Flora and Annual Distribution of Flowers and Fruits in the Ubajara National Park, Ceará, Brazil

Andréa Pereira Silveira¹ 0000-0001-6785-5319
Bruno Sousa de Menezes² 0000-0003-1134-8996
Maria Iracema Bezerra Loiola² 0000-0003-3389-5560
Luiz Wilson Lima-Verde² 0000-0002-6908-1692
Dalva Neta e Zanina² 0000-0002-4653-445X
Ellen Cristina Dantas de Carvalho² 0000-0002-6887-3970
Bruno Cruz de Souza² 0000-0002-4746-2638
Rafael Carvalho da Costa² 0000-0002-0942-3128
Waldir Mantovani² 0000-0002-9394-6860
Marcelo Oliveira Teles de Menezes³ 0000-0003-2129-6843
Lilian Maria Araújo Flores³ 0000-0001-8037-6021
Francisco Carlos Barboza Nogueira³
Ligia Queiroz Matias³ 0000-0001-889-5354
Lívia Silvia Barbosa³
Fernanda Melo Gomes³ 0000-0002-4213-6577
Luciana Silva Cordeiro³ 0000-0001-5624-2285
Valéria da Silva Sampaio³ 0000-0002-6551-8877
Maria Edenville Peixoto Batista³ 0000-0002-1239-0902
Raimundo Luciano Soares Neto³ 0000-0002-5643-9464
María Arlene Pessoa da Silva³ 0000-0001-8148-5350
Natália Barbosa Campos³
Arycelle Alves de Oliveira³
Francisca Soares de Araujo³ 0000-0003-4661-6137

Abstract

Although the conservation of tropical biodiversity depends on protected areas, there is still a very large ‘gap’ of knowledge on the flora of Brazilian reserves, especially in the Northeast region of Brazil. Field and herbarium surveys of the phanerogamic flora of the Ubajara National Park, located on the Brazilian Northeast, were made and analyses on phenology and dispersal syndromes were performed. 418 taxa (213 trees and shrubs, 100 terrestrial herbs, 68 climbing plants, 33 sub-shrubs, two epiphytes, one hemiparasite and one aquatic herb) were recorded. The most representative families were: Fabaceae, Malvaceae, Asteraceae, Rubiaceae and Euphorbiaceae. The annual flowering / fruiting peak hypothesis was not fully confirmed, therefore, the forest may be an important food resource for the fauna all year long (especially in the moister region). Zoochory was the predominant dispersal syndrome in the moister area, whereas, autochory and anemochory together, predominated in the drier area.

Keywords: biodiversity, mountain forest, protected areas, evergreen forest, deciduous forest.

¹Universidade Estadual do Ceará (UECE), Faculdade de Educação de Itapipoca (FACEDI), Itapipoca, CE, Brasil
²Universidade Federal do Ceará (UFC), Departamento de Biologia, Fortaleza, CE, Brasil
³Instituto Federal do Ceará (IFCE), Fortaleza, CE, Brasil
⁴Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), Fortaleza, CE, Brasil
⁵Superintendência Estadual de Meio Ambiente (SEMACE), Fortaleza, CE, Brasil
⁶Universidade Federal de Pernambuco (UFPE), Departamento de Botânica, Recife, PE, Brasil
⁷Universidade Regional do Cariri (URCA), Departamento de Biologia, Crato, CE, Brasil
1. Introduction and objective

The Brazilian semi-arid domain covers an area with a huge physiographic and climatic heterogeneity (associated with continentality, altitude and slope) – which influences moisture and rainfall (Mantovani et al., 2017). In this context, many kinds of vegetation may occur, such as stepic savanna (caatinga and carrasco), savanna (cerrado), coastal semideciduous forest (mata de tabuleiro), semideciduous/deciduous forest (mata seca) and semideciduous/evergreen forest (mata úmida) – the last two can be found mainly in montane regions (Souza & Oliveira, 2006; IBGE, 2012; Moro et al., 2015; Mantovani et al., 2017). According to Zappi et al. (2015), at least 4,659 species of angiosperms were reported for all these plant formations.

The climate in montane regions of the Brazilian semi-arid domain is usually moister than the surroundings, due to orographic precipitation. These habitats are arranged like moist islands in a dry landscape, where forest flora and vegetation develop (Pereira et al., 2010; Nascimento et al., 2012; Pinto et al., 2012; Silva & Figueiredo, 2013). Known as brejos de altitude, they often shelter deciduous, semideciduous and/or evergreen forests, with high species richness in comparison with the surrounding semi-arid landscapes (Pereira et al., 2010; Nascimento et al., 2012; Pinto et al., 2012; Silva & Figueiredo, 2013). Thus, the brejos de altitude may form a patchy and fragmented mosaic of relic vegetation from a moist paleoclimate (Bétard et al., 2007; Mantovani et al., 2017).

The vegetation in the brejos de altitude is also an important resource to local and migratory fauna. The few researches made on these areas show that the seasonality and the water availability rule the phenological patterns and dispersion syndromes. It seems to be a tendency for this kind of biological community to have flower and fruit availabilities all year long (Locatelli & Machado, 2004). Also, it seems to be a predominance of zoococho in moist areas, while autochocho and anemochory are predominant in dry areas (Diogo et al., 2016).

The Brazilian semi-arid domain, in which these montane forests are located, is also subjected to overpopulation, about 15% of the national population with 27 million inhabitants (Araújo, 2011), and to an intense rhythm of anthropic exploitation since the Portuguese colonization, especially on the highlands, which are moister than surrounding semi-arid depression (Lopes et al., 2017; Mantovani et al., 2017). Furthermore, protected areas in the Brazilian semi-arid domain account for only 7.8% of its area, of which only 1.3% is under the full protection usage regime, i.e. with restrictions to human intervention (Menezes et al., 2010). Thus, according to Rylands & Brandon (2005), it is one of the most poorly protected regions of Brazil.

Although the conservation of tropical biodiversity depends on protected areas and their surrounding vegetation (Mantovani et al., 2017), there is still a very large ‘gap’ on the knowledge of the flora of Brazilian protected areas. Most of them are still poorly known, making a consistent analysis of their effectiveness for conservation very difficult (Oliveira et al., 2017; Mattar et al., 2018). According to Moro et al. (2015), floristic studies in the Ubajara mountain forest are highly desirable, since extensive floristic surveys for the Ceará highlands were only performed for Baturité and Araripe areas.

Thus, floristic surveys on Brazilian protected areas have a huge role on supporting conservation, management and restoration programs. Although many efforts have been made to assess the flora of Ceará (Loiola, 2013; Tabosa et al., 2016; Ribeiro & Loiola, 2017; Carneiro et al., 2018; Sampaio et al., 2019), there are still very few published studies on the flora of the protected areas of the state of Ceará. From an inventory of the phanerogamic flora, it could be presented some analysis on the floristic composition, the phenological patterns and the dispersal syndromes found in the Ubajara National Park, located in a montane region of the state of Ceará, Brazil. This protected area is considered of extreme biological importance due to its high diversity and for being listed as a priority area for conservation and sustainable use (Brasil, 2007).

2 Material and methods

2.1. Study area

The Ubajara National Park is a full protection reserve, created in 1959. After two additions (the first in 1973 and the second in 2002) to the Ubajara National Park, its protected area reached 6,288 ha. It is located in the north of the Ibiapaba plateau, near the coast (3° 45’ S, 40° 54’ W). Due to orographic rainfall, most part of the park is under a moister climate (Aw, Köppen-Geiger) than the surrounding valleys (Bsh, Köppen-Geiger). The terrain stands on a sedimentary sandstone on the higher altitude areas with outcrops of calcareous rocks on the windward slope. The Tropical Seasonal Deciduous Forest (TDSF) develops between 400-700 m and accounts for 72.1% of the area of the park. Between 700-900 m, there is a Tropical Seasonal Evergreen Forest (TSEF), accounting for 18% of the park; and in the lowlands (bellow 400 m), there is the steptic savanna, which accounts for 9.9% of the park (Figure 1).

The park is well preserved, it has about 88.7% of conserved vegetation and only 1.9% of disturbed vegetation. On the surroundings of the park, there is significant anthropogenic disturbance, especially on the moist side, with permeability of only 36.8%, while on the dryer side the permeability is 56% (Mantovani et al., 2017).

On the lands with altitudes around 400-700 meters, the average annual rainfall is 950 mm, concentrated from January to June, and the temperature is 28.2 °C (Figure 2A). The soil is...
Figure 1. Vegetation of the Ubajara National Park in Ceará, Brazil.

A) Ubajara - TSEF 3°51'S - 40°55'W (840 m) 1987 - 2017 26.1°C 1500 mm

B) Frecheirinha - TSDF 3°46'S - 40°49'W (120 m) 1987 - 2017 28.2°C 950 mm

Figure 2. Walter & Lieth climatic diagrams for Vegetation of the Ubajara National Park, Ceará, Brazil. (A) Tropical Seasonal Deciduous Forest (TSEF); and (B) Tropical Seasonal Evergreen Forest (TSEF).
shallow and stony and could be classified as Dystrophic Regolith Neosol. The main headwaters of the Acaráu River basin are located inside the Ubajara National Park. Additionally, the rainfall of the eastern slope of Ibiapaba infiltrates into calcareous rocks and resurface in the lower altitudes. This water is used to irrigate agriculture and also for household use. However, both the headwaters and the resurgent water can deplete during the dry season of deforested area (inside or outside the park) during consecutive years of drought.

