

THE WOODY FLORA OF CERRADO VEGETATION IN THE STATE OF PIAUÍ, NORTHEASTERN BRAZIL

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Cerrado vegetation covers about 33% of the total area of the state of Piauí, northeastern Brazil, where there are also large areas of transition and contact with other vegetation types. Although the Piauí cerrados are a direct northern prolongation of the central core area, they are considered marginal by almost all authors. There are few previous records of their woody flora. This paper presents a floristic list of woody species based on the survey of 11 localities and updating of two already published lists. The climate belongs to Thornthwaite's subhumid category due to Piauí's position between the semiarid northeastern domain and the superhumid Amazon. The annual total rainfall is similar to that of the major part of the Brazilian cerrado area, but the rainy season is shorter. The soils differ from most cerrado soils in containing a greater proportion of concretions and plinthite with generally lighter colours, which may be interpreted as indicating large fluctuations of the water-table during pedogenesis. There are also widespread indications of seasonal high water-table showing that many of the Piauí cerrados probably belong to Sarmiento's hyperseasonal savannah category. A total of 60 families is represented by 307 woody taxa (including 14 family indet., four genera indet. and 80 species indet.). The lowest floristic diversity (richness) occurred in pure cerrado, the greatest in transition and contact areas.

O cerrado do Piauí, nordeste do Brasil, cobre cerca de 33% da área do estado e apresenta extensas áreas de transição e contato com outros tipos de vegetação. É um prolongamento setentrional do cerrado central, mas é considerado marginal. Sua flora lenhosa é pouco conhecida. Este trabalho apresenta uma lista florística lenhosa baseada em 11 levantamentos de campo e atualização de duas listas já publicadas. Os climas são subúmidos de Thornthwaite, em decorrência de sua localização entre o domínio semi-árido nordestino e o superúmido amazônico. O total anual de chuva é semelhante ao do resto do cerrado, mas a estação chuvosa é bem mais curta. Os solos são diferentes dos do restante dos cerrados, apresentando concreções, plintita e cores claras, indicando grandes flutuações do lençol freático durante a pedogênese. As grandes flutuações estacionais do lençol freático implicam em que boa parte do cerrado piauiense possa ser classificada como savana hiperestacional de Sarmiento. Apresenta-se um total de 60 famílias conhecidas e 308 táxons lenhosos (14 desconhecidos no nível de família, 4 desconhecidos no nível de gênero e 80 desconhecidos no nível de espécie). A menor diversidade (riqueza) florística ocorreu no domínio puro do cerrado; as maiores ocorreram nas áreas de transição.

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INTRODUCTION

The state of Piauí is located in the northeastern region of Brazil (Fig. 1) and has a total area of 25,093,400ha of which about 33.3% (8,349,759ha) is covered by cerrado vegetation *sensu lato*, and 14.0% (3,507,107ha) represents transition and contact areas of cerrado with other types of vegetation: caatinga (dry thorn woodland and shrubland), carrasco (dry cerrado-caatinga transition), dry deciduous forest, seasonal subdeciduous forest, *Orbignya* palm forest, riparian forest and grasslands (CEPRO, 1992). Cerrado constitutes the second most extensive type of vegetation in the state; its area is only exceeded by that of the caatinga.

Although the cerrado area in the state of Piauí is a direct continuation of that of the core area on the Central Plateau of Brazil, it is generally considered marginal (e.g. Rizzini, 1963) since it is located at the northern extreme of the distribution area of the biome. There is little information available about its flora: only five relevant papers have so far been published, of which two (Goergen, 1983; Jenrich, 1989) did not have floristic survey as their main goal. Of the others, Rizzini (1976) produced a preliminary list of 61 species of angiosperms based on a single field survey and an examination of herbarium material, but Barroso & Guimarães (1980) and Castro (1984) reported intensive field surveys. The present paper communicates the results of surveys of some representative areas in the state.

MATERIALS AND METHODS

Eleven different localities (locs. 102 and 121–130, Fig. 1) were surveyed by means of the plot method (Mueller-Dombois & Ellenberg, 1974). The vegetation of all localities fell into the physiognomic class of cerrado *sensu stricto* (Coutinho, 1978); many were sited in regions of vegetation transition (principally between cerrado and deciduous forest or cerrado and caatinga).

In one locality (loc. 102) the area was surveyed by a systematic grid consisting of thirty 10 × 20m plots, 50m apart, and all woody plants with at least one trunk with diameter at ground level ≥ 3 cm were recorded. All other localities (see Table 1 and caption of Fig. 1 for details) were sampled by single 20 × 500m (1ha) plots on which all woody plants with at least one trunk of ≥ 5 cm DBH were recorded.

The species records of Barroso & Guimarães (1980) from the Sete Cidades National Park (loc. 69, Fig. 1) and Castro (1984) from Uruçuí-Una Ecological Station (loc. 95) are also included to make the list as complete as possible. The identifications in the latter work have been updated. These authors used the 'preferential collecting' method (Castro, 1994), i.e., a general reconnaissance and collecting, or wide-patrolling or walking-and-gathering method, without setting any specific area or plant size limits. Arboreal and shrubby species have been selected from their lists, which also included species from the lower layers of vegetation.

