DYNAMICS OF A WOODY COMMUNITY IN A CERRADO *sensu stricto* AREA IN SPACE AND TIME

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Resumo

D*inâmica de uma comunidade lenhosa em área de Cerrado* sensu stricto *no espaço e no tempo*. O objetivo desse trabalho foi analisar as mudanças na comunidade lenhosa em um período de quatro anos. Foram estabelecidas 50 parcelas de 10 x 10 m onde foram amostrados todos os indivíduos com circunferência altura do peito acima de 10 centímetros (CAP ≥ 10 cm) em 2014 e 2018. No inventário de julho de 2014 foram encontrados 2128 indivíduos pertencentes a 110 espécies, 86 gêneros e 46 famílias, ao passo que no ano de 2018 foram amostrados 1956 indivíduos, distribuídos em 107 espécies, 83 gêneros e 39 famílias. Em 2014 foram amostrados 66 indivíduos mortos em pé e 2018 foram diagnosticados 155 indivíduos mortos, além disso, foi possível diagnosticar no levantamento de 2018 que sete espécies foram extintas, ou seja, as mesmas não se encontravam entre as mortas em pé avaliadas em 2014. Entretanto, vale ressaltar que no levantamento de 2018 foram incluídas quatro novas espécies, dessa forma, avaliou-se que 56 espécies conseguiram tolerar a passagem do fogo com temperatura aproximada de 400ºC. Valores de diversidade Shannon - Weaver (H') variaram entre os dois levantamentos de 2014 e 2018, sendo em 2014 obteve-se um valor de (3,52) e 2018 (3,61) e a equabilidade de Pielou (J') em 2014 foi de 0,79 e 2018 foi de 0,77. O Índice de Sorensen obteve valor de 0,95 homogeneidade ambiental entre os dois levantamentos 2014/2018. Em agosto de 2015 e julho de 2017 foi registrada a ocorrência de incêndio florestal na área, o que leva a crer que esse fenômeno pode ter sido o agente modulador.

Palavras-chave: Biodiversidade, Fogo no Cerrado, Levantamento florístico, Mudanças estruturais, Mortalidade.

Abstract

The objective of this work was to analyze the changes in the woody community over four years. We established 50 permanent plots of 10 x 10 m where all individuals with breast height circumference above 10 centimeters (CAP ≥ 10 cm) were sampled in 2014 and 2018. In the July 2014 inventory, 2128 individuals belonging to 110 species, 86 genus and 46 families were found, while in the year 2018, 1956 individuals were sampled, distributed in 107 species, 83 genera, and 39 families. In 2014, 66 dead standing individuals were sampled and in 2018, 155 dead individuals were diagnosed. In addition, it was possible to diagnose that in the 2018 survey, seven species were extinct, that is, they were not among the dead standing individuals evaluated in 2014. It is worth noting though that, in the 2018 survey, four new species were included. Thus, it was evaluated that 56 species were able to tolerate the passage of fire with a temperature of approximately 400ºC. The Shannon - Weaver (H') diversity values varied between the two surveys 2014 and 2018, with a value of (3.52) and 2018 (3.61) in 2014. The equability of Pielou (J') in 2014 was 0.79, against 0.77 in 2018, while the Sorensen Index was 0.95 homogeneity between the two surveys 2014/2018. In August 2015 and July 2017, forest fires occurred in the area, which leads to believe that this phenomenon may have been the modulating agent.

Keywords: Biodiversity, Fire in the Cerrado, Floristic survey, Structural changes, Mortality.

INTRODUCTION

The Cerrado is the second largest domain in South America behind only the Amazon biome, occupying an area of 2,036,448 km², about 22% of the national territory, with a high level of endemism, sheltering 11,627 native plant species already cataloged (BRASIL, 2019), and with a great diversity of physiognomies that can be explained by variations in soil characteristics (texture, availability of water and nutrients, pH), topography, frequency of fire and diverse human interferences (CÂNDIDO *et al*., 2019).

It is estimated that 51% of the Cerrado Domain has been deforested, leaving only 20% of its original coverage, that is, the Cerrado has been considered an extremely threatened environment, based on the great advance of urban, agricultural, and livestock expansion and the indiscriminate use of fire. It is important to point out that 67% of the Cerrado domain in the states of Maranhão, Tocantins, Goiás, and Mato Grosso is destined for cattle raising, and 27% for agriculture (FERREIRA *et al*., 2017).

