Rodriguésia 70: e04002017. 2019
http://rodriguesia.jbrj.gov.br
DOI: http://dx.doi.org/10.1590/2175-7860201970070

Original Paper / Artigo Original

Angiosperms of dry grasslands and savannahs of Jalapão, the largest conserved Cerrado area in Brazil

Guilherme Medeiros Antar[1,2,3] & *Paulo Takeo Sano*[1]

Abstract

This study provides a checklist of angiosperm species from Jalapão region, Tocantins, Brazil, inserted within the Cerrado biome, a global biodiversity hotspot. The region of Jalapão is still well preserved despite current threats to its biodiversity, however its plant diversity is still poorly understood. To generate the present checklist, fieldwork was carried out and relevant herbarium collections were consulted. Angiosperms distributed in the grassland and savanna physiognomies with dry, non-rocky soils were recorded. We detected 550 species within 85 families. The richest families are Leguminosae, Poaceae, Asteraceae, Lamiaceae, Rubiaceae, Myrtaceae, Malpighiaceae and Euphorbiaceae. Among the plant species, ten are listed as rare, ten are threatened, and twelve were identified as new to science. This study increases the number of angiosperm species occurring in these vegetation types in Jalapão almost 2-fold compared to previous inventories. The Cerrado biome and Jalapão region are under heavy threat due to agricultural expansion, and our study contributes to the knowledge of plant biodiversity as a fundamental step towards designing and carrying out conservation actions.

Key words: checklist, conservation, floristics, new records, seed dispersal.

Resumo

Esse estudo fornece uma listagem das espécies de angiospermas que ocorrem na região do Jalapão, Tocantins, Brasil, inserida no domínio do Cerrado, um dos *hotspots* globais de diversidade. A região do Jalapão é ainda altamente conservada, apesar dos vários tipos de ameaça à sua biodiversidade; sua flora, contudo, ainda é pouco conhecida. Para gerar o presente checklist, expedições para levantamento florístico foram realizadas, complementadas pela revisão de espécimes provenientes da região depositados em herbários. Angiospermas que ocorrem em fisionomias campestres e de savana com solo seco, não rochoso foram registradas. Detectamos 550 espécies distribuídas em 85 famílias. As famílias com maior riqueza foram Leguminosae, Poaceae, Asteraceae, Lamiaceae, Rubiaceae, Myrtaceae, Malpighiaceae e Euphorbiaceae. Dentre as espécies registradas, dez foram listadas como raras, dez como ameaçadas de extinção e doze foram apontadas como novas para a ciência. Esse estudo aumenta quase duas vezes o número de espécies registradas para essas fisionomias no Jalapão. O bioma do Cerrado e a região do Jalapão são altamente ameaçados pela expansão da fronteira agrícola, e nosso estudo contribui para o conhecimento da biodiversidade vegetal da área, um passo fundamental requerido para a proposição e execução de ações de conservação.

Palavras-chave: *checklist*, conservação, levantamento florístico, novas espécies, dispersão de sementes.

Introduction

The Cerrado is the second largest biome of Brazil, covering approximately 23% of the country's land area and reaching across the border into Bolivia and Paraguay (Ratter *et al.* 1997; Ribeiro & Walter 2008). Despite being characterized as a savannah domain, it is composed by different physiognomies such as *veredas* (palm swamp forests), *cerradões* (savannah woodland), dry forests, *campos rupestres* (highland rocky fields) and open areas where a tree density gradient is found, ranging from *campo limpo*,

See supplementary material at <https://doi.org/10.6084/m9.figshare.9894170.v1>

[1] Universidade de São Paulo, Inst. Biociências, Depto. Botânica, R. do Matão 277, 05508-090, São Paulo, SP, Brazil.
[2] ORCID: <https://orcid.org/0000-0001-8109-4544>
[3] Author for correspondence: guilherme.antar@gmail.com

with only a herbaceous layer, to "cerrado *sensu strictu"* with approximately 50% of wood cover (Coutinho 1978, 1990; Ratter *et al.* 1997; Ribeiro & Walter 2008; Sampaio *et al*. 2008). These different physiognomies are shaped by factors including water availability, fire regimen, nutrient availability, depth and composition of the soil, species interactions, grazing, and slope gradient (Coutinho 1990; Pivello & Coutinho 1996; Ratter *et al*. 1997; Moreira 2000; Ribeiro & Walter 2008; Silva & Batalha 2011; Amaral *et al.* 2013).

This variety of vegetation types of the Cerrado may explain its vast biodiversity (Gottsberger & Silberbauer-Gottsberger 2006). The Cerrado is home to c. 12,700 known vascular plant species, of which 35% are endemic, and it has the highest plant diversity of any savanna region in the world (Forzza *et al*. 2012; BFG 2015; BFG 2018). Despite of its biodiversity, the Cerrado has been historically undervalued by the Brazilian government, international NGOs, and even by the Brazilian population, who sees the Atlantic and Amazon rainforests as more valuable (Ratter *et al*. 1997; Klink & Machado 2005; Strassburg *et al*. 2017). More than 50% of the Cerrado area has been deforested to make way for mechanized agriculture, especially soybean and corn monocultures, cattle ranching, and charcoal production (Klink & Machado 2005; Strassburg *et al*. 2017), while remnants of the region are geographically fragmented (Gottsberger & Silberbauer-Gottsberger 2006) and threatened by the invasion of African alien grasses, especially from the genera *Urochloa* P.Beauv. and *Melinis* P.Beauv. (Pivello *et al*. 1999). This elevated biodiversity, with high endemism and intense anthropogenic pressure, turns the Cerrado into one of the biodiversity hotspots in the world (Mittermeier *et al.* 2011).