Information on the geographic distribution of cerrado woody species was obtained from many references (e.g. Ratter *et al.*, 1973; Heringer *et al.*, 1977; Sarmiento, 1983;

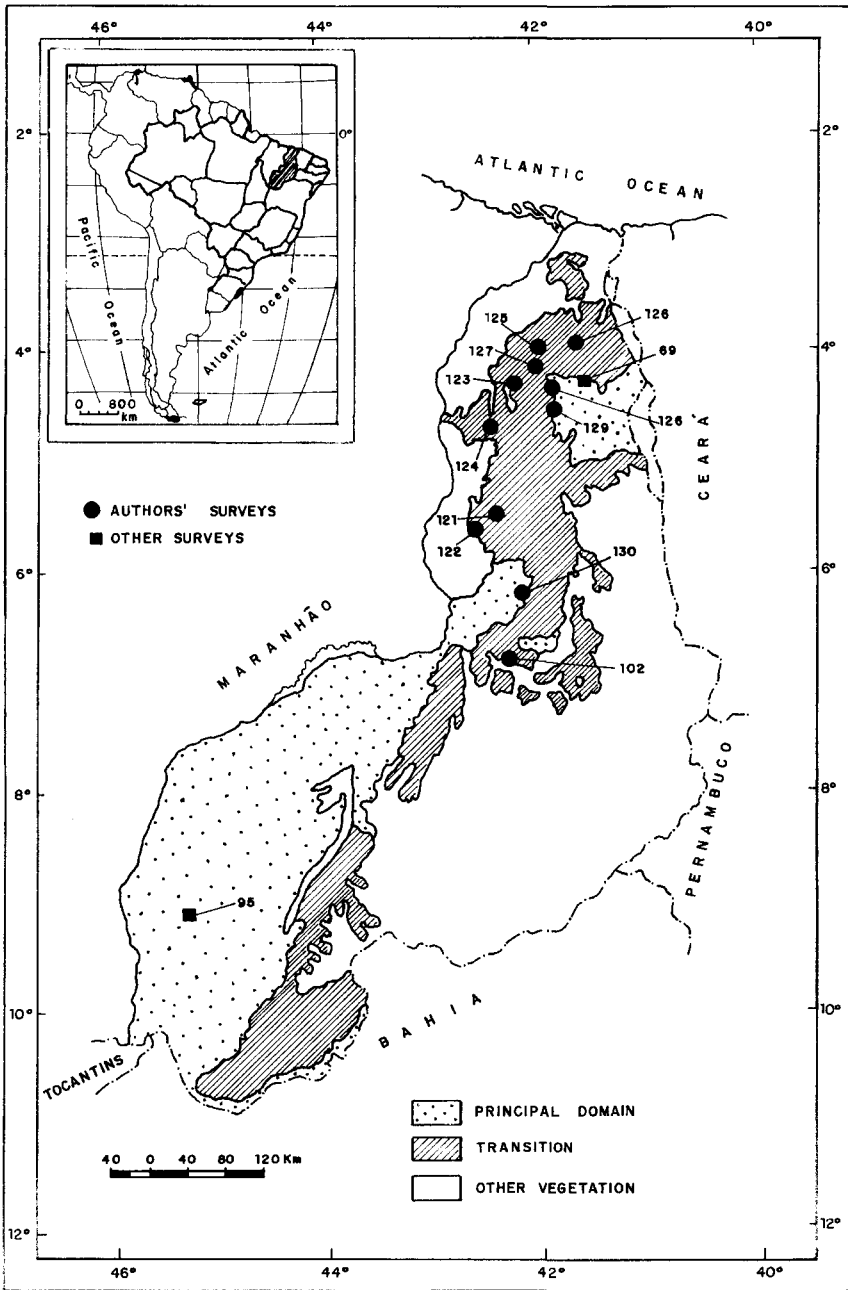


FIG. 1. Map of Piauí showing distribution of cerrado and transitional vegetation (CEPRO, 1992) and the positions of the survey localities.

TABLE 1. Details of the 13 survey areas (from north to south). Information on the soil units is given in Table 2.