The TSEF area (above 700 m) exhibits average annual rainfall of 1,500 mm, concentrated from January to June, and an average temperature of 26.1 °C (Figure 2B). The soil was classified as deep Dystrophic Tb Haplic Cambisol (CXBd).

2.2. Data collection and analysis

During approximately six years, the team went through the main park trails and vegetation patches to collect samples of the flora. The first collection was made between 2011 and 2014, being part of the project “Efetividade de UCs Federais do estado do Ceará na conservação biológica do semiárido brasileiro” (CNPq/ICMBio 13/2011, N°. 551998/2011-3). Additional samples were obtained between 2017 and 2018 during the project “Conservação da biodiversidade em nível de paisagem: mudanças climáticas e distúrbios antropogênicos” (CNPq/ICMBio/FAPs 18/2017, N° 421350/2017-2). Collections were also made in phytosociological and functional survey plots (unpublished data). Whenever possible, samples in reproductive state (with flowerbuds, flowers and/or fruits) were obtained. Vouchers were deposited in the Herbarium Prisco Bezerra (EAC) at the Universidade Federal do Ceará (UFC). The survey was complemented by gathering samples deposited by other researchers into the EAC collection.

The botanical determination was based on specialized literature, expert opinions and comparisons with other specimens from the EAC collection. The Angiosperm Phylogeny Group IV (APG IV, 2016) classification system was adopted. Names of the families, genera, species and authors names were confirmed on the International Plant Names Index (IPNI, 2019) and in the Flora of Brazil 2020 under construction website (IBRJ, 2019). The classification of exotic species was adopted, as suggested by Moro et al. (2012).

It could be gathered data on family, species, vernacular name, main collector, plant formation, growth-form, flowering / fruiting period, fruit size, fruit type and dispersal syndrome only for native flora.

Classification of growth forms followed the Instituto Brasileiro de Geografia e Estatística (IBGE, 2012): tree – woody plants higher than 3 m; shrub – woody plants with the main branch up to 50 cm above the ground level and generally shorter than 3 m; sub-shrub – plants with woody main stem and secondary herbaceous branches, generally having a height of less than 2 m; terrestrial herb – terrestrial plants with herbaceous aerial stem; epiphytic herb – plants with herbaceous stem which develop with another plant’s support; climbing plants – lianas or vine plants with elongated stems, that usually are supported by a substrate or epiphytes that rely on their phorophyte for support, and also hemiparasite – plants that use the resources of their host, but have chlorophyll and perform photosynthesis.

The reproductive phenophases were compiled of exsiccates of the EAC. Fruit size information and diaspora dispersal syndromes were obtained from herbarium sheets whenever possible, and from the literature when not. Diaspores were classified in small, medium and large following the length/width ratio criterion, as proposed by Tabarelli & Peres (2002). The dispersal syndromes were classified as anemochorous, autochorous or zoochorous, followed by Van der Pijl (1982).

The number of species per growth form, dispersal syndromes and diaspora size were analyzed through frequency diagrams. Flowering and fruiting patterns throughout the year were analyzed through circular histograms made with ORIANA 4 software (Kovach, 2011), based on the percentage of species which were flowering and fruiting (there was data on flowering for 80% of the species and on fruiting for only 30%). The following parameters were calculated for the phenology evaluation (with months corresponding to 30° angles): mean angle (μ); and vector (r), which is a measure concentration around the mean angle. The null hypothesis on the (Z) test is that flowering and fruiting are distributed evenly throughout the year, and therefore there is no seasonality of each phenophase. The alternative hypothesis is that there is seasonality (if the mean angle is significant). The vector (r) varies from 0 (when the phenological activity is evenly distributed throughout the year) to 1 (when the phenological activity is seasonal/concentrated in a period of the year).

3. Results and discussion

Were found 418 specific/sub-specific taxa (84 families; 274 genera) could be found, from which 335 were found in the TSEF, 53 in TSDF, and 30 in both vegetations. Due to the absence of flowers or fruits, from this total number of registered data, only 22 species were identified up to genus and four were only identified up to family (Appendix A). This floristic richness was higher than any other ever recorded in
montane forests of Brazilian semi-arid domain. According to the study of Nascimento et al. (2012), the researchers could find 293 species in Planalto da Borborema (Paraíba), nevertheless, Pereira et al. (2010) found 136 species in Serra Negra (Pernambuco), and Silva & Figueiredo (2013) only 100 species in Serra da Meruoca (Ceará). However, this disparity in the species richness of the Ubajara National Park may be due to the high number of terrestrial herbs recorded, in other words, 100 species that comprise 23.9% of the species; on the other hand, other studies did not indicate no more than 10% of herbs in the species richness. In addition, the other forests cited may have different areas and the respective surveys in each study may have different sampling effort, so the comparison may not be conclusive.

The families with the highest species richness were Fabaceae (64 spp.), Malvaceae (24 spp.), Asteraceae (20 spp.), Rubiaceae (18 spp.), Euphorbiaceae (16 spp.), Sapindaceae (14 spp.), Apocynaceae (13 spp.) and Myrtaceae (11 spp.). These data are in accordance to the same studies performed in other montane forests of the northeastern Brazil (Rodal & Nascimento, 2002; Nascimento et al., 2012; Silveira et al., 2019). All other families had 10 or less species each. The most numerous genera were *Erythroxylum* (9 spp.), *Passiflora* (7 spp.), *Croton* (7 spp.) and *Combretum* (6 spp.) – Appendix A.

In addition to the species listed in the Appendix A, 28 exotic species (26 genera, 17 families) could be cataloged – Appendix B. The families with greatest numbers of exotic species were Araceae (6 spp.), Apocynaceae and Amaryllidaceae (3 spp. each). These species are mostly ornamental and were planted on the park entrance and along the pathway to the cable car. Only five exotic species were found inside the park: *Cryptostegia madagascariensis* Bojer ex Decne., *Coffeea arabica* L., *Artocarpus heterophyllus* Lam., *Mangifera indica* L. and *Bambusa sp*. In this case, the exotic species probably were present in the park before of its creation because it was a human occupied area. In the case of zoochorous plant species, exotic fruitful species may compete for the dispersers with native flora. Once the perpetuation of the native flora depends on both preservation and dispersal of diaspores (see Oliveira et al., 2017; Mattar et al., 2018), indigenous biodiversity may be somehow threatened.

Regarding the growth form, considering only indigenous species, it could be recorded 213 trees and shrubs, 100 terrestrial herbs, 68 climbing, 33 sub-shrubs, two epiphytic herbs, one hemiparasite and one aquatic herb (Figure 3A). Forests usually have a low proportion of herb richness in comparison to trees and shrubs. One possible cause of the high proportion of herbs in the flora of the Ubajara National Park may be a consequence of the compilation of data from the herbarium collection; while rainfall forest trees may exhibit supra-annual flowering/fruiting patterns (see Pereira et al., 2008), herbs usually have annual patterns (increasing the chances of being incorporated to the herbarium – once EAC have not accepted vegetative samples in the last years). A complete floristic checklist for the Ubajara National Park will only be possible after a long-term phytosociological survey or reproductive phenodinamic study on the future.

On spectrum of dispersal syndromes (Figure 3B), as expected, zoochory was predominant on the total flora (55%) and in the TSEF alone (201 species, 56%); while in the TSDF alone, the proportion of zoochory was lower (37 species, 46%). This predominance of zoochory in forests was found by Locatelli & Machado (2004) and by Diogo et al. (2016), showing that the Brazilian montane regions are important to preserve the richness of native species and available resource supply for local and migratory fauna. In both vegetations (TSEF and TSDF), the large and very large diaspores predominated, followed by medium and small ones (Figure 3C). The predominant type of fruit are capsule, drupe, bacca, legume, achene, samara, follicle and schizocarp (Figure 3D).

The Rayleigh test was only significant for fruit production (Figure 3F), seeing that this production is concentrated on June (in the end of the rainy season) with standard deviation from April to July (μ = 150.334°, sd = 105.854°, Z = 4.215, p = 0.02, r = 0.181). This fruiting peak in the beginning of the dry season seems to be an adaptation of plants from seasonal and dry climates, whose seeds have the following wet season to germinate and establish (Locatelli & Machado; 2004; Pau et al., 2011). On the other hand, the vectors r exhibited low results, indicating that the frequencies of the fruiting species are distributed evenly all year long. In addition, data on fruiting was available for only 30% of the species, so conclusions are not supported by these evidences. However, our results allowed generalizing that Ubajara National Park (as other montane forest from Northeast region of Brazil) offers resources for the fauna all year long.

Our results also showed that the Ubajara National Park has an important contribution to conservation of biodiversity, because the number of flowering plant species protected by this area is higher than those of other montane forests in Northeast region of Brazil (Carnaval et al., 2009; Homeier et al., 2010; Leite et al., 2016; Kamimura et al., 2017). The high diversity found in the Ubajara National Park may be attributed to its environmental heterogeneity, seeing that its topographic variation provides a range of different habitats, sheltering different vegetations and therefore a high floristic diversity.
4. Conclusions

The Ubajara National Park exhibits a huge species richness and an outstanding floristic composition – which makes this protected area very important for preservation of the local biodiversity. Beside the preservation of the plant species, the diversity of phenological patterns, types of fruits and dispersal syndromes create a substantial resource supply for local fauna almost all year long.

