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# Records of endangered vascular plant species in Sergipe State, Brazil

*Registros de espécies de plantas vasculares ameaçadas de extinção no estado de Sergipe, Brasil*

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## Abstract

Knowing the geographic distribution of endangered species is essential to manage actions and to identify conservation areas demanding priority. The aim of the present study is to gather information on the geographic distribution of endangered vascular plant species in Sergipe State. The vulnerable, endangered and critically endangered categories of the "Official List of Threatened Species of the Brazilian Flora" and data on speciesLink, the Reflora Virtual Herbarium and the National Center for Plant Conservation were used in the study. The search led to 32 endangered vascular plant species in Sergipe. In total, 17 species of this total are in danger of extinction and 15 are vulnerable. Most of these species are endemic trees to Brazil found in Atlantic Forest remnants. There is at least one endangered species in 46.7% of municipalities in the state. Therefore, sampling efforts in forest remnants must be expanded to get new records and to elaborate an official list of endangered species in Sergipe.

**Keywords**
Floristics. Inventory. Biodiversity. Red list. Conservation.

## *Resumo*

*O conhecimento sobre a distribuição geográfica das espécies ameaçadas é fundamental para ações de manejo e identificação de áreas prioritárias para a conservação. Esse estudo teve como objetivo sistematizar as informações referentes à distribuição geográfica de espécies de plantas vasculares ameaçadas de extinção no estado de Sergipe. Foram utilizadas as categorias vulnerável, em perigo e criticamente em perigo da "Lista Oficial de Espécies da Flora Brasileira Ameaçadas de Extinção", além dos dados disponíveis no speciesLink, Herbário Virtual Reflora e no Centro Nacional de Conservação da Flora. O levantamento resultou em 32 espécies de plantas vasculares ameaçadas de extinção em Sergipe. Destas, 17 espécies encontram-se em perigo de extinção e 15 são vulneráveis. A maioria das espécies são árvores, endêmicas do Brasil e ocorrem em áreas de Mata Atlântica. Em 46,7% dos municípios existem pelo menos uma espécie ameaçada. Sugere-se a ampliação do esforço amostral de coletas em remanescentes florestais para verificação de novos registros e a elaboração da lista oficial de espécies ameaçadas de extinção em Sergipe.*

***Palavras-chave***
*Florística. Inventário. Biodiversidade. Lista vermelha. Conservação.*

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## Introduction

The word biodiversity can have different definitions. It can be understood from more restricted to broader scales when it comes to species. These definitions often cover numerical diversity (species richness), genetic diversity (gene variability in individuals) and ecological diversity (distribution in different habitats and ecosystems) (Purvis; Hector, 2000). Species are units connected by morphology, genetics, ecology, geographic distribution, reproductive systems and other important descriptors used for decision-making in different knowledge fields (Judd et al., 2009).

Biological collections also work as large repositories when they are associated with botanical organisms because they make data sharing between researchers around the world easier (Pearce et al., 2020). Herbaria successfully show how the diversity of their archives acts as core element to assess the past and to open new windows for further studies (Shweta et al., 2024). Moreover, small herbaria provide interesting information to fill knowledge gaps (Marsico et al., 2020).

This understanding becomes crucial if one bears in mind that there are approximately 374 thousand species on the planet and a number close to two thousand new species is cataloged every year, mainly in Australia, Brazil, China and New Guinea (Christenhusz; Byng, 2016). Brazil holds from 8.8% to 12.8% of total terrestrial vascular plant species on the planet (Forzza, 2010). The country documented from 1.380 to 1.420 native fern and lycophyte species, from 23 to 122 gymnosperm species and 32.696 to 36.600 angiosperm species (BFG, 2022).

Although biodiversity is recent compared to the planet's formation, a decrease in species diversity has occurred throughout history. In recent decades, however, this decline has accelerated, largely driven by various forms of environmental disruption, the intensity and effects of these changes remain not fully understood (Boef, 2007). Changes in land and sea use, direct exploitation of organisms and climate change are among the main global causes of biodiversity loss (Nic Lughadha et al., 2020).