Loc. No.	Name & municip.	No. of spp.	No. of individ.	Co-ord.	Alt. (m)	Soil unit	Clim. topol.
128	Alto Bonito, Piracuruca	22	252	3°58'S 41°43'W	70	AQ-1	^a C ₁ S ₁ A ₄ a'
125	Caiçara, Batalha	29	322	4°01'S 42°04'W	80	R-2	^b C ₁ S ₂ A ₄ a'
69*	Sete Cidades, Piripiri e Piracuruca	116	—	4°06'S 42°43'W	275	PV-16	^b C ₁ S ₂ A ₄ a'
127	Bom Princípio, Batalha	20	270	4°08'S 42°09'W	80	R-2	^b C ₁ S ₂ A ₄ a'
124	Lagoa Seca, Barras	25	249	4°14'S 42°37'W	75	LA-9	^b C ₁ S ₂ A ₄ a'
126	Carnaubal, Piripiri	23	213	4°16'S 41°47'W	160	LA-14	^c C ₂ S ₁ A ₄ a'
129	Santana, Capitão de Campos	35	405	4°27'S 41°56'W	140	LA-11	^a C ₁ S ₁ A ₄ a'
123	Tucum, José de Freitas	35	396	4°45'S 42°35'W	137	PT-3	^b C ₁ S ₂ A ₄ a'
121	Descanso, Beneditinos	39	323	5°27'S 42°21'W	80	PT-4	^b C ₁ S ₂ A ₄ a'
122	Toti Negra, Monsenhor Gil	25	323	5°33'S 42°37'W	115	PV-11	^b C ₁ S ₂ A ₄ a'
130	Vista Alegre, Elesbão Veloso	27	336	6°12'S 42°08'W	230	R-13	^d C ₁ d ₂ A ₄ a'
102	Chapada Grande, Oeiras	84	2,136	6°36'S 42°16'W	430	LA-1	^d C ₁ d ₂ A ₄ a'
95**	Uruçuí-Una, Ribeiro Gonçalves	128	—	8°51'S 45°15'W	400	LA-3	^e C ₁ S ₁ A ₃ a'

^a Dry subhumid with a moderate water excess in the autumn, fourth megathermic

^b Dry subhumid with a large water excess in the autumn, fourth megathermic

^c Humid subhumid with a moderate water deficit in the spring, fourth megathermic

^d Dry subhumid with slight water excess in the autumn, fourth megathermic

^e Dry subhumid with a moderate water excess in the autumn, third megathermic

* Barroso & Guimarães (1980)

** CASTRO (1984)

Furley *et al.*, 1988; Fernandes & Bezerra, 1990; Leitão Filho, 1992; Rodal, 1992, 1994), by examination of herbarium specimens and by personal communication.

Voucher specimens are deposited in the Graziela Barroso Herbarium (TEGB) of the Departamento de Biologia/Centro de Ciências Naturais/Universidade Federal do Piauí, Prisco Bezerra Herbarium (EAC) of the Departamento de Biologia/Centro de Ciências/Universidade Federal do Ceará, and Herbarium of the Departamento de Botânica/Instituto de Biologia/Universidade Estadual de Campinas (UEC).

Information on climatic elements and soils was obtained from Brasil (1990), Jacomine *et al.* (1986), Krishnan (1980), Lima *et al.* (1982), Nimer & Brandão (1985, 1989), and Varejão-Silva & Reis (1988). The hydric balance and the classification of the climate of each locality were determined according to Thornthwaite (1948) and Thornthwaite & Mather (1955), following the instructions of Nimer & Brandão (1985, 1989) and Varejão-Silva & Reis (1988).

PHYSICAL ENVIRONMENT

All localities have a fair degree of climatic similarity with average annual temperature between 26.3°C and 27.0°C, precipitation between 1,217mm and 1,709mm, and annual average hydric deficiency between 365mm and 560mm. They all fall into Thornthwaite's dry subhumid climatic type with the exception of locality 126 which just falls into his humid subhumid category (Table 1). The prevalence of subhumid climatic types in the localities studied is a consequence of the geographic position of the state of Piauí. They indicate the transition between the two great groups present in northern and northeastern Brazil, the Wet and Dry climates of Thornthwaite (1948). This transitional climatic character is expected, since the state is under both the northeastern influence, with its semiarid climate, and the Amazonian influence, with its superhumid climate (Azevedo & Caser, 1980). The yearly total precipitation is similar to that of the bulk of the cerrado area in Brazil, and the climate shows a marked hydric seasonality, as it is highly megathermic all the year round and the rains are concentrated in a few months (December to April).

The soil mapping units to which each locality belongs are given in Table 1 and are described in Table 2. Most of the soils show evidence of hydric seasonality in the presence of concretions, plinthite, or light grey or yellow colours (Tables 1 and 2). Concretions and plinthite result most commonly from the interaction between iron, or iron and aluminium, and water in conditions of alternating soaking and drying, as can happen when the water-table shows great variation. Greyish colours may be produced by anaerobic conditions due to the elevation of the water-table, while yellow colours may indicate an excessive humidity with formation of goethite (when iron is present), but may also indicate low iron content and prevalence of kaolinite (Oliveira *et al.*, 1992). The presence of *Copernicia* and *Orbignya* palms also indicates the influence of the soil water-table (Rizzini *et al.*, 1988). The prevalence of soils showing the presence of a seasonally high water-table indicates that these Piauian cerrados may be classified closer to hyperseasonal savannahs than to purely

TABLE 2. The soil mapping units found in the 13 survey areas, following Jacomine (1986).

