

# Magnoliophyta, *restinga* vegetation, state of Ceará, Brazil

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**ABSTRACT:** Sandy coastal plain (*Restinga*) vegetation is composed of the plant communities that grow on Quaternary Neosols along the entire Brazilian coast. Ceará state has a coastal extension of 578 km and lies totally within the semi-arid zone of northeastern Brazil. Here we present a checklist of the phanerogamic species found along the coast of Ceará that was compiled from surveys and collections found at the EAC herbarium (Fortaleza, Ceará). A total of 391 species distributed among 208 genera and 41 families were identified. The families with the greatest numbers of species were Fabaceae sensu lato (130 species), Cyperaceae (51), Poaceae (47), Rubiaceae (27), Euphorbiaceae (19), Asteraceae (13), Bignoniaceae (11) and Malvaceae (12), representing over 78.77% of the species collected.

## INTRODUCTION

*Restinga* vegetation is composed of the communities of plants that grow on Quaternary Neosols (Suguio and Tessler 1984; Rizzini 1997; Marques *et al.* 2004). *Restingas* can have different physiognomies that vary from grasslands to shrublands or forests (Silva and Brites 2005), and they occur along the entire Brazilian coast (Oliveira-Filho 1993).

The coastal band of northeastern Brazil can be divided in two sectors: an eastern super-humid region comprising the coastal areas of the states of Bahia, Sergipe, Alagoas, Pernambuco, Paraíba and Rio Grande do Norte; and a northern semi-arid region comprising coastal areas of the states of Rio Grande do Norte, Ceará, Piauí and Maranhão (Suguio and Tessler 1984; Villwock *et al.* 2005).

Among the northeastern states, more floristic and structural studies of *restinga* ecosystems have been undertaken in Pernambuco, Bahia and Piauí, with only scattered information being available for the other states.

Ceará state has 578 km of coastline that is predominantly composed of sea cliffs of the Barreiras Formation and quaternary quartz sand deposits. *Restinga* vegetation occupying dunes and inter-dune regions can be found along the entire coast of this state.

Despite this extensive coastline, only one scientific paper (Matias and Nunes 2001) and one technical report (Matias and Silva 2001) have been published with data referring to *restinga* vegetation in Ceará. In an effort to fill this gap, we present here a checklist of the phanerogamic species registered in *restinga* areas of Ceará state, Brazil.

## MATERIALS AND METHODS

Ceará state has a total territorial area of 148,825 km<sup>2</sup>, making it the fourth largest state in northeastern Brazil (Figure 1). The coast of Ceará is 573 km long, representing 17.3% of the coast of northeastern and 7.8% of the Brazilian coast. The vegetation cover is predominantly *Caatinga*, which occurs in the “Depressão Sertaneja Setentrional”

region, according to the classification proposed by Velloso *et al.* (2002). The coast of Ceará state is marked by the predominance of psammophilous vegetation (covering dunes). Cliffs are found in some regions (“Barreiras” Formation)

The species listed in this study were compiled from data available in the Prisco Bezerra Herbarium (EAC) collection at the Universidade Federal do Ceará (UFC) and from floristic surveys carried out in the Jericoacoara Environmental Protection Area (Matias and Nunes 2001; Matias and Silva 2001). All herbarium specimens were considered, including invasive species that grow in lacustrine environments and species typical of areas in contact with mangrove swamps; exotic species or those with doubtful identifications were excluded. A recent study indicated a Complexo Litorâneo phytoecological unit with the highest percentage of species collected, considering all of the EAC herbarium collection (24% species and 24% *exsiccatae*) (Freitas and Matias 2010).

The herbarium material comprises collections made in 21 coastal municipalities in Ceará state, all located on coastal plains with predominantly Quaternary Neosols.

The checklist places the genera in the family, followed by a species list. The classification system used was based on APG II (2003). Current species names and new synonyms were confirmed by consulting the MOBOT data base (2009) as well as the specialized literature for certain groups. The life forms of the species were identified based on the classification system of Whittaker (1975); information on the life forms was obtained from herbarium labels.

## RESULTS AND DISCUSSION

All of the herbarium samples collected along the coast of Ceara state were examined. The final list of phanerogamic species reported for *restinga* areas in Ceará state totaled 391 species, distributed among 208 genera and 41 families (Table 1). The families with the greatest numbers of species

were: Fabaceae *sensu lato* (130), Cyperaceae (51), Poaceae (47), Rubiaceae (27), Euphorbiaceae (19), Asteraceae (13), Bignoniaceae (11) and Malvaceae (10), which correspond to 78.77% of the total number of species; 41.46% of the families had only one species.

Fabaceae, Poaceae, Cyperaceae, Rubiaceae and Euphorbiaceae are the families most cited in floristic surveys in Brazilian *restingas* (Rambo, 1954; Pereira and Araújo, 2000; Kersten and Silva, 2005). A checklist prepared by Zickel *et al.* (2007) for Pernambuco state likewise noted high frequencies for the families Fabaceae (67 spp.), Poaceae (39 spp.), Cyperaceae (26 spp.) and Euphorbiaceae (25 spp.). In a recent floristic survey carried out in Piauí state that included part of the upper northeastern coast (F. S. Santos-Filho personal communication), the families Fabaceae, Poaceae, Cyperaceae and Euphorbiaceae were likewise found to have the highest number of species. These same families, together with the Orchidaceae, Bromeliaceae and Sapotaceae (Araújo and Henriques 1984; Assis *et al.* 2004; Martins *et al.* 2008) are well represented in restinga areas in southeastern Brazil.