Several criteria are used to calculate such endangerment risk. According to these criteria, a given species can be associated with categories such as not assessed (NE), insufficient data (DD), least concern (LC), near threatened (NT), vulnerable (VU), endangered (EN), critically endangered (CR), extinct in the wild (EW) and extinct (EX) (IUCN, 2022). The total of 1.974 species belonging to the spermatophyte plant group (gymnosperms and angiosperms) were classified into the CR, EN or VU categories in Brazil (BFG, 2015). However, only 15.5% of the total number of native plant species have been assessed for extinction risk and only half of this percentage falls into one of the endangered categories (Martins et al., 2018).

With respect to Sergipe State, 1.864 native gymnosperm and angiosperm plant species were cataloged (BFG, 2022). Twenty-eight (14.5%) of its 193 flora species assessed by taxonomists for extinction risk are endangered (Martins et al., 2018). Nine of the 530 species recorded in this state's National Forest Inventory are classified as endangered (SFB, 2017).

Elaborating official risk lists is one of the actions to identify endangered species. Some states like Bahia, Espírito Santo, Minas Gerais and Rio Grande do Sul have state endangered species lists (Biodiversitas, 2008; SEMA, 2014; SEMA, 2017; DIO/ES, 2022). Unfortunately, Sergipe does not have one, despite the monograph of several families described in three volumes of its flora (Prata et al., 2013; 2015; 2018).

Therefore, studies to support the elaboration of an endangered species lists for Sergipe State are essential. Knowing these species' geographic distribution is paramount at the time to take targeted managerial actions and to identify conservation areas demanding priority. Thus, the aim of the present study was to gather information on the distribution of endangered vascular plant species in Sergipe State based on records of botanical specimes collected in the state and made available in virtual herbaria.

## Materials and Methods

Sergipe State, Northeastern Brazil, is the smallest state in the country and its territory covers 21.938 km² (IBGE, 2022). Its vegetation encompasses remnants of two phytogeographical domains, *Caatinga* (Brazilian Seasonal Dry Forest) and Atlantic Forest, as well as seasonal forests, mangroves and *restinga* (Brazilian Sandy Coastal) phytophysiognomies, besides the transition zone known as Agreste, which presents intermediate climate and floristic features (Farias, 2013). Only 5% of its territory is protected, and these protection areas are distributed among 23 federal, state, municipal areas, and private reserves (SFB, 2017).

Initially, the "Official List of Species of Brazilian flora threatened by extinction" was provided on GM/MMA Ordinance n. 300, from December 13, 2022 (MMA, 2022). It was used to better understand the endangered species in Brazil and their categories. This list was officially adopted in Brazil to assess species' extinction risk based on categories defined by the International Union for Conservation of Nature (IUCN, 2022). It only takes VU, EN and CR as endangered species categories, and it does not include DD, LC and NT species in these categories. Therefore, the same standard was herein adopted to elaborate the list of endangered vascular plant species in Sergipe, which only included species belonging to the first three aforementioned categories, although the other categories are equally important.

Information on species geographic distribution in municipalities, on phytogeographic domains and phytophysiognomy in Sergipe State was gathered through searches carried out from January to March 2023, and in July 2025, at the *species*Link virtual herbaria database (CRIA, 2025). The search was made based on filling the fields "scientific name" of each species and Sergipe "state". Exsiccate images were analyzed to check correct species identification by botanical specialists. Species with erroneous or doubtful identification were excluded from the study.

Searches were made based on scientific name at the Reflora Virtual Herbarium (Reflora, 2025) and National Center for Plant Conservation - CNCFLORA (CNCFlora, 2025) in order to determine family, life form, whether it was endemic to Brazil and the geographic distribution of the confirmed endangered species in Brazil. All the collected data were organized and analyzed in Excel software.