In Tocantins, the Cerrado occupies 91% of its territory. The rest is occupied in the North of the state by transition areas with the Amazon biome, having only 7.44% of its area effectively protected by a conservation unit, where about 50% of the native vegetation is currently intact, although disturbed by anthropic activities, especially agriculture and cultivated pasture (MMA, 2015).

According to (FERREIRA *et al*., 2017) the Cerrado has been considered an extremely threatened environment, based on the great advance of urban, agricultural, and cattle raising expansion and the indiscriminate use of fire, they also affirm that its species are dependent on its preservation and conservation.

Abiotic factors, climate, anthropic disorders, and fire can direct succession, phytosociological structure, floristic composition, and recruitment of species in the community (ALMEIDA *et al*., 2014). It can be affirmed that the Cerrado species evolved under the influence of fire, behaving as a modulating agent of ecological succession (SANTOS *et al.,* 2020). Fire occurs in the dry season of the year normally due to anthropic events, and can directly reach biological diversity, which means that the dryer the environment, the greater the proportions of burning (ALMEIDA, 2014). Thus, according to Coutinho, 2006 affirms that studies of floristic comparison in areas of Cerrado compose a relevant tool to understand the composition and behavior of vegetation as well as their interactions.

Considering the high biodiversity of the Cerrado domain and assuming that knowledge about it has been inversely proportional to changes in its dynamics and structure, floristic and phytosociological studies that address the dispersion and distribution of species are of paramount importance for ecological succession processes (CÂNDIDO *et al*., 2019).

There are few studies in the state of Tocantins about the dynamics of the floristic and phytosociological composition of the Cerrado's shrubby-arbous flora, therefore, considering the diversity of the Cerrado species and fire as a modulating agent of this biome, it becomes urgent and necessary to develop studies that aim at a better knowledge of the relationship between fire and the Cerrado vegetation, aiming to investigate and indicate fire-tolerant shrubby-arbous species for similar physiognomies that need to be recovered.

In this context, the objective of this study was to analyze the changes in the structure, floristic composition, and diversity of a Cerrado physiognomy. Besides evaluating the tolerant and non-tolerant tree species to the passage of fire in a period of four years (2014 to 2018).

MATERIALS AND METHODS

Characterization of the study area

This study was conducted on a fragment of Cerrado *sensu stricto* of approximately 25 hectares in the Reserva Legal da Fazenda Experimental da UFT, Campus of Gurupi - TO, under the geographical coordinates 11º46' 21.08" South 49º3' 21.56" West, from July 2014 to July 2018. There is no established form of management in the area and there is no presence of domestic animals.

The region's climate is seasonal, with two well-defined seasons, with about six months of drought comprising the winter period and six months of rain corresponding to summer. The average annual temperature varies between 25º to 29º C and the average annual precipitation varies between 1,200 to 2,100 mm, with the highest values of precipitation occurring in the North of the state, which is under the influence of the Amazonian domain (SEPLAN, 2012).

Data collection and analysis

In 2014, a continuous forest inventory (CFI) was developed using the plots method Mueller-Dombois and Ellenberg (1974) with five 20×50 m permanent plots were systematically allocated, where they were spaced 10 meters apart, totaling a sample area of 0.5 ha. All living and dead standing trees were sampled, with a circumference of 1.30 meters from the ground (CAP) greater than or equal to 10 cm (SILVA and SOUZA, 2016). In 2018, after 4 years, the inventory of the study area was again carried out to characterize the vegetation dynamics. On this occasion, all individuals were measured again and new recruits were included (living and dead standing individuals that reached the minimum inclusion criterion greater than or equal to 10 cm).

It is worth noting that in July 2015 and July 2017, occurrences of forest fire were recorded in the area of cerrado *sensu stricto* evaluated (SILVA and SOUZA, 2016). Thus, the following criterion was adopted for classifying trees: fire-tolerant and non-fire tolerant. Therefore, all species that had none of their individuals killed, whereas the criterion of non-tolerant was one or more individuals of the species killed by fire (SILVA and SOUZA, 2016).

The taxonomic identification of the species, whenever possible, was performed in the field. When not identified in loco, botanical material was collected for later identification through comparisons with material from the Herbarium of Tocantins (HTO), located at the Universidade Federal do Tocantins - Campus Porto Nacional, and consult the specialized literature (SILVA, 2012).