The most representative genera in the present survey were *Cyperus* (14 spp.), *Eleocharis* (12), *Mimosa* (10), *Chamaecrista* (10), *Aeschynomene* (8), *Paspalum* (7), *Croton* (7), *Rhynchospora* (6), *Senna* (6), *Sida* (6), *Caesalpinia* (5), *Centrosema* (5) and *Fimbristylis* (5), representing 25.83% of all of the species recorded. In spite of the fact that these genera occur in many other areas of restinga, specific localities tend to have their own flora due to environmental

factors that influence species composition (Barros 2009).

The species *Ipomoea asarifolia* (Desr.) Roem. and Schult., *Remirea maritima* Aubl., *Richardia grandiflora* (Cham. and Schltld.) Steud., *Heliotropium lanceolatum* Ruiz and Pav., *Blutaparon portulacoides* (A. St.-Hil.) Mears, *Sesuvium portulacastrum* (L.) L., and *Mollugo verticillata* L. (in addition to many members of the Fabaceae, Poaceae and Cyperaceae families) are among the most common plants in the dune areas and along the coast of Ceará state (Matias and Nunes 2001). Species of the families Poaceae and Cyperaceae produce large numbers of seeds and have great capacities for adapting to and resisting adverse environments (Bove *et al.* 2003). The species composition observed reflects not only of the peculiarities of the restinga ecosystem (e.g., high salinity, low levels of soil nutrients) but also habitat degradation.

In comparisons made with other *restingas* in northeastern Brazil (Cabral-Freire and Monteiro 1994 - Maranhão; F.S. Santos-Filho personal communication - Piauí; Freire 1990; Almeida Jr. *et al.* 2006; Almeida Jr. and Zickel 2009 - Rio Grande do Norte; Carvalho and Oliveira-Filho 1993; Oliveira-Filho and Carvalho 1993; Pontes and Barbosa 2008 - Paraíba; Andrade-Lima 1951; 1960; 1979; J.R.R. Cantarelli personal communication; Leite and Andrade 2004; Sacramento *et al.* 2007; Zickel *et al.* 2007; Silva *et al.* 2008; Almeida Jr. *et al.* 2009 - Pernambuco; Esteves 1980 - Alagoas; and Pinto *et al.* 1984; Viana *et al.* 2006 - Bahia), 91% of the species listed for Ceará were also reported in other coastal areas of northeastern

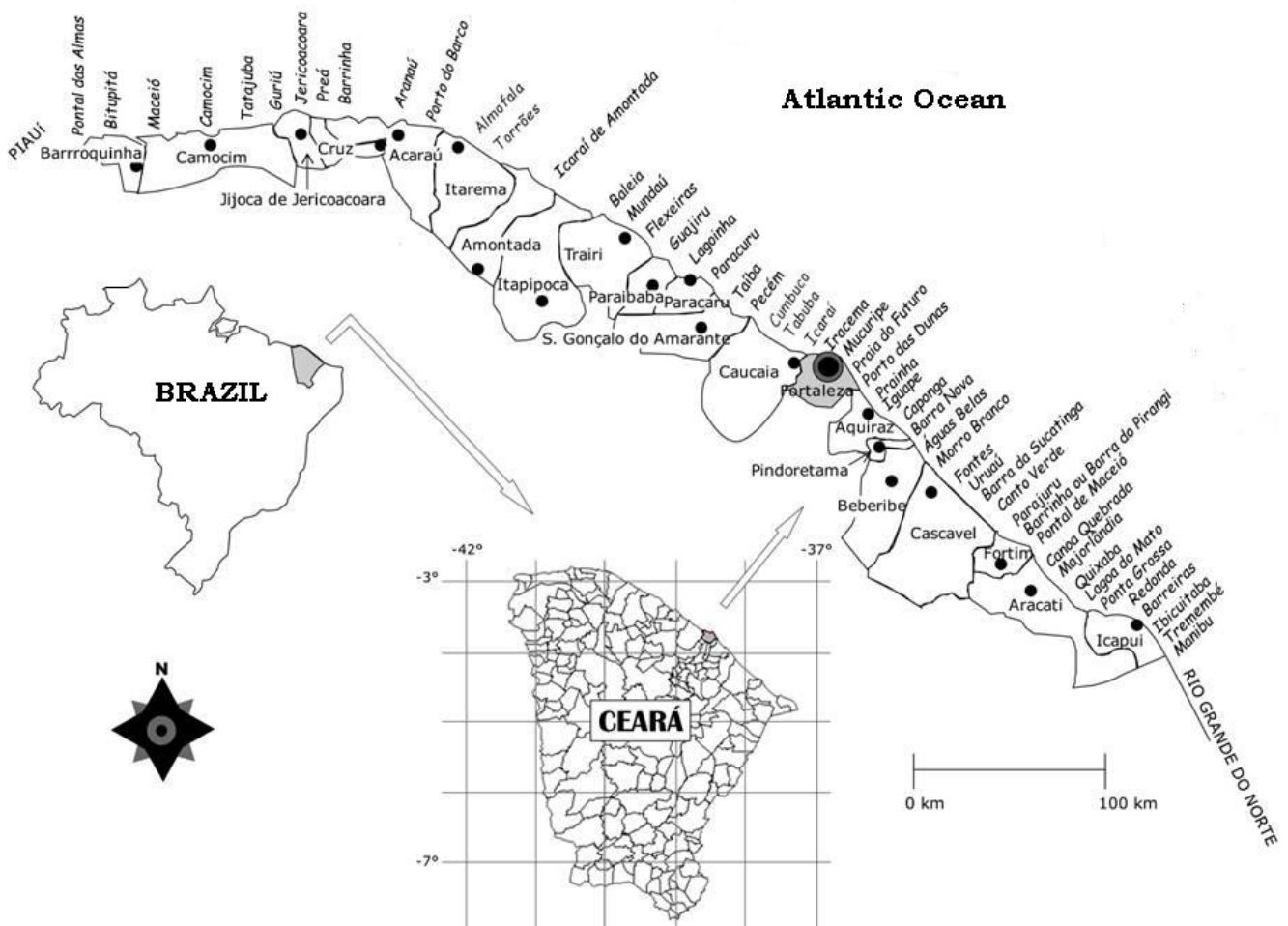
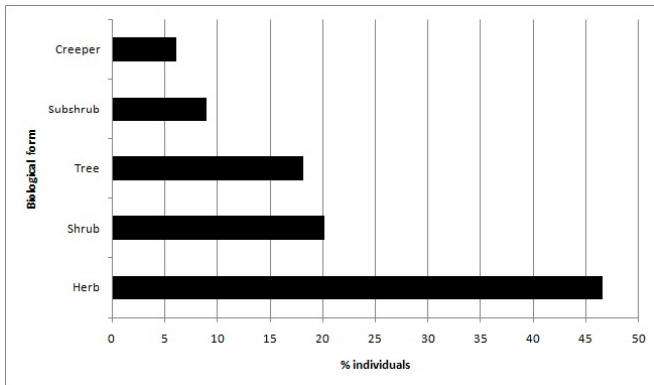