The Jalapão region is the most undisturbed area within the Cerrado, mostly due to its nutrient-poor sandy soils and being one of the less populated parts of Brazil (Schmidt *et al.* 2007; Yamamoto *et al*. 2008). The region is also the largest continuous protected Cerrado area (Silva & Bates 2002), comprising 10 protected areas of which stands out the: Parque Estadual do Jalapão with 158,885 ha, Estação Ecológica Serra Geral do Tocantins with 707,078.75 ha, and Parque Nacional Nascentes do Parnaíba with 724,324.61 ha (Schmidt *et al.* 2007; Portaria do Ministério do Meio Ambiente nº 434/2016). However, presently, the relative reprieve of the Jalapão region from anthropogenic disturbance within the Cerrado is under threat due the recent MATOPIBA (Presidência da República 2015) initiative, which includes the region as part of an expanding agricultural frontier (Silva *et al*. 2017). Therefore, the Jalapão region is in critical need of a current, rigorous biodiversity assessment (Seplan 2003).

The objective of this work is to provide a checklist of the angiosperm flora of the Jalapão region. The first checklist of plant species from Jalapão comprised 434 vascular plant species but estimated diversity to be closer to 600 species (Arruda & Behr 2002). Since then, there have been few advances in the floristic inventory of the area (A.B. Sampaio, personal communication) except a one-time addendum of new collection efforts bringing the total of plant species for all physionogmies in Jalapão to 463 (Seplan 2003), and a limited number of new collecting expeditions (Proença *et al.* 2007). Nevertheless, a relatively large number of new species have been described from the region or rediscovered there recently (*e.g.*, Proença *et al.* 2007; França & Proença 2007; Araujo & Souza 2007; Yamamoto *et al.* 2008; Rua *et al.* 2008; Vieira & Souza 2008; Devecchi & Pirani 2015; Borges & Antar 2016; Araújo *et al*. 2016; Mendes *et al*. 2017; Moreira *et al*. 2017; Antar *et al*. 2017) highlighting its incomplete floristic knowledge (Proença *et al*. 2007; Antar *et al*. 2017). Thus, our work represents an important contribution to the understanding of the biodiversity within this botanically underexplored, highly threatened region within the Cerrado domain.

Material and Methods

Study area

Jalapão is located in the eastern part of Tocantins state in the border between Piauí, Bahia and Maranhão states. There is no official delimitation of the region. For this study, only the core Jalapão area was considered, consisting of the municipalities of Mateiros, Ponte Alta do Tocantins and the south portion of São Felix do Tocantins (Fig. 1). The areas covered by these municipalities are largely similar in climate, soil composition and physiognomy structure.

The climate is Köppen's Aw (Alvares *et al*. 2014), as in the Cerrado domain in general, with two well-delineated seasons: a wet one from October to March, and a dry one from April to September (Ratter *et al.* 1997). During the dry season, anthropogenic fires are frequent, mainly

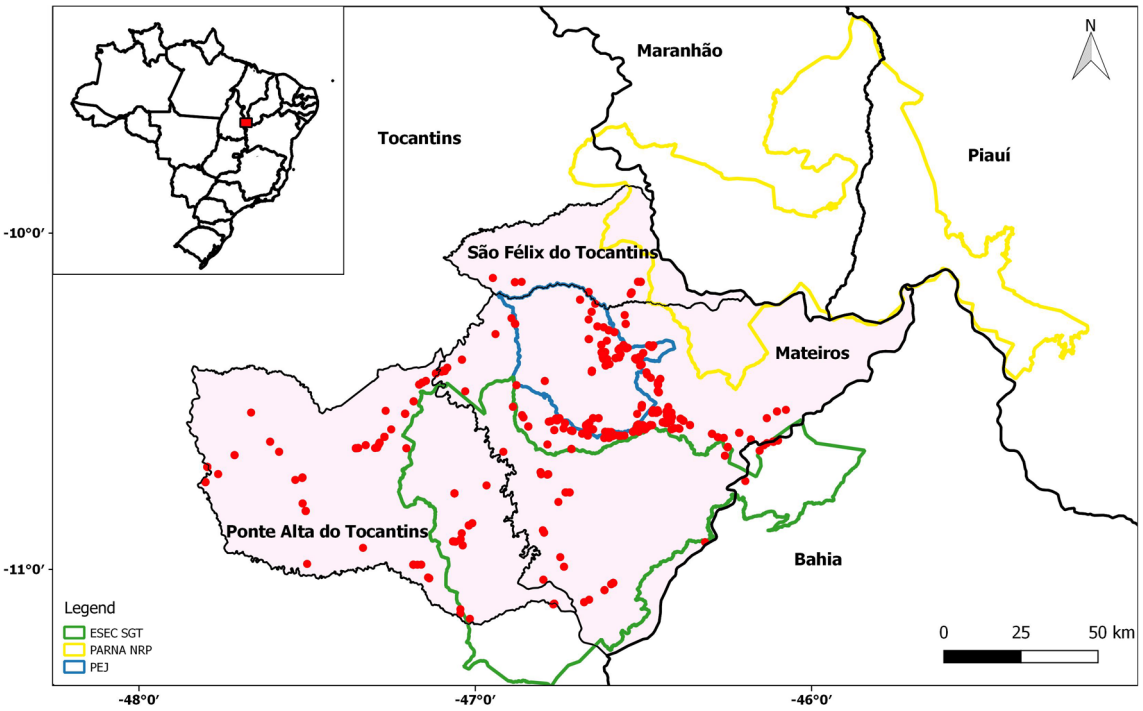

Figure 1 – Study area, protected areas, and sampling points in municipalities located in eastern Tocantins, Brazil. (PEJ = Parque Estadual do Jalapão; PARNA NRP = Parque Nacional das Nascentes do Rio Parnaíba; ESEC SGT = Estação Ecológica Serra Geral do Tocantins).