The classification system adopted was the "Angiosperm Phylogeny Group" (APG IV, 2009). The spelling and authorship of the specific binomials and synonyms were confirmed in the databases "Lista de Espécies da Flora do Brasil" (REFLORA - Virtual Herbarium, 2020) and IPNI - "International Plant Names Index" (IPNI, 2018). The phytosociological parameters relative density (DR), absolute density (DA), absolute dominance (DoA), relative dominance (DoR), absolute frequency (FA), relative frequency (FR), importance value index (IVI), Shannon - Weaver diversity index (H'), Pielou equability (J) and Sorensen index were calculated by traditional formulas using the Fitopac program version 2.1.2 (SHEPHERD, 2010).

RESULTS

Table 1 presents the results referring to the changes in the floristic and phytosociological survey in the four-year period.

Some changes were quantified in the floristic and phytosociological survey in the four years from 2014 to 2018 (Table 1). In the first inventory carried out in 2014, 2,128 individuals with CAP≥ 10 cm were found, distributed in 110 species, 86 genera, and 46 families, in addition to the standing dead. The average height of the population was 7.25 meters and the average basal area of 10.88 m²/ha where a total of 149 branched individuals were sampled, making a total of hile in 2018, 1,956 individuals were sampled, of which 124 are branched, which constitutes about 6.33% of the total sampled, distributed in 107 species, 82 genera and 39 families, in addition to the group of dead standing trees, the average height of the population was already 6.70 meters and the average basal area of 10.17 m²/ha.

Table 1. Quantitative changes in the floristic and phytosociological survey in the four-year period.
Tabela 1. Mudanças quantitativas no levantamento florístico e fitossociológico no quadriênio.

2014	2018
0,5 ha	0,5 ha
2128 Individuals	1956 Individuals
66 deads	158 deads
110 species	107 species
86 genus	82 genus
46 families	39 families
7,23 m average height	6,70 m average height
10,88 m²/ha basal area	10,17 m²/ha basal area

Even with the increase in individuals with CAP≥ 10 cm in 2018, there was a decrease by 172 individuals in the inventory from 2018 to 2014, due to the deaths suffered by some individuals during the period. Regarding the value of the basal area from 2014 to 2018, there was a decrease of 0.70 m²/ha in the average basal area from 2014 to 2018. The negative changes recorded here may be related to the presence of fire during the period under evaluation, a condition that disfavored the establishment of many individuals, increasing the average mortality rate between 2014 and 2018.

Table 2 shows the estimate of phytosociological parameters of species and groups of dead trees in 0.5 ha of cerrado sensu stricto in 2018, arranged in descending order of importance value.

The species with the highest numbers of individuals consequently obtained the highest phytosociological parameters in 2018. They were *Tapirira guianensis* (233 individuals), *Protium heptaphyllum* (173), *Myrcia splendens* (130), *Vatairea macrocarpa* (82), *Astronium fraxinifolium* (66), *Terminalia argentea* (44), and *Dilodendron bipinnatum* (60), together adding up to more than 35.33% of IVI.

Table 2. Estimation of phytosociological parameters of species and group of dead trees in 0.5 ha of cerrado s*ensu stricto* in 2018, arranged in descending value of importance.
Tabela 2. Estimativa de parâmetros fitossociológicos de espécies e grupos de árvores mortas em 0,5 ha de cerrado *sensu stricto* em 2018, dispostos em ordem decrescente de valor de importância.

Species	NI	AD	RD	AF	RF	AD	RD	IVI
Tapirira guianensis. Aubl.	233	466	11,91	100	1,83	26.03	12,96	8,9
Protium heptaphyllum (Aubl.) Marchand	173	346	8,84	100	1,83	9,59	4,77	5,15
Myrcia splendens (Sw.) DC.	130	260	6,65	100	1,83	10,39	5,17	4,55
Group of dead trees	158	316	8,08	100	1,83	6,22	3,1	4,34
Vatairea macrocarpa (Benth) Ducke	84	168	4,29	100	1,83	11,58	5,76	3,96
Astronium fraxinifolium Schott.	66	132	3,37	100	1,83	10,77	5,36	3,52
Anadenanthera peregrina (L.) Speng.	53	106	2,71	80	1,47	11,33	5,64	3,27
Terminalia argentea. Mart	44	88	2,25	100	1,83	11,12	5,54	3,21
Dilodendron bipinnatum Radlk.	60	120	3,07	100	1,83	8,39	4,17	3,02
Copaifera langsdorffii Desf.	71	142	3,63	100	1,83	5,87	2,92	2,79
Guettarda viburnoides. Cham. & Schltdl.	76	152	3,89	100	1,83	4,52	2,25	2,66
Qualea parviflora Mart.	58	116	2,97	100	1,83	5,75	2,86	2,55
Myracrodruon urundeuva Allemão.	51	102	2,61	100	1,83	6,34	3,15	2,53
Tabebuia roseoalba. (Ridl.) Sandwith.	48	96	2,45	80	1,47	5,19	2,58	2,17

Where: In what: NI = number of individuals; AD = absolute density; RD = relative density (%); AD = absolute dominance; RD = relative dominance; AF = absolute frequency (%); FR = relative frequency (%) and IVI = Value index of importance (%).

