



ECOLOGY OF THE ARBOREAL VEGETATION OF THE CERRADO IN URBAN AREA, PALMAS – TOCANTINS

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ABSTRACT

Objective: To investigate the floristic diversity in three remaining urban forest fragments in Palmas, Tocantins, aiming to understand the structure and floristic composition and their importance for urban biodiversity conservation.

Theoretical Framework: Based on concepts of phytosociology and biodiversity conservation, highlighting the importance of urban fragments for the preservation of native flora and the challenges posed by increasing urbanization.

Method: Setup of 10 plots, each measuring 20x50 meters in the three studied fragments. All individuals with a circumference at breast height (CBH) equal to or greater than 10 cm were sampled. The phytosociological data were collected and analyzed using FITOPAC software.

Results and Discussion: A total of 1,346 individuals belonging to 67 species and 44 families were found. The observed phytophysiognomies were cerrado sensu stricto and cerradão. The species *Connarus suberosus*, *Caryocar brasiliense*, and *Qualea parviflora* showed higher occurrence and wider distribution. These results reflect the richness and diversity that can be found in remaining fragments of the Cerrado.

Research Implications: The practical and theoretical implications of this research are discussed, providing results that influence conservation practices and sustainable management in urban areas.

Originality: Universidade Federal do Tocantins, Palmas, Tocantins, Brasil.

Value: This study contributes to the literature by providing a detailed analysis of the floristic composition of urban fragments of the Cerrado, highlighting their importance for biodiversity conservation in urban areas. The relevance of this research is evidenced by the proposed strategies for the preservation of native species in Palmas' urbanization plan.

Keywords: Phytosociology, Forest Fragmentation, Sustainable Management, Native Species, Urban Ecosystems.

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ECOLOGIA DA VEGETAÇÃO ARBÓREA DE CERRADO EM ÁREA URBANA, PALMAS - TOCANTINS

RESUMO

Objetivo: Investigar a diversidade florística em três fragmentos florestais urbanos remanescentes em Palmas, Tocantins, com o intuito de entender a estrutura e composição florística e sua importância para a conservação da biodiversidade urbana.

Referencial Teórico: Fundamenta-se em conceitos de fitossociologia e conservação da biodiversidade, destacando a importância dos fragmentos urbanos para a preservação da flora nativa e os desafios impostos pela crescente urbanização.

Método: Montagem de 10 parcelas, medindo 20x50 metros em cada um dos três fragmentos estudados. Todos os indivíduos com circunferência da altura do peito (CAP) igual ou superior a 10 cm foram amostrados. Os dados fitossociológicos foram coletados e analisados utilizando o software FITOPAC.

Resultados e Discussão: Foram encontrados 1.346 indivíduos, pertencentes a 67 espécies e 44 famílias. As fitofisionomias observadas foram de cerrado sentido restrito e cerradão. As espécies *Connarus suberosus*, *Caryocar brasiliense* e *Qualea parviflora* apresentaram maior ocorrência e distribuição mais ampla. Esses resultados refletem a riqueza e diversidade que podem ser encontradas em fragmentos remanescentes do Cerrado.

Implicações da Pesquisa: As implicações práticas e teóricas desta pesquisa são discutidas, fornecendo resultados que influenciam práticas de conservação e manejo sustentável em áreas urbanas.

Originalidade/Valor: Este estudo contribui para a literatura ao fornecer uma análise detalhada da composição florística dos fragmentos urbanos do Cerrado, destacando sua importância para a conservação da biodiversidade em áreas urbanas. A relevância desta pesquisa é evidenciada pela proposta de estratégias para a preservação das espécies nativas no plano de urbanização de Palmas.

Palavras-chave: Fitossociologia, Fragmentação Florestal, Manejo Sustentável, Espécies Nativas, Ecossistemas Urbanos.

ECOLOGÍA DE LA VEGETACIÓN ARBÓREA DEL CERRADO EN ÁREA URBANA, PALMAS - TOCANTINS

RESUMEN

Objetivo: Investigar la diversidad florística en tres fragmentos forestales urbanos remanentes en Palmas, Tocantins, con el fin de entender la estructura y composición florística y su importancia para la conservación de la biodiversidad urbana.

Marco Teórico: Se basa en conceptos de fitosociología y conservación de la biodiversidad, destacando la importancia de los fragmentos urbanos para la preservación de la flora nativa y los desafíos impuestos por la creciente urbanización.