Loc. no.	Soil code	Soil type	Vegetation
128	AQ-1	Quartz Sands	Subdeciduous cerrado
		Greyish Podzolics	Subdeciduous cerrado
125, 127	R-2	Litholic soils	Subdeciduous cerrado
		Concretionary Yellow-Red Podzolics	Subdeciduous cerrado
		Plinthosols	Subdeciduous cerrado/caatinga with <i>Orbignya</i>
69	PV-16	Concretionary Yellow-Red Podzolics	Subdeciduous cerrado and transition to caatinga
		Litholic soils	Subdeciduous cerrado and transition to caatinga
124	LA-9	Yellow Latosols	Subdeciduous cerrado, subdeciduous forest/cerrado with and without <i>Orbignya</i>
		Plinthosols	Subdeciduous cerrado, subdeciduous forest/cerrado with and without <i>Orbignya</i>
126	LA-14	Yellow Latosols (with pebbles)	Subdeciduous cerrado with or without <i>Copernicia</i>
		Concretionary Plinthosols	Subdeciduous cerrado with or without <i>Copernicia</i>
		Indiscriminate assemblage (Plinthosols, Greyish Podzols, Quartz Sands)	Subdeciduous cerrado with or without <i>Copernicia</i>
129	LA-11	Yellow Latosols	Subdeciduous cerrado with or without <i>Copernicia</i> , and transition to subdeciduous forest
		Plinthosols	Subdeciduous cerrado with or without <i>Copernicia</i> , and transition to subdeciduous forest
123	PT-3	Plinthosols	Campo Maior complex*
		Solodic Planosols	Campo Maior complex*
121	PT-4	Plinthosols	Campo Maior complex*
		Yellow-Red Podzolicss	Campo Maior complex*
		Litholic soils	Campo Maior complex*
122	PV-11	Concretionary Yellow-Red Podzolics	Subdeciduous forest with or without <i>Orbignya</i> and transition to cerrado with or without <i>Orbignya</i>
		Litholic soils	Deciduous forest and transition to subdeciduous cerrado
130	R-13	Litholic soils	Hypoxerophyllous caatinga and transition to deciduous cerrado
		Quartz Sands	Hypoxerophyllous caatinga and transition to deciduous cerrado

TABLE 2. (Continued).

		Planosols	Hypoxerophyllous caatinga with <i>Copernicia</i> , and floodable savannah with <i>Copernicia</i>
102	LA-1	Yellow Latosols	Subdeciduous cerrado and transition to subdeciduous forest
95	LA-3	Yellow Latosols	Subdeciduous cerrado

* The Campo Maior complex is a mosaic of many vegetation types: campo cerrado, *Copernicia* savannah, floodplain grassland, parkland

seasonal ones (Sarmiento, 1984). Soils with light colours are not very frequent under cerrado vegetation, where predominantly reddish colours indicative of well-drained soils generally occur (Furley & Ratter, 1988). Another important feature is that cerrado is a characteristic vegetation of calcium-poor dystrophic soils, while the presence of deciduous and subdeciduous forest and both *Orbignya* and *Copernicia* palms is linked to mesotrophic soils with higher calcium levels.

RESULTS AND DISCUSSION

Table 1 gives the number of species and individuals, the co-ordinates, altitude and soil type for each locality sampled. It shows that the three localities surveyed by nonstandardized methods showed the highest number of species. Localities 95 and 69 surveyed by the 'preferential collecting' method without reference to limited area or plant size qualification had 128 and 116 species respectively. Locality 102, where the size qualification used was trunk only ≥ 3 cm diam. at ground level, contained no less than 2163 individuals of 84 species in 0.6ha. The other 10 areas were all surveyed by the same method (≥ 5 cm DBH on 1ha plots of the same shape) and are thus directly comparable.

In these 10 areas the climate is very similar but there seems to be a relation of species diversity (richness) to soil type. It was greatest (loc. 121, 123, 129) where Plinthosols prevail in the mapping units and least (loc. 124, 126, 127, 128) where Latosols and Quartz Sands predominate, with intermediate levels (loc. 122, 125, 130) where Litholic Soils preponderate. The number of species *S* was roughly proportional to the absolute density *N* (Table 1). Therefore, the soil mapping units may influence both the density and the species richness of the vegetation. In the present study the greatest species diversity was found in plots occurring in the Campo Maior complex (a very heterogeneous environment) and in areas of transition to subdeciduous forest, that is in the transition to better (more mesotrophic) soils. The least diversity was found in plots occurring in pure physiognomies of subdeciduous cerrado. Intermediate diversity was found in areas of transition to deciduous forest and to caatinga, that is in the transition to more xeric vegetation types.

The values of *N* in Table 1 indicate that the absolute density of thick-stemmed

woody plants is not as high as that found in typical cerrado *sensu stricto* in Central Brazil (e.g. Furley *et al.*, 1988), but is closer to that occurring on waterlogged or concretionary and rocky soils.

Of the 307 species encountered in the surveys only 22 occurred in 50% or more of the localities, and only *Byrsonima crassifolia*, *Qualea grandiflora*, *Q. parviflora*, *Stryphnodendron coriaceum* and *Vatairea macrocarpa* were present in all 13 surveys, thus indicating a great spatial heterogeneity of species composition in the cerrado vegetation in Piauí. This accords well with the high levels of heterogeneity recorded by Ratter & Dargie (1992) in their survey of 26 areas of the cerrado biome throughout Brazil.