Table 3 shows the number of individuals from each family in the two inventories.

In both inventories, 2014 and 2018, the families with the highest number of individuals remained the same: Anacardiaceae (352), Fabaceae (269), Vochysiaceae (166), and Myrtaceae (154). The families with the highest numbers of individuals were: Anacardiaceae (17.99%), Fabaceae (6.54%), Vochysiaceae (8.33%), and Myrtaceae (7.82%), totaling 40.68% of the total number of individuals.

Table 3. Numbers of individuals of each family in the two inventories (2014 and 2018).
Tabela 3. Número de indivíduos de cada família nos dois inventários (2014 e 2018).

2014		2018	
Family	**Number of individuals**	**Family**	**Number of individuals**
Anacardiaceae	391	Anacardiaceae	352
Fabaceae	305	Fabaceae	271
Burseraceae	227	Vochysiaceae	166
Vochysiaceae	205	Burseraceae	175
Myrtaceae	174	Myrtaceae	154
Rubiaceae	153	Rubiaceae	121

In the 2018 inventory, the species that stood out in number of individuals were: *Tapirira guianensis* (233), *Protium heptaphyllum* (173), Group of the Deads (158), *Myrcia splendens* (130), *Vatairea macrocarpa* (82), *Guettarda viburnoides* (76), *Copaifera langsdorffii* (71), *Astronium fraxinifolium* (66), *Dilodendron bipinnatum* (60), *Qualea parviflora* (58), *Anadenanthera peregrina* (53) and *Terminalia argentea* (44), as seen in table 2.

Table 4 presents the indices of importance values for the inventoried families, respectively.

The families Anacardiaceae and Vochysiaceae had an increase in their IVI of 1.33% and 0.76% from 2014 to 2018, while the Fabaceae family had no increase and the Myrtaceae family had a decrease of 0.05%. It

should be noted that of the 39 families, 21 obtained 100% frequency in the survey, demonstrating a wide range of dispersion in the inventory area.

Table 4. Value index of importance of inventoried families.
Tabela 4. Índice de valor de importância das famílias inventariadas.

Families	IVI (%) 2014	Families	IVI (%) 2018
Anacardiaceae	12.97	Anacardiaceae	14.3
Fabaceae	11.36	Fabaceae	11.36
Vochysiaceae	7.12	Vochysiaceae	6.36
Burseraceae	6.55	Myrtaceae	5.8
Myrtaceae	5.85	Burseraceae	5.74
Rubiaceae	4.48	Dead group	4.86
Sapindaceae	4.56	Sapindaceae	4.74
Malvaceae	4.33	Rubiaceae	4.56
Combretaceae	3.58	Combretaceae	3.73
Bignoniaceae	3.09	Bignoniaceae	3.09
Bombacaceae	2.94	Bombacaceae	2.89
Dead group	2.67	Apocynaceae	2.36
Tiliaceae	2.46	Chrysobalanaceae	2.27
Apocynaceae	1.99	Tiliaceae	2.25
Malpighiaceae	1.96	Polygonaceae	1.95

It was possible to diagnose a strong environmental homogeneity between the two surveys, 2014 and 2018. The second measurement did not quantify changes suffered in the area, the disorder suffered in the same area had no great proportions. Comparing the second survey with the first, the Sorensen index was close to one, which indicates little transformation in four years.

In Table 5, the numbers of species found dead are presented in percentages, respectively.

Of the 111 species found in both the 2014 and 2018 surveys, 58 species were quantified as dead with one or more individuals supposedly due to biotic factors, abiotics, and the passage of fire, thus it was possible to observe that the species that had more damage and death were: *Protium heptaphyllum* with 31 individuals (17% of the total species), *Tapirira guianensis* with 25 individuals (10% of the species), *Myrcia splendens* with 19 individuals (14% of the species), *Vatairea macrocarpa* with 11 individuals (13.4% of the species), *Qualea multiflora* with 7 individuals (17% of the species), *Qualea parviflora* with 7 individuals (12% of the species), *Copaifera langsdorffii* with 6 individuals (12% of the species), *Tabebuia roseoalba* with 6 individuals (12.5% of the species), among other species.