Método: Montaje de 10 parcelas, midiendo 20x50 metros en cada uno de los tres fragmentos estudiados. Se muestrearon todos los individuos con circunferencia a la altura del pecho (CAP) igual o superior a 10 cm. Los datos fitosociológicos fueron recolectados y analizados utilizando el software FITOPAC.

Resultados y Discusión: Se encontraron 1.346 individuos, pertenecientes a 67 especies y 44 familias. Las fitofisionomías observadas fueron cerrado sensu stricto y cerradão. Las especies *Connarus suberosus*, *Caryocar brasiliense* y *Qualea parviflora* presentaron mayor ocurrencia y distribución más amplia. Estos resultados reflejan la riqueza y diversidad que se pueden encontrar en fragmentos remanentes del Cerrado.

Implicaciones de la Investigación: Se discuten las implicaciones prácticas y teóricas de esta investigación, proporcionando resultados que influyen en las prácticas de conservación y manejo sostenible en áreas urbanas.



Originalidad/Valor: Este estudio contribuye a la literatura al proporcionar un análisis detallado de la composición florística de los fragmentos urbanos del Cerrado, destacando su importancia para la conservación de la biodiversidad en áreas urbanas. La relevancia de esta investigación se evidencia por la propuesta de estrategias para la preservación de especies nativas en el plan de urbanización de Palmas.

Palabras clave: Fitosociología, Fragmentación Forestal, Manejo Sostenible, Especies Nativas, Ecosistemas Urbanos.

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1 INTRODUCTION

Brazilian flora is recognized worldwide for its enormous biological diversity, distributed among the six main biomes: Amazon Forest, Caatinga, Cerrado, Atlantic Rain Forest, Pantanal and Pampa (Souza and Felfili, 2006). Each biome has predominant vegetation and phytophysiology characteristics, influenced by climate, soil, geomorphology and topography (Aguilar *et al.*, 2016; Ribeiro e Walter, 1998).

The Cerrado, located mainly in the Central Plateau of Brazil, is the second largest biome in the country, occupying about 23% of the national territory (Ribeiro e Walter, 1998). With an average temperature of 24°C and an annual rainfall of 1500 mm, the Cerrado presents two distinct seasons: a rainy season from October to April and a dry season from May to September (Klink and Machado, 2005). It is considered the richest tropical savanna in the world, with high species diversity and 40% endemism (Borlaug, 2002).

In recent decades, the Cerrado has suffered intense anthropic pressure due to urbanization, technological advances in agriculture and lack of protection of the remaining natural areas (Verly *et al.*, 2020). This biome is one of the most threatened on the planet (Oliveira *et al.*, 2019). Phytosociological studies are essential for the knowledge of the floristic richness and the distribution of the phylogenetic heritage, besides contributing to the development of new management techniques for the conservation and preservation of native species (Pegorari, 2007).

Modern cities have few green areas with native vegetation (Dacanal *et al.*, 2010), which face difficulties to survive due to constant disturbances, reducing the wealth of plant and animal species and affecting the structure of ecosystems (Mckinney, 2002). Urban afforestation, besides beautifying spaces, is fundamental for restructuring urban environments, bringing them closer to natural environmental conditions and improving the quality of life (Ribeiro, 2009).



Given the lack of information on the distribution and composition of urban forest fragments, there is a major limitation on the effort to recover and conserve native flora (FONSECA and CARVALHO, 2012). Conservation studies often focus only on tree cover, without considering the actual composition of the species (Nowak, 2016). Therefore, it is crucial to carry out phytosociological studies to understand the diversity and floristic richness of the remaining fragments of the Cerrado, providing solid bases for conservation practices and sustainable management (Pegorari, 2007).

Thus, the present work has as its main objective to know the species present in three urban forest fragments remaining in Palmas, Tocantins, understanding the composition and floristic structure, describing the state of conservation and potential disturbances.