These results derived from a long-term sampling effort – an unparalleled study in the whole Brazilian semi-arid region. They represent not only an important contribution for the knowledge on the biodiversity of the semi-arid domain in northeast Brazil, but also a fundamental subside to the management of the park (including the formation of seed banks and seedlings production for restoration) and to further research on biodiversity, ecology, ethnobiology and effectiveness of protected areas.

Our results highlight the importance of studying the flora of the Brazilian protected areas. This is a fundamental step in assessing the effectiveness of protected areas in maintaining biodiversity.

Acknowledgements
We thank the Managers of Ubajara PARNA for logistics support.
Submission status
Received: 8 May, 2019
Accepted: 27 Dec., 2019
Associated Editor: Rodrigo Studart Corrêa (ORCID: 0000-0002-9422-2629)

Correspondence to
Andréa Pereira Silveira
Universidade Estadual do Ceará (UECE), Faculdade de Educação de Itapipoca (FACEDI), Av. da Universidade, S/N - Madalenas, CEP 62.205-090, Itapipoca, CE, Brasil
e-mail: andrea.silveira@uece.br

Financial support
Conselho Nacional de Desenvolvimento Científico e Tecnológico/Instituto Chico Mendes de Conservação da Biodiversidade - CNPq/ICMBio (551998/20113, 421350/2017-2) e Fundação Cearense de Apoio ao Desenvolvimento Científico -FUNCAP (0132-00007.01.00/18).

References
Angiosperm Phylogeny Group IV – APG IV. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants. *Botanical Journal of the Linnean Society* 2016; 181(1): 1-20. http://dx.doi.org/10.1111/bot.12385.

Araújo SMS. A região semiárida do nordeste do Brasil: questões ambientais e possibilidades de uso sustentável dos recursos. *Rios Eletrônica-Revista Científica da FASETE* 2011; 5(5): 89-98.

Bétard F, Peulvast JP, Sales CV. Caracterização morfopedológica de uma serra úmida no semi-árido do nordeste brasileiro: o caso do Maciço de Baturité-CE. *Mercator-Revista de Geografia da UFC* 2007; 6(12): 107-126.

Brasil. Ministério do Meio Ambiente. Áreas prioritárias para conservação, uso sustentável e repartição de benefícios da Biodiversidade Brasileira: Atualização - Portaria MMA n.º 09 de 23 de janeiro de 2007 [online]. Brasília: Ministério do Meio Ambiente; 2007 [cited 2019 Sept 18]. Available from: https://www.mma.gov.br/estruturas/chm_/arquivos/biodiversidade31.pdf

Carnaval AC, Hickerson MJ, Haddad CFB, Rodrigues MT, Moritz C. Stability predicts genetic diversity in the Brazilian Atlantic forest hotspot. *Science* 2009; 323(5915): 785-789. http://dx.doi.org/10.1126/science.1169555. PMid:19197066.

Carneiro JAA, Rebouças NC, Ribeiro RTM, Gomes FM, Miranda RR, Soares-Neto RL et al. Flora do Ceará, Brasil: cleomaceae. *Rodriguesia* 2018; 69(4): 1659-1672. http://dx.doi.org/10.1590/2175-7860201869413.

Diogo IJS, Martins FR, Verola CF, Costa IR. Variation in plant-animal interactions along an elevational gradient of moist forest in a semi-arid area of Brazil. *Acta Botanica Brasilia* 2016; 30(1): 27-34. http://dx.doi.org/10.1590/0102-33062015aab0198.

Homeier J, Breckle SW, Günter S, Rollebenk RT, Leuschner C. Tree diversity, forest structure and productivity along altitudinal and topographical gradients in a species-rich Ecuadorian montane rain forest. *Biotropica* 2010; 42(2): 140-148. http://dx.doi.org/10.1111/j.1744-7429.2009.00547.x.

Instituto Brasileiro de Geografia e Estatística – IBGE. *Manual técnico da vegetação brasileira*. Rio de Janeiro: IBGE; 2012. 275 p.

International Plant Names Index – IPNI [online]. 2019 [cited 2019 Sept 18]. Available from: http://www.ipni.org

Jardim Botânico do Rio de Janeiro – JBRJ [online]. 2019 [cited 2019 Sept 18]. Available from: http://floradobrasil.jbrj.gov.br

Kamimura VA, Moraes PLR, Ribeiro HL, Joly CA, Assis MA. Tree diversity and elevational gradient: the case of Lauraceae in the Atlantic Rainforest. *Flora* 2017; 234(9): 84-91. http://dx.doi.org/10.1016/j.flora.2017.05.013.

Kovach WL. *Oriana-circular statistics for windows*, ver. 4. Wales, UK: Kovach Computing Services; 2011.

Leite YLR, Costa LP, Loss AC, Rocha RG, Batalha-Filho H, Bastos AC et al. Neotropical forest expansion during the last glacial period challenges refuge hypothesis. *Proceedings of the National Academy of Sciences of the United States of America* 2016; 113(4): 1008-1013. http://dx.doi.org/10.1073/pnas.1513062113. PMid:2675597.

Locatelli E, Machado IC. Fenologia das espécies arbóreas de uma mata serrana (Brejo de Altitude) em Pernambuco, Nordeste do Brasil. In: Porto KC, Cabral JJP, Tabarelli M, editors. *Brejos de altitude em Pernambuco e Paraiba: história natural, ecologia e conservação*. Brasília: Ministério do Meio Ambiente; 2004. p. 255-276.

Loiola MIB. A new species of Erythroxylum (Erythroxylaceae) from the Brazilian semi-arid region. *Phytotaxa* 2013; 150(1): 61-64. http://dx.doi.org/10.11646/phytotaxa.150.1.5.

Lopes SDF, Ramos MB, Almeida GRD. The role of mountains as refugia for biodiversity in brazilian caatinga: conservationist implications. *Tropical Conservation Science* 2017; 10: 1-12. http://dx.doi.org/10.1177/1940028917702651.

Mantovani W, Anjos L, Monteiro RF, Araújo FS. A conservação da biodiversidade no domínio caatinga. Fortaleza: Edições UFC; 2017.

Matta EPL, Barros TTV, Cunha BB, Souza JFD, Silva AMDC. Federal Conservation Units in Brazil: the situation of biomes and regions. *Floresta e Ambiente* 2018; 25(2): 2-10. http://dx.doi.org/10.1590/2179-8087.005115.

Menezes MOT, Araújo FS, Romero RE. O sistema de conservação biológica do estado do Ceará: diagnóstico e recomendações. *Revista Eletrônica do Prodema* 2010; 5(2): 7-31.

Moro MF, Macedo MB, Moura-Fê MM, Castro AS, Costa RC. Vegetação, unidades fitocológicas e diversidade paisagística do estado do Ceará. *Rodriguesia* 2015; 66(3): 717-743. http://dx.doi.org/10.1590/2175-7860201566305.

Moro MF, Souza VC, Oliveira-Filho ATD, Queiroz LPD, Fraga CND, Rodal MJN et al. Alienígenas na sala: o que fazer com espécies exóticas em trabalhos de taxonomia, florística e fitossociologia? *Acta Botanica Brasilia* 2012; 26(4): 991-999. http://dx.doi.org/10.1590/S0102-33062012000400029.

Nascimento LM, Rodal MJN, Silva AG. Florística de uma floresta estacional no Planoalto da Borborema, nordeste do Brasil. *Rodriguesia* 2012; 63(2): 429-440. http://dx.doi.org/10.1590/S2175-78602012000200015.

Oliveira U, Soares-Filho BS, Paglia AP, Brescovit AD, Carvalho CJB, Silva DP et al. Biodiversity conservation gaps in the Brazilian...
protected areas. Scientific Reports 2017; 7(1): 9141. http://dx.doi.org/10.1038/s41598-017-08707-2. PMID:28831073.

Pau S, Wolkovich EM, Cook BI, Davies TJ, Kraft NJB, Bolmgren K et al. Predicting phenology by integrating ecology, evolution and climate science. Global Change Biology 2011; 17(12): 3633-3643. http://dx.doi.org/10.1111/j.1365-2486.2011.02515.x.

Pereira RCA, Silva JA, Barbosa JJS. Flora de um "brejo-de-altitude" de Pernambuco: reserva Ecológica da Serra Negra. Anais da Academia Pernambucana de Ciência Agronômica 2010; 7: 286-304.

Pereira TS, Costa MLMN, Moraes LFD, Luchiari C. Fenologia de espécies arbóreas em floresta Atlântica da Reserva Biológica de Poço das Antas, Rio de Janeiro, Brasil. Iheringia. Série Botânica 2008; 63(2): 329-339.

Pinto MSC, Sampaio EVSB, Nascimento LM. Florística e estrutura da vegetação de um brejo de altitude em Pesqueira, PE, Brasil. Revista Nordestina de Biologia 2012; 21(1): 47-79.

Ribeiro RTM, Loiola MIB. Flora do Ceará, Brasil: bixaceae. Rodriguésia 2017; 68(4): 1313-1322. http://dx.doi.org/10.1590/2175-7860201768413.

Rodal MJ, Nascimento LM. Levantamento florístico da floresta serrana da reserva biológica de Serra Negra, microrregião de Itaparica, Pernambuco, Brasil. Acta Botanica Brasílica 2002; 16(4): 481-500. http://dx.doi.org/10.1590/S0102-33062002000400009.

Rylands AB, Brandon K. Unidades de conservação brasileiras. Megadiversidade 2005; 1(1): 27-35.