Table 5. Numbers and percentage of species found dead.
Tabela 5. Números e porcentagem de espécies encontradas mortas.

Species	Number of individuals sampled in 2014	Number of individuals dead after the fire	%
Protium heptaphyllum (Aubl.) Marchand	175	31	17
Tapirira guianensis Aubl.	258	25	10
Myrcia splendens (Sw.) DC.	129	19	14
Vatairea macrocarpa (Benth) Ducke	82	11	13.4
Qualea multiflora Mart.	41	7	17
Qualea parviflora Mart.	58	7	12
Copaifera langsdorffii Desf.	35	6	12
Tabebuia roseo-alba (Ridl.) Sandwith	48	6	12.5
Others	1155	46	-

The families with the highest number of individuals inventoried in 2018 after the passage of fire (Table 3), were: Anacardiaceae with 352 individuals (17.9%), Burseraceae with 175 individuals (8.9%), Vochysiaceae with 166 individuals (8.4%), group of the dead with 158 individuals (8.0%), Myrtaceae with 154 individuals (7.87%), Fabaceae with 133 individuals (6.80%), Rubiaceae with 121 individuals (6.18%) and Sapindaceae with 91 individuals (4.65%) totaling 68.89% of the total number.

The families with the highest numbers of species did not change their position between the two surveys, deserving prominence for the Fabaceae, Malvaceae, Myrtaceae, and Rubiaceae families with 16, 7, 7, and 7 species, respectively.

The families that represented the highest rates of importance in 2018 corresponded to 48.29% of the total, with the Anacardiaceae family being the most representative with 14.30%, followed by Fabaceae with 11.36%, Vochysiaceae with 6, 35%, Myrtaceae with 5.80%, Burseraceae with 5.74%, group of the dead with 4.79% and Sapindaceae with 4.74%, with an increase over 2014 of 29.44%, 11.22%, 5%, 11%, 10.48%, 6.26%, 9.47% respectively of their IVI (Table 4).

DISCUSSION

In the inventory carried out in 2018, 39 species were observed, which together represented a group of 36% of the sampled species, which were classified as rare species because they had from one to two individuals, that means, low abundance and high species richness (SANTOS *et al.*, 2020).

The vegetation found in the inventory was typical of tropical formations, where a small number of species occurred as dominant and the great majority as rare corroborating with (FELFILI *et al*., 2000) it is worth pointing out that this pattern tends to be maintained, even in the presence of some disturbances such as fire % (SILVA and SOUZA, 2016).

In the inventory conducted in 2014 (Silva and Souza, 2016) were identified some species that disappeared in the 2018 inventory, such as *Kielmeyera speciosa*, *Connarus suberosus*, *Bauhinia rufa*, *Plathymenia reticulata*, *Swartzia multijuga*, *Agonandra brasiliensis*, and *Styrax camporum*. In the 2018 inventory, however, after the passage of fire, four new species were verified: *Aspidosperma parviflorum*, *Bowdichia virgilioides*, *Myrocarpus, frondosus*, and *Eerythrina falcata*.

It was verified that the occurrence of fire in the area, in 2015, and the recurrence of fire in 2017 caused the death of many individuals of several species, mainly young and small individuals, a fact that corroborates with Mews *et al.,* 2011.

The families that presented the highest rates of importance in 2014 were Anacardiaceae (12.97%), Fabaceae (11.36%), Vochysiaceae (7.12%), and Myrtaceae (5.85%) (SILVA and SOUZA, 2016). In 2018, the most important families added 37.82% of the total IVI, being Anacardiaceae the most important, with 14.30% of IVI, followed by Fabaceae (11.36%), Vochysiaceae (6.36%), Myrtaceae (5.80%).

With the Shannon diversity and Pielou equability indices, a small variation could be observed in the 2014 and 2018 inventories, that is, in 2014 a value of 3.52 and 2018 a value of 3.61 was obtained, values that corroborate with other works in the region. The equation of Pielou (J') ranged from 0.70 to 0.80, demonstrating a high diversity and wealth (2014 = 0.79 and 2018 = 0.77) with the value of J determined in a range of 0 to 1. The maximum value represents the situation where all species have the same abundance (SILVA and SOUZA, 2016).

