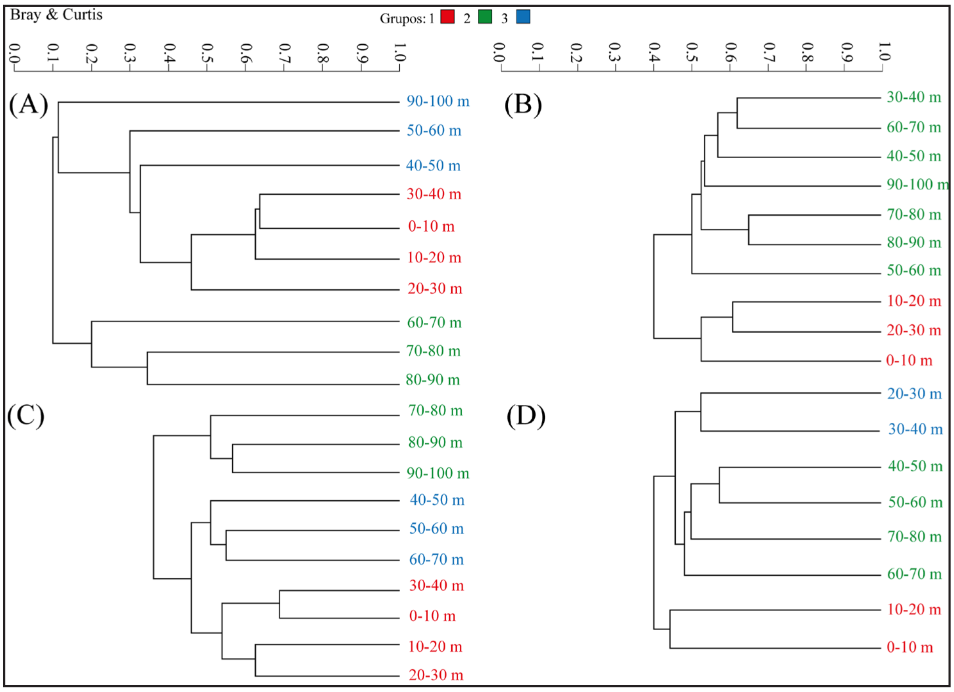
3.1 Tree stratum

In the tree stratum, the mean species richness was 71 (± 9.33) species, with a density of 406 (1310 ind.ha-1) individuals; in fragment A1. there were 654 (2180 ind. ha-1) individuals, in fragment A2, 456 (1520 ind.ha-1) individuals, in fragment A3 and 388 (1617 ind.ha-1) individuals were sampled in fragment A4. Regarding the basal area, in fragment A1 it was 8.04 m² (25.94 m².ha-1), in fragment A2 8.83 m² (29.4 m²/ha-1), in fragment A3 6.17 m² (20.6 m².ha-1) and in fragment A4 it was 14.78 m² (24.6 m².ha-1). The distribution by number of individuals, richness, basal area and data of tree strata height compared to the distance from the edge in each area are shown in Attachment 1.

The similarity dendrogram based on the Bray-Curtis Index showed division into three groups for A1 (Figure 3A) where the plots farthest from the edge, at 60 to 80 m, formed an interior group while the edge group occupied from 0 to 40 meters from the edge. In fragment A2 (Figure 3B) two groups were formed, where distances closest to the edge in one group were 0 to 30 meters and in the other, 40 to 100 meters. In A3 and A4 the groups closest to the edge were at 0 to 40 meters and 0 to 20 meters while the groups farthest from the edge were at 70 to 100 meters and 40 to 80 meters, respectively (Figure 3C and 3D).