FIGURE 1. Map of the coast of the state of Ceará.

Brazil; the remaining 9% were recorded only in *restingas* in Ceará (including *Cryptostegia grandiflora* Roxb. ex R.Br., *Amaranthus viridis* L., *Pycnus macrostachyos* (Lam.) J. Raynal, *Sapium glandulatum* (L.) Morong, *Tanacetum vulgare* L. and *Tetracera willdenoviana* Steud.) (Table 1).

Our survey indicates that 46.54% of the species recorded for the coastal areas of Ceará state are herbaceous plants (Figure 2). This reflects the significant presence of pioneer species that rapidly colonize this environment (mainly dune areas typical of the Ceará coast), with low, open physiognomies of erect herbaceous species and creeping-psammophytes. The herbaceous species recorded in the present study can be found in frontal dunes or fixed dune



**FIGURE 2.** Frequency distribution of individuals in relation to life form of the species from coastal areas of Ceará state, Brazil.



**FIGURE 3.** Flowers and fruits of species from the restingas of Ceará state, Brazil. A - *Matelea maritima* subsp. *ganglinosa* (Vell.) Fontella; B - *Ipomoea asarifolia* (Desr.) Roem. and Schult.; C - *Cnidocolus urens* (L.) Arthur; D - *Bowdichia virgilioides* Kunth; E - *Copaifera luetzelburgii* Harms; F - *Mimosa somnians* Humb. and Bonpl. ex Willd.; G - *Stylosanthes viscosa* (L.) Sw.; H - *Stigmaphyllon paralias* A. Juss.; I - *Ximenia americana* L.; J - *Passiflora foetida* L.; K - *Coutarea hexandra* (Jacq.) K. Schum.; L - *Lantana camara* L.

zones along most of the Brazilian coast (Pinto *et al.*, 1984; Cordazzo and Costa, 1989).

Matias and Nunes (2001) reported that woody *restinga* species occur in open or closed islands of vegetation, with a marked presence of *Chrysobalanus icaco* L., *Abrus precatorius* L., *Anacardium occidentale* L., *Byrsonima crassifolia* Kunth and *Cereus jamacaru* A. DC. The authors also noted that these woody species represent a mixture of *cerrado* and *caatinga* plants.

In general, many species observed along in this region of northeastern coast (northern coast of northeastern Brazil) are also present in the *cerrado* and *caatinga* biomes. Santos-Filho (personal communication) analyzed the restinga flora of Piauí state and, in spite of its floristic similarity with *cerrado* and *caatinga*, a significant presence of Atlantic Forest species was also noted.

The data presented here indicate the importance of herbaceous species in the physiognomic composition of beach areas. However, it is quite possible that due to their immediate proximity to the ocean the restinga areas of Ceará state have been widely altered due to human utilization for leisure and tourism. As such, conservation efforts focusing on coastal plant communities must include quantitative studies and attempt to decelerate anthropogenic impacts.

**TABLE 1.** List of phanerogamic species of restinga areas of the state of Ceará.

FAMILIES / SPECIES	HABIT
<b>Acanthaceae</b>	
<i>Avicennia germinans</i> (L.) L.	Tree
<i>Avicennia schaueriana</i> Stapf and Leechm. ex Moldenke	Tree
<b>Aizoaceae</b>	
<i>Sesuvium portulacastrum</i> (L.) L.	Herb
<b>Amaranthaceae</b>	
<i>Alternanthera brasiliana</i> (L.) Kuntze	Herb
<i>Alternanthera littoralis</i> P. Beauv.	Herb
<i>Alternanthera littoralis</i> var. <i>maritima</i> (Mart.) Pedersen	Herb
<i>Amaranthus viridis</i> L.	Herb
<i>Blutaparon portulacoides</i> (A.St.-Hil.) Mears	Herb
<i>Froelichia humboldtiana</i> (Roem. and Schult.) Seub.	Herb
<i>Gomphrena demissa</i> Mart.	Herb
<b>Anacardiaceae</b>	
<i>Anacardium occidentale</i> L.	Tree
<b>Apocynaceae</b>	
<i>Allamanda blanchetii</i> A. DC.	Shrub
<i>Aspidosperma pyriforme</i> Mart.	Shrub
<i>Calotropis procera</i> (Aiton) W.T. Aiton	Shrub
<i>Cryptostegia grandiflora</i> Roxb. ex R. Br.	Shrub
<i>Hancornia speciosa</i> Gomes	Tree
<i>Himatanthus drasticus</i> (Mart.) Plumel	Tree
<i>Matelea maritima</i> subsp. <i>ganglinosa</i> (Vell.) Fontella (Figure 3A)	Creeper
<i>Tabernaemontana catharinensis</i> A.DC.	Subshrub
<b>Araceae</b>	
<i>Montrichardia linifera</i> (Arruda) Schott	Shrub
<i>Philodendron imbe</i> Schott ex Endl.	Shrub
<b>Arecaceae</b>	
<i>Copernicia prunifera</i> (Mill.) H.E. Moore	Tree
<b>Asteraceae</b>	
<i>Acmella oleracea</i> (L.) R.K. Jansen	Herb
<i>Centratherum punctatum</i> Cass.	Herb

TABLE 1. CONTINUED.