due to cattle ranching management (Schmidt *et al.* 2007). The mean precipitation is approximately 1,500 mm/year, and mean temperature is around 26ºC (Seplan 2012). The soils are quartzitic neosoils, which are mostly composed of deep sand, well drained, and very nutrient-poor. The elevation ranges mostly from 400 to 550 m, but reaches up to 800 m in some the higher areas locally known as "Chapadões" (Seplan 2012).

The main physiognomies (sensu Ribeiro & Walter 2008) are open savanna vegetation (Seplan 2003), such as *campo sujo* and *cerrado sensu stricto* and "veredas" associated with water-logged fields (*campo úmido*) along the numerous waterways (Schmidt *et al.* 2007; Sampaio *et al*. 2008).

Data collection

We carried out seven expeditions in Jalapão from 2013 to 2017. These expeditions included different periods of the year to sample specimens both from the dry and wet seasons. We collected all angiosperms in reproductive phase using a "walk-through" method (Filgueiras *et al.* 1994). We intensively collected specimens within the protected areas of "Estação Ecológica Serra Geral do Tocantins" and "Parque Estadual do Jalapão". We processed field-collected and deposited them at the University of São Paulo herbarium (SPF). We also surveyed representative collections from Jalapão in herbaria and revised identifications as needed. We examined herbarium collections at (according to Thiers, continuously updated) BHCB, CEN, CEPEC, ESA, HCF, HEPH, HRCB, HTO, HUEFS, HUTO, MBM, SPF, UB and UEC, and we analyzed digital images from RB, UFG and NY.

We considered only plant specimens occurring in the non forested savannah physiognomies with dry, non-rocky soils in this study (Fig. 2). These encompassed *campo limpo*, *campo sujo*, *campo cerrado* and *cerrado sensu stricto* physiognomies according to definitions in Coutinho (1978), including also the dune vegetation, which is characteristic of the Serra do Espírito Santo (Seplan 2003). We determined the physiognomies of other collectors specimens based on the labels of herbarium specimens and our field experience. When a herbarium label was unclear regarding the physiogonomy, we used other herbarium specimens or the literature to ascertain a vegetation type to the species.

For field-collected and herbarium specimens, we consulted specialists in different taxonomic groups for identification of specimens or confirmation of identifications (Table S1 in supplementary material <https://doi.org/10.6084/m9.figshare.9894170.v1>). We followed the taxonomy of "Flora of Brazil 2020" (under construction) for species names and synonymy with authorities following the The International Plant Names Index - IPNI 2018 (<http://www.ipni.org>), and we assigned species to plant families according to APG IV (2016). We ascertained the habit of species based on Beentje (2012) and according to our observations in the field or herbarium label information. We assigned dispersal syndrome following van der Pijl (1982), using our own observations of fruits or a survey of the literature when fruits were unavailable to us (mostly Barroso *et al*. 1999 and Gottsberger & Silberbauer-Gottsberger 2006). In some cases, we inferred that a taxon had more than one mode of dispersal, and we classified these according to the more important or dominant mode.