2 METHODOLOGY

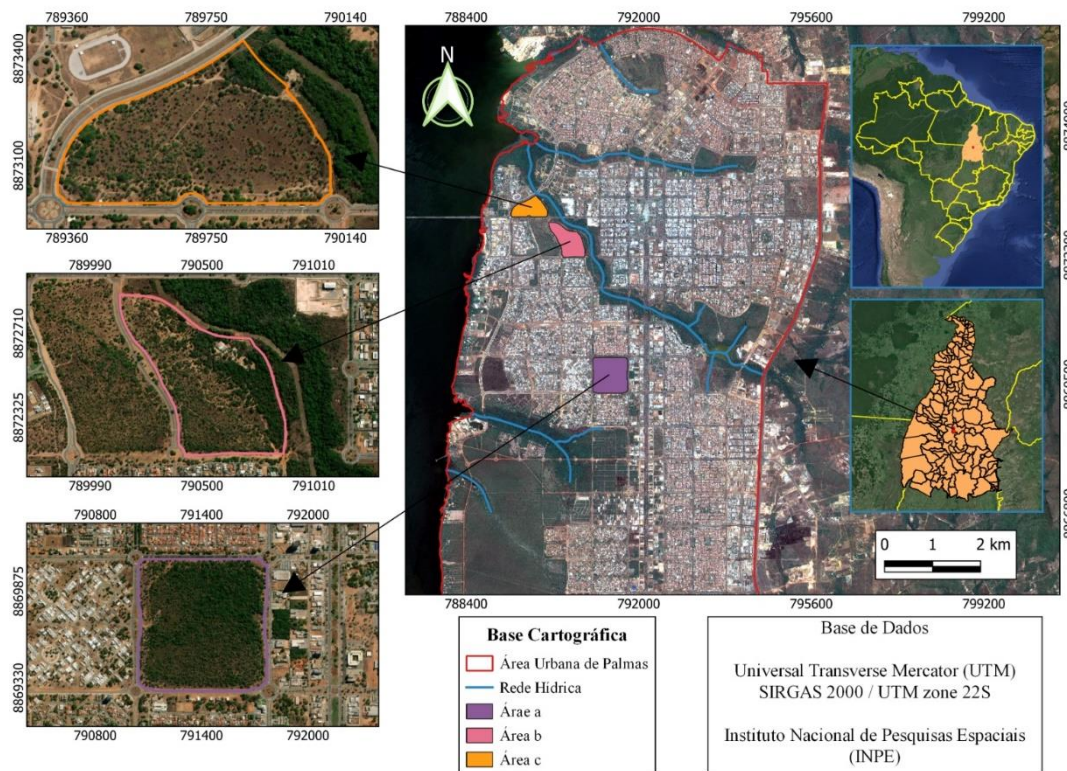
The study was carried out in the city of Palmas, founded on May 20, 1989, being the youngest capital and the last to be planned in the country in the twentieth century (Velasques et al., 2017). Currently, it is the largest city in the state of Tocantins, located between the geographical coordinates 10°10' South and 48°25' West, with a territorial area of 2,223,329 km² and 228,332 inhabitants in 2010, projecting 306,296 inhabitants for 2020 (IBGE, 2019).

The forest fragments chosen for the collections were selected on the basis of two criteria: proximity to the areas established for priority occupation and presence of preserved native vegetation. These fragments are classified as urban Gleba in the Municipal Master Plan, green spaces reserved for lots that have not yet been parceled out, and these areas will probably be transformed in a short time, losing the biological collection present before being studied (Figure 1).



Figure 1

Map of the location of the Study area. Highlight for the three delimited fragments Quadras 505 South (a), Q.105 South (b) and Q. 107 North (c). Located in Palmas-TO



For phytosociological studies, 10 temporary plots were set up in each fragment, measuring 20 x 50 meters each, totaling 1 hectare (Felfili *et al.*, 1994). All living or dead tree individuals were measured 1.3 meters from the ground, with circumference of the chest height (CAP) equal to or greater than 10 cm (Rodrigues and Gandolfi, 2004), and the total height (H) was also estimated. Scientific nomenclature was governed by the APG IV Classification System (APG IV, 2016), with scientific names corrected by the REFLORA Program. The exsiccatas were stored in the Herbarium of Tocantins (HTO), at the Federal University of Tocantins, in Porto Nacional. The parameters of density, frequency, dominance, coverage and importance value index, diversity and similarity index were calculated, according to Daubenmire (1968) and Mueller-Dombois and Ellenberg (1974). The FITOPAC software version 2.1 was used to treat the collected data (Shepherd, 2010).



3 RESULTS AND DISCUSSIONS

3.1 GENERAL PARAMETERS

After analyzing data from the

1,346 subjects were measured. Of which, 1,269 were alive and 77 were dead, but remained standing and for complying with this and other criteria previously defined were fixed. All species identified at the specific level are native to the Cerrado.

3.2 PHYTOSOCIOLOGICAL PARAMETERS OF FRAGMENT 1 (BLOCK 505 SOUTH)

321 individuals were sampled in this fragment. Of these, 307 were alive and 14 dead. There were 45 species, belonging to 33rd-century families. The species *Connarus suberosus*, *Caryocar brasiliense* and *Qualea parviflora*, were the most abundant, most frequent and of greatest importance, presenting IVI of 17.4; 8.3 and 8.1%,

Table 1

Species sampled in Fragment 1 (Quadra 505 Sul), sorted by importance value index (IVI). In addition to this parameter, the number of subjects (NI), relative density (DR.), relative frequency (RF), relative density (DoR) and coverage value index (CVI) were enrolled.