FAMILIES / SPECIES	HABIT
<i>Delilia biflora</i> (L.) Kuntze	Herb
<i>Eclipta alba</i> (L.) Hassk.	Herb
<i>Egletes viscosa</i> (L.) Less.	Herb
<i>Elephantopus hirtiflorus</i> DC.	Herb
<i>Elephantopus mollis</i> Kunth	Herb
<i>Mikania micrantha</i> Kunth	Creeper
<i>Stilpnopappus trichospiroides</i> Mart. ex DC.	Herb
<i>Tanacetum vulgare</i> L.	Herb
<i>Tilesia baccata</i> (L.f.) Pruski	Herb
<i>Vernonia chalybaea</i> Mart. ex DC.	Subshrub
<i>Wedelia scaberrima</i> Benth.	Herb
<b>Bataceae</b>	
<i>Batis maritima</i> L.	Subshrub
<b>Bignoniaceae</b>	
<i>Adenocalymma pedunculatum</i> (Vell.) L. Lohmann	Herb
<i>Cuspidaria argentea</i> (Wawra) Sandwith	Creeper
<i>Fridericia dispar</i> (Bureau ex K. Schum.) L. Lohmann	Creeper
<i>Fridericia platyphylla</i> (Cham.) L.G. Lohmann	Creeper
<i>Fridericia subverticillata</i> (Bureau and K. Schum.) L.G. Lohmann	Creeper
<i>Handroanthus impetiginosus</i> Mattos	Tree
<i>Jacaranda brasiliiana</i> (Lam.) Pers.	Tree
<i>Jacaranda cuspidifolia</i> Mart.	Tree
<i>Lundia cordata</i> (Vell.) A. DC.	Creeper
<i>Neojoberbia candolleana</i> (Mart. ex DC.) Bureau and K.Schum.	Creeper
<i>Tabebuia roseoalba</i> (Ridl.) Sandwith	Tree
<b>Boraginaceae</b>	
<i>Cordia oncocalyx</i> Allemão	Tree
<i>Cordia rufescens</i> A. DC.	Tree
<i>Heliotropium polyphyllum</i> Lehm.	Subshrub
<i>Varronia leucomalloides</i> (Taroda) J.S. Mill.	Tree
<i>Varronia polycephala</i> Lam.	Shrub
<b>Cactaceae</b>	
<i>Cereus jamacaru</i> DC.	Shrub
<b>Capparaceae</b>	
<i>Capparis flexuosa</i> (L.) L.	Shrub
<b>Chrysobalanaceae</b>	
<i>Chrysobalanus icaco</i> L.	Shrub
<i>Hirtella ciliata</i> Mart. and Zucc.	Shrub
<i>Hirtella racemosa</i> Lam.	Shrub
<b>Combretaceae</b>	
<i>Conocarpus erectus</i> L.	Shrub
<b>Commelinaceae</b>	
<i>Commelina diffusa</i> Burm.f.	Herb
<b>Convolvulaceae</b>	
<i>Cuscuta racemosa</i> Mart.	Herb
<i>Evolvulus ovatus</i> Fernald	Herb
<i>Ipomoea asarifolia</i> (Desr.) Roem. and Schult. (Figure 3B)	Creeper
<i>Ipomoea carnea</i> Jacq.	Shrub
<i>Ipomoea pes-caprae</i> (L.) R. Br.	Creeper
<i>Jacquemontia sphaerostigma</i> (Cav.) Rusby	Herb
<i>Merremia aegyptia</i> (L.) Urb.	Herb
<b>Cyperaceae</b>	
<i>Bulbostylis capillaris</i> (L.) C.B. Clarke	Herb
<i>Bulbostylis hirta</i> (Thunb.) Svenson	Herb
<i>Bulbostylis junciformis</i> (Kunth) C.B. Clarke	Herb
<i>Bulbostylis juncooides</i> (Vahl) Kük.	Herb
<i>Cyperus aggregatus</i> (Willd.) Endl.	Herb
<i>Cyperus amabilis</i> Vahl	Herb

TABLE 1. CONTINUED.