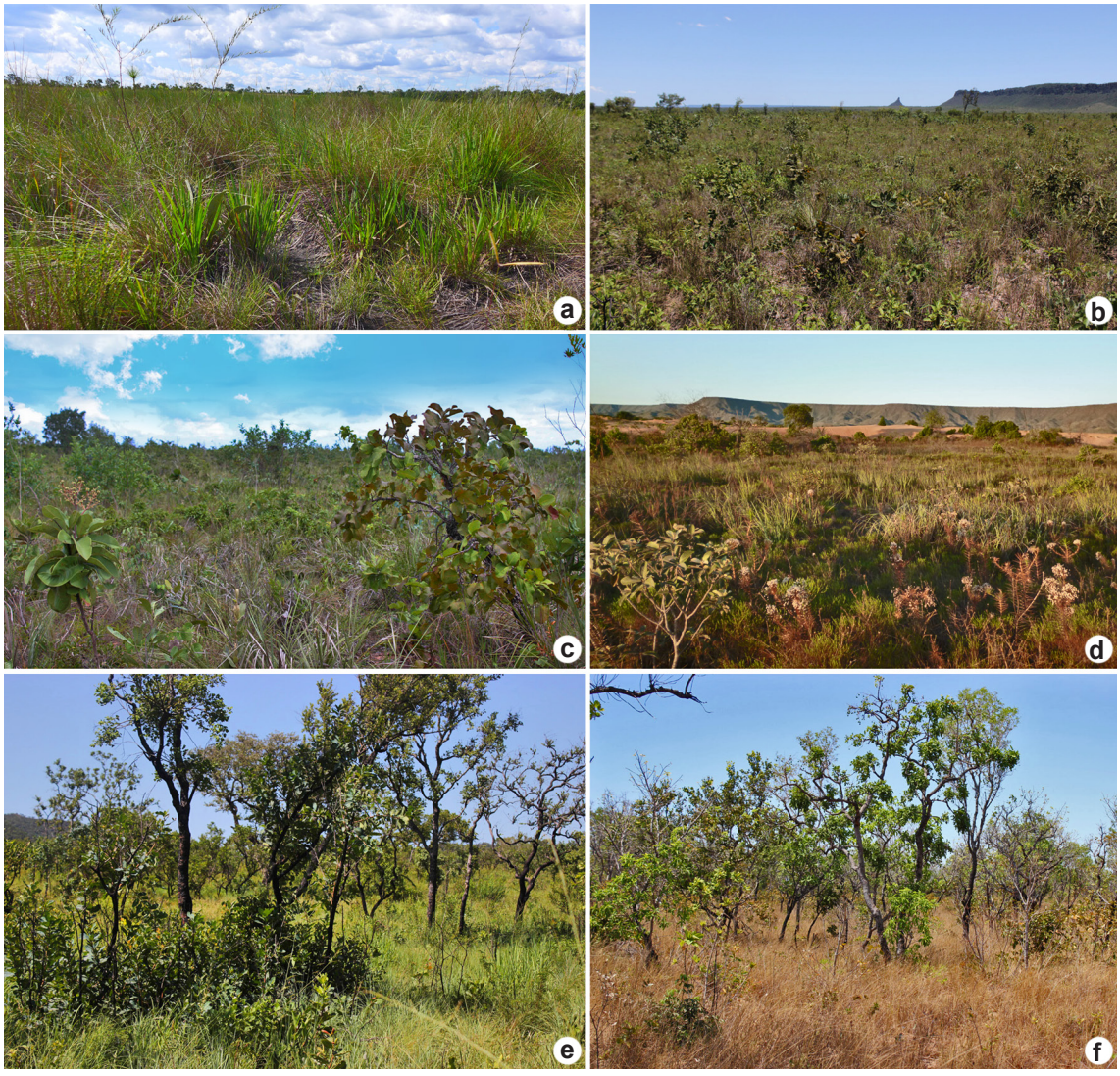

Figure 2 – a-f. Physiognomies considered in the study (Mateiros municipality) – a. *campo limpo*, grassland with herbaceous layer only (Photo: R. Viana); b. *campo sujo*, grassland with an herbaceous and shrubby layer, with few scattered low trees; c. *campo cerrado* savanna physiognomy with up to 10% tree cover; d. dune vegetation; e. *cerrado sensu stricto*, savanna physiognomy with up to 50% tree cover (wet season); f. *cerrado sensu stricto* (dry season).

Results

We detected a total of 550 species from 85 families (Table S2 in supplementary material <https://doi.org/10.6084/m9.figshare.9894170.v1>) representing 553 unique OTUs, including infraspecific taxa. Of these, 12 species are considered new to science: *Bauhinia* sp. nov.1, *Bauhinia* sp. nov.2 (Leguminosae), *Couepia* sp. nov. (Chrysobalanaceae), *Eriope* sp. nov. (Lamiaceae), *Eugenia* sp. nov. (Myrtaceae), *Gouania* sp. nov. (Rhamnaceae), *Lippia* sp. nov. (Verbenaceae) *Piriqueta* sp. nov. (Turneraceae) *Polygala* sp. nov. (Polygalaceae), *Turnera* sp. nov. (Turneraceae), *Varronia* sp. nov. (Boraginaceae) and *Xyris* sp. nov. (Xyridaceae).

The most species-rich families were Leguminosae (91 spp.), Poaceae (39), Asteraceae (31), Lamiaceae (25), Rubiaceae (22), Myrtaceae (20), Malpighiaceae (19) and Euphorbiaceae (18). The species represented by these eight families comprise 48.1% of the species recorded in the checklist. Fourty-two families had only one or two species within the region. The most highly representated genera were *Chamaecrista* Moench (15), *Mimosa* L. (12), *Byrsonima* Rich *ex* Kunth (11), *Paspalum* L. (11), *Polygala* L. (10), *Eugenia* L. (10), *Bauhinia* L. (8), *Hyptis* Jacq. (8), *Myrcia* DC. (8), *Ouratea* Aubl. (7) and *Borreria* G.Mey. (7).

Ten species occurring in Jalapão were considered rare according to Giulietti et al. (2009): *Borreria irwiniana* E.L.Cabral, *Chamaecrista coradinii* H.S.Irwin & Barneby, *Diplusodon gracilis* Koehne, *Diplusodon trigintus* T.B.Calvalc., *Duguetia rotundifolia* R.E.Fr., *Hyptidendron conspersum* (Benth.) Harley, *Hyptis caduca* Epling, *Ouratea acicularis* R.G.Chacon & K.Yamam., *Rhabdodendron gardnerianum* (Benth.) Sandwith, and *Stachytarpheta integrifolia* (Pohl) Walp.

Six species were considered threatened based on Martinelli & Moraes (2013): *Attalea barreirenses* Glassman (vulnerable), *Cereus mirabella* N.P.Taylor (vulnerable), *Diplusodon gracilis* (critically endangered), *Discocactus catingicola* Buining & Brederoo (vulnerable), *Hyptidendron conspersum*, and *Strophopappus bicolor* DC. (endangered). According to Martinelli *et al.* (2014), four species were considered threatened: *Chamaecrista coradinii* (vulnerable), *Diplusodon tringitus* (endangered), *Ouratea acicularis* (endangered), and *Stachytarpheta integrifolia* (endangered).