Sampaio VS, Vieira IMF, Lima-Júnior EAL, Loiola MIB. Flora do Ceará, Brasil: Solanum (Solanaceae). Rodriguésia 2019; 70: e02512017. http://dx.doi.org/10.1590/2175-7860201970029.

Silva MEA, Figueiredo MF. Flora fanerógâmica de um enclave úmido no Ceará: serra da Meruoca. Enciclopédia Biosfera 2013; 9(17): 2811-2820.

Silveira AP, Loiola MIB, Gomes VS, Verde LWL, Oliveira TS, Silva EF et al. Flora of Baturite - Ceará: a wet island in the brazilian semi-arid. Floresta e Ambiente 2019. In press.

Souza MJN, Oliveira VPV. Os enclaves úmidos e sub-úmidos do semi-árido do nordeste brasileiro. Revista Mercator 2006; 5(9): 85-102.

Tabarelli M, Peres CA. Abiotic and vertebrate seed dispersal in the Brazilian Atlantic forest: implications for forest regeneration. Biological Conservation 2002; 106(2): 165-176. http://dx.doi.org/10.1016/S0006-3207(01)00243-9.

Tabosa FRS, Almeida EM, Melo E, Loiola MIB. Flora do Ceará, Brasil: polygonaceae. Rodriguésia 2016; 67(4): 981-996. http://dx.doi.org/10.1590/2175-786020167409.

Van der Pijl L. Principles of dispersal in higher plants. Berlim: Springer-Verlag. 1982. http://dx.doi.org/10.1007/978-3-642-87925-8.

Zappi DC, Filardi FLR, Leitman P, Souza VC, Walter BMT, Pirani JR et al. Growing knowledge: an overview of seed plant diversity in Brazil. Rodriguésia 2015; 66(4): 1085-1113. http://dx.doi.org/10.1590/2175-7860201566411.
Appendix A. List of families and species of the Tropical Seasonal Deciduous Forest (TSDF) and the Tropical Seasonal Evergreen Forest (TSEF) of the Ubajara National Park in Ceará, Brazil, where x = presence of taxa.

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|-------------|----------------|
|                  | TSDF | TSEF |
| 1. Acanthaceae   |     |     |
| Ruellia asperula (Mart. ex Ness) Lindau | x | Fernandes, A. (EAC 27690) |
| R. geminiflora Kunth | x | Cavalcanti, E.S. 549 |
| 2. Alstromeriaceae |     |     |
| Bomarea edulis (Tussac) Herb. | x | Loiola, M.I.B. 1591 |
| 3. Amaranthaceae  |     |     |
| Alternanthera brasiliana (L.) Kuntze | x | Castro, A.J. (EAC 6153) |
| A. tenella Colla | x | Loiola, M.I.B. 1528 |
| Cyathula achyranthoides (Kunth) Moq. | x | Fernandes, A. (EAC 3973) |
| Iresine diffusa Humb. & Bonpl. ex Willd. | x | Fernandes, A. (EAC 5064) |
| 4. Amaryllidaceae |     |     |
| Hippeastrum stylasum Herb. | x | Cavalcanti, E.S. 595 |
| Zephyranthes cearensis (Herb.) Baker | x | Cavalcanti, E.S. 594 |
| 5. Anacardiaceae  |     |     |
| Astronium fraxinifolium Schott | x | Fernandes, A. (EAC 15095) |
| Myracrodruon urundeuva Allemão | x | Matos (EAC 6897) |
| Spondias mombin L. | x | Freitas, B. |
| Tapirira guianensis Aubl. | x | Loiola, M.I.B. 1940 |
| Thysanotus proculaneum Benth. | x | Fernandes, A. (EAC 27839) |
| 6. Annonaceae     |     |     |
| Annona eusucca DC. | x | Fernandes, A. (EAC 27751) |
| A. leptopetala (R.E.Fr.) H.Rainer | x | Fernandes, A. (EAC 8287) |
| Annonaceae sp1 | x | Sterile material |
| Guatteria pogonopus Mart. | x | Loiola, M.I.B. 1939 |
| G. schomburgkiana Mart. | x | Lima-Verde, L.W. 3542 |
| Guatteria sp. | x | Sterile material |
| Oxandra sessiliflora R.E.Fr. | x | Loiola, M.I.B. 1489 |
| Xylopia sp. | x | Sterile material |
| 7. Apiaceae       |     |     |
| Spananthe paniculata Jacq. | x | Fernandes, A. (EAC 27943) |
| 8. Apocynaceae    |     |     |
| Aspidosperma pyrifolium Mart. & Zucc. | x | Loiola, M.I.B. 1872 |
| A. riedelii subsp. oliganthum (Woodson) Marc.-Ferr. | x | Fernandes, A. (EAC 8895) |
| A. subincanum Mart. | x | Araújo, E.S. 699 |
| Forsteronia pubescens A. DC. | x | Loiola, M.I.B. 2229 |
| Mandevilla hirsuta (A.Rich.) K.Schum. | x | Fernandes, A. (EAC 27684) |
| Matelea denticulata (Vahl) Fontella & E.A.Schwarz | x | Loiola, M.I.B. 1527 |
| Rauvolfia ligustrina Wild. | x | Fernandes, A. (EAC 27923) |
| R. paucifolia A.DC. | x | Castro, A.S.J. 1377 |
| Schubertia grandiflora Mart. | x | Fernandes, A. (EAC 27886) |
| Tabernaemontana catharinensis A.DC. | x | Fernandes, A. (EAC 3997) |
| Apocynaceae sp1 | x | Sterile material |
| Apocynaceae sp2 | x | Sterile material |
| Apocynaceae sp3 | x | Sterile material |
| 9. Araceae        |     |     |
| Anthurium sinuatum Benth. ex Schott | x | Fernandes, A. (EAC 27781) |
| Caladium bicolor (Aiton) Vent. | x | Fernandes, A. (EAC 28493) |
| Monstera praeternissa E.G.Gonç. & Temponi | x | Loiola, M.I.B. 1804 |
| Philodendron acutatum Schott | x | Fernandes, A. (EAC 27815) |
| P. ornatum Schott | x | Fernandes, A. (EAC 28491) |
| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|-----------------|------------|----------------|
|                  | TSD        |                |
|                  | TSEF       |                |
| **FAMILY / SPECIES** |           |                |
| **VEGETATION** |            |                |
| **MAIN COLLECTOR** |           |                |
| **TSDF** |            |                |
| **TSEF** |            |                |

10. Areaceae

Acrecomia aculeata (Jacq.) Lodd. ex Mart.
Attalea speciosa Mart. ex Spreng.

11. Asteraceae

Acanthospermum australe (Loefl.) Kuntze

Ageratum conyzoides L.

Aspilia andrade-limae J.U.Santos

Blainvillea acmella (L.) Philipson

Bisens cynapiifolia Kunth

B. pilosa L.

Brickellia diffusa (Vahl) A.Gray

Cenchrus punctatus Camss.

Conocliniopsis prasifolia (DC.) R.M.King & H.Rob.

Elephantopus mollis Kunth

Emilia fosbergii Nicolson

E. sonchifolia (L.) DC. ex Wight

Galinsoga parviflora Cav.

Gymnanthemum amygdalinum (Delile) Sch.Bip. ex Walp.

Lepidaploa salzmannii (DC.) H.Rob.

Sphagneticola trilobata (L.) Pruski

Galega angustifolia (Hoffmann) A.Gray

G. asclepiadea (Hoffmann) A.Gray

**FAMILY / SPECIES** |           |                |
| **VEGETATION** |            |                |
| **MAIN COLLECTOR** |           |                |
| **TSDF** |            |                |
| **TSEF** |            |                |

12. Begoniaceae

Begonia reniformis Dryand.

B. saxicola A.DC.

13. Bignoniaceae

Anemopaegma citrinum Mart. ex DC.

Bignonia sp.

Dolichandra unguis-cati (L.) G.Lohmann

Fredricia dispar (Bureau ex K.Schum.) G.Lohmann

E. platypylla (Cham.) G.Lohmann

E. triflinervea (Mart. ex DC.) G.Lohmann

Handroanthus impetiginosus (Mart. ex DC.) Mattos

H. serratifolium (A.H.Gentier) G. Grose

Zeyheria tuberculosa (Vell.) Bureau ex Verl.

14. Bixaceae

Cochlospermum vitifolium (Willd.) Spreng.

15. Boraginaceae

Cordia bicolor A.DC.

C. rufescens A.DC.

C. toqueve Aubl.

C. trichotoma (Vell.) Arrab. ex Steud.

Euploca procumbens (Mill.) Diane & Hilger

Tournefortia membranacea (Gardner) DC.

Varronia leucomalloides (Taroda) J.S.Mill.

16. Burseraceae

Protium heptaphyllum (Aubl.) Marchand

Appendix A. Continued...
### Appendix A. Continued...