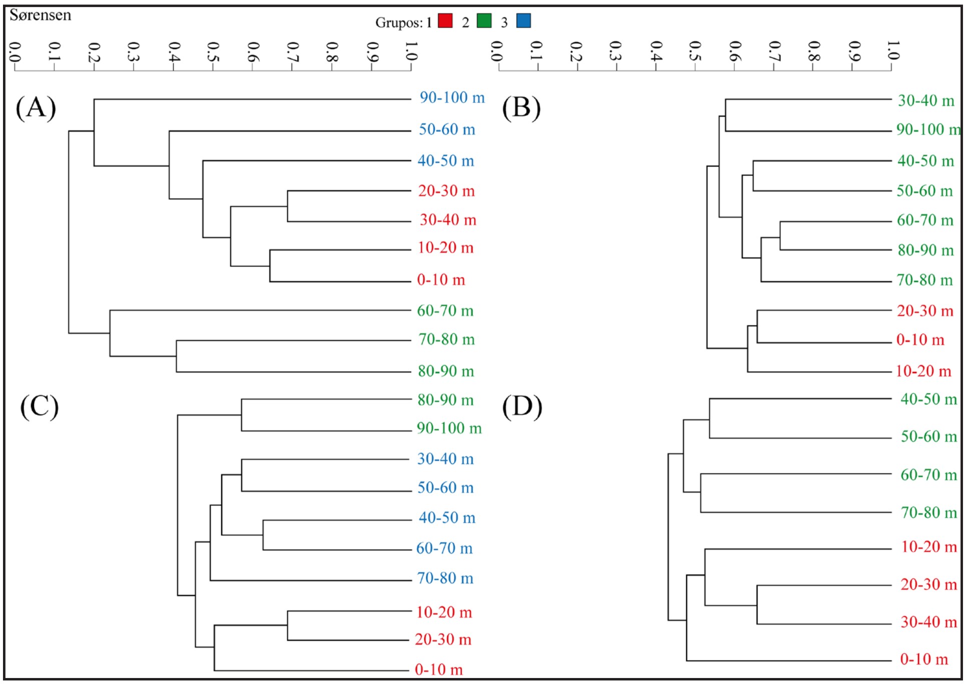
According to the dendrograms generated by cluster analysis and the Sørensen Coefficient mean distance (Figure 4A, 4B and 4D), two groups were formed, one with plots more interior in the forest represented by plots at 30 to 100 m from the edge in A1 (Figure 4B), 60-90 m in A2 (Figure 4A) and 40 to 80 m in A4 (Figure 4D) and in the other group plots were located closer to the edge. The only exception was the plots at 90-100 m in A1. Three groups formed in A3. with plots 0-30 m, another similar group with plots from 30 to 80 m and a further group deeper in the forest interior at 80-100 m (Figure 4C). For A1, the plots 90-100m clustered with the group located in the plots 90-100m, 50-60m and 40-60 m clustered more distant than the plots of 0-10 m to 30-40 m, a group considered closer to what would be the forest edge (Figure 4A). In A2. from 0 to 30 meters and 60 to 90 meters for the edge and interior groups, respectively (Figure 4B). In fragment A3 three groups formed, from 0 to 30 m (considered edge), 30-80 m and another 80-100 m (considered interior) (Figure 4C). In fragment A4 (Figure 4D) the division of the groups was between edge (0 to 40 meters) and interior (40 to 80 meters).

Figure 3 – Dendrograms generated by cluster analysis and the Bray-Curtis Index distance measurement using edge distance data in the tree stratum of seasonal semideciduous forest fragments A1 (A), A2 (B), A3 (C) and A4 (D)



Source: Authors (2021)

Figure 4 – Dendrograms generated by cluster analysis and distance measurement or Sørensen's Coefficient using edge distance data in the tree stratum of fragments A1 (A), A2 (B), A3 (C) and A4 (D)



Source: Authors (2021)

In each fragment, the ten most relevant species for edge and interior groups formation contributed more than 40% to the Similarity Analysis (SIMPER). These species were used to define which occurred most at the edge and which occurred more in the interior of the forest. Thus, this analysis enabled indication of the presential species of each group, that is, which species were most significant for the occurrence of the division (Table 1). The complete SIMPER results for each area are in Attachment 2-5.