FAMILIES / SPECIES	HABIT
<i>Cyperus articulatus</i> L.	Herb
<i>Cyperus compressus</i> L.	Herb
<i>Cyperus distans</i> L.	Herb
<i>Cyperus entrerianus</i> Boeckeler	Herb
<i>Cyperus hermaphroditus</i> (Jacq.) Standl.	Herb
<i>Cyperus iria</i> L.	Herb
<i>Cyperus laxus</i> Lam.	Herb
<i>Cyperus ligularis</i> L.	Herb
<i>Cyperus maritimus</i> Poir.	Herb
<i>Cyperus odoratus</i> L.	Herb
<i>Cyperus sphacelatus</i> Rottb.	Herb
<i>Cyperus surinamensis</i> Rottb.	Herb
<i>Eleocharis acutangula</i> (Roxb.) Schult.	Herb
<i>Eleocharis atropurpurea</i> (Retz.) J. Presl and C. Presl	Herb
<i>Eleocharis barrosii</i> Svenson	Herb
<i>Eleocharis flavescens</i> (Poir.) Urb.	Herb
<i>Eleocharis geniculata</i> (L.) Roem. and Schult.	Herb
<i>Eleocharis interstincta</i> (Vahl) Roem. and Schult.	Herb
<i>Eleocharis maculosa</i> (Vahl) Roem. and Schult.	Herb
<i>Eleocharis minima</i> Kunth	Herb
<i>Eleocharis montana</i> (Kunth) Roem. and Schult.	Herb
<i>Eleocharis mutata</i> (L.) Roem. and Schult.	Herb
<i>Eleocharis plicarhachis</i> (Griseb.) Svenson	Herb
<i>Eleocharis sellowiana</i> Kunth	Herb
<i>Fimbristylis complanata</i> (Retz.) Link	Herb
<i>Fimbristylis cymosa</i> (Lam.) R. Br.	Herb
<i>Fimbristylis dichotoma</i> (L.) Vahl	Herb
<i>Fimbristylis spadicea</i> (L.) Vahl	Herb
<i>Fimbristylis vahlii</i> (Lam.) Link	Herb
<i>Fuirena umbellata</i> Rottb.	Herb
<i>Kyllinga brevifolia</i> Rottb.	Herb
<i>Kyllinga odorata</i> Vahl	Herb
<i>Kyllinga squamulata</i> Thonn. ex Vahl	Herb
<i>Kyllinga vaginata</i> Lam.	Herb
<i>Pycreus fugax</i> (Liebm.) C.D. Adams	Herb
<i>Pycreus macrostachyos</i> (Lam.) J.Raynal	Herb
<i>Pycreus polystachyos</i> (Rottb.) P.Beauv.	Herb
<i>Remirea maritima</i> Aubl.	Herb
<i>Rhynchospora barbata</i> (Vahl) Kunth	Herb
<i>Rhynchospora caracasana</i> (Kunth) Boeckeler	Herb
<i>Rhynchospora contracta</i> (Nees) J.Raynal	Herb
<i>Rhynchospora emaciata</i> (Nees) Boeckeler	Herb
<i>Rhynchospora holoschoenoides</i> (Rich.) Herter	Herb
<i>Rhynchospora riparia</i> (Nees) Boeckeler	Herb
<i>Scleria latifolia</i> Sw.	Herb
<b>Dilleniaceae</b>	
<i>Curatella americana</i> L.	Tree
<i>Tetracera breyniana</i> Schlttdl.	Shrub
<i>Tetracera willdenowiana</i> Steud.	Shrub
<b>Euphorbiaceae</b>	
<i>Acalypha villosa</i> Jacq.	Herb
<i>Astraea lobata</i> (L.) Klotzsch	Subshrub
<i>Chamaesyce chamaecaula</i> (Weath.) Millsp.	Herb
<i>Cnidoscolus urens</i> (L.) Arthur (Figure 3C)	Shrub
<i>Croton anisodontus</i> Müll. Arg.	Shrub
<i>Croton glandulosus</i> L.	Subshrub
<i>Croton heliotropiifolius</i> Kunth	Shrub
<i>Croton jacobinensis</i> Baill.	Shrub
<i>Croton nepetifolius</i> Baill.	Shrub
<i>Croton pedicellatus</i> Kunth	Subshrub

TABLE 1. CONTINUED.

FAMILIES / SPECIES	HABIT
<i>Croton sonderianus</i> Müll. Arg.	Shrub
<i>Dalechampia pernambucensis</i> Baill.	Creeper
<i>Dalechampia scandens</i> L.	Herb
<i>Euphorbia heterophylla</i> L.	Herb
<i>Euphorbia hyssopifolia</i> L.	Herb
<i>Euphorbia prostrata</i> Aiton	Herb
<i>Microstachys corniculata</i> (Vahl) Griseb.	Herb
<i>Sapium glandulosum</i> (L.) Morong	Tree
<i>Sebastiania brasiliensis</i> Spreng.	Herb
<b>Fabaceae</b>	
<i>Abrus precatorius</i> L.	Creeper
<i>Aeschynomene brevipes</i> Benth.	Subshrub
<i>Aeschynomene evenia</i> C. Wright ex Sauvalle	Subshrub
<i>Aeschynomene filosa</i> Mart.	Shrub
<i>Aeschynomene histrix</i> Poir.	Herb
<i>Aeschynomene marginata</i> Benth.	Herb
<i>Aeschynomene rudis</i> Benth.	Subshrub
<i>Aeschynomene sensitiva</i> Sw.	Shrub
<i>Aeschynomene viscidula</i> Michx.	Subshrub
<i>Albizia inundata</i> (Mart.) Barneby and J.W.Grimes	Tree
<i>Amburana cearensis</i> (Allemão) A.C.Sm.	Tree
<i>Anadenanthera colubrina</i> (Vell.) Brenan	Tree
<i>Andira humilis</i> Mart. ex Benth.	Tree
<i>Andira surinamensis</i> (Bondt) Splitg. ex Amshoff	Tree
<i>Apuleia leiocarpa</i> (Vogel) J.F.Macbr.	Tree
<i>Bauhinia dubia</i> G. Don	Shrub
<i>Bauhinia pentandra</i> (Bong.) Vogel ex Steud.	Shrub
<i>Bauhinia unguolata</i> L.	Shrub
<i>Bowdichia virgilioides</i> Kunth (Figure 3D)	Tree
<i>Caesalpinia bracteosa</i> Tul.	Tree
<i>Caesalpinia echinata</i> Lam.	Tree
<i>Caesalpinia ferrea</i> Mart.	Tree
<i>Caesalpinia pulcherrima</i> (L.) Sw.	Shrub
<i>Caesalpinia pyramidalis</i> Tul.	Shrub
<i>Calliandra depauperata</i> Benth.	Subshrub
<i>Calliandra sessilis</i> Benth.	Tree
<i>Calliandra spinosa</i> Ducke	Shrub
<i>Calopogonium caeruleum</i> (Benth.) C. Wright	Tree
<i>Calopogonium mucunoides</i> Desv.	Creeper
<i>Canavalia brasiliensis</i> Mart. ex Benth.	Herb
<i>Canavalia rosea</i> (Sw.) DC.	Herb
<i>Cassia grandis</i> L. f.	Tree
<i>Centrosema brasilianum</i> (L.) Benth.	Creeper
<i>Centrosema pascuorum</i> Mart. ex Benth.	Herb
<i>Centrosema rotundifolium</i> Mart. ex Benth.	Creeper
<i>Centrosema sagittatum</i> (Humb. and Bonpl. ex Willd.) Brandegee	Herb
<i>Centrosema virginianum</i> (L.) Benth.	Creeper
<i>Chamaecrista calycioides</i> (DC. ex Collad.) Greene	Herb
<i>Chamaecrista desvauxii</i> (Collad.) Killip	Herb
<i>Chamaecrista diphylla</i> (L.) Greene	Subshrub
<i>Chamaecrista ensiformis</i> (Vell.) H.S. Irwin and Barneby	Tree
<i>Chamaecrista flexuosa</i> (L.) Greene	Subshrub
<i>Chamaecrista hispida</i> (Vahl) H.S. Irwin and Barneby	Herb
<i>Chamaecrista ramosa</i> (Vogel) H.S. Irwin and Barneby	Herb
<i>Chamaecrista rotundifolia</i> (Pers.) Greene	Subshrub
<i>Chamaecrista supplex</i> (Mart. ex Benth.) Britton and Rose ex Britton and Killip	Herb