Table 3 lists the species and attempts to indicate their geographical distribution where sufficient information is available. Information on geographical distribution can be obtained for only about 60% of the total species listed in Table 3, and is available in a very uneven fashion. Yet, although very speculative, some interpretation can be made of the known geographical distribution. Rizzini (1976) and Heringer *et al.* (1977) claimed that the cerrados of the states of Maranhão and Piauí have a very different woody flora from the central core area, the two areas having only about 50% of their species in common, and, for this reason, should be considered as a separate floristic or phytogeographic unit. Fernandes & Bezerra (1990) designated the vegetation of these states as the Parnaíba Basin Sector of the Cerrado Province, thus stressing its individuality. Castro (1994) proposed the existence of eight diversity supercentres for Brazilian cerrados, one of them in the northeastern region of the cerrado biome, providing evidence based on the multivariate numerical analyses of many surveys. However, Table 3 shows that many species have wide geographic distribution in neotropical savannahs (Sarmiento, 1983). Some of these species (marked by 'W' in Table 3 and representing about 17% of the species listed) have areas that extend far to the south and north. Others (marked by 'S' in Table 3; about 22% of the species listed) have a large area of distribution to the south (Leitão Filho, 1992), with the cerrados of Piauí close to their northern limit. Yet others (marked by 'N'; about 6%) extend further to the north, the Piauían cerrados representing roughly their southern limit. Some species (marked 'C'; about 16%) are elements from the shrub-tree caatingas (Rodal, 1992, 1994), while others (marked 'A'; about 5%) also occur in Amazon terra firme (noninundated) forests. Species marked 'R' (about 8%) have their distribution restricted to the cerrados of Piauí and Maranhão. Finally, calcicolous species are indicated by 'Ca' (about 4%) since this soil preference is known to be important in determining species occurrence in cerrado habitats (Ratter *et al.*, 1977, 1978). The percentages given above add up to more than the c.60% of species for which information of geographic distribution is available since some species occur in more than one distribution category.

Our results show that the Piauían cerrados have some distinct characteristics of their woody flora, not found elsewhere, thus supporting, at least partially, the ideas of Fernandes & Bezerra (1990), Heringer *et al.* (1977) and Rizzini (1976). The differences can even be observed at family level, e.g. *Bombacaceae* and *Proteaceae*, two important families in other areas that have not been found in our surveys in

TABLE 3. Woody species of the cerrado vegetation of the state of Piauí, northeastern Brazil. Families according to Cronquist (1988). Code letters: W, wide distribution extending far north and south; S, wide distribution to the south; N, wide distribution to the north; C, also found in shrub-tree caatinga; A, also found in *terra firme* (non-inundated) Amazonian forest; R, restricted distribution; Ca, calcicolous species. (Available information on distribution is often incomplete so that future research may demonstrate that, for instance, an S may prove to be a W). Total: 60 families; at least 159 genera; 307 taxa.

Species	W	S	N	C	A	R	Ca
ANACARDIACEAE							
<i>Anacardium occidentale</i> L.	•				•		
<i>Astronium fraxinifolium</i> Schott	•				•		•
<i>Myracrodruon urundeuva</i> Allemão	•				•		•
<i>Tapirira guianensis</i> Aubl.	•				•		
ANNONACEAE							
<i>Annona coriacea</i> Mart.	•			•			
<i>Annona</i> spp. (3 spp.)							
<i>Duguetia echinophora</i> R.E.Fr.							
<i>Guatteria</i> aff. <i>minarum</i> R.E.Fr.							
<i>Xylopia aromatica</i> Mart.	•						
APOCYNACEAE							
<i>Aspidosperma multiflorum</i> A.DC.							
<i>A. pyrifolium</i> Mart.				•			
<i>A. subincanum</i> Mart. ex A.DC.	•						•
<i>Aspidosmera</i> s.p.							
<i>Hancornia speciosa</i> M. Gómez	•						
<i>Himatanthus articulatus</i> (Vahl) Woodson					•		
<i>H. obovatus</i> (Müll.Arg.) Woodson		•					
<i>Peschiera affinis</i> (Müll.Arg.) Miers		•					
<i>Rauvolfia ternifolia</i> Kunth							
<i>Secondatia densiflora</i> A.DC.							
ARALIACEAE							
<i>Didymopanax</i> sp.							
ARECACEAE							
<i>Bactris</i> sp.							
<i>Copernicia prunifera</i> (Mill.) H.E. Moore				•			
<i>Mauritia martiana</i> (Mart.) Burret		•					
ASTERACEAE							
<i>Brickellia pinifolia</i> A. Grey		•					
<i>Clibadium rotundifolium</i> DC.		•					
<i>Trichogonia campestris</i> Gardner		•					
<i>Vernonia fruticulosa</i> Mart. ex DC.		•					
<i>Vernonia</i> sp.							
BIGNONIACEAE							
<i>Anemopaegma laeve</i> DC.							
<i>Arrabidaea inaequalis</i> Baill.			•				
<i>A. conjugata</i> Mart.							
<i>Arrabidaea</i> sp.							
<i>Cybistax antisyphilitica</i> (Mart.) Mart.	•						
<i>Jacaranda brasiliana</i> (Lam.) Pers.	•			•			

TABLE 3. (Continued).