Table 2 – Preferential edge, interior and generalist species obtained by the Percentage Similarity Analysis (Similarity Percentage - SIMPER) for the tree stratum species of the four semideciduous forest fragments

Species (Contribution %)		
Edge	**Interior**	**Generalist**
Coccoloba mollis (6.65%)	*Aspidosperma discolor* (3.58%)	*Guatteria australis* (4.38%)
Roupala montana (4.72%)	*Calophyllum brasiliense* (3.51%)	*Licania apetala* (19.21%)
Rhamnidium elaeocarpum (3.74%)	*Cordiera sessilis* (5.23%)	*Myracrodruon urundeuva* (7.03%)
Nectandra membranacea (5.31%)	*Emmotum nitens* (3.76%)	*Maprounea guianensis* (4.44%)
Qualea grandiflora (12.31%)	*Lithraea molleoides* (3.06%)	
Sclerolobium paniculatum (5.99%)	*Cheiloclinium cognatum* (2.33%)	
Siparuna guianensis (5.96%)	*Myrcia splendens* (8.58%)	
Tapirira obtusa (4.83%)	*Pouteria speciosa* (5.41%)	
Virola sebifera (6.63%)	*Xylopia emarginata* (3.91%)	
Xylopia aromatica (5.02%)	*Myrsine gardneriana* (3.65%)	
Terminalia glabrescens (4.02%)	*Protium heptaphyllum* (3.60%)	
Qualea parviflora (4.44%)		
Terminalia argentea (3.46%)		

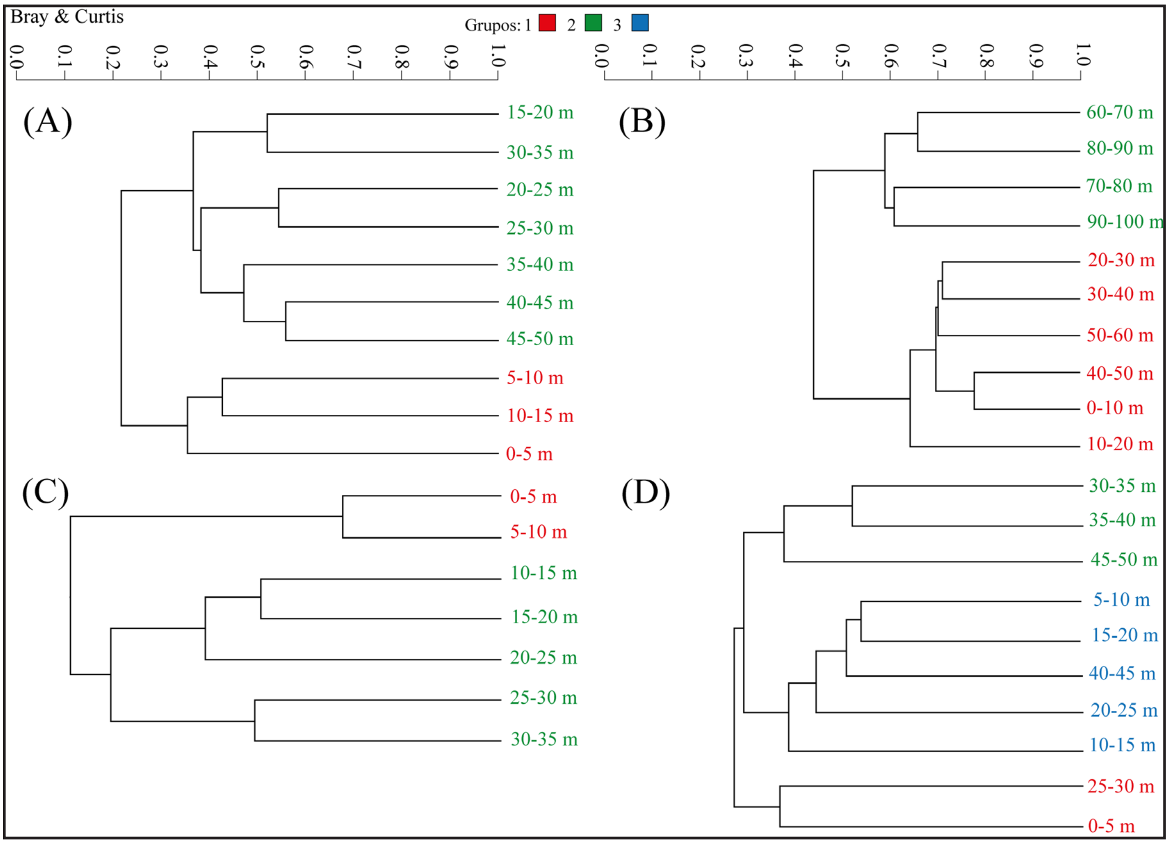
Source: Authors (2021)

3.2 Regenerative strata

In the regenerative strata, the mean species richness was 53 (± 17.97) species, with density of 706 (4630 ind/ha-1) individuals in fragment A1. 822 (2740 ind/ha-1) individuals in fragment A2. 183 (3660 ind/ha-1) individuals in fragment A3 and 342 (6840 ind/ha-1) individuals sampled in fragment A4. The distribution by number of individuals, richness, basal area and height data of the regenerative strata (D1.30 < 5 cm) in relation to the distance from the edge in each area is shown in Attachment 6.