ESPÉCIES	NI	DR	FR	DoR	IVI	IVC
<i>Connarus suberosus</i>	78	24,3	6,1	22,0	17,4	23,1
<i>Caryocar brasiliense</i>	26	8,1	6,8	11,1	8,7	9,6
<i>Qualea parviflora</i>	28	8,7	6,1	9,6	8,1	9,2
Morta	14	4,4	5,3	5,1	4,9	4,7
<i>Salvertia convallariodora</i>	16	5,0	3,0	6,5	4,8	5,8
<i>Tachigali subvelutina</i>	15	4,7	4,6	4,7	4,7	4,7
<i>Mabea fistulifera</i>	18	5,6	5,3	0,5	3,8	3,0
<i>Anacardium occidentale</i>	9	2,8	4,6	3,4	3,6	3,1
<i>Palicourea rigida</i>	8	2,5	4,6	3,3	3,5	2,9
<i>Plathymenia reticulata</i>	9	2,8	4,6	1,9	3,1	2,4
<i>Eriotheca gracilipes</i>	6	1,9	2,3	4,7	2,9	3,3
<i>Mouriri pusa</i>	5	1,6	2,3	4,5	2,8	3,1
<i>Xylopia aromatica</i>	11	3,4	2,3	2,6	2,8	3,0
<i>Qualea grandiflora</i>	8	2,5	3,0	2,1	2,5	2,3
<i>Byrsonima verbascifolia</i>	9	2,8	3,0	1,7	2,5	2,3
<i>Byrsonima coccolobifolia</i>	5	1,6	2,3	1,2	1,7	1,4
<i>Emmotum nitens</i>	3	0,9	2,3	1,4	1,5	1,2
<i>Pouteria ramiflora</i>	4	1,3	2,3	0,7	1,4	1,0
<i>Vatairea macrocarpa</i>	4	1,3	1,5	1,3	1,4	1,3
<i>Andira vermifuga</i>	3	0,9	1,5	1,5	1,3	1,2
<i>Matayba guianensis</i>	3	0,9	2,3	0,6	1,3	0,8
<i>Virola sebifera</i>	4	1,3	1,5	0,9	1,2	1,1
<i>Lafoensia pacari</i>	4	1,3	1,5	0,8	1,2	1,0



<i>Aspidosperma macrocarpon</i>	3	0,9	1,5	1,1	1,2	1,0
<i>Annona crassiflora</i>	3	0,9	1,5	0,7	1,0	0,8
<i>Bowdichia virgilioides</i>	2	0,6	1,5	0,9	1,0	0,8
<i>Tachigali vulgaris</i>	2	0,6	0,8	1,2	0,9	0,9
<i>Parkia platycephala</i>	2	0,6	1,5	0,3	0,8	0,5
<i>Kielmeyera coriacea</i>	2	0,6	1,5	0,2	0,8	0,4
<i>Spp.</i>	1	0,3	0,8	0,6	0,6	0,5
<i>Tratinichia sp.</i>	1	0,3	0,8	0,4	0,5	0,4
<i>Neea theifera</i>	1	0,3	0,8	0,4	0,5	0,3
<i>Tabebuia sp.</i>	1	0,3	0,8	0,3	0,5	0,3
<i>Spp. 1</i>	1	0,3	0,8	0,3	0,5	0,3
<i>Curatella americana</i>	1	0,3	0,8	0,3	0,5	0,3
<i>Hirtella ciliata</i>	1	0,3	0,8	0,2	0,4	0,3
<i>Ouratea hexasperma</i>	1	0,3	0,8	0,2	0,4	0,3
<i>Vitex sp.</i>	1	0,3	0,8	0,2	0,4	0,3
<i>Myrcia splendens</i>	1	0,3	0,8	0,2	0,4	0,3
<i>Brosimum gaudichaudii</i>	1	0,3	0,8	0,1	0,4	0,2
<i>Diospyros hispida</i>	1	0,3	0,8	0,1	0,4	0,2
<i>Hymenaea stigonocarpa</i>	1	0,3	0,8	0,1	0,4	0,2
<i>Vochysia rufa</i>	1	0,3	0,8	0,0	0,4	0,2
<i>Hancornia speciosa</i>	1	0,3	0,8	0,0	0,4	0,2
<i>Casearia sylvestris</i>	1	0,3	0,8	0,0	0,4	0,2
<i>Spp. 2</i>	1	0,3	0,8	0,0	0,4	0,2
TOTAIS (46)	321	100%	100%	100%	100%	100%

3.3 PHYTOSOCIOLOGICAL PARAMETERS OF FRAGMENT 2 (BLOCK 105 SOUTH)

A total of 718 individuals were surveyed in this area, of which 659 were alive and 59 were dead. When compared to the other fragments, this was the richest and the number of dead found was also .