Table 6. Comparison of diversity values with other studies conducted in the cerrado *sensu stricto* area.
Tabela 6. Comparação dos valores de diversidade com outros estudos realizados na área de cerrado *sensu stricto*.

Study Areas	A (ha)	H’	J’	References
2014 Survey	0,5	3,52	0,79	Silva; Souza (2017)
2018 Survey	0,5	3,61	0,77	This study
Gurupi-TO	0,5	3,7	0,8	Ferreira et al., (2015)
Porto Nacional- TO	0,5	3,68	0,87	Pedreira et al (2011)
Caseara – TO	0,2	2,36	0,73	Santos; Lólis (2007)
Pium – TO	0,5	3,67	0,84	Santos; Lólis (2007)
Marianópolis-TO	0,4	2,99	0,73	Santos; Lólis (2007)
Filadeufia-TO	1	3,32	0,83	Medeiros; Valter (2012)

Where A = sample area in Hectares, H' = Shannon - Weaver diversity index, J' = Pielou equation index.

The richness and floristic diversity of the area, although in small proportions, have suffered modifications due to biotic and abiotic disturbances, such as fire, predation between the two surveys in 2014 and 2018. The area has maintained the original characteristics of the 2014 vegetation though, suggesting that it is relatively stable in the regime of disturbances that may be occurring (LIBANO and FELFILI, 2006). It was possible to observe in the area studied that several individuals have new branching/sprouting phenomena common in Cerrado physiognomies, in which the presence of plant adaptations such as resistance and resilience in places with frequent natural disturbances such as herbivorous, fire, and climatic seasonality is notorious (SILVA *et al*., 2010).

However, it was possible to observe in the community dynamics through the 2018 inventory and in the value of the Sorensen index that the cerrado *sensu stricto* area analyzed presented high values regarding the diversity and richness index keeping its floristic characteristics preserved which has kept the researched area in ecological balance. The floristic similarity between the two inventories 2014 and 2018 was high, that is, the value of the Sorensen index was 0.95. Given that this corroborates the work of (FELFILI and SILVA JUNIOR, 2005) and (ABREU *et al*., 2014), where both studied the diversity of species of the cerrado *sensu stricto* physiognomy, the aforementioned authors proved a high amount of species of common occurrence between the different areas.

Thus, it can be said that some families and species are tolerant and not tolerant of the passage of fire. According to (SILVA *et al*., 2010), frequent burning promotes a phenotypic alteration of some families and species, acting as an environmental filter that consequently selects families and species capable of surviving and tolerating abiotic conditions derived from burning.

Of the 72 individuals included in the 2018 inventory, the group of dead obtained the highest number of recruitments with 19 individuals, while the species that obtained new individuals were: *Tapirira guianensis* (17), *Myrcia splendens* (9), *Dilodendron bipinnatum* (4), and *Copaifera langsdorffii* (3). The others were included with only one individual per species.

In the 2014 inventory, 66 dead standing trees were identified and included within the group of dead trees (SILVA and SOUZA, 2016). In the 2018 inventory, 158 dead standing trees were identified, a fact that is believed to be due to biotic and abiotic factors (lack of nutrients and the passage of fire) present in the study area in 2015 and 2017.

The mortality of some trees in the Cerrado is a typical pattern for individuals of smaller size and susceptibility to the effect of fire according to (SILVA and SOUZA, 2016).).

Of the 107 species sampled in 2018, in 53 species, there was no mortality of any individual with the passage of fire in 2015 and 2017: *Annona coriacea*, *Guatteria villosissima*, *Hirtella ciliata*, *Curatella americana*, *Dimorphandra mollis*, *Andira vermifuga*, *Acacia polyphylla*, *Byrsonima basiloba*, *Myrcia tomentosa*, among others. These species can be considered fire-resistant due to their xeromorphic characteristics, thick rising, tortuous trunks, fire resistance, presenting no death of individual of the species.

For the authors, xeromorphic characteristics such as bark thickness, presence of underground reserve organs, and tree size are essential for the survival of the species to fire, otherwise, species that do not have adaptations and well-developed xeromorphic characteristics, such as young individuals, fire can cause great mortality.

As noted by Silva *et al.,* (2010), the species that had more individuals counted as dead showed high recruitment in the period. According to Silva *et al.,* (2010), the most abundant species will always be subject to the highest mortality and recruitment rates, precisely because they have a high density, continuing this pattern over time.