Samples recorded within the borders of Sergipe and deposited in national and international herbaria (ALCB, ASE, CEPEC, CWN, DVPR, EAC, FURB, HEPH, HPER, HST, HUEFS, HUESB, HUFSJ, HURB, INPA, IPA, JPB, LAG, LUSC, MAC, MBM, MFS, NY, PEUFR,RBR, SORO, SPF, SPFR, SP, TEPB, UB, UEC, UFG, UFP, VIC, VIES, codes according to Thiers (updated continuously) were accessed via *species*Link (CRIA, 2025) to trace species distribution points. Duplicate records with the same geographic coordinates were excluded to avoid redundancies. Spatial analysis was carried out in QGIS 3.28 software (Quantum GIS Development Team, 2024). The points were plotted into a map and their distribution in phytogeographic domains *Caatinga* (Brazilian Seasonal Dry Forest) and Atlantic Forest were assessed, as well as their distribution in one of the 23 protected areas in Sergipe State.

## Results and Discussion

Data on botanical materials collected from virtual herbaria resulted in 32 endangered vascular plant species in Sergipe State, and it represents 19 families and 27 genera (Table 1). All species belong to angiosperms, except for *Anemia dentata* Gardner, which is a fern belonging to family Anemiaceae. *Anemia* Sw. is the second genus in this group and it presents the largest number of species in the state - it was assessed as vulnerable taxon (Andrade et al., 2024).

The number of endangered species should be larger because most of them have limited geographic distribution and were not assessed (NE) by specialists. Accordingly, these plants are not included in the official list of endangered Brazilian flora species. *Aspilia itabaianensis* J.U. Santos (only found in Itabaiana municipality - PARNA Serra de Itabaiana); *Mcvaughia sergipana* Amorim & R.F.Almeida (in Japaratuba and mainly in Pirambu municipalities); and *Melocactus sergipensis* N.P.Taylor & M.V.Meiado (in Simão Dias municipality) are some examples of species that were only distributed in single locations, in Sergipe State. Taylor et al. (2014) assessed *Melocactus sergipensis* based on criteria in the IUCN (2022); they classified it as CR because its population only comprised 120 mature individuals and its habitat has been converted into agricultural areas.

Fabaceae (five species), Sapotaceae (four spp.), Orchidaceae (three spp.), Burseraceae, Meliaceae, Myrtaceae and Ochnaceae (two spp. each) were the families presenting the largest number of endangered species, and they were followed by other families that only presented one species, each (Table 1, Figure 1). This finding is assumingly related to species richness, because Fabaceae, Orchidaceae and Myrtaceae are among the ten largest families in Brazil (BFG, 2022). Along with Asteraceae, Bromeliaceae and Melastomataceae, they hold the largest number of endangered native land plant species (Martins et al., 2018). *Cattleya* Lindl., *Cedrela* P.Browne, *Manilkara* Adans., *Ouratea* Aubl. and *Protium* Burm.f. (two spp. each) were the most representative genera.

With respect to life forms, trees have prevailed (18 species; 56.2%) and they were followed by herbs (seven spp.; 21.9%), shrubs (four spp.; 12.5%), subshrubs (two spp.; 6.2%) and by one palm tree (3.0%) (Figure 2). Overall, most endangered plants in Brazil are herbs and they are followed by trees, shrubs and subshrubs (Martins et al., 2018).

Most herein recorded endangered species (28 spp.; 87.5%) are endemic to Brazil (Table 1). Species that are geographically concentrated in only one location hold higher probability of extinction (Pimm et al., 2014). More than 80% of species belonging to the group of neotropical angiosperms have small distribution area, approximately 100 limited endemic species become extinct on a yearly basis due to forest area losses (Morawetz; Raedig, 2007).