Based on habit, we classified 196 species as shrubs, 153 as herbs, 108 as subshrubs, 72 as trees, 13 as vines, and 8 as palms (Tab. 1; Fig. 3). According to dispersal syndrome, we classified 229 species as autochores, 190 zoochores, and 131 as anemochores (Tab. 1; Fig. 4).

Discussion

The most species-rich families and genera detected in the Jalapão region are, overall, highly represented and diverse in the Cerrado domain (Eiten 1972; Ratter *et al.* 1997; Gottsberger & Silberbauer-Gottsberger 2006), and this is especially true for Leguminosae, which is the most diverse group accounted for in this study. However, we found a much larger than expected

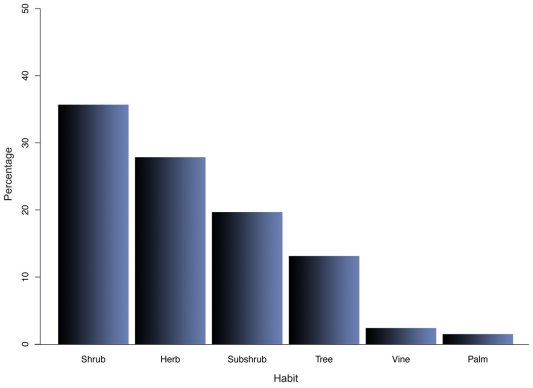

Figure 3 – Percentage of habits represented by 550 species of non-forested savannah physiognomies, with dry, non-rocky soils of Jalapão region, Tocantins, Brazil.

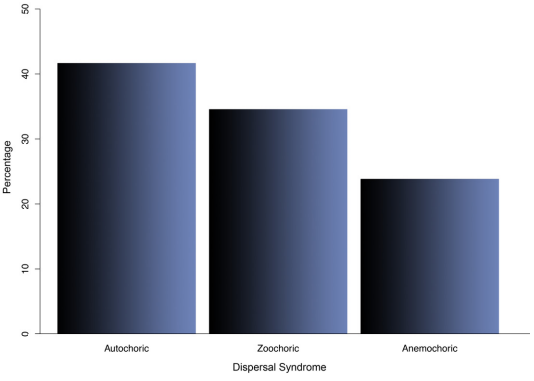

Figure 4 – Percentage of dispersal syndromes (authochoric, zoochoric and anemochoric) represented by non-forested savannah physiognomies, with dry, non-rocky soils of Jalapão region. Total of 550 species.

Table 1 – Total number by dispersal syndromes and habit. Species recorded in Jalapão region for open cerrado physiognomies with dry non-rocky soils. Total of 552 species.

	Number of taxa						
Dispersal modes	total	herb	palm	shrub	subshrub	tree	vine
Zoochory	190	28	8	90	17	43	4
Anemochory	131	43	0	37	16	28	7
Autochory	229	82	0	69	75	1	2

proportion of legume species compared to other families than other surveys (*e.g.*, Mantovani & Martins 1993; Batalha *et al.* 1997a; Batalha & Mantovani 2001; Carvalho *et al.* 2010; Amaral *et al.* 2013). Nevertheless, Medeiros *et al.* (2012), found a similar proportion of legume species compared to other families within Cerrado physiognomies of southern Tocantins and northern Goiás. Therefore, the high species richness represented by Leguminosae in this study is not likely to be a collecting artefact, although legumes are conspicuous, especially during their long reproductive stages. There are several large genera of legumes in the Cerrado, such as *Chamaecrista*, *Bauhinia*, and *Mimosa* (Irwin & Barneby 1982; Barneby 1991; BFG 2015), and these genera probably account for the exceptional species richness of the family compared to others.

The Jalapão area has high species richness (Seplan 2003; Antar *et al*. 2017) and is botanically underexplored, evidenced by the 12 new species detected during our survey and that are currently being described. However, the number of rare and threatened species was not particularly high. This could be related to stringent criteria used to designate plants as rare or threatened or to insufficient data for some of the species. For instance, *Diospyros ovalis* Hiern is poorly known and represented by few collections (Antar *et al*. 2017) but is not regarded as threatened or rare due to limited data available.

We regard the following species as endemic to the Jalapão region: *Varronia* sp. nov., *Eriope* sp. nov., *Bauhinia* sp. nov., *Eugenia* sp. nov., *Piriqueta* sp. nov., *Lippia* sp. nov., *Xyris* sp. nov., *Bonamia campestris* A.Moreira & Sim-Bianch., *Dioscorea compacta* D.Araújo, *Homalolepis tocantina* (Devecchi & Pirani) Devecchi & Pirani, *Ouratea acicularis*, and *Senna biglandularis* A.O.Araujo & V.C.Souza. We believe that these species should be considered as conservation priorities within the management plans of protected areas and institutes of nature management within the Jalapão region.

The 550 species in our checklist increases almost 2-fold the number of species known for the surveyed physiognomies, which had 274 known species until now (Seplan 2003). We expect that additional sampling in all vegetation types, incluidng *veredas*, gallery forest, *cerradões*, rocky-soil savannahs and wet-soil fields, may increase species richness to roughly 1,000 species for the entire Jalapão region. Thus, we expect that the total species richness of the Jalapão region is similar to that detected among all physiognomies within a different Cerrado area of Tocantins and Goiás states (Medeiros *et al.* 2012).