J. jasminoides (Thunb.) Sandwith	•	•
Jacaranda spp. (2 spp.)		
Tabebuia aurea (Manso) Benth. & Hook.	•	•
T. ochracea (Cham.) Standl.	•	•
T. serratifolia (Vahl) Nicholson	•	•
Tabebuia spp. (2 spp.)		
Zeyheria montana Mart.	•	
Unknown (1 sp.)		
BORAGINACEAE		
Cordia superba Cham.	•	
Cordia spp. (2 spp.)		
BURSERACEAE		
Protium heptaphyllum (Aubl.) Marchand	•	
CACTACEAE		
Cereus jamacaru DC.	•	•
CAESALPINIACEAE		
Bauhinia cuyabensis (Bong.) Steud.	•	
B. dubia Don		
B. macrostachya Benth.		•
B. pulchella Benth.	•	
B. rufa (Bong.) Steud.	•	
Bauhinia spp. (2 spp.)		
Caesalpinia ferrea Mart. ex Tul.		•
Cenostigma gardnerianum Tul.	•	•
Chamaecrista desvauxii (Colladon) Killip var.		
langsdorffii (Kunth ex Vogel) H.S. Irwin		
& Barneby	•	
Ch. desvauxii var. malacophylla (Vogel)		
H.S. Irwin & Barneby	•	
Ch. juruenensis (Hoehne) H.S. Irwin &		•
Barneby		
Ch. rotundata (Vogel) H.S. Irwin & Barneby	•	
Ch. zygophylloides (Taub.) H.S. Irwin &		
Barneby	•	
Chamaecrista sp.		
Copaifera coriacea Mart.		•
C. luetzelburgii Harms		•
C. martii Hayne	•	•
Dimorphandra gardneriana Tul.		•
Hymenaea courbaril L. var. courbaril	•	•
H. courbaril var. stilbocarpa (Hayne) Lee &		
Langenh.	•	
H. maranhensis Lee & Langenh.		•
H. stigonocarpa Mart. ex Hayne	•	•
H. stigonocarpa var. pubescens Benth.	•	•
H. velutina Ducke		•
Martiodendron mediterraneum (Mart. ex		
Benth.) Koeppen		•
Peltogyne confertiflora (Hayne) Benth.	•	

TABLE 3. (Continued).

<i>Sclerolobium aureum</i> (Tul.) Benth.	•			
<i>S. hypoleucum</i> Benth.		•		
<i>S. paniculatum</i> Vogel	•			
<i>Senna latifolia</i> (G. Meyer) H.S. Irwin & Barneby			•	
<i>S. macranthera</i> DC. ex Colladon var.				
<i>pubibunda</i> (Mart. ex Benth.) H.S. Irwin & Barneby		•		•
<i>S. pendula</i> (Willd.) H.S. Irwin & Barneby	•			
<i>S. silvestris</i> (Vell.) H.S. Irwin & Barneby		•		
<i>S. trachypus</i> (Benth.) H.S. Irwin & Barneby		•		•
<i>Senna</i> sp.				
CARYOCARACEAE				
<i>Caryocar coriaceum</i> Wittm.				•
CECROPIACEAE				
<i>Cecropia cinerea</i> Miq.		•		
CELASTRACEAE				
<i>Maytenus</i> sp.				
CHRYSOBALANACEAE				
<i>Exellodendron gardneri</i> (Hook.f.) Prance				•
<i>Hirtella ciliata</i> Mart. & Zucc.			•	
<i>Hirtella</i> sp.				
<i>Licania</i> spp. (2 spp.)				
CLUSIACEAE				
<i>Clusia microphylla</i> Klotzsch ex Engl.			•	
<i>Kielmeyera</i> sp.				
<i>Platonia insignis</i> Mart.				•
<i>Vismia guianensis</i> (Aubl.) Choisy			•	•
<i>V. magnoliifolia</i> Cham. & Schldl.		•		
<i>Vismia</i> sp.				
COCHLOSPERMACEAE				
<i>Cochlospermum regium</i> (Schrank) Pilg.		•		•
COMBRETACEAE				
<i>Buchenavia grandis</i> Ducke			•	
<i>Combretum ellipticum</i> Kuhlmann				
<i>C. fruticosum</i> (Loefl.) Stuntz				
<i>C. leprosum</i> Mart.		•		•
<i>C. mellifluum</i> Eichler		•		•
<i>Terminalia fagifolia</i> Mart. & Zucc.		•	•	•
<i>Terminalia</i> sp.				
<i>Thiloa glaucocarpa</i> (Mart.) Eichler				•
CONNARACEAE				
<i>Connarus suberosus</i> Planch. var. <i>suberosus</i>		•		
<i>C. suberosus</i> var. <i>fulvus</i> (Planch.) Forero		•		
<i>Connarus</i> sp.				
DILLENACEAE				
<i>Curatella americana</i> L.		•		•
<i>Davilla cearensis</i> Huber				•
<i>D. aff. multiflora</i> A. St.-Hil.				
<i>Davilla</i> sp.				