Most cataloged species (26 spp.; 81.3%) only occur in Atlantic Forest, four species (12.5%) only occur in *Caatinga* (Brazilian Seasonal Dry Forest), whereas two species (6.2%) were recorded in both domains (Table 1). Endangered species occur in all Brazilian domains; however, the highest percentage (number of endangered species due to total assessed species) is currently concentrated in *Cerrado* (44.2%), Atlantic Forest (43.9%), *Caatinga* (34.6%), *Pampa* (34.3%), Amazon Rainforest (12.8%) and *Pantanal* (12.5%) (Martins et al., 2018).

The Atlantic Forest Domain corresponds to a series of continuous ecosystems along the Brazilian coast. It is a global biodiversity hotspot due to its high richness and high endemism level (Myers et al., 2000). The total number of endangered species in the Atlantic Forest, at any spatial scale, is underestimated and it highlights the need for correct species identification and awareness of their original geographic distribution (Tabarelli et al., 2005).

With respect to endangered species categories, 17 species (53.1%) are EN (very high risk) and 15 species (46.9%) are VU (high risk) (Table 1). A taxon is classified as endangered when it meets any of the five assessment criteria based on populations' biological indicators, such as reduced population size and limited geographic distribution (IUCN, 2022). Species classification into one of the endangered species categories, mainly at the highest levels, requires public conservation policies like guarantees that they occur in protected areas subjected to appropriate managerial planning (Colli-Silva et al., 2016).

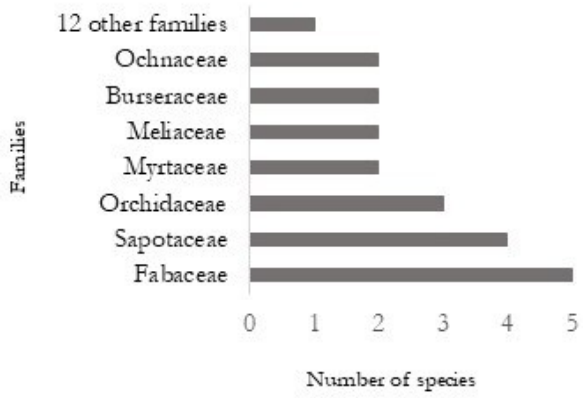



**Figure 1.** Families showing the largest number of endangered vascular plant species in Sergipe State, Brazil.

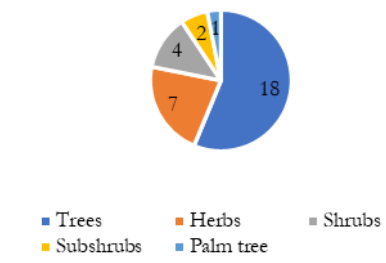



**Figure 2.** Life forms of endangered vascular plant species in Sergipe State, Brazil.

**Table 1.** Endangered vascular plant species in Sergipe State, Brazil. (LF: life form; Ssh: subshrub; EB: endemic to Brazil; Unk: unknown; PD: Phytogeographical domain in Sergipe; CA: *Caatinga* (Brazilian Seasonal Dry Forest); AF: Atlantic Forest; ERC: extinction risk category; EN: endangered; VU: vulnerable). *States with species geographic distribution ([1] Only according to the Reflora Virtual Herbarium; [2] Only according to National Center for Plant Conservation).