The dendrogram based on the Bray-Curtis Index for the regenerative strata formed a group with plots close to the edge at 0 to 15 m and another group with plots at 15 to 50 meters from the edge in fragment A1 (Figure 5A). In fragment A2. the edge group presented plots with distances from 0 to 60 m from the edge and the farthest plots (at 60 to 100 m) formed the second group (Figure 5B). For fragment A3. group 1 (edge) consisted of the plots at 0 to 10 m and group 2 (interior) from 10 to 35 m from the edge (Figure 5C). In A4 there was division into three groups, the first with the plot closest to the edge at 0-5 m and 25-30m plot size, the second with plots 5 to 25m at 40-45 m from the edge and a third group with plots between 30 and 50 m (except 40-45m) (Figure 5D).

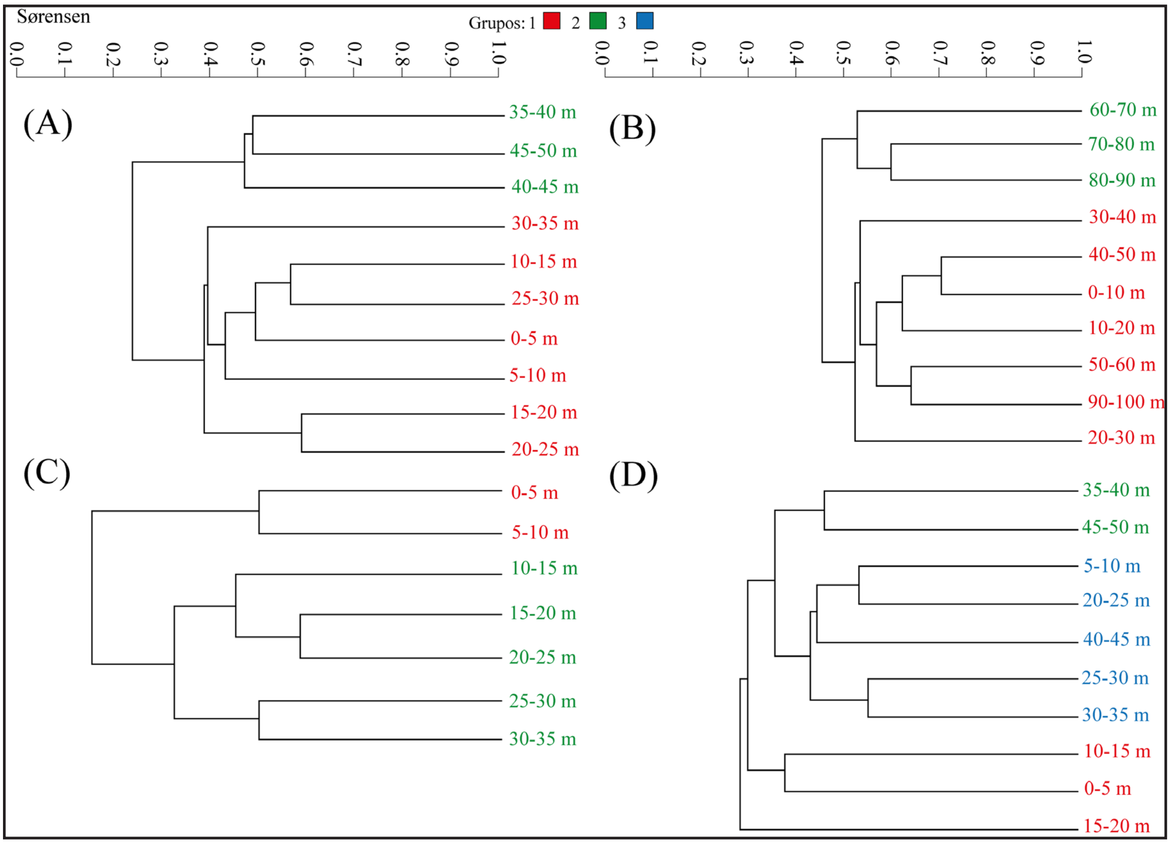
Figure 5 – Dendrograms generated by cluster analysis and distance measurement and the Bray-Curtis Index using edge distance data in the regenerative stratum of fragments A1 (A), A2 (B), A3 (C) and A4 (D)