TABLE 3. (Continued).

EBENACEAE

Diospyros brasiliensis Mart. •**D. coccolobaefolia** Mart. •**D. sericea** A.DC. •

ERYTHROXYLACEAE

Erythroxylum spp. (4 spp.)

EUPHORBIACEAE

Mabea fistulifera Mart. •**Mabea** sp.**Manihot coerulescens** Pohl •**M. pruinosa** Pohl •**Manihot** sp.**Maprounea** sp.

FABACEAE

Acosmium dasycarpum (Vogel) Yakovlev •**Andira laurifolia** Benth. •**A. surinamensis** (Boudt.) Splitz. ex Pulle •**A. vermifuga** (Mart.) Benth. •**Bowdichia virgilioides** Kunth •**Camptosema coriaceum** (Nees & Mart.) •

Benth.

Dalbergia miscolobium Benth. •**Deguelia nitidula** (Benth.) A.-Tozz. •**Dioclea glabra** Mart. ex Benth. •**D. reflexa** Hook.f. •**Eriosema aff. congestum** Benth. •**Eriosema** sp.**Harpalyce brasiliana** Benth. •**Lonchocarpus araripensis** Benth. •**Luetzelburgia auriculata** (Allemão) Ducke •**Machaerium acutifolium** Vogel •**M. opacum** Vogel •**Machaerium** sp.**Pterocarpus violaceus** Vogel •**Pterodon emarginatus** Vogel •**Vatairea macrocarpa** (Benth.) Ducke •**Vigna firmula** (Benth.) Maréchal, Mascherpa &

Stainier •

FLACOURTIACEAE

Casearia arborea (A. Rich.) Urb.**C. sylvestris** Sw. •**Lindackeria latifolia** Benth. •

ICACINACEAE

Emmotum nitens (Benth.) Miers •

HIPPOCRATEACEAE

Salacia micrantha (Mart.) Peyr. •**Salacia** spp. (3 spp.)

HUMIRIACEAE

Humiria balsamifera Aubl. •

TABLE 3. (Continued).

KRAMERIACEAE			
Krameria argentea Mart. ex Spreng.		•	
Krameria sp.			
LAURACEAE			
Ocotea sp.			
Unknown (1 sp.)			
LECYTHIDACEAE			
Lecythis sp.			
LOGANIACEAE			
Antonia ovata Pohl		•	
Mitreola sp.			
Strychnos mitscherlichii M.R. Schonb. var.			
amapensis Krukoff & Barneby			
LYTHRACEAE			
Diplusudon sp.			
Lafoensia replicata Pohl		•	
MALPIGHIACEAE			
Banisteriopsis calcicola B. Gates			
B. pubipetala (A. Juss.) Cuatrec.			
B. stellaris (Griseb.) B. Gates var. latifolia			
A. Juss.		•	
Banisteriopsis spp. (2 species)			
Byrsonima blanchetiana Miq.			•
B. crassifolia Kunth	•		•
B. sericea DC.		•	
B. vacciniifolia A. Juss.			•
Byrsonima spp. (2 spp.)			
Heteropterys sp.			
Tetrapteryx squarrosa Griseb.			
Tetrapteryx sp.			
MALVACEAE			
Hibiscus furcellatus Desr.			
MARCGRAVIACEAE			
Norantea sp.			
MELASTOMATACEAE			
Clidemia sp.			
Leandra sp.			
Miconia albicans (Swartz) Triana		•	
M. theaezans (Bonpl.) Cogn.		•	
Miconia sp.			
Mouriri acutiflora Naudin			•
M. pusa Gardner		•	
MENISPERMACEAE			
Cissampelos sp.			
MIMOSACEAE			
Calliandra abbreviata Benth.			•
C. parviflora Benth.			•
Chloroleucum foliolosum (Benth.)		•	
G.P. Lewis ¹			

TABLE 3. (Continued).

C. mangense (Jacq.) Britton & Rosè		•	•	
Enterolobium contortisiliquum (Vell.) Morong	•		•	•
E. schomburgkii (Benth.) Benth.				•
Enterolobium sp.				
Inga fagifolia (L.) Willd. ex Benth.	•		•	
I. scabriuscula Benth.			•	
Mimosa acutistipula Benth.			•	
M. caesalpiniifolia Benth.			•	
M. pithecolobioides Benth. ²		•		
M. aff. somnians Humb. & Bonpl. ex Willd.	•			
M. verrucosa Benth.			•	•
Mimosa sp.				
Parkia platycephala Benth.				•
Piptadenia moniliformis Pers.			•	
Plathymenia foliolosa Benth.				•
P. reticulata Benth.		•		
Stryphnodendron coriaceum Benth.				•
S. polyphyllum Mart.		•		
Stryphnodendron sp.				
MONIMIACEAE				
Siparuna sp.				
MORACEAE				
Brosimum guianensis (Aubl.) Huber				•
Brosimum spp. (2 spp.)				
Ficus gamelleira Kunth & Bouché ex Kunth		•		
Ficus sp.				
MYRISTICACEAE				
Viola sessilis (A.DC.) Warb.				•
V. surinamensis (Rol.) Warb.				•
MYRSINACEAE				
Cybianthus sp.				
MYRTACEAE				
Campomanesia lineatifolia Ruiz & Pav.			•	
Eugenia puniceifolia (Kunth) DC.		•		•
Eugenia spp. (2 spp.)				
Myrcia hayneana Berg		•		
M. obtusata (Schauer) Legrand				
M. polyantha DC.		•		
M. tomentosa (Aubl.) DC. var. alloiota		•		
(Berg) Legrand				
Myrciaria aff. maragnensis Berg				•
Psidium spp. (3 spp.)				
Unknown (1 sp.)				
NYCTAGINACEAE				
Guapira sp.				
OCHNACEAE				
Ouratea hexasperma (A. St.-Hil.) Baill.		•		
Ouratea sp.				