TABLE 1. CONTINUED.

FAMILIES / SPECIES	HABIT
<i>Chamaecrista trichopoda</i> (Benth.) Britton and Rose ex Britton and Killip	Herb
<i>Chloroleucon acacioides</i> (Ducke) Barneby and J.W. Grimes	Tree
<i>Clitoria fairchildiana</i> R.A. Howard	Tree
<i>Clitoria laurifolia</i> Poir.	Shrub
<i>Copaifera arenicola</i> (Ducke) J.Costa and L.P. Queiroz	Tree
<i>Copaifera luetzelburgii</i> Harms (Figure 3E)	Shrub
<i>Cratylia argentea</i> (Desv.) Kuntze	Shrub
<i>Crotalaria incana</i> L.	Herb
<i>Crotalaria pallida</i> Aiton	Herb
<i>Crotalaria retusa</i> L.	Shrub
<i>Crotalaria stipularia</i> Desv.	Herb
<i>Dalbergia cearensis</i> Ducke	Shrub
<i>Dalbergia ecastaphyllum</i> (L.) Taub.	Shrub
<i>Dalbergia frutescens</i> (Vell.) Britton	Tree
<i>Desmodium barbatum</i> (L.) Benth.	Herb
<i>Desmodium triflorum</i> (L.) DC.	Herb
<i>Dioclea lasiophylla</i> Mart. ex Benth.	Subshrub
<i>Dioclea sclerocarpa</i> Ducke	Creeper
<i>Dioclea violacea</i> Mart. ex Benth.	Shrub
<i>Enterolobium contortisiliquum</i> (Vell.) Morong	Tree
<i>Galactia striata</i> (Jacq.) Urb.	Creeper
<i>Geoffroea spinosa</i> Jacq.	Tree
<i>Guilandina bonduc</i> L.	Shrub
<i>Hymenaea courbaril</i> L.	Tree
<i>Hymenaea martiana</i> Hayne	Shrub
<i>Indigofera hirsuta</i> L.	Shrub
<i>Indigofera microcarpa</i> Desv.	Subshrub
<i>Indigofera suffruticosa</i> Mill.	Shrub
<i>Inga ingoides</i> (Rich.) Willd.	Tree
<i>Inga vera</i> Willd.	Tree
<i>Leptolobium dasycarpum</i> Vogel	Tree
<i>Leptolobium parvifolium</i> (Harms) Sch.Rodr. and A.M.G. Azevedo	Tree
<i>Lonchocarpus araripensis</i> Benth.	Tree
<i>Luetzelburgia auriculata</i> (Allemão) Ducke	Tree
<i>Macroptilium lathyroides</i> (L.) Urb.	Subshrub
<i>Macroptilium panduratum</i> (Mart. ex Benth.) Maréchal and Baudet	Herb
<i>Mimosa acutistipula</i> (Mart.) Benth.	Tree
<i>Mimosa arenosa</i> (Willd.) Poir.	Tree
<i>Mimosa caesalpinifolia</i> Benth.	Shrub
<i>Mimosa camporum</i> Benth.	Shrub
<i>Mimosa hirsutissima</i> Mart.	Shrub
<i>Mimosa misera</i> Benth.	Subshrub
<i>Mimosa paraibana</i> Barneby	Shrub
<i>Mimosa pigra</i> L.	Shrub
<i>Mimosa somnians</i> Humb. and Bonpl. ex Willd. (Figure 3F)	Subshrub
<i>Mimosa tenuiflora</i> (Willd.) Poir.	Shrub
<i>Mucuna sloanei</i> Fawc. and Rendle	Herb
<i>Neptunia oleracea</i> Lour.	Subshrub
<i>Neptunia plena</i> (L.) Benth.	Subshrub
<i>Parkinsonia aculeata</i> L.	Tree
<i>Piptadenia stipulacea</i> (Benth.) Ducke	Shrub
<i>Piptadenia viridiflora</i> (Kunth) Benth.	Shrub
<i>Pithecellobium diversifolium</i> Benth.	Shrub
<i>Pithecellobium dulce</i> (Roxb.) Benth.	Tree
<i>Pityrocarpa moniliformis</i> (Benth.) Luckow and R.W. Jobson	Shrub

TABLE 1. CONTINUED.