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |
| *P. warmingianum* Marchand | x          | Mata, M.F. (EAC 15587) |
| 17. Cactaceae    |            |                |
| *Cereus jamacaru* DC. | x          |                |
| *Epiphyllum phyllanthus* (L.) Haw. | x          | Loiola, M.I.B. 2202 |
| 18. Campanulaceae |            |                |
| *Centropogon cornutus* (L.) Druce | x          | Fernandes, A. (EAC 5090) |
| 19. Cannabaceae  |            |                |
| *Celtis brasiliensis* (Gardner) Planch. | x          | Fernandes, A. (EAC 27793) |
| *C. iguanea* (Jacq.) Sarg. | x          | Loiola, M.I.B. 1822 |
| *Trena micrantha* (L.) Blume | x          | Nurse, E. (EAC 27875) |
| 20. Capparaceae  |            |                |
| *Cynophalla flexuosa* (L.) J. Presl | x          | Fernandes, A. (EAC 27673) |
| *C. hastata* (Jacq.) J.Presl | x          | Fernandes, A. (EAC 27991) |
| 21. Chrysobalanaceae |            |                |
| *Hirtella glandulosa* Spreng. | x          | Fernandes, A. (EAC 3970) |
| 22. Clusiaceae   |            |                |
| *Clusia pana-panari* (Aubl.) Choisy | x          | Fernandes, A. (EAC 27766) |
| 23. Combretaceae |            |                |
| *Buchenavia tetrphylla* (Aubl.) R.A.Howard. | x          | Fernandes, A. (EAC 27750) |
| *Combretum duarteanum* Cambess. | x          | Fernandes, A. (EAC 4002) |
| *C. frutosum* (Loefl.) Stuntz | x          | Loiola, M.I.B. 1845 |
| *C. glaucarpum* Mart. | x          | Loiola, M.I.B. 2219 |
| *C. lanceolatum* Pohl ex Eichler | x          | Loiola, M.I.B. (EAC 53995) |
| *C. laxum* Jacq. | x          | Cavalcanti, E.S. 551 |
| *C. leprosum* Mart. | x          | Nurse, E. (EAC 27829) |
| 24. Commelinaceae |            |                |
| *Dichorisandra hexandra* (Aubl.) Kunte ex Hand-Mazz. | x          | Loiola, M.I.B. 2273 |
| *Floscopa glabrata* (Kunth) Hassk. | x          | Cavalcanti, E.S. 550 |
| 25. Convolvulaceae |            |                |
| *Distimake macroalyx* (Ruiz & Pav.) A.R. Simões & Staples | x          | Fernandes, A. (EAC 27495) |
| *Ipomoea alba* L. | x          | Cavalcanti, E.S. (EAC 28459) |
| *I. blanchetii* Choisy | x          | Fernandes, A. (EAC 27907) |
| *I. brasiliana* (Choisy) Meisn. | x          | Arazito, E.S. 602 |
| *I. marcella* Meisn. | x          | Sterile material |
| *Merremia umbellata* (L.) Hallier f. | x          | Observed |
| 26. Cucurbitaceae |            |                |
| *Cayaponia tayuya* (Vell.) Cogn. | x          | Cavalcanti, E.S. 554 |
| *Psiguria ternata* (M.Roem.) C.Jeffrey | x          | Loiola, M.I.B. 2263 |
| *P. umbrosa* (Kunth) C.Jeffrey | x          | Fernandes, A. (EAC 27884) |
| *Rytidostylis amazonica* (Mart. ex Cogn.) Kunte | x          | Loiola, M.I.B. 2244 |
| 27. Cyperaceae    |            |                |
| *Cyperus laxus* Lam. | x          | Loiola, M.I.B. 1545 |
| *C. odoratus* L. | x          | Loiola, M.I.B. 1790 |
| *C. simplex* Kunth | x          | Loiola, M.I.B. 1797 |
| *Fuirena umbellata* Rottb. | x          | Fernandes, A. (EAC 5073) |
| *Rhynchospora corymbosa* (L.) Britton | x          | Fernandes, A. (EAC 27882) |
| *Scleria latifolia* Sw. | x          | Fernandes, A. (EAC 3978) |
| *S. secans* (L.) Urb. | x          | Loiola, M.I.B. 1490 |
| 28. Dilleniaceae  |            |                |
| *Doliocarpus dentatus* (Aubl.) Standl. | x          | Cavalcanti, E.S. (EAC 28474) |
### Appendix A. Continued...

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|-------------|----------------|
| **29. Dioscoreaceae** | | |
| Dioscorea dodecaneura Vell. | x | Sterile material |
| D. hassleri ana Chodat | x | Fernandes, A. (EAC 28016) |
| D. multiflora Mart. ex Griseb | x | Loiola, M.I.B. 1547 |
| D. orthogoneura Uline ex Hochr. | x | Fernandes, A. (EAC 5003) |
| D. piperifolia Humb. & Bonpl. ex Wild. | x | Fernandes, A. (EAC 8239) |
| **30. Ebenaceae** | | |
| Diospyros inconstans subsp. obovata (Mart. ex Miq.) B.Walln. | x | Fernandes, A. (EAC 5096) |
| D. sericea A.DC. | x | Fernandes, A. (EAC 27869) |
| **31. Elaeocarpaceae** | | |
| Sloanea obtusa (SPLIT.) Schum. | x | Fernandes, A. (EAC 8264) |
| **32. Erythroxylaceae** | | |
| Erythroxylum barbatum O.E.Schulz | x | Fernandes, A. (EAC 27852) |
| E. citrifolium A.St.-Hil. | x | Loiola, M.I.B. 1778 |
| E. deciduum A.St.-Hil. | x | Loiola, M.I.B. 2231 |
| E. laetevirens O.E.Schulz | x | Araújo, ES. 827 |
| E. mucronatum Benth. | x | Loiola, M.I.B. 2255 |
| E. pulchrum A.St.-Hil. | x | Castro, A.S.F. 1378 |
| E. simonis Plowman | x | Loiola, M.I.B. 2211 |
| E. subglaucescens Peyr. | x | Fernandes, A. (EAC 27910) |
| E. subrotundum A.St.-Hil. | x | Costa-Lima, J.L. 2263 |
| **33. Euphorbiaceae** | | |
| Acalypha poiretii Spreng. | x | Fernandes, A. (EAC 27936) |
| A. villosa Jacq. | x | Nunes, E. (EAC 27830) |
| Cnidoscolus urens (L.) Arthur | x | Fernandes, A. (EAC 27716) |
| Croton adenocalyx Baill. | x | Nunes, E. (EAC 27876) |
| C. betaceus Baill. | x | Loiola, M.I.B. 2180 |
| C. blanchetianus Baill. | x | Loiola, M.I.B. 2183 |
| C. floribundus Spreng. | x | Fernandes, A. (EAC 27925) |
| C. hirtus L'Hér. | x | Fernandes, A. (EAC 27927) |
| C. jacobinensis Baill. | x | Loiola, M.I.B. 2214 |
| C. triqueeter Lam. | x | Loiola, M.I.B. 2200 |
| Dalechampia pernambucensis Baill. | x | Fernandes, A. (EAC 27952) |
| D. tiliifolia Lam. | x | Fernandes, A. (EAC 15081) |
| Joannesia princeps Vell. | x | Loiola, M.I.B. 2233 |
| Margaritaria nobilis L.f. | x | Loiola, M.I.B. 1590 |
| Microstachys corniculata (Vahl) Griseb. | x | Fernandes, A. (EAC 27935) |
| Tragia caearensis Pax & K.Hoffm. | x | Loiola, M.I.B. 1475 |
| **34. Fabaceae** | | |
| Aeschynomene paniculata Willd. ex Vogel | x | Fernandes, A. (EAC 8241) |
| A. sensitiva Sw. | x | Fernandes, A. (EAC 3949) |
| Abirzia polycephala (Benth.) Killip ex Record | x | Loiola, M.I.B. 1938 |
| Anadenanthera colubrina var. cebil (Griseb.) Altschul | x | Fernandes, A. (EAC 27782) |
| Ancistrotropus peduncularis (Kunth) A.Delgado | x | Fernandes, A. (EAC 3930) |
| Andira vermitiuga Mart. ex Benth. | x | Fernandes, A. (EAC 7947) |
| Apuleia leioarpa (Vogel) J.F.Macbr. | x | Fernandes, A. (EAC 4094) |
| Atelia guaraya Herzog | x | Fernandes, A. (EAC 3957) |
| Bauhinia pulchella Benth. | x | Loiola, M.I.B. 1978 |
| B. unguulata L. var. unguulata | x | Loiola, M.I.B. 1947 |
| Bowdichia virgilioides Kunth | x | Fernandes, A. (EAC 3936) |
| Calopogonium mucunoides Desv. | x | Fernandes, A. (EAC 4012) |
| FAMILY / SPECIES                      | VEGETATION | MAIN COLLECTOR           |
|--------------------------------------|------------|--------------------------|
|                                       | TSDF       | TSEF                     |
| C. velutinum (Benth.) Amshoff         |            |                         |
| Canavalia grandiflora Benth.         | x          | Fernandes, A. (EAC 27497) |
| Cassia ferruginea (Schrad.) Schrad. ex DC. | x          | Loiola, M.I.B. 1935      |
| Centrosema brasilianum (L.) Benth. var. brasilianum | x          | Fernandes, A. (EAC 3929) |
| C. sagittatum (Humb. & Bonpl. Ex Willd.) Brandegee | x          | Loiola, M.I.B. 1486      |
| Chamaecrista duckeana (PBezerra & Afr.Fern.) H.S.Irwin & Barneby | x          | Fernandes, A. (EAC 27853) |
| Chamaecrista rotundifolia (Pers.) Greene | x          | Fernandes, A. (EAC 27990) |
| Copaifera ducxi Dwyer                | x          | Loiola, M.I.B. 1895      |
| Crotalaria incana L.                 | x          | Fernandes, A. (EAC 3964) |
| C. retusa L.                         | x          | Fernandes, A. (EAC 3984) |
| C. stipularia Desv.                  | x          | Fernandes, A. (EAC 3948) |
| Dalbergia cearensis Ducke            | x          | Fernandes, A. (EAC 3935) |
| Deguelia nitidula (Benth.) A.M.G.Azevedo & R.A. Camargo | x          | Araújo, F.S. (UEC 96442) |
| Desmodium axillare (Sw.) DC.          | x          | Loiola, M.I.B. 1488      |
| D. barbatum (L.) Benth.               | x          | Fernandes, A. (EAC 3913) |
| D. distortum (Aubl.) J.F.Macbr.       | x          | Fernandes, A. (EAC 3900) |
| D. incanum (Sw.) DC.                 | x          | Fernandes, A. (EAC 27749) |
| D. uncinatum (Jacq.) DC.             | x          | Fernandes, A. (EAC 3934) |
| Dioeclea megacarpa Rolfe              | x          | Loiola, M.I.B. 1864      |
| D. sclerocarpa Ducke                  | x          | Loiola, M.I.B. 1805      |
| D. virgata (Rich.) Amshoff            | x          | Cavalcanti, F.S. 560     |
| Galactia striata (Jacq.) Urb.         | x          | Fernandes, A. (EAC 4009) |
| Hymenaea coubaril L.                 | x          | Loiola, M.I.B. 1926      |
| Indigofera suffruticosa Mill.         | x          | Cavalcanti, F.S. 28463   |
| Inga alba (Sw.) Wild.                 | x          | Loiola, M.I.B. 1921      |
| L. ingoides (Rich.) Wild.             | x          | Loiola, M.I.B. 1829      |
| Libidibia ferrea (Mart. ex Tul.) L.P. Queiroz var. ferrea | x          | Loiola, M.I.B. 1846      |
| Machaerium acutifolium Vogel          | x          | Cavalcanti, F.S. 534     |
| M. amplum Benth.                      | x          | Loiola, M.I.B. 1827      |
| M. hirtum (Vell.) Stellfeld           | x          | Loiola, M.I.B. 1930      |
| Mimosa caesalpinifolia Benth.         | x          | Loiola, M.I.B. 2191      |
| M. candollei R. Grether              | x          | Fernandes, A. (EAC 27893) |
| M. parabuna Barneby                   | x          | Fernandes, A. (EAC 3962) |
| M. xanthocentra Mart.                | x          | Fernandes, A. (EAC 3908) |
| Mucuna sloanei Fawc. & Rendle         | x          | Loiola, M.I.B. 52593     |
| Myroxyylon peruaiferum L.f.           | x          | Fernandes, A. (EAC 10788) |
| Ormosia arborea (Vell.) Harms         | x          | Fernandes, A. (EAC 27778) |
| Periandra coccinea (Schrader) Benth.  | x          | Loiola, M.I.B. 1815      |
| Phanera glabra (Jacq.) Vaz            | x          | Loiola, M.I.B. 1928      |
| P. oitumoua (Aubl.) L.P.Queiroz       | x          | Andrade, M. (EAC 28711)  |
| Pterocarpus sp.                      | x          | Sterile material         |
| Pierogyne nitens Tul.                 | x          | Fernandes, A. (EAC 3938) |
| Rhynchosia phaseoloides (Sw.) DC.     | x          | Fernandes, A. (EAC 15585) |
| Senegalia polyphylla (DC.) Britton & Rose | x          | Loiola, M.I.B. 1931      |
| S. tenuifolia (L.) Britton & Rose     | x          | Loiola, M.I.B. 1544      |
| Senna pendula var. dolichandra H.S.Irwin & Barneby | x          | Fernandes, A. (EAC 3906) |
| S. obtusifolia (L.) H.S.Irwin & Barneby | x          | Fernandes, A. (EAC 27921) |
| S. pilifera (Vogel) H.S.Irwin & Barneby | x          | Fernandes, A. (EAC 4000) |
| S. rizzinii H.S.Irwin & Barneby       | x          | Cavalcanti, F.S. 539     |
| Stryphnodendron guianense (Aubl.) Benth. | x          | Loiola, M.I.B. 1936      |
### Appendix A. Continued...