In the present study, the appearance and disappearance of species were limited to the low abundance of individuals ≤ 2. These species of low abundance are classified as rare species (ASSUNÇÃO and FELFILI, 2004). These data corroborate with (FELFILI *et al*., 2000; HOFFMANN and MOREIRA, 2002) in areas of cerrado *sensu stricto*.

The changes observed in the floristic composition of the studied community are related to the disappearance and emergence of species, between 2014 and 2018. 158 dead individuals were determined; however, 72 individuals were included. The number of individuals and new species was lower than that of mortality, which resulted in a negative balance for the community, as the fire acts as a thinning in the woody vegetation (FELFILI, 2000). The results show that fire played an important role in modifying the floristic composition and structure of the vegetation, which extinguished individuals, species, and families in the community.

Despite the changes that occurred in the richness and floristic composition, the H ’values of 2014 (3.65) and 2018 (3.61) and equability practically did not change between inventories (2014 = 0.77 and 2018 = 0.771).

CONCLUSION

- The community dynamics patterns of the families and species evaluated suggest changes in the floristic composition and community structure, characterized by the negative balance between the entry and exit of some species and the decrease in the density of individuals and biomass.
- There was a negative balance of species where *Kielmeyera speciosa, Connarus suberosus, Bauhinia rufa, Plathymenia reticulata, Swartzia multijuga, Agonandra brasiliensis and Styrax camporum* were extinct and included *Aspidosperma parviflorum, Bowdichia virgilioides, Myrocarpus frondosus, and Erythrina falcata*.
- The changes in the floristic composition of the evaluated area are probably related to the presence of fire in 2015 and the recurrence of fire in 2017, favoring higher mortality.
- The species tolerant to fire and that can be indicated for the recovery of areas after the passage of the fire are *Annona coriacea, Guatteria villosissima, Guatteria nigrescens*, and *Curatella americana*.
- Species that are not tolerant to fire and therefore cannot be indicated for the recovery of degraded areas after fire *are Protium eptaphyllum, Tapirira guianensis, Myrcia splendens, Vatairea macrocarpa, Qualea multiflora, Qualea parviflora, Copaifera langsdorffii,* and *Tabebuia roseo-alba.*

REFERENCES

ABREU T.A.L.; PINTO J.R.R.; LENZA E.; MEWS H.A.; SANTOS T.R.R.; 2014. **Composição florística e estrutura da vegetação arbustivo-arbórea em Cerrado sentido restrito na Serra de Jaraguá**, Goiás, Brasil. Heringeriana, 6(2), p. 42-53.

ALMEIDA S.P.; PROENÇA C.E.B.; SANO S.M.; RIBEIRO J.F. (1998). **Cerrado**: espécies vegetais uteis. Planaltina, EMBRAPA-CPAC, 464p.

ARCHER S.; COUGHENOUR M.; DALL'AGLIO C.; FERNANDEZ G.W.; HAY J.; HOFFMANN W., SOLBRIG OT.; 1996. Savanna biodiversity and ecosystem properties. In: **Biodiversity and savanna ecosystem processes**. Springer, Berlin, Heidelberg, 207-215.

ASSUNÇÃO S.L., FELFILI J.M.; 2004. Fitossociologia de um fragmento de cerrado *sensu stricto* na APA do Paranóa, DF, Brasil. **Revista Acta Botanica Brasilica**, Brasília/DF, v.18, 903-909.

BRASIL. Ministério do Meio Ambiente (MMA). **Bioma Cerrado** - 2019. Available in: <http://www.mma.gov.br/biomas/cerrado>. Acess in: 20 mai. 2019. Coutinho LM. (1990) Fire in the ecology of the Brazilian cerrado. In: Fire in the tropical biota. Springer, Berlin, Heidelberg. 82-105.

COUTINHO L.M.; 2006. O conceito de bioma. **Acta Botanica Brasilica**, Belo Horizonte, 20(1),1-11.

CÂNDIDO, J. B.; VIANA, R. H. O.; MORAIS, I. G.; AMORIM, M. V. D. M.; SOUZA, P. B. Chave de identificação dendrológica das espécies mais comuns de uma área de Cerrado sensu stricto, Gurupi, Tocantins. **Ciência Florestal**, Santa Maria, RS. v. 29, n. 1, p. 347-362, 2019.