For the surveyed physiognomies within the Jalapão region, we found that the proportions of species habits were roughly similar to results presented by BFG (2015) for the entire Brazilian Cerrado except that they showed herbs as more numerous than shrubs, and in this checklist, we show that shrubs were more numerous than herbs. Different proportions where found by Kuhlmann & Ribeiro (2016) who found shrubs less representative than trees when working with the flora of Brazilian Federal District. We found that the proportion of trees to other habits is 1:6.5, which is similar to that observed within the whole Brazilian Cerrado (BFG 2015). Overall, the pattern of habit diversity that we observed in the Jalapão region is consistent with that of the whole Cerrado, which has a species rich herbaceous layer and less tree diversity (Ratter *et al*. 1997, 2003; BFG 2015).

Regarding dispersal syndromes, our results differ from those obtained by other studies of Cerrado areas. Most studies (Batalha *et al.* 1997b; Batalha & Mantovani 2000; Gottsberger & Silberbauer-Gottsberger 2006; Ishara & Maimoni-Rodella 2011) showed a predominance of zoochore species, followed by anemochore and autochores. These studies largely represent a peripheral Cerrado

area within the state of São Paulo with a different floristic composition (Oliveira & Gibbs 2002; Ishara & Maimoni-Rodella 2011). In the "Parque Nacional das Emas" of the state of Goiás, Batalha & Martins (2004) found that autochores were most common, followed by the zoochores and lastly the anemochores, and this is consistent with our results, though the percentages of syndrome types differ between their study and ours. While Kuhlmann & Ribeiro (2016) found a ratio of 1:1:1 among these dispersal syndromes within the Brazilian Federal District flora, they detected a predominance of autochoric species for open vegetation areas such as in our study. Similar to prior studies (Batalha *et al.* 1997b; Batalha & Mantovani 2000; Gottsberger & Silberbauer-Gottsberger 2006; Kuhlmann & Ribeiro 2016), we found that trees and shrubs have a higher percentage of zoochore species, and herbs and subshrubs have tend to have authocore and anemochore strategies.

Final remarks

The main threat to the Jalapão region, despite the conservation status of much of its area, is the advance of the agricultural frontier, which has already lead to deforestation and transformation of large parts of adjacent Cerrado regions, especially in the state of Bahia (Borges & Antar 2016). Other threats are indiscriminate tourism, off-road vehicles races, uncontrolled extraction of traditional products, and anthropogenic fires during the dry season that are common in the Jalapão region (Schmidt *et al*. 2007). The conservation outlook for the Cerrado as a whole is extremely precarious due to projections for extensive deforestation and mass extinctions in near future (Strassburg *et al*. 2017) combined with governmental policies that are likely to accelerate, rather than minimize, disturbances loss of biodiversity within the region (*e.g.*, the creation of MATOPIBA - Presidência da República, 2015 - stimulating the agricultural business). More than ever, the time to act of the conservation of the Cerrado is now, and biodiversity knowledge represents an important, fundamental step required for planning and executing conservation actions. This study contributes to the knowledge of plant biodiversity in Jalapão region of the Cerrado, and highlights its species richness and, consequently, its biological importance. Despite that, the region is still relatively poorly explored and other physiognomies, such as swamp, gallery forest, seasonal dry forest and wet-soil field, require additional studies.

Acknowledgements

We thank all plant experts who helped confirming or identifying specimens (Table S1 in supplementary material <https://doi.org/10.6084/m9.figshare.9894170.v1>); ICMBio and Naturatins for providing collection permits and field work support at "Parque Estadual do Jalapão" and "Estação Ecológica Serra Geral do Tocantins"; Ubiratan Chagas, Lucas Nascimento, Marcela Escaramai, Heloisa Antar, Vera Scatena, Rebeca Viana and Márcio Martins for helping during field work; Alexandre B. Sampaio and Isabel B. Schmidt for helping with references and information about Jalapão; Luiz Henrique M. Fonseca for comments in an earlier version of this paper; two anonymous reviewers for improvements to our manuscript; CAPES, CNPq (proc. 308300/2012-2 and proc. 310437/2015-6), FAPESP (2014/01851-7) and Idea Wild for financial support.

References

Alvares CA, Stape JL, Sentelhas PC, Gonçalves JLM & Sparovek G (2014) Köppen's climate classification map for Brazil. Meterologische Zeitschrift 22: 711-728.

Amaral AG, Munhoz CBR, Eugênio CUO & Felfili JM (2013) Vascular flora in dry-shrub and wet grassland Cerrado seven years after a fire, Federal District, Brazil. Check List 9: 387-503.

Antar GM, Santos MF & Sano PT (2017) Rediscovery and taxonomic reassessment of four angiosperms in the savannas of Jalapão, Central Brazil. Edinburgh Journal of Botany (online first, DOI: 10.1017/S0960428617000348): 1-17.

APG IV - Angiosperm Phylogeny Group (2016) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Botanical Journal of Linnean Society 181: 1-20.

Araujo AO & Souza VC (2007) Uma nova espécie de *Senna* Mill. (Leguminosae-Caesalpinoideae) do Brasil. Rodriguésia 58: 359-362.

Araújo D, Antar GM & Lombardi JA (2016) *Dioscorea compacta* (Dioscoreaceae), a new endangered dwarf species from the Jalapão region, Tocantins, Brazil. Kew Bulletin 71: 27-32.

Arruda MB & Behr MV (2002) Jalapão: expedição científica e conservacionista. Ibama, Ministério do Meio Ambiente, Brasília. 93p.

Barneby RC (1991) Sensitivae censitae: a description of the genus *Mimosa* Linnaeus (Mimosaceae) in the new world. Memories of the New York Botanical Garden 65: 1-835.

Batalha MA, Aragaki S & Mantovani W (1997a) Florística do Cerrado em Emas (Pirassununga, SP). Boletim de Botânica da Universidade de São Paulo 16: 49-64.