Source: Authors (2021)

The dendrogram generated by the cluster analysis, mean distance measurement and the Sørensen Coefficient in fragment A1 formed two groups, with the plots closest to the edge at 0 to 35 m and the other group with the last plots up to 50 meters from the edge (Figure 6A). In A2. the interior group had plots at 0 to 60m from the edge and also the plots at 90-100 meters and the second group, considered the plots from 60 to 90 meters from the edge (Figure 6B). In fragment A3. the plots at 0 to 10 m represented the edge group and at 10 to 35 meters the plots farther inside the forest represented the interior group (Figure 6C). In fragment A4 there was division into several groups and one isolated plot (15-20 m): group 1 with the plots (0-5 m and 10-15 m); group 2 with plots at mean distance (20-45m) except for 5-10 m; and group 3 with plots 35-40 m and 45-50 meters (Figure 6D).

Figure 6 – Dendrograms generated by cluster analysis, distance measurement and the Sørensen coefficient using edge distance data in the regenerative stratum of fragments A1 (A), A2 (B), A3 (C) and A4 (D)



Source: Authors (2021)

Regarding the regenerative strata, ten species contributed more than 57% to the Similarity Analysis. This analysis showed the preferential species of each group, that is, the species that were most significant for the segregation (Table 3). The complete SIMPER result is shown in Attachment 7-10.

Table 3 – Preferential edge, interior and generalist species obtained by the Percentage of Similarity Analysis (Similarity Percentage - SIMPER) for the species of the regenerative stratum in the four fragments of semideciduous forest in southeastern Goiás state, Brazil

Species (Contribution %)		
Edge	**Interior**	**Generalist**
Matayba elaeagnoides (7.66%)	*Nectandra membranacea* (3.86%)	*Cardiopetalum calophyllum* (9.76%)
Miconia albicans (4%)	*Alibertia edulis* (3.70%)	*Cordiera sessilis* (10.35%)
		Leandra dasytricha (6.63%)
		Licania apetala (13.34%)
		Siparuna guianensis (2.16%)
		Terminalia glabrescens (6.44%)
		Virola sebifera (17.87%)