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|-------------|----------------|
| Stylosanthes capitata Vogel | x | Fernandes, A. (EAC 3958) |
| S. scabra Vogel | x | Fernandes, A. (EAC 3965) |
| **35. Gesneriaceae** | | |
| Drymonia serrulata (Jacq.) Mart. | x | Castro, A.S.F. (EAC 24892) |
| Sinningia nordestina Chautems, Baracho & Siqueira-Filho | x | Loiola, M.I.B. 1812 |
| Sphaerorrhiza sarmentiana (Gardner ex Hook) Roalson & Boggan | x | Fernandes et al. (EAC 28014) |
| **36. Heliconiaceae** | | |
| Heliconia psittacorum L.f. | x | Loiola, M.I.B. 1780 |
| H. spathocircinata Aristeg. | x | Fernandes, A. (EAC 3971) |
| **37. Hernandiaceae** | | |
| Sparattanthelium botucudorum Mart. | x | Loiola, M.I.B. 2242 |
| **38. Hypericaceae** | | |
| Vismia guianensis (Aubl.) Choisy | x | Fernandes, A. (EAC 27762) |
| **39. Iridaceae** | | |
| Eleuthereine bulbosa (Mill.) Urb. | x | Nunes, E. (EAC 27872) |
| **40. Lamiaceae** | | |
| Hyptis atrorubens Poit. | x | Fernandes, A. (EAC 3967) |
| Cantinoa mutabilis (Rich.) Harley & J.F.B. Pastore | x | Fernandes, A. (EAC 3979) |
| Marsypianthes chamaedrysa (Vahl) Kuntze | x | Fernandes, A. (EAC 27890) |
| Ocimum gratissimum L. | x | Fernandes, A. (EAC 3992) |
| Vitex panshiniana Moldenke | x | Fernandes, A. (EAC 14839) |
| **41. Lauraceae** | | |
| Aïouea saligna Meissn. | x | Sterile material |
| Ocotea glomerata (Nees) Mez | x | Fernandes, A. (EAC 28013) |
| Ocotea sp. | x | Sterile material |
| **42. Lythraceae** | | |
| Cuphea impatiensfolia A. St.-Hil. | | Fernandes, A. (EAC 27912) |
| **43. Loganiaceae** | | |
| Strychnos sp. | x | Sterile material |
| **44. Malpighiaceae** | | |
| Banisteriopsis stellaris (Griseb.) B. Gates | x | Sterile material |
| Bunchosia pernambucana W.R.Anderson | x | Fernandes, A. (EAC 27801) |
| Byrsonima crispa A.Juss. | x | Loiola, M.I.B. 1933 |
| B. sericea DC. | x | Fernandes, A. (EAC 3914) |
| Byrsonima sp. | x | Sterile material |
| Diplodipterys pubipetala (A.Juss.) W.R. Anderson & C. Davis | x | Fernandes, A. (EAC 27736) |
| Heteropterys coeloptera A.Juss. | x | Sterile material |
| H. macrodena (DC.) W.R.Anderson | x | Fernandes, A. (EAC 7940) |
| Janusia anisandra (A.Juss.) Griseb | x | Sterile material |
| **45. Malvaceae** | | |
| Apeiba tibourbou Aubl. | x | Loiola, M.I.B. 2224 |
| Brioquetastrum spicatum (Kunth) Bovini | x | Fernandes, A. (EAC 4007) |
| Byttneria catalpifolia Jacq. | x | Loiola, M.I.B. 2265 |
| Callianthe bezerrae (Monteiro) Donnel | x | Fernandes, A. (EAC 31063) |
| Ceiba glaziovii (Kuntze) K. Schum. | x | Observed |
| Guaizuma almifolia Lam. | x | Loiola, M.I.B. 1542 |
| Helicteres heptandra L.B.Sm. | x | Loiola, M.I.B. 2220 |
| Luehea sp. | x | Sterile material |
| Melochia nodiflora Sw. | x | Fernandes, A. (EAC 4003) |
| Pavonia cancellata (L.) Cav. | x | Lima-Verde, L.W. 2390 |
## Appendix A. Continued...