The species, *Caryocar brasiliense* (*Caryocaraceae*), *Qualea parviflora* (*vochysiaceae*), *Qualea grandiflora* (*Vochysiaceae*) and *Tachigali subvelutina* (*Fabaceae*), were of the highest occurrence, presenting respectively 85, 76, 69 and 65 individuals. *Simarouba amara*, with only 59 individuals was the most important species with 27.5% dominance, IVI of 13.2% and for its wide distribution along the fragment with calculated IVCem17.9 (Table 2).

**Table 2**

Species sampled in Fragment 2 (Quadra 105 Sul) sorted by Importance Value Index (IVC). In addition to this parameter, the number of subjects (NI), the relative density (DR.), relative frequency (FR), relative density (DoR) and the value of importance index (IVI).

SPECIES	NI	DR.	FR	PAIN	IVICVI
<i>Simarouba amara</i>	59	8.2	4.0	27.5	13.217.9
<i>Caryocar brasiliense</i>	85	11.8	6.6	15.7	11.413.8
<i>Qualea parviflora</i>	76	10.6	6.0	6.3	7.68.5
<i>Qualea grandiflora</i>	69	9.6	5.3	5.5	6.87.6
<i>Tachigali subvelutina</i>	65	9.1	4.0	5.9	6.37.5
<i>Eriotheca gracilipes</i>	37	5.2	6.0	6.3	5.85.7
<i>Dead</i>	59	8.2	4.0	5.1	5.86.7
<i>Kielmeyera coriacea</i>	31	4.3	6.0	2.4	4.23.4
<i>Connarus suberosus</i>	25	3.5	5.3	3.1	4.03.3
<i>Bowdichia virgilioides</i>	22	3.1	2.7	4.0	3.23.5
<i>Plathymenia reticulata</i>	20	2.8	3.3	2.4	2.82.6
<i>Byrsonima verbascifolia</i>	14	2.0	5.3	1.2	2.81.6
<i>Anacardium occidentale</i>	8	1.1	3.3	1.4	2.01.3
<i>Dimorphanthera mollis</i>	8	1.1	4.0	0.7	1.90.9
<i>Mabea fistulifera</i>	17	2.4	2.0	1.1	1.81.7
<i>Xylopia aromatica</i>	17	2.4	1.3	1.8	1.82.1
<i>Byrsonima coccolobifolia</i>	11	1.5	2.0	1.2	1.61.4
<i>Himatantus sucubus</i>	9	1.3	2.0	0.4	1.20.8
<i>Tabebuia sp</i>	5	0.7	2.0	0.8	1.20.8
<i>Parkia platycephala</i>	5	0.7	1.3	1.4	1.11.0
<i>Physocalymma scaberrimum</i>	7	1.0	1.3	0.7	1.00.9
<i>Solanum lycocarpum</i>	15	2.1	0.7	0.2	1.01.1
<i>Annona crassiflora</i>	5	0.7	1.3	0.7	0.90.7
<i>Trema micrantha</i>	7	1.0	1.3	0.3	0.90.6
<i>Salvertia convallariodora</i>	4.	0.6	1.3	0.6	0.80.6
<i>Andira vermifuge</i>	5	0.7	1.3	0.4	0.80.5
<i>Psidium myrsinoides</i>	3.	0.4	1.3	0.3	0.70.4
<i>Mouriri pusa</i>	2.	0.3	1.3	0.4	0.70.3
<i>Myrcia albicans</i>	4.	0.6	0.7	0.6	0.60.6
<i>Schefflera macrocarpa</i>	2.	0.3	1.3	0.1	0.60.2
<i>Tocoyena formosa</i>	2.	0.3	1.3	0.0	0.60.2
<i>Casearia arborea</i>	2.	0.3	1.3	0.0	0.50.2
<i>American curatella</i>	3.	0.4	0.7	0.5 0.3	0.4
<i>Handroanthus impetiginosus</i>	2.	0.3	0.7	0.4 0.3	0.3
<i>Vochysia rufa</i>	1.	0.1	0.7	0.4 0.4	0.2
<i>Palicourea rigida</i>	2.	0.3	0.7	0.4 0.1	0.2
<i>Pouteria ramiflora</i>	1.	0.1	0.7	0.2 0.3	0.1
<i>Hancornia speciosa</i>	1.	0.1	0.7	0.1 0.3	0.1
<i>Tabebuia aurea</i>	1.	0.1	0.7	0.1 0.3	0.1
<i>Casearia sylvestris</i>	1.	0.1	0.7	0.1 0.3	0.1
<i>Emmotum nitens</i>	1.	0.1	0.7	0.1 0.3	0.1
<i>Hymenaea stilbocarpa</i>	1.	0.1	0.7	0.1 0.3	0.1
<i>Spp.</i>	1.	0.1	0.7	0.0 0.3	0.1
<i>Cecropia pachystachya</i>	1.	0.1	0.7	0.0 0.3	0.1
<i>Spp. 1.</i>	1.	0.1	0.7	0.0 0.3	0.1
<i>Brosimum gaudichaudii</i>	1.	0.1	0.7	0.0 0.3	0.1
TOTALS (46)	718	100%	100%	100% 100%	100%