Batalha MA, Aragaki S & Mantovani W (1997b) Variações fenológicas das espécies do cerrado em Emas (Pirassununga, SP). Acta Botanica Brasilica 11: 61-78.

Batalha MA & Mantovani W (2000) Reproductive phenological patterns of cerrado plant species at the Pé-de-Gigante Reserve (Santa Rita do Passa Quatro, SP, Brazil): a comparison between the herbaceous and woody floras. Revista Brasileira de Biologia 60: 129-145.

Batalha MA & Mantovani W (2001) Floristic composition of the Cerrado in the Pé-do-Gigante reserve (Santa Rita do Passo Quatro, Southeastern Brazil). Acta Botanica Brasilica 15: 289-304.

Batalha MA & Martins FR (2004) Reproductive phenology of the cerrado plant community in Emas National Park (central Brazil). Australian Journal of Botany 52: 149-161.

Beentje H (2012) The Kew plant glossary: an illustrated dictionary of plant terms. Royal Botanical Garden, Kew. 164p.

BFG - The Brazil Flora Group (2015) Growing knowledge: an overview of seed plant diversity in Brazil. Rodriguésia 66: 1085-1113.

BFG - The Brazil Flora Group (2018) Brazilian Flora 2020: innovation and collaboration to meet Target 1 of the Global Strategy for Plant Conservation (GSPC). Rodriguésia 69: 1513-1527.

Borges LM & Antar GM (2016) Four they are! Broadening the description of *Mimosa flabelifolia* (Leguminosae Mimosoideae), a rare species from the Brazilian Cerrado. Phytotaxa 243: 155-162.

Carvalho MB, Ishara KL & Maimoni-Rodella RCS (2010) Vascular Flora of a Cerrado *sensu stricto* remmant in Pratânia, state of São Paulo, southeastern Brazil. Checklist 6: 350-357.

Coutinho LM (1978) O conceito do cerrado. Revista Brasileira de Botânica 1: 17-23.

Coutinho LM (1990) Fire in the ecology of Brazilian Cerrado. Ecological studies: analysis and synthesis 84: 82-105.

Devecchi MF & Pirani JR (2015) A new species of *Simaba* sect. *Grandiflorae* (Simaroubaceae) from Jalapão region, Tocantins, Brazil. Phytotaxa 227: 167-174.

Eiten G (1972) The cerrado vegetation of Brazil. Botanical Review 38: 201-341.

Filgueiras TS, Nogueira PE, Brochado AL & Guala GF (1994) Caminhamento: um método expedito para levantamentos florísticos qualitativos. Caderno de Geociências 12: 39-43.

Flora do Brasil 2020 (under construction) Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. Available at <http://floradobrasil.jbrj.gov.br/>. Access on 01 August 2019.

Forzza RC, Baumgratz JFA, Bicudo CEM, Canhos DAL, Carvalho A, Coelho MAN, Costa AF, Costa DP, Hopkins MG, Leitman PM, Lohmann LG, Lughadha EN, Maia LC, Martinelli G, Menezes M, Morim MP, Peixoto AL, Pirani JR, Prado J, Queiroz LP, Souza S, Souza VC, Stehmann JR, Sylvestre LS, Walter BMT & Zappi DC (2012) New Brazilian floristic list highlights conservation challenges. Bioscience 62: 39-45.

França F & Proença CEB (2007) *Vochysia palmirana* (Vochysiaceae), a new species from Goiás and Tocantins, Brazil. Brittonia 59: 374-376.

Giulietti AM, Rapini A, Andrade MJG, Queiroz LP & Silva JMC (2009) Plantas raras do Brasil. Conservação Internacional, Belo Horizonte. 496p.

Gottsberger G & Silberbauer-Gottsberger I (2006) Life in the Cerrado, a South American tropical seasonal ecosystem. Vol. 1. Origin, structure, dynamics and plant use. Reta Verlag, Ulm. 277p.

IPNI - The International Plant Names Index (2018) Electronic database. Available at <http://www.ipni.org>. Access on 05 February 2018.

Irwin HS & Barneby RC (1982) The American Cassiinae. Memoirs of the New York Botanical Garden 35: 455-918.

Ishara KL & Maimoni-Rodella CS (2011) Pollination and dispersal systems in a cerrado remnant (Brazilian Savanna) in southeastern Brazil. Brazilian archives of biology and technology 54: 629-642.

Klink CA & Machado RB (2005) Conservation of Brazilian Cerrado. Conservation Biology 19: 707-713.

Kuhlman M & Ribeiro JF (2016) Evolution of seed dispersal in the Cerrado biome: ecological and phylogenetic considerations. Acta Botanica Brasilica 30: 271-282.

Mantovani W & Martins FR (1993) Florística do Cerrado na Reserva Biológica de Mogi Guaçu, SP. Acta Botanica Brasilica 7: 33-60.

Martinelli G & Moraes MA (2013) Livro vermelho da flora do Brasil. Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. Centro Nacional de Conservação da Flora, Rio de Janeiro. 1100p.

Martinelli G, Messina T & Santos-Filho L (2014) Livro vermelho da flora do Brasil: plantas raras do Cerrado. Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. Centro Nacional de Conservação da Flora, Rio de Janeiro. 320p.

Medeiros MB, Walter BMT, Silva GP, Gomes BM, Lima ILP, Silva SR, Moser P, Oliveira WL & Cavalcanti TB (2012) Vascular flora of the Tocantins River Middle Basin, Brazil. Checklist 8: 852-885.