FAMILIES / SPECIES	HABIT
<i>Plathymenia reticulata</i> Benth.	Tree
<i>Platymiscium floribundum</i> Vogel	Tree
<i>Poeppigia procera</i> C. Presl	Tree
<i>Pterogyne nitens</i> Tul.	Tree
<i>Rhynchosia phaseoloides</i> (Sw.) DC.	Creeper
<i>Senegalia polyphylla</i> (DC.) Britton and Rose	Tree
<i>Senna alata</i> (L.) Roxb.	Shrub
<i>Senna macranthera</i> (DC. ex Collad.) H.S. Irwin and Barneby	Tree
<i>Senna obtusifolia</i> (L.) H.S. Irwin and Barneby	Herb
<i>Senna occidentalis</i> (L.) Link	Herb
<i>Senna rizzinii</i> H.S. Irwin and Barneby	Tree
<i>Senna splendida</i> (Vogel) H.S. Irwin and Barneby	Shrub
<i>Sesbania exasperata</i> Kunth	Shrub
<i>Sophora tomentosa</i> L.	Shrub
<i>Stryphnodendron coriaceum</i> Benth.	Tree
<i>Stylosanthes angustifolia</i> Vogel	Subshrub
<i>Stylosanthes capitata</i> Vogel	Subshrub
<i>Stylosanthes scabra</i> Vogel	Subshrub
<i>Stylosanthes viscosa</i> (L.) Sw. (Figure 3G)	Subshrub
<i>Tephrosia cinerea</i> (L.) Pers.	Subshrub
<i>Tephrosia egregia</i> Sandwith	Shrub
<i>Trischidium molle</i> (Benth.) H.E. Ireland	Shrub
<i>Vachellia farnesiana</i> (L.) Wight an Arn.	Shrub
<i>Vatairea macrocarpa</i> (Benth.) Ducke	Tree
<i>Vigna peduncularis</i> (Kunth) Fawc. and Rendle	Creeper
<i>Zapoteca portoricensis</i> Jacq.	Subshrub
<i>Zornia cearensis</i> Huber	Herb
<i>Zornia latifolia</i> Sm.	Herb
<i>Zornia orbiculata</i> Mohlenbr.	Herb
<b>Lamiaceae</b>	
<i>Aegiphila verticillata</i> Vell.	Shrub
<i>Marsypianthes chamaedrys</i> (Vahl) Kuntze	Herb
<i>Vitex flavens</i> Kunth	Tree
<b>Lythraceae</b>	
<i>Cuphea campestris</i> Koehne	Herb
<b>Malpighiaceae</b>	
<i>Byrsonima crassifolia</i> (L.) Kunth	Shrub
<i>Byrsonima gardneriana</i> A. Juss.	Tree
<i>Byrsonima sericea</i> DC.	Tree
<i>Byrsonima verbascifolia</i> (L.) DC.	Shrub
<i>Stigmaphyllon bannisterioides</i> (L.) C.E. Anderson	Herb
<i>Stigmaphyllon paralias</i> A. Juss. (Figure 3H)	Subshrub
<b>Malvaceae</b>	
<i>Luehea candicans</i> Mart. and Zucc.	Tree
<i>Pavonia cancellata</i> (L.) Cav.	Herb
<i>Pavonia varians</i> Moric.	Herb
<i>Peltaea trinervis</i> (C. Presl) Krapov.Cristóbal.	Subshrub
<i>Sida angustissima</i> Miq.	Herb
<i>Sida ciliaris</i> L.	Herb
<i>Sida galheirensis</i> Ulbr.	Herb
<i>Sida glomerata</i> Cav.	Herb
<i>Sida rhombifolia</i> L.	Subshrub
<i>Sida tuberculata</i> R.E.Fr.	Herb
<b>Melastomataceae</b>	
<i>Mouriri cearensis</i> Huber	Tree
<i>Mouriri guianensis</i> Aubl.	Tree
<b>Molluginaceae</b>	
<i>Mollugo verticillata</i> L.	Herb
<b>Moraceae</b>	

TABLE 1. CONTINUED.