3.4 PHYTOSOCIOLOGICAL PARAMETERS OF FRAGMENT 3 (BLOCK 107 NORTH)

It was found in this fragment, 32 species, belonging to 21 families totaling 307 individuals, all alive and 44 dead. Of all the species found, *Caryocar brasiliense* was the most abundant with 135 individuals and the most important, with IVI of 32.9%, and IVC of 43.9%. These indices were the highest found when we compared

Table 3

Species sampled in fragment 3 (Quadra 107 Norte), sorted by importance value index (IVC). In addition to this parameter, the number of subjects (NI), the relative density (DR.), relative frequency (FR), relative density (DoR) and the value of importance index (IVI).

SPECIES	NI	DR.	FR	DoR	IVI	CVI
<i>Caryocar brasiliense</i>	135	44.0	10.8	43.8	32.9	43.9
<i>Qualea parviflora</i>	33	10.8	7.5	15.6	11.3	13.2
<i>Qualea grandiflora</i>	33	10.8	6.5	4.5	7.2	7.6
<i>Kielmeyera coriacea</i>	16	5.2	8.6	6.0	6.6	5.6
<i>Byrsonima verbascifolia</i>	11	3.6	6.5	3.6	4.5	3.6
<i>Plathymenia reticulata</i>	9	2.9	4.3	3.4	3.5	3.2
<i>Anacardium occidentale</i>	6	2.0	4.3	2.9	3.1	2.4
<i>Connarus suberosus</i>	9	2.9	5.4	0.8	3.0	1.9
<i>Diospyros hispida</i>	7	2.3	4.3	2.5	3.0	2.4
<i>Tachigali subvelutina</i>	10	3.3	3.2	2.4	3.0	2.8
Dead	4.	1.3	4.3	0.6	2.1	0.9
<i>Eriotheca gracilipes</i>	3.	1.0	3.2	1.4	1.9	1.2
<i>Andira cujabensis</i>	2.	0.7	2.2	2.7	1.8	1.7
<i>Hymenaea stilbocarpa</i>	1.	0.3	1.1	4.0	1.8	2.2
<i>Tabebuia aurea</i>	4.	1.3	3.2	0.2	1.6	0.8
<i>Simarouba amara</i>	3.	1.0	3.2	0.2	1.5	0.6
<i>Dimorphanandra mollis</i>	2.	0.7	2.2	0.5	1.1	0.6
<i>Simarouba versicolor</i>	2.	0.7	2.2	0.2	1.0	0.4
<i>Tocoyena formosa</i>	2.	0.7	2.2	0.1	1.0	0.4
<i>American curatella</i>	1.	0.3	1.1	1.0	0.8	0.7
<i>Pouteria ramiflora</i>	1.	0.3	1.1	0.9	0.8	0.6
<i>Myrcia splendens</i>	2.	0.7	1.1	0.5	0.7	0.6
<i>Handroanthus impetiginosus</i>	1.	0.3	1.1	0.5	0.6	0.4
<i>Bowdichia virgilioides</i>	1.	0.3	1.1	0.5	0.6	0.4
<i>Vochysia rufa</i>	1.	0.3	1.1	0.3	0.6	0.3
<i>Hancornia speciosa</i>	1.	0.3	1.1	0.3	0.6	0.3
<i>Spp.</i>	1.	0.3	1.1	0.3	0.6	0.3
<i>Salacia crassifolia</i>	1.	0.3	1.1	0.2	0.5	0.2
<i>Annona crassiflora</i>	1.	0.3	1.1	0.1	0.5	0.2
<i>Myconia albicans</i>	1.	0.3	1.1	0.1	0.5	0.2
<i>Erythroxylum suberosum</i>	1.	0.3	1.1	0.1	0.5	0.2
<i>Vatairea macrocarpa</i>	1.	0.3	1.1	0.1	0.5	0.2
<i>Aspidosperm macrocarpon</i>	1.	0.3	1.1	0.0	0.5	0.2
TOTALS (32)	307	100%	100%	100%	100%	100%