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *P. malacophylla* (Link & Otto) Garcke | x          | Loiola, M.I.B. 1929 |
| *Peltrea trinervis* (C.Presl) Krapov. & Cristóbal | x          | Fernandes, A. (EAC 5074) |
| *Pseudobombax marginatum* (A.St.-Hil., Juss. & Cambess.) A. Robyns | x          | Sterile material |
| *Sida acuta* Burm.f. | x          | Fernandes, A. (EAC 27937) |
| *Sida cordifolia* L. | x          | Fernandes, A. (EAC 27693) |
| *S. glutinosa* Comm. ex Cav. | x          | Fernandes, A. (EAC 4195) |
| *S. rhombifolia* L. | x          | Fernandes, A. (EAC 27894) |
| *S. urens* L. | x          | Mata, M.F. (EAC 15599) |
| *Sidastrum micranthum* (A.St.-Hil.) Fryxell | x          | Fernandes, A. (EAC 5091) |
| *Sterculia striata* A.St.-Hil. & Naudin | x          | Sterile material |
| *Triumfetta semitriloba* Jacq. | x          | Cavalcanti, F.S. 556 |
| *Urena lobata* L. | x          | Fernandes, A. (EAC 27821) |
| *Waltheria viscosissima* A.St.-Hil. | x          | Fernandes, A. (EAC 4004) |
| *Wissadula periplocifolia* (L.) C.Presl. ex Thwaites | x          | Fernandes, A. (EAC 2750) |

### 46. Marantaceae

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *Goeppertia effusa* Saka & Lombradi | x          | Fernandes, A. (EAC 27840) |
| *G. squarros* (Anderss. & Kennedy) Borchs. & S.Suárez | x          | Fernandes et al. (EAC 27920) |
| *Maranta protracta* Miq. | x          | Fernandes, A. (EAC 27774) |

### 47. Melastomataceae

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *Acisanthera variabilis* (Mart. & Schrank) Triana. | x          | Fernandes, A. (EAC 27755) |
| *Clidemia bisserrata* DC. | x          | Loiola, M.I.B. 1491 |
| *C. debilis* Crueg. | x          | Castro, A.S.F. 154 |
| *C. hirta* (L.) D.Don | x          | Fernandes, A. (EAC 27866) |
| *Miconia minutiflora* (Bonpl.) DC. | x          | Cavalcanti, F.S. (EAC 28472) |
| *M. nervosa* (Sm.) Triana | x          | Fernandes, A. (EAC 27834) |
| *M. prasina* (Sw.) DC. | x          | Fernandes, A. (EAC 8211) |

### 48. Meliaceae

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *Cedrela odorata* L. | x          | Matos (EAC 6897) |
| *Guarea macrophylla* subsp. *tuberculata* (Vell.) T.D.Penn. | x          | Fernandes, A. (EAC 27775) |
| *Trichilia hirta* L. | x          | Fernandes, A. (EAC 5009) |

### 49. Molluginaceae

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *Mollugo verticillata* L. | x          | Fernandes, A. (EAC 27823) |

### 50. Moraceae

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *Brosimum gaudichaudii* Trécul | x          | Fernandes, A. (EAC 27739) |
| *Ficus broadwayi* Urb. | x          | Loiola, M.I.B. 1543 |
| *Maclura tinctoria* (L.) D.Don ex Steud. | x          | Fernandes, A. (EAC 27838) |

### 51. Myrsinaceae

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *Myrsineguianensis* (Aubl.) Kuntze | x          | Fernandes, A. (EAC 27857) |

### 52. Myrtaceae

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
|                  | TSDF       | TSEF           |                  |
| *Campomanesia aromatica* (Aubl.) Griseb. | x          | Fernandes et al. (EAC 27806) |
| *Eugenia supraaxilaris* Spring | x          | Sterile material |
| *E. dysenterica* DC. | x          | Sterile material |
| *E. flavescens* DC. | x          | Sterile material |
| *E. florida* DC. | x          | Fernandes, A. (EAC 28012) |
| *E. pachnantha* O.Berg | x          | Fernandes, A. (EAC 4011) |
| *Eugenia* sp. | x          | Sterile material |
| *Myrcia multiflora* (Lam.) DC. | x          | Sterile material |
| *Myrcia sp.1* | x          | Fernandes, A. (EAC 27800) |
| *Myrcia sp.2* | x          | Sterile material |
| *Psidium* sp. | x          | Fernandes, A. (EAC 27502) |

### 53. Nyctaginaceae
### Appendix A. Continued...

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|-------------|----------------|
| **FAMILY** / **SPECIES** | **TSDF** | **TSEF** | **MAIN COLLECTOR** |
| Guapira graciliflora (Mart. ex Schmidt) Lundell | x | | Fernandes, A. et al. (EAC 28018) |
| G. opposita (Vell.) Reitz | x | | Sterile material |
| **54. Ochnaceae** | | | |
| Ouratea salicifolia (A.St.-Hil. & Tul.) Engl. | x | | Fernandes, A. (EAC 5010) |
| Sauvagesia erecta L. | x | | Fernandes, A. (EAC 27776) |
| **55. Olacaceae** | | | |
| Cathedra rubraulis Miers | x | | Fernandes, A. (EAC 5025) |
| **56. Opiliaceae** | | | |
| Agonandra brasiliensis Miers ex Benth. & Hook.f. | x | x | Fernandes, A. (EAC 27758) |
| **57. Orchidaceae** | | | |
| Oeceoclades maculata (Lind.) Lindl. | x | | Loiola, M.I.B. 1538 |
| Polystachya concreta (Jacq.) Garay & Sweet | x | | Fernandes, A. (EAC 27905) |
| **58. Oxalidaceae** | | | |
| Oxalis alstonii Lourteig | x | | Loiola, M.I.B. 2197 |
| O. cratensis Oliv. ex Hook. | x | | Loiola, M.I.B. 1496 |
| O. grisea A.St.-Hil. & Naudin | x | | Loiola, M.I.B. 1539 |
| O. triangularis A.St.-Hil. | x | | Loiola, M.I.B. 1507 |
| **59. Passifloraceae** | | | |
| Passiflora cincinnata Mast. | x | | Fernandes, A. (EAC 27757) |
| P. glandulosa Cav. | x | | Castro, A.S.F. 1653 |
| P. laurifolia L. | x | | Fernandes, A. (EAC 27825) |
| P. misera Kunth | x | | Sterile material |
| P. suberosa L. | x | | Sterile material |
| P. tricuspis Mast. | x | | Sterile material |
| Passiflora sp. | x | | Sterile material |
| **60. Phyllanthaceae** | | | |
| Phyllanthus subermaginatus Mull.Arg. | x | | Castro, A.S.F. 1654 |
| P. tenellus Roxb. | x | | Loiola, M.I.B. 1498 |
| **61. Phytolaccaceae** | | | |
| Gallesia integrifolia (Spreng.) Harms | x | | Fernandes, A. (EAC 8668) |
| Microtea glochidiata Moq. | x | | Fernandes, A. (EAC 27859) |
| **62. Piperaceae** | | | |
| Peperomia cincinnata Link | x | | Loiola, M.I.B. 1844 |
| Piper arboreum Aubl. | x | x | Fernandes, A. (EAC 27753) |
| P. caldense C.DC. | x | | Fernandes, A. (EAC 27727) |
| P. divaricatum G.Mey. | x | | Fernandes, A. (EAC 27939) |
| P. hispidum Sw. | x | | Fernandes, A. (EAC 27731) |
| P. tuberculatum Jacq. | x | | Cavalcanti, F.S. (EAC 28461) |
| **63. Plantaginaceae** | | | |
| Scoparia dulcis L. | x | | Loiola, M.I.B. 1526 |
| **64. Plumbaginaceae** | | | |
| Plumbago scandens L. | x | | Cavalcanti, F.S. (EAC 28466) |
| **65. Poaceae** | | | |
| Homolepis isocalycia (G.Mey.) Chase | x | | Fernandes, A. (EAC 28221) |
| Lasiacis ligulata Hitchc. & Chase | x | | Fernandes, A. (EAC 3912) |
| Megathyrsus maximus (Jacq.) B.K.Simon & S.W.L.Jacobs | x | | Fernandes, A. (EAC 27804) |
| Olyra latifolia L. | x | | Fernandes, A. (EAC 27895) |
| Opismenus hirtellus (L.) P.Beauv. | x | | Loiola, M.I.B. 1796 |
| Panicum millegrana Poir. | x | | Fernandes, A. (EAC 4225) |
| Setaria adhaerens (Forssk.) Chiov. | x | | Fernandes, A. (EAC 27911) |
| **66. Podostemaceae** | | | |
| Apinagia gardneriana Tul. | x | | Fernandes, A. (EAC 8671) |
Appendix A. Continued...