| Family/Species | LF | EB | PD | ERC | States* | Collectors |
|---|---|---|---|---|---|---|
| **FERN** | | | | | | |
| **Anemiaceae** | | | | | | |
| *Anemia dentata* Gardner | Herb | Unk | CA | VU | Alagoas, Bahia[1], Goiás, Minas Gerais, Pernambuco | R.M.Déda et al. 321 (ASE) |
| **ANGIOSPERM** | | | | | | |
| **Amaryllidaceae** | | | | | | |
| *Griffinia espiritensis* Ravenna | Herb | Yes | CA, AF | EN | Bahia, Espírito Santo | G.Viana 461 (ASE) |
| **Arecaceae** | | | | | | |
| *Allagoptera brevicalyx* Moraes | Palm tree | Yes | AF | VU | Bahia, Sergipe | J.E.Nascimento-Jr 1044 (ASE) |
| **Bromeliaceae** | | | | | | |
| *Cryptanthus zonatus* (Vis.) Vis. | Herb | Yes | AF | VU | Alagoas, Paraíba[1], Pernambuco, Rio Grande do Norte, Sergipe[1] | K.Mendes et al. 228 (UFP) |
| **Burseraceae** | | | | | | |
| *Protium bahianum* Daly | Tree | Yes | AF | EN | Alagoas, Bahia, Paraíba[2], Pernambuco, Sergipe | C.S.Santos 321 (ASE) |
| *Protium occhionii* Rizzini | Tree | Yes | AF | EN | Alagoas[1], Bahia, Sergipe[1] | C.Farney 2836 (NY) |
| **Cactaceae** | | | | | | |
| *Melocactus violaceus* Pfeiff. | Herb | Yes | AF | VU | Alagoas[1], Bahia, Ceará[1], Espírito Santo, Minas Gerais, Paraíba, Pernambuco, Rio de Janeiro, Rio Grande do Norte, Sergipe | E.S.Ferreira & E.V.S.Oliveira 165 (ASE) |
| **Chrysobalanaceae** | | | | | | |
| *Licania cymosa* Fritsch | Tree | Yes | AF | EN | Bahia, Pará[1] | J.P.Souza-Alves 1161 (ASE) |
| **Erythroxylaceae** | | | | | | |
| *Erythroxylum nordestinum* Costa-Lima, Loiola & M.Alves | Tree | Yes | CA | EN | Alagoas[2], Bahia, Paraíba[2], Pernambuco, Sergipe | D.G.Oliveira et al. 147 (ASE) |
| **Fabaceae** | | | | | | |
| *Apuleia leiocarpa* (Vogel) J.F.Macbr. | Tree | No | AF | VU | Todos (exceto Amapá) | J.P.Souza-Alves 2A (ASE) |
| *Chamaecrista unijuga* (Benth.) Conc., L.P. Queiroz & G.P. Lewis | Bush | Yes | AF | EN | Alagoas, Bahia, Pernambuco, Sergipe | A.Robeiro 586 (HUEFS) |
| *Inga suborbicularis* T.D.Penn. | Tree | Yes | AF | EN | Alagoas[2], Bahia, Minas Gerais, Sergipe[2] | E.M.Carneiro 414 (ASE) |
| *Paubrasilia echinata* (Lam.) Gagnon, H.C.Lima & G.P.Lewis | Tree | Yes | AF | EN | Alagoas, Bahia, Espírito Santo, Paraíba, Pernambuco, Rio de Janeiro, Rio Grande do Norte, Sergipe[1] | T.R.Silva & J.P.S.Santos 97 (ASE) |
| *Swartzia alagoensis* R. B. Pinto, Torke & Mansano | Tree | Yes | AF | EN | Alagoas, Bahia[2], Sergipe | T. Carregosa & L.A.S.Santos 265 (ASE) |
| **Lamiaceae** | | | | | | |
| *Eriope blanchetii* (Benth.) Harley | Ssh | Yes | AF | VU | Bahia, Sergipe | M.C.Santana 195 (ASE) |
| **Meliaceae** | | | | | | |