FELFILI J.M.; NOGUEIRA P.E.; SILVA JÚNIOR M.C.; MARINON B.S.; DELITTI W.B.C. Composição florística e fitossociologia do cerrado restrito do município de Água Boa, MT. **Acta Botânica Brasílica**, São Paulo,16(1),103-112, 2002.

FELFILI J.M., VENTUROLI F. FELFILI, Tópicos em análise de vegetação. **Comunicações técnicas florestais**, Brasilia-DF, v. 2, n. 2, p. 1-25, 2000.

FELFILI J.M.; 1995. Growth, **recruitment and mortality in the Gama gallery forest in central Brazil** over a six-year period (1985-1991). J. Trop. Ecol.11, 67-8.

FERREIRA, R. Q. S.; CAMARGO, M. O.; TEIXEIRA, P. R.; DE SOUZA, P. B.; DE SOUZA, D. J. Diversidade florística do estrato arbustivo arbóreo de três áreas de cerrado sensu stricto, Tocantins. DESAFIOS, v. 4, n. 2, p. 69-82, 2017.

HOFFMANN W.A.; MOREIRA A.G.; 2002. The role of fire in population dynamics of woody plants. **The Cerrados of Brazil**: ecology and natural history of a neotropical savanna, Columbia University Press. 159-177.

LIBANO A.M.; FELFILI M.J.; 2006. Mudanças temporais na composição florística e na diversidade de um cerrado *sensu stricto* do Brasil Central em um período de 18 anos. **Acta Botanica Brasilica**, São Paulo,20(4), 927-936.

MAGURRAN A.E.;1988. Why diversity: In: **Ecological diversity and its measurement**. Springer, Dordrecht, 1-5.

MEWS, H. A. wantes Marimon B., Maracahipes L., Franczak DD., Marimon-Junior, BH. Dinâmica da comunidade lenhosa de um Cerrado Típico na região Nordeste do Estado de Mato Grosso, Brasil. **Biota Neotropica**, São Paulo, v. 11, p. 73-82, 2011.

MENDONÇA, R. C.; FELFILI,J.M.; WALTER,B.M.T.; SILVA JÚNIOR,M.C.; REZENDE, A.V.; FILGUEIRAS,T.S.; NOGUEIRA,P.E.; FAGG,C.W. Flora vascular do bioma cerrado: checklist com 12356 espécies. In Cerrado:ecologia e flora (S.M. Sano; S.P. Almeida; J.F. Ribeiro, eds.). Brasília: **Embrapa Cerrados.** Vol. 2. 2008.

MINISTÉRIO DO MEIO AMBIENTE (MMA). Mapeamento do Uso e Cobertura do Cerrado: Projeto TerraClass Cerrado 2013. **Brasília: MMA.** 42-47 p. ISBN 978-85-7738-255-2, 2015.

MIRANDA, H.S.; BUSTAMANTE, M.M.C. & MIRANDA, A.C. 2002. The fire factor. **In Cerrados of Brazil**: ecology and natural history a Neotropical Savanna (P.S. Oliveira & R.J. Marquis, eds.). Columbia University Press, New York, p.51-68.

MUELLER-DOMBOIS D, ELLENBERG H. **Aims and methods of vegetation ecology.** New York: John Wiley & Sons; 1974.

SANTOS, B. M. M.; AGUIAR, B. A. C.; SOUZA, P. B. Efeito do fogo na florística e fitossociologia de um remanescente de cerrado *sensu stricto*, to. **Desafios-Revista Interdisciplinar da Universidade Federal do Tocantins**, Palmas-TO, v. 7, n. 4, p. 54-62, 2020.

SEPLAN.; 2012. Atlas do Tocantins: subsídios de planejamento da gestão territorial. 6. Ed. Palmas: **Secretaria do Planejamento e da Modernização da Gestão Pública**, 80 p.

SHEPHERD G.J.; 2009. Fitopac 2: **Manual do usuário**. Campinas: Unicamp, 2010. 91p.

SILVA JUNIOR M.C.; 2012. 100 Árvores do cerrado – **Sentido restrito**: guia de campo. Brasília -DF. Ed. Rede de sementes do cerrado, 304 p.

SILVA.; SOUZA P.B; 2016. Fitossociologia e Estrutura Diamétrica de um Fragmento de Cerrado *Sensu Stricto*, Gurupi-TO. **Desafios**, Palmas-TO, v.3, 22-29.

SILVA JUNIOR M.C.;2010. Árvores do cerrado – **Matas de galeria**: guia de campo. Brasilia -DF. Ed. Rede de sementes do cerrado, 288 p.