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
| **67. Polygalaceae** | | |
| Bredemeyera brevifolia (Benth.) Klotzsch ex A.W.Benn. | x | Bezerra, P. (EAC 5095) |
| Bredemeyera floribunda Willd. | x | Fernandes, A. (EAC 3890) |
| Polygala sp. | x | Martins, P. (EAC 8238) |
| **68. Polygonaceae** | | |
| Coccoloba mollis Casar | x | Loiola, M.I.B. 1924 |
| Triplaris gardneriana Wedd. | x | Loiola, M.I.B. 2059 |
| **69. Portulacaceae** | | |
| Talinum triangulare(Jacq.) Willd. | x | Fernandes, A. (EAC 27950) |
| **70. Ranunculaceae** | | |
| Clematis affine A.St.-Hil. | x | Fernandes, A.P. (EAC 15141) |
| **71. Rhamnaceae** | | |
| Gouania virgata Reissek | x | Loiola, M.I.B. 1546 |
| Ziziphus undulata Reissek | x | Fernandes, A. (EAC 27499) |
| **72. Rubiaceae** | | |
| Bertiera guianensis Aubl. | x | Loiola, M.I.B. 1480 |
| Borreria verticillata (L.) G.Mey. | x | E.B. Souza |
| Chomelia pohliana Müll.Arg. | x | Brandão, E.K.S. 56 |
| Coussarea hydrangeifolia (Benth.) Müll.Arg. | x | Souza, E.B. 2042 |
| Coutarea hexandra (Jacq.) K. Schum. | x | Sterile material |
| Geophila repens (L.) R.M.Johnst. | x | Loiola, M.I.B. 1786 |
| Guettarda viburnoides Cham. & Schltdl. | x | Loiola, M.I.B. 2205 |
| Isora brevifolia Benth. | x | Fernandes, A. (EAC 3943) |
| Palicourea marcgavri A.St.-Hil. | x | Loiola, M.I.B. 1479 |
| Psychotria bahiensis DC. | x | Loiola, M.I.B. 1478 |
| P. capitata Ruiz & Pav. | x | Loiola, M.I.B. 1783 |
| P. carthagenensis Jacq. | x | Loiola, M.I.B. 1789 |
| P. colorata (Willd. ex Schult.) Müll.Arg. | x | Loiola, M.I.B. 1482 |
| P. deflexa DC. | x | Loiola, M.I.B. 1781 |
| Psychotria sp. | x | Sterile material |
| Randia armata (Sw.) DC. | x | Loiola, M.I.B. 1847 |
| Rudgea sp. | x | Fernandes, A. (EAC 28000) |
| Sabicea cinerea Aubl. | x | Fernandes, A. (EAC 4215) |
| **73. Rutaceae** | | |
| Ertela trifolia (L.) Kuntze | x | Souza, E.B. 3974 |
| Esenbeckia grandflora Mart. | x | Cavalcanti, F.S. (EAC 28460) |
| Zanthoxylum caribaeum Lam. | x | Fernandes, A. (EAC 27752) |
| Z. rhoifolium Lam. | x | Loiola, M.I.B. 2239 |
| **74. Salicaceae** | | |
| Banara guianensis Aubl. | x | Loiola, M.I.B. 2232 |
| Casearia commersoniana Cambess. | x | Fernandes, A. (EAC 27685) |
| C. decandra Jacq. | x | Loiola, M.I.B. 2208 |
| C. grandiflora Cambess. | x | Fernandes, A. (EAC 27744) |
| C. javitensis Kunth | x | Loiola, M.I.B. (EAC 53993) |
| Xylosma ciliatifolia (Clos) Eichler | x | Lima-Verde, L.W. (EAC 27836) |
| **75. Santalaceae** | | |
| Phoradendron piperoides (Kunth) Trel. | x | Fernandes, A. (EAC 27833) |
| **76. Sapindaceae** | | |
| Allophylus edulis (A.St.-Hil. et al.) Hieron. ex Niederl. | x | Loiola, M.I.B. 1474 |
| A. puberulus Radlk | x | Fernandes, A. (EAC 27917) |
| Cardiopermum corindum L. | x | Castro, A.I. (EAC 6149) |
| Cupania impressinervia Acev.-Rodr. | x | Fernandes, A. (EAC 5004) |
### Appendix A. Continued...

| FAMILY / SPECIES | VEGETATION | MAIN COLLECTOR |
|------------------|------------|----------------|
| **C. oblongifolia Mart.** | x | Sterile material |
| Matayba guianensis Aubl. | x | Fernandes, A. (EAC 27742) |
| *Paullinia cearensis* Somner & Ferrucci | x | Fernandes, A. (EAC 27799) |
| E. pinata L. | x | Fernandes, A. (EAC 27796) |
| *Paullinia* sp. | x | Sterile material |
| Serjania glabrata Kunth | x | Loiola, M.I.B. 1821 |
| S. hebecarpa Benth. | x | Fernandes, A. (EAC 3928) |
| Serjania sp. | x | Sterile material |
| Talisia esculenta (Cambess.) Radlk. | x | Loiola, M.I.B. 1920 |
| *Urvillea laevis* Radlk. | x | Fernandes, A. (EAC 15135) |
| 77. Sapotaceae | | |
| Chrysophyllum arenarium Allemão | x | Cavalcanti, F.S. 530 |
| C. rufum Mart. | x | Fernandes, A. (EAC 7950) |
| *Pouteria macrophylla* (Lam.) Eyma | x | Loiola, M.I.B. 2210 |
| 78. Simaroubaceae | | |
| Simarouba amara Aubl. | x | Fernandes, A. (EAC 27737) |
| 79. Smilacaceae | | |
| Smilax irrorata Mart. ex Griseb | x | Loiola, M.I.B. 2212 |
| 80. Solanaceae | | |
| Actinistus arborescens (L.) Schltdl. | x | Nunes, E. (EAC 27789) |
| Capsicum parvifolium Sendtn. | x | Fernandes, A. (EAC 27826) |
| Cestrum axillare Vell. | x | Mata, M.F. (EAC 15617) |
| C. latifolium Lam. | x | Fernandes, A. (EAC 5081) |
| Schwenckia grandiflora Benth. | x | Fernandes, A. (EAC 3968) |
| Solanum asperum Rich. | x | Loiola, M.I.B. 2237 |
| S. campaniforme Roem. & Schult. | x | Fernandes, A. (EAC 27843) |
| S. robustum H.L.Wendl. | x | Fernandes, A. (EAC 27957) |
| S. stipulaceum Willd. ex Roem. & Schult. | x | Fernandes, A. (EAC 27870) |
| 81. Urticaceae | | |
| Cecropia pachystachya Trécul | x | Cavalcanti, F.S. 533 |
| Ureora caracasana (Jacq.) Gaudich. ex Griseb. | x | Carauta, J.P.P. 550 |
| 82. Verbenaceae | | |
| Citharexylum sp. | x | Fernandes, A. (EAC 6840) |
| Lantana canescens Kunth | x | Fernandes, A. (EAC 4005) |
| L. fucata Lindl. | x | Fernandes, A. (EAC 7939) |
| Stachytarpheta cayenensis (Rich.) Vahl. | x | Fernandes, A. (EAC 3999) |
| 83. Violaceae | | |
| Pombalia communis (A.St.-Hil.) Paula-Souza | x | Fernandes, A. (EAC 5655) |
| 84. Vitaceae | | |
| Cissus gonglyodes (Baker) Planch. | x | Loiola, M.I.B. 1593 |
| Clematicissus simsiana (Schult. & Schult.f.) Lombardi | x | Fernandes, A. (EAC 27929) |
### Appendix B. List of alien species of the Tropical Seasonal Evergreen Forest (TSEF) and the Tropical Seasonal Deciduous Forest (TSDF) of the Ubajara National Park in Ceará, Brazil, where VN = vernacular name; GF = Growth form: tree (tr), shrub (sh), climber (cl), terrestrial herb (th); O = outskirts, I = inside, x = presence of taxa, * absence of vernacular name.

| FAMÍLIA/ESPÉCIE | VN | GF        | TSEF | TSDF |
|-----------------|----|-----------|------|------|
|                 |    |           | O    | I    |
|                 |    |           | x    | x    |
|                 |    |           | x    | x    |
| 1. Amaryllidaceae |    |           |      |      |
| Crinum procerum Carey ex Herb. | crino-branco | th | x |
| Eucharis grandiflora Planch. & Lindén | estrela-d'alva | th | x |
| Hymenocallis littoralis (Jacq.) Salisb | lirio-aranha | th | x |
|                 |   |           |      |      |
| 2. Anacardiaceae |    |           |      |      |
| Mangifera indica L. | mangueira | tr | x | x | x |
|                 |   |           |      |      |
| 3. Annonaceae |    |           |      |      |
| Annona squamosa L. | atá | tr | x | x | x | x |
|                 |   |           |      |      |
| 4. Apocynaceae |    |           |      |      |
| Allamanda cathartica L. | alamanda | cl | x | x |
| Calotropis procera (Aiton) W.T.Aiton | algodão-da-praia | th | x |
| Cryptostegia madagascariensis Bojer ex Decne. | unha-do-diabo | th | x | x | x |
| 5. Araceae |    |           |      |      |
| Aglagonema commutatum Schott | café-de-salão-dourado | th | x | x |
| Anthurium andraeanum L. | antúrio | th | x |
| Caladium × hortulanum Birdsey | tinhórao | th | x |
| Dieffenbachia amoena Bull. | comigo-ninguém-pode | th | x |
| Philodendron imbe Schott ex Endl * | th | x | x |
| Spathiphyllum cannifolium (Dryand. ex Sims) Schott | * | th | x |
| 6. Arecaceae |    |           |      |      |
| Chamaedorea cataractarum Mart. | palmeira-cascata | tr | x | x |
| 7. Balsaminaceae |    |           |      |      |
| Impatiens walleriana Hook.f. | maria-sem-vergonha | th | x |
| 8. Davalliaceae |    |           |      |      |
| Nephrolepis biserrata (Sw.) Schott | rabo-de-peixe | th | x | x | x |
| N. pectinata (Willd.) Schott | samambaia | th | x | x |
| 9. Heliconiaceae |    |           |      |      |
| Heliconia bihai L. | * | tr | x | x | x | x |
| H. psittacorum L. | helicónia, bananinha | tr | x | x |
| 10. Iridaceae |    |           |      |      |
| Neomarica candida (Hassl.) Sprague | falso-iris | th | x | x |
| 11. Melastomataceae |    |           |      |      |
| Tibouchina sp. | quaresmeira | sh | x | x |
| 12. Meliaceae |    |           |      |      |
| Azadirachta indica A. Juss | nim | tr | x | x | x | x |
| 13. Moraceae |    |           |      |      |
| Artocarpus heterophyllus Lam. | jaqueira | tr | x | x | x | x |
| 14. Poaceae |    |           |      |      |
| Bambusa sp. | bambu | tr | x | x |
| 15. Rubiaceae |    |           |      |      |
| Coffea arabica L. | café | sh | x | x | x | x |
| 16. Rutaceae |    |           |      |      |
| Citrus latifolia Tan. | limoeiro | tr | x | x |
| 17. Zingiberaceae |    |           |      |      |
| Alpinia purpurata (Vieill.) K.Schum. | * | sh | x | x | x | x |