| *Cedrela fissilis* Vell. | Tree | No | CA, AF | VU | Todos (exceto Amapá[1], Paraíba[1], Rio Grande do Norte, Roraima, Sergipe[2]) | L.A.S.Santos et al. 709 (ASE) |
| *Cedrela odorata* L. | Tree | No | CA | VU | Todos (exceto Piauí, Rio Grande do Norte, Rio Grande do Sul, Roraima, Tocantins) | G.Viana 686 (ASE) |
| **Myrtaceae** | | | | | | |
| *Calycolpus legrandii* Mattos | Bush | Yes | AF | VU | Alagoas, Bahia, Sergipe | D.M.Oliveira 67 (ASE) |
| *Neomitranthes obtusa* Sobral & Zambom | Tree | Yes | AF | EN | Alagoas, Bahia, Espírito Santo, Sergipe | T.C.Pereira 92 (ASE) |
| **Ochnaceae** | | | | | | |
| *Ouratea pycnostachys* (Mart.) Engl. | Tree | Yes | AF | EN | Alagoas, Bahia, Espírito Santo, Minas Gerais[2], Pernambuco[2], Sergipe[2] | I.S.Matos et al. 106 (ASE) |
| *Ouratea robusta* F.O.Silva & M.R.V.Barbosa | Tree | Yes | AF | VU | Alagoas, Bahia, Sergipe | C.E.B.Proença & M.Landim 4052 (ASE) |
| **Orchidaceae** | | | | | | |
| *Campylocentrum pernambucense* Hoehne | Herb | Yes | AF | EN | Alagoas, Bahia[1], Paraíba[1], Pernambuco, Sergipe[1] | L.M.S.Melo et al. 64 (ASE) |
| *Cattleya labiata* Lindl. | Herb | Yes | AF | VU | Alagoas, Bahia[1], Ceará, Espírito Santo[2], Paraíba, Pernambuco, Rio de Janeiro[2], Sergipe[1] | I.C.Lemos et al. 79 (ASE) |
| *Cattleya tigrina* A.Rich. | Herb | Yes | AF | VU | Bahia, Pernambuco, Rio Grande do Sul, Santa Catarina, São Paulo, Sergipe[1] | T.S.A.Menezes 01 (ASE) |
| **Phyllanthaceae** | | | | | | |
| *Phyllanthus gladiatus* Müll.Arg. | Ssh | Yes | AF | VU | Bahia, Espírito Santo, Minas Gerais[2], Sergipe[1] | G.Viana 892 (ASE) |
| **Rubiaceae** | | | | | | |
| *Guettarda blanchetiana* Müll.Arg. | Tree | Yes | AF | VU | Bahia, Sergipe | J.P.Souza-Alves 4A (ASE) |
| **Rutaceae** | | | | | | |
| *Zanthoxylum unifoliolatum* Groppo & Pirani | Tree | Yes | AF | EN | Sergipe | J.P.Santana & T.R.Silva 162 (ASE) |
| **Sapotaceae** | | | | | | |
| *Manilkara decrescens* T.D. Penn. | Bush | Yes | AF | VU | Alagoas[2], Bahia | L.A.Gomes et al. 967 (JPB) |
| *Manilkara maxima* T.D.Penn. | Tree | Yes | AF | EN | Bahia, Sergipe | L.A.Gomes et al. 317 (ASE) |
| *Pouteria macahensis* T.D.Penn. | Tree | Yes | AF | EN | Alagoas, Bahia, Espírito Santo, Pernambuco, Rio de Janeiro, Sergipe | A.P.Prata et al. 2687 (ASE) |
| *Pradosia restingae* Terra-Araujo | Tree | Yes | AF | EN | Bahia[2], Paraíba[2], Pernambuco[1], Rio Grande do Norte[2], Sergipe[2] | C.Amaral & E.Santos 41 (ASE) |
| **Solanaceae** | | | | | | |
| *Solanum jabrense Agra* & M.Nee | Bush | Yes | CA | EN | Bahia, Ceará, Paraíba, Pernambuco | I.C.Lemos 89 (ASE) |