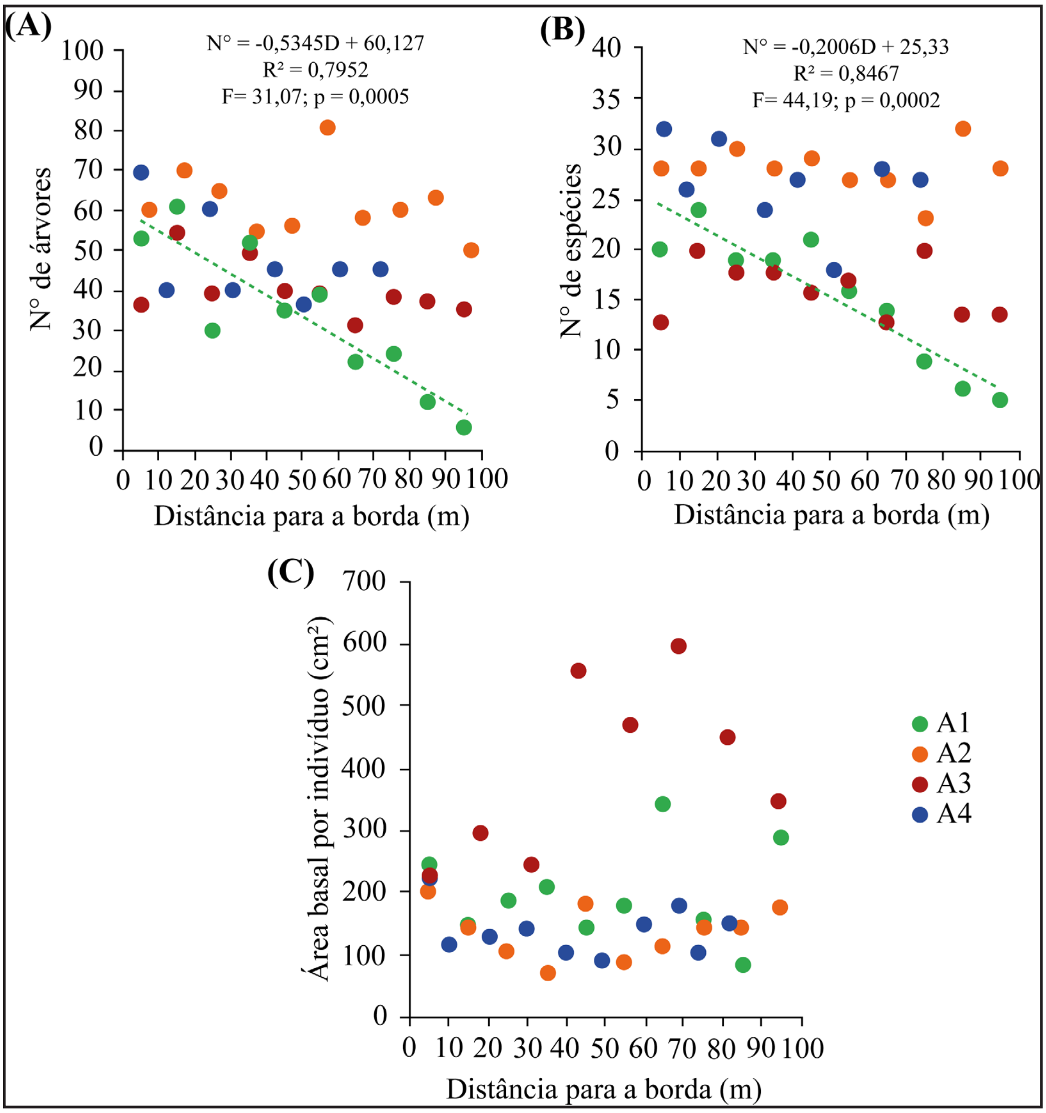
Source: Authors (2021)

The groups were confirmed by the Similarity Analysis (ANOSIM) in all the strata, tree (RANOSIM between 0.73 and 1; $p < 0.05$) and regenerative (RANOSIM between 0.48 and 0.82; $p < 0.05$). The details are shown in Attachment 11 and 12.

3.3 Structural Relationships

Relationships were found between the number of individuals (Figure 7A), the number of species (Figure 7B) and distance from the edge only in the first fragment studied, and these values decreased as the forest was entered. A statistically proven relationship was not found between the basal area per individual and distance from the edge in any of the areas analyzed (Figure 7C).

Figure 7 – Dispersions from the result of linear regressions: number of trees (A), number of species (B) and basal area (cm²) per individual (C) in relation to distance to edge for four seasonal semideciduous forests in southeastern Goiás



Source: Authors (2021)

4 DISCUSSIONS

In studies on the phytophysiognomy of semideciduous forests, the basal area values (space that the trees occupy in the soil) per hectare were close to the 25.14 m².ha-1 sampled on average for the four seasonal semideciduous forests in southeastern Goiás. Other forests located in the Cerrado region vary in basal area depending on the degree of disturbance and the soil physical chemical characteristics, usually between 25-35 m².ha1 (Lopes *et al*., 2012). In another study, the number of individuals sampled per hectare (mean 1657 ind.ha-1) was superior to the densities sampled in ten semideciduous forests (798 to 1292 ind/ha-1) (Lopes *et al*., 2012).