3.5 WEALTH AND DIVERSITY

Analyzing the results of the three fragments studied, in the end, 1,346 were found individuals, who belonged to 44 families, adding 674 species over the 3ha. The indices of diversity and equability were close, differentiating themselves from the cerrado in the restricted sense (Table 4). Andrade et al., (2002) defines that the number of species found in the areas of Thus, the number of species, shows- conforming to the expected pattern for areas such as these. Native green spaces like these, are daily damaged by the high and growing correspondingly levels of the large green spaces, and consequently, it is necessary to rethink how much effort there has been for the knowledge and appreciation of the flora of these fragments (Oliveira, 2012).

Despite the poor characteristic of its soil, the Cerrado abriga (a large plant species) estimated at more than 6,000 species of trees as well as harboring Other life forms in their different phytophysiognomies (Silva, 2007). The Cerradão, although it is a forest formation, is closer floristically to the Cerrado in the restricted sense, since small trees, inclined, with tortuous trunks, with irregular ramifications and indicia of burning are found in small trees (Oliveira, 2014).

From a floristic point of view, the fragments studied are typically a forest formation of the type Cerradão (Quadra 504 Sul) and Cerrado sense restricted (Quadra 105 South and 107 North) by the predominance of a well-defined arboreal stratum, with the presence of the well-defined arboreal stratum, with the presence of the species Cerradão, *Plathymenia reticulata*, *Qualea grandiflora* and *Xylopia aromatica*, occurring in conjunction with shrubland herbaceous species such as *Curatela americana* and *Solanum lycocarpum* (Ribeiro, 2007).

Table 4

Summary of indices used to analyze the diversity (H') and equability (J') of the three fragments studied in the urban areas of Palmas-TO.

Fragment	Shannon Index (H')	Pielou (J') Equability
Quadra 501 Sul — Cerradão	3.024	0.790
Quadra 105 Sul - Cerradão	3.041	0.794
Court 107 North - Cerrado Sense Restricted	2.224	0.636

Through the Veen Diagram (Figure 2), it was possible to observe that the occurrence of exclusive species was in a smaller proportion, since most of the species were found in the three species.



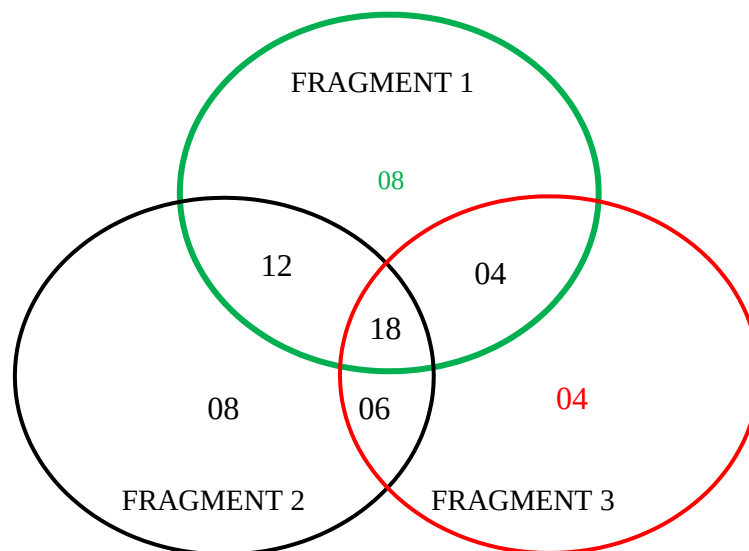
Among the exclusive species located in Fragment 1 are: *Tratinichia* sp. (Burseraceae), *Hirtella ciliata* (Chrysobalanaceae), *Tachigali vulgaris* (Fabaceae), ☒ *Vitex* sp. (Lamiaceae), *Lafoensia pacari* (Lythraceae), *Virola sebifera* (Myristicaceae), *Neea theifera* (Nyctaginaceae), *Ouratea hexasperma* (Ochnaceae) and *Matayba guianensis* (Sapindaceae).