TABLE 3. (Continued).

OLACACEAE			
<i>Ximenia americana</i> L.	.	.	.
OPILIACEAE			
<i>Agonandra brasiliensis</i> Miers	.		
PASSIFLORACEAE			
<i>Passiflora foetida</i> L.		.	
<i>P. haematostigma</i> Mart.			
<i>P. kermesina</i> Link			
<i>Passiflora</i> sp.			
POLYGALACEAE			
<i>Bredemeyera floribunda</i> Willd.	.		
<i>Securidaca volubilis</i> L.			
RUBIACEAE			
<i>Alibertia concolor</i> (Cham.) Schum.	.		
<i>A. edulis</i> (L. Rich.) A. Rich.	.		
<i>A. obtusa</i> Schum.	.		
<i>A. sessilis</i> (Vell.) Schum.	.		
<i>Chomelia obtusa</i> Cham. & Schltld.			
<i>Genipa americana</i> L.	.		
<i>Guettarda angelica</i> Mart. ex Müll.Arg.		.	
<i>Palicourea</i> sp.			
<i>Psychotria</i> sp.			
<i>Thieleodoxa lanceolata</i> Cham.	.		
<i>Tocoyena formosa</i> (Cham. & Schltld.) Schum.			
ssp. <i>formosa</i>	.		
<i>T. formosa</i> ssp. <i>tomentosa</i> (Mart.) A.L. Prado		.	.
<i>Tocoyena</i> sp.			
SAPINDACEAE			
<i>Allophylus quercifolius</i> (Mart.) Radlk.		.	.
<i>Allophylus</i> sp.			
<i>Cupania revoluta</i> Radlk.		.	.
<i>Magonia pubescens</i> A. St.-Hil	.		.
<i>Serjania caracasana</i> (Jacq.) Willd.	.		
<i>S. marginata</i> Casar.	.		
Unknown (1 sp.)			
SAPOTACEAE			
<i>Manilkara</i> spp. (2 spp.)			
<i>Pouteria ramiflora</i> (Mart.) Radlk.	.	.	
SIMAROUBACEAE			
<i>Simaba warmingiana</i> Engl.	.		
<i>Simarouba versicolor</i> A. St.-Hil.	.	.	
SOLANACEAE			
<i>Solanum baturitense</i> Huber		.	.
<i>S. cordifolium</i> Dunal	.		
<i>S. macranthum</i> Dunal			
STERCULIACEAE			
<i>Helicteres sacarolha</i> A. St.-Hil.	.		
<i>Sterculia striata</i> A. St.-Hil. & Naudin	.	.	.
<i>Sterculia</i> sp.			

TABLE 3. (Continued).

STYRACACEAE			
Styrax sp.			
TILIACEAE			
Luehea paniculata Mart.	•		•
VERBENACEAE			
Aegiphila splendens Schauer	•		
Lippia salviifolia Cham.	•		
Vitex flavens Kunth		•	•
VOCHYSIACEAE			
Callisthene fasciculata Mart.	•	•	•
C. microphylla Warm.		•	•
Qualea grandiflora Mart.	•		
Q. parviflora Mart.	•		
Salvertia convallariodora A. St.-Hil.	•	•	
Vochysia gardneri Warm.			•
Vochysia sp.			
FAMILY UNKNOWN			
14 spp.			

¹ *Chloroleucon foliolosum* (Benth.) G.P. Lewis (= *Pithecellobium foliolosum* Benth.).

² *Mimosa pithecolobioides* Benth. (= *M. lasiophylla* Benth.).

Piauí. However, our research on the geographical distribution of species does not support the high degree of species endemism claimed by Rizzini (1976) and Heringer *et al.* (1977). Such claims must be considered against the background of extremely high floristic heterogeneity throughout the cerrado region: Castro (1994) found that about 40% of all woody species occurred at only a single locality out of the total of 145 which he compared. In fact, the number of probably endemic woody species in the Piauían cerrados is no greater than that found by Castro (1994) in other areas of the Brazilian cerrados. This, together with the high proportion of species with wide geographic distribution, suggests that the Piauían cerrados were not isolated from other cerrado areas for any long period during evolution.

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