FAMILIES / SPECIES	HABIT
<i>Maclura tinctoria</i> (L.) D. Don ex Steud.	Tree
<b>Myrtaceae</b>	
<i>Eugenia luschnathiana</i> (O. Berg) Klotzsch ex. B. D. Jacks.	Shrub
<i>Eugenia tapacumensis</i> O. Berg	Shrub
<i>Myrcia guianensis</i> (Aubl.) DC.	Shrub
<i>Myrcia multiflora</i> (Lam.) DC.	Tree
<i>Psidium guyanense</i> Pers.	Shrub
<b>Olacaceae</b>	
<i>Ximena americana</i> L. (Figure 3I)	Shrub
<b>Passifloraceae</b>	
<i>Passiflora cincinnata</i> Mast.	Creeper
<i>Passiflora foetida</i> L. (Figure 3J)	Creeper
<i>Passiflora subrotunda</i> Mast.	Creeper
<b>Phyllanthaceae</b>	
<i>Phyllanthus tenellus</i> Roxb.	Herb
<b>Poaceae</b>	
<i>Andropogon bicornis</i> L.	Herb
<i>Andropogon fastigiatus</i> Sw.	Herb
<i>Andropogon leucostachyus</i> Kunth	Herb
<i>Andropogon selloanus</i> (Hack.) Hack	Herb
<i>Anthephora hermaphrodita</i> (L.) Kuntze	Herb
<i>Aristida adscensionis</i> L.	Herb
<i>Aristida longifolia</i> Trin.	Herb
<i>Aristida setifolia</i> Kunth	Herb
<i>Axonopus capillaris</i> (Lam.) Chase	Herb
<i>Axonopus marginatus</i> (Trin.) Chase	Herb
<i>Cenchrus ciliaris</i> L.	Herb
<i>Cenchrus echinatus</i> L.	Herb
<i>Chaetium festucoides</i> Nees	Herb
<i>Chloris barbata</i> Sw.	Herb
<i>Chloris virgata</i> Sw.	Herb
<i>Cyphonanthus discrepans</i> (Döll) Zuloaga and Morrone	Herb
<i>Dactyloctenium aegyptium</i> (L.) Willd.	Herb
<i>Dichantherium sciurotis</i> (Trin.) Davidse	Herb
<i>Digitaria aequiglumis</i> (Hack. and Arechav.) Parodi	Herb
<i>Digitaria ciliaris</i> (Retz.) Koeler	Herb
<i>Digitaria horizontalis</i> Willd.	Herb
<i>Eleusine indica</i> (L.) Gaertn.	Herb
<i>Eragrostis ciliaris</i> (L.) R. Br.	Herb
<i>Eragrostis maypurensis</i> (Kunth) Steud.	Herb
<i>Eragrostis rufescens</i> Schrad. ex Schult.	Herb
<i>Eragrostis scaligera</i> Salzm. ex Steud.	Herb
<i>Eriochloa polystachya</i> Kunth	Herb
<i>Eriochloa punctata</i> (L.) Desv. ex Ham.	Herb
<i>Gymnopogon foliosus</i> (Willd.) Nees	Herb
<i>Ischaemum rugosum</i> Salisb.	Herb
<i>Mesosetum loliforme</i> (Hochst. ex Steud.) Chase	Herb
<i>Mesosetum pappophorum</i> (Nees) Kuhlman.	Herb
<i>Oplismenus burmannii</i> (Retz.) P. Beauv.	Herb
<i>Panicum aquaticum</i> Poir.	Herb
<i>Panicum trichoides</i> Sw.	Herb
<i>Paspalidium geminatum</i> (Forssk.) Stapf	Herb
<i>Paspalum clavuliferum</i> C. Wright	Herb
<i>Paspalum convexum</i> Humb. and Bonpl. ex Flügge	Herb
<i>Paspalum densus</i> Poir.	Herb
<i>Paspalum maritimum</i> Trin.	Herb
<i>Paspalum pleostachyum</i> Döll	Herb
<i>Paspalum scutatum</i> Nees ex Trin.	Herb
<i>Paspalum vaginatum</i> Sw.	Herb
<i>Sporobolus virginicus</i> (L.) Kunth	Herb

TABLE 1. CONTINUED.

FAMILIES / SPECIES	HABIT
<i>Steirachne diandra</i> Ekman	Herb
<i>Urochloa plantaginea</i> (Link) R.D. Webster	Herb
<b>Polygalaceae</b>	
<i>Polygala gracilis</i> Kunth	Herb
<b>Rhamnaceae</b>	
<i>Ziziphus joazeiro</i> Mart.	Tree
<b>Rubiaceae</b>	
<i>Alibertia rigida</i> K.Schum.	Subshrub
<i>Alibertia edulis</i> (Rich.) A. Rich. ex DC.	Shrub
<i>Alseis floribunda</i> Schott	Tree
<i>Borreria ocymoides</i> (Burm.f.) DC.	Herb
<i>Borreria latifolia</i> (Aubl.) K.Schum.	Herb
<i>Borreria scabiosoides</i> Cham. and Schltld.	Herb
<i>Borreria verticillata</i> (L.) G.Mey.	Herb
<i>Chiococca alba</i> (L.) Hitchc.	Shrub
<i>Chiococca nitida</i> Benth.	Shrub
<i>Chomelia martiana</i> Müll. Arg.	Tree
<i>Chomelia obtusa</i> Cham. and Schltld.	Shrub
<i>Coutarea hexandra</i> (Jacq.) K. Schum. (Figure 3K).	Shrub
<i>Diodella apiculata</i> (Willd. ex Roem. and Schult.) Delprete	Herb
<i>Diodella radula</i> (Willd. ex Roem. and Schult.) Delprete	Herb
<i>Diodella teres</i> (Walter) Small	Herb
<i>Faramea nitida</i> Benth.	Shrub
<i>Genipa americana</i> L.	Tree
<i>Guettarda platypoda</i> DC.	Shrub
<i>Guettarda viburnoides</i> Cham. and Schltld.	Shrub
<i>Machaonia brasiliensis</i> (Hoffmanns. ex Humb.) Cham. and Schltld.	Shrub
<i>Manettia cordifolia</i> Mart.	Creeper
<i>Margaritopsis carrascoana</i> (Delprete and E.B.Souza) C.M.Taylor and E.B.Souza	Subshrub
<i>Mitracarpus frigidus</i> (Willd. ex Roem. and Schult.) K. Schum.	Herb
<i>Randia armata</i> (Sw.) DC.	Shrub
<i>Richardia grandiflora</i> (Cham. and Schltld.) Steud.	Herb
<i>Staelia galioides</i> DC.	Subshrub
<i>Tocoyena sellowiana</i> (Cham. and Schltld.) k. Schum.	Tree
<b>Sapotaceae</b>	
<i>Chrysophyllum arenarium</i> Allemão	Tree
<i>Manilkara salzmannii</i> (A. DC.) H. J. Lam	Tree
<i>Manilkara triflora</i> (Allemão) Monach.	Shrub
<i>Pouteria reticulata</i> (Engl.) Eyma	Tree
<b>Solanaceae</b>	
<i>Solanum paludosum</i> Moric.	Shrub
<b>Turneraceae</b>	
<i>Turnera calyptrocarpa</i> Urb.	Herb
<i>Turnera diffusa</i> Willd. ex Schult.	Herb
<i>Turnera melochioides</i> Cambess	Herb
<i>Turnera subulata</i> Sm.	Herb
<b>Verbenaceae</b>	
<i>Lantana camara</i> L. (Figure 3L)	Shrub
<i>Lippia alba</i> (Mill.) N.E. Br.	Herb
<i>Stachytarpheta cayennensis</i> (Rich.) Vahl	Subshrub
<b>Violaceae</b>	
<i>Hybanthus calceolaria</i> (L.) Oken	Herb

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