In Fragment 2 the exclusive species were: *Schefflera macrocarpa* (Araliaceae), *Himantus sucuba* (Apocynaceae), *Trema micranta* (Cannabaceae), *Physocalymma scaberrimum* (Lythraceae), *Psidium myrsinoides* (Myrtaceae), *Casearia arborea* (Salicaceae), *Solanum lycocarpum* (Solanaceae) and *Cecropia pachystachya* (Urticaceae), totaling eight species and eight exclusive families.

Few unique species have occurred in Fragment. The results were: *Salacia crassifolia* (Celastraceae), *Erythroxylum suberosum* (Erythroxylaceae), *Andira cujabensis* (Fabaceae) and *Simarouba versicolor* (Simaroubaceae).

Figure 2

Diagram of Venn, indicating the quantity of exclusive and common species in each of the forest fragments studied in urban areas of Palmas-TO.



3.6 MORTALITY

Naturally we find individuals killed when we study a forest fragment. For numerous physiological processes occur throughout the cycle of a tree's life, leading to its growth until eventually its death occurs, it being difficult to determine when it happens and what motives,



caused, since death can occur by water deficit, by suppression and lack of nutrient stock to sustain its growth, by the action of wind, lightning, pests (Rossi et al., 2006), by human action or by the passage of fire.

As noted in Santos et al., (2020), when studying fire tolerance and noticing the increase in mortality of species of shrub-bush, in a remaining

Unlike what Gama et al., (2018) observed when studying an area of Tocantinense cerradão, there was no presence of dead individuals in all of the fragments analyzed. In Fragment 3, for example, WHEREa (a) fitofisionomia (a) is also a dense Cerrado, we observed the lowest relative frequency of 1.3% and absolute 40% mortality, and only four dead individuals were found.

Fragment 2 exhibits similar distributional behavior over the plots, with the exception of (P6) and seven (P7), where we observed a concentration of mortality, 22 445 and 25 individuals, respectively.

As no recent signs of passing fire, as well as falling lightning and the direct action of human activities, have been noticed, we suppose that such a result derives from senility or competition, since these plots are more ricas when compared with all the other studied fragments, each presenting 134 individuals.

Still in this fragment, P10 presented the largest number of the entire study, totaling 189, of which eight were dead. Third highest mortality rate found in the areas of study, corroborating the mortality ratio with the mortality rate. The relative frequency found here was 4% and the correspondingly absolute was 60%, with the attendance of 400 subjects.

In fragment 1, the frequencies of dead individuals found were the highest (FR 5%, FA 70%), although only 14 individuals in this condition were found. Unlike the areas mentioned above, we believe that these values are associated with the edge effect resulting from direct activity.

4 CONCLUSION

The results indicate a high floristic diversity in the fragments, demonstrating the importance for the maintenance of urban biodiversity and providing refuge for various native species. This study revealed that the native vegetation in the three forest fragments of the city of Palmas shows little human interference. From the floristic point of view, these areas are typically characterized as forest formations of the type Cerradão and Cerrado restricted sense, evidenced by the composition of the species found. Given the city's advance and growth, which



continually degrade and suppress remnant fragments, studies such as this are increasingly needed to understand and preserve these areas. The negative effects of the process of urbanization are especially damaging to the urban forests and, consequently, to the Tocantinense Cerrado.

However, the limitations of the study include the lack of long-term monitoring, which would allow observation of changes in the composition and structure of communities over time. Future research should consider implementing long-term monitoring studies to better understand the ecological dynamics of these urban fragments. These studies could reveal temporal patterns of ecological succession, changes in the composition of species, and the responses of plant communities to stochastic events, such as droughts and fires. Studies that integrate multidisciplinary approaches, combining ecology, botany and environmental management, will be fundamental for developing effective conservation and restoration strategies in urban areas.

As a continuation of this work, it is proposed to draw up a list with the species found in the three forest fragments analyzed, containing morphological information, such as average size, foliar composition, flowers and fruit. This list should also include places indicated for the planting of these species throughout the city, such as in central beds, under electrical wiring, in parks and green areas intended for preservation. The intention is to guarantee the permanence, conservation and insertion of these native species of the Cerrado in the urban planning of the city, contributing towards the preservation of the local biodiversity.

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