The estimate of 8.394 ind/ha-1 for the regenerative strata is similar to that found in studies on the regenerative strata in semideciduous forests with little history of disturbance close to the study region (8.454 ind/ha-1 and 6.970 ind/ha-1) (Pereira-Silva *et al*., 2004). More anthropized forests with trails and fire events may have values lower than 5.000 ind/ha-1 (Milhomem *et al*., 2013)

The results obtained from the dendrogram generation showed that the edge effect is variable among the forests, but it seems to reach distances of up to 40 meters when the tree stratum is assessed, where the flora begins to become more differentiated compared to the edge flora. In fragments A1 and A3. the edge seems to be situated at up to 40 m, location where the tree flora differentiates from the flora deeper in the forest interior. In A2 and A4. where this pattern was not so clear, it was still possible to separate from the edge at 0 to 30 m in A2 and at 0-20m in A4. In A4. the plots at 20-40 m were still different in relation to the more interior plots, that reinforces the edge effect up to close to 40 m for the tree stratum. In studies using similar sampling methodologies, forest gradients were found, that demonstrated differentiation through the forest in its structure, with more or less abundance of trees and species, and in the forest composition, with a higher predominance of species at determined distances in the forest, usually with a high number of pioneer species and some typical of the Cerrado at the edge compared to the forest interior (Oliveira *et al*., 2014).

Regarding the species found in the edge region, for example, *Qualea grandiflora*, *Q. parvifora*, *Xylopia aromatica* and *Roupala montana* are species with phytophysiognomies such as the typical cerrado and the dystrophic cerradão since the species predominant in forest formation appear in higher numbers and frequency after 30-40 meters inside the forest (Oliveira *et al*., 2014; Silva *et al*., 2021). Some species such as Virola sebifera, Sclerolobium paniculatum, Tapirira obtusa, Terminalia glabrescens and Terminalia argentea are recognized for survival in open environments and are considered light demanding, so a higher occurrence of these species is not uncommon in the edge band. Less frequently found in the edge zone are the species Aspidosperma discolor, Emmotum nitens, Cheiloclinium cognatum and Myrcia splendens, that were found in the interior zone of the forest, which are species that are more predominant in other forest formations (Cabacinha & Fontes, 2014).

Results reported in other studies also corroborate the idea of advance of the edge effect up to about 50 meters in pine (araucária) forest (Pscheidt *et al*., 2018). But other analyses, in a submountain tropical forest fragment, reported decrease in pioneer species abundance at 30 meters in the edge-interior direction (Rigueira *et al*., 2012). Furthermore, other variables, such as microclimates (moisture, wind and temperature) and microbial activities in the soil show distances of 40 meters for edge effect interference (Silva *et al*., 2021; Blumenfeld *et al*., 2016; D'abadia *et al*., 2020).

The distances at which the edge modifies the species composition can vary, depending on the fragment size and phytophysiognomy. For humid tropical forest, the edge can reach from 40 to 80 m in fragments of up to 10 hectares, and the distance of the edge effect can also vary in function of the vegetation, in the Amazon Forest it can reach from 10 to 400 meters (Guanier *et al*., 2020). The strong anthropological pressure on extensive areas of the Amazon Forest make them ever more susceptible to fragmentation and consequently the edge effect, which tends to increase the distances ever more over time (Broadbent *et al*., 2008). It is expected that the forest in the Cerrado will have similar impacts not only from microclimate modification but from the occurrence of criminal fire, still used as a pasture management technique.

Regarding the regenerative stratum, the distance covered by the edge effect became less evident, even when taking the environmental gradiente into account the effects are not always perceptible (Ferreira *et al*., 2016). But from the dendrograms it can be inferred that the effect was 15-20 meters from the edge, that opens the way for more studies on the regenerative stratum due to the importance of making estimates for the future of the fragments (Milhomem *et al*., 2013).

The structural data did not show any statistical significance to detect the edge effect for all the forest. Even with the structure and diversity of the communities being altered characteristically by the edge effect, other studies have reported difficulty in making analyses with structural data to check the edge effect (Pereira *et al*., 2021). A larger number of sample units (transects) might be able to confirm statistically the significance of the results for the parameters analyzed or the structural modification are more difficult to detect. It has been shown that many parameters are necessary to verify differences between the edge and interior, as for example climatic data (Blumenfeld *et al*., 2016), soil analyses (D'abadia *et al*., 2020) and similarity analyses, as was proven in the present study.

5 CONCLUSIONS

The results of the similarity analyses for the tree stratum and the regenerative stratum were different. For the tree stratum the edge effect influenced the fragments up to 40 meters from the edge, for the regenerative stratum, even in a not so evident manner, the edge effect reached distances from 15 to 20 meters. Thus, for semideciduous forests in the Cerrado and other forest formations it is recommended to study the edge effect by analyzing several parameters.

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