Mendes TP, Souza AO & Silva MJ (2017) A new species hidden in the lowlands of Tocantins, Brazil: *Chamaecrista tocantinensis* (Fabaceae). Systematic Botany 42: 326-337.

Mittermeier RA, Turner WR, Larsen FW, Brooks TM & Gascon C (2011) Global biodiversity conservation: the critical role of hotspots. *In*: Zachos E & Habel JC (eds.) Biodiversity hotspots. Springer Publishers, London. Pp. 3-22.

Moreira AG (2000) Effects off fire protection on savanna structure in Central Brazil. Journal of Biogeography 27: 1021-1029.

Moreira ALC, Antar GM, Simão-Bianchini R & Cavalcanti TB (2017) Contribution to the knowledge of *Bonamia* (Convolvulaceae) in Brazil: a new species and a new occurrence. Phytotaxa 306: 146-152.

Oliveira PE & Gibbs PE (2002) Pollination and reproductive biology in cerrado plant communities. *In*: Oliveira PS & Marquis RJ (eds.) The Cerrados of Brazil: ecology and natural history of a neotropical savanna. Columbia University Press, New York. Pp. 329-347.

Pivello VR & Coutinho LM (1996) A qualitative successional model to assist in the management of Brazilian cerrados. Forest Ecology Management 87: 127-138.

Pivello VR, Carvalho VMC, Lopes PF, Peccinini AA & Rosso S (1999) Abundance and distribution of native and alien grasses in a "Cerrado" Brazilian savanna biological reserve. Biotropica 31: 71-82.

Proença CEB, Farias-Singer R & Gomes BM (2007) *Pleonotoma orientalis* (Bignoniaceae-Bignonieae): expanded description, distribution and a new variety of a poorly known species. Edinburgh Journal of Botany 64: 17-23.

Ratter JA, Ribeiro JF & Bridgewater S (1997) The Brazilian Cerrado vegetation and threats to its biodiversity. Annals of biology 80: 223-230.

Ratter JA, Bridgewater S & Ribeiro JF (2003) Analysis of the floristic composition of the Brazilian Cerrado vegetation III: comparison of the woody vegetation of 376 areas. Edinburgh Journal of Botany 60: 57-109.

Ribeiro JF & Walter BMT (2008) As principais fitofisionomias do bioma Cerrado. *In*: Sano SM, Almeida SP & Ribeiro JF (eds.) Cerrado: ecologia e flora. Vol. 1. Embrapa Cerrados/Embrapa Informação Tecnológica, Brasília. Pp. 153-212.

Rua GH, Valls JFM, Gracino-Ribeiro D & Oliveira RC (2008) Four new species of *Paspalum* (Poaceae, Panicee) from Central Brazil, and resurrection of and old one. Systematic Botany 33: 267-276.

Sampaio MB, Schmidt IB & Figueiredo IB (2008) Harvesting effects and population ecology of the Buriti Palm (*Mauritia flexuosa* L.f., Arecaceae) in the Jalapão region, Central Brazil. Economic Botany 62: 171-181.

Schmidt IB, Figueiredo IB & Scariot A (2007) Ethnobotany and effects of harvesting on the population of *Syngonanthus nitens* (Bong.) Ruhland (Eriocaulaceae), a NTFP from Jalapão region, Central Brazil. Economic Botany 61: 73-85.

SEPLAN - Secretaria do Planejamento e Meio Ambiente do Estado de Tocantins (2003) Plano de manejo da Área de Proteção Ambiental do Jalapão. Seplan, Palmas. 205p.

SEPLAN - Secretaria do Planejamento e Meio Ambiente do Estado de Tocantins (2012) Atlas do Tocantins: subsídios ao planejamento da gestão territorial. Seplan, Palmas. 79p.

Silva IA & Batalha MA (2011) Plant functional types in Brazilian savannas. The niche partitioning between herbaceous and woody species. Perspectives in Plant Ecology, Evolution and Systematics 13: 201-206.

Silva JMC & Bates JM (2002) Biogeographic patterns and conservation in the South America Cerrado: a tropical savana hotspot. BioScience 52: 225-233.

Silva DP, Amarala AG, Bijos NR & Munhos CBR (2017) Is the herb-shrub compostition of veredas (Brazilian palm swamps) distinguishable? Acta Botanica Brasilica (online first): 1-8.

Strassburg BBN, Brooks T, Feltran-Barbieri R, Iribarrem A, Crouzeilles R, Loyola R, Latawiec AE, Filho FJBO, Scaramuzza CAM, Scarano FR, Soares-Filho B & Balmford A (2017) Moment of truth of the Cerrado hotspot. Nature Ecology & Evolution 1, 0099: 1-3.

Thiers B [continuously updated] Index Herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. Available at <http://sweetgum.nybg.org/science/ih/>. Access on 06 March 2016.

van der Pijl L (1982) Principles of dispersal in higher plants. Springer Verlag, Berlin. 212p.

Vieira S & Souza VC (2008) Four new species of *Maranta* L. (Marantaceae) from Brazil. Botanical Journal of Linnean Society 158: 131-139.

Yamamoto K, Chacon RG, Proença C, Cavalcanti TB & Graciliano-Ribeiro D (2008) A distinctive new species of *Ouratea* (Ochnaceae) from the Jalapão region, Tocantins, Brazil. Novon 18: 397-404.

Editora de área: Dra. Daniela Zappi

Artigo recebido em 01/11/2017. Aceito para publicação em 09/02/2018.