The geographic distribution of endangered species in Brazil showed variation in the number of states - there was occurrence in a single state and register in 25 states (Table 1). *Licania cymosa* Fritsch occurs in the state of Pará, however, the locality record was invalidated by the specialist due to incorrect taxonomic identification (Fernandez; Rosa, 2018). Attention is drawn to *Zanthoxylum unifoliolatum* Groppo & Pirani, which only occurred in Sergipe State. This species was classified as EN due to its limited geographic distribution in five locations and to the fast deforestation of its habitat (Groppo; Pirani, 2017).

Even species that occur in almost all and that assumingly could not be endangered were classified as VU, among them one finds *Apuleia leiocarpa* (Vogel) J.F.Macbr., *Cedrela fissilis* Vell. and *C. odorata* L. It is so because of their populations' reduction due to the action of the timber industry, given their high economic value (Messina; Moraes, 2012; Prieto; Moraes, 2012a,b). *Melocactus violaceus* Pfeiff. is distributed in ten states, but it is vulnerable because some of its subpopulations have disappeared due to their habitat replacement by agricultural areas (Moraes, 2012).

Five (15,2%) of the total number of observed species do not have geographic distribution in Sergipe State based on the Reflora Virtual Herbarium and/or CNCFlora (Table 1). The *species*Link network provides open and free access to Brazilian herbarium data in digital databases; however, it has some limitations such as delay in updating. Flora and Funga of Brazil lists species that have been reviewed by botanical specialist, but some species recorded in the field and confirmed by taxonomists were not added to the platform yet (Moura et al., 2015).

Continuous financial resources to train specialists and floristic surveys are necessary, as well as support services for the operational system of global biodiversity portals. The *species*Link network has been supported by project-based funding with no public mechanisms to fund the system's maintenance and ongoing development on the long term (Canhos et al., 2015).

With respect to the species' geographic distribution, 34 (45,3%) of the 75 municipalities in Sergipe State have records of endangered species (Table 2). *Campylocentrum pernambucense* Hoehne, *Cattleya labiata* Lindl., *C. tigrina* A.Rich., *Cryptanthus zonatus* (Vis.) Vis., *Manilkara decrescens* T.D. Penn., *Protium occhionii* Rizzini and *Solanum jabrense* Agra & M.Nee recorded a more limited distribution in the state because they were only recorded in a single municipality.

Municipalities accounting for the largest number of endangered species were Itabaiana and Itaporanga d´Ajuda (10 spp. each), Pirambu (nine spp.), Estância and Santo Amaro das Brotas (eight spp. each) (Figure 3). This finding is assumingly related to the presence of forest remnants in them. Municipalities presenting the largest areas covered by forests were Areia Branca, Canindé de São Francisco, Santo Amaro das Brotas and Santa Luzia do Itanhy (SFB, 2017).

Some areas in Areia Branca, Itabaiana, Campo do Brito, Itaporanga d'Ajuda and Laranjeiras are part of Serra de Itabaiana National Park, which is an ecotone region between the Atlantic Forest and the *Caatinga*. It recorded 828 vascular plant species (Silva et al., 2019). Such finding may also have resulted from a great collection effort that led to materials deposition in herbaria. The collection was motivated by field studies carried out in these remnants, mainly in Atlantic Forest areas. Studies carried out by Dantas and Ribeiro (2010) in Serra de Itabaiana National Park, and by Oliveira et al. (2023) in Santo Amaro das Brotas Municipality are some examples of these studies.

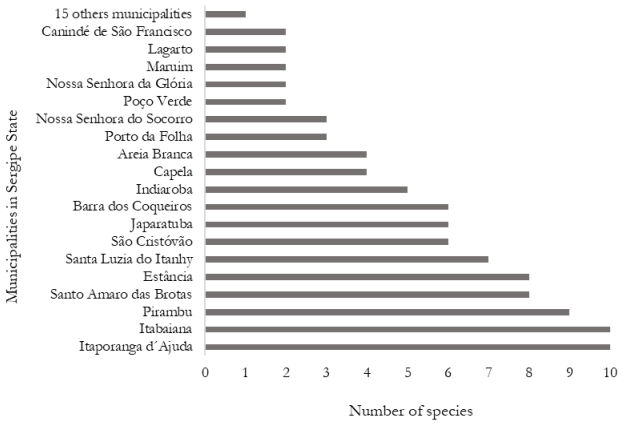



**Figure 3.** Municipalities presenting the largest number of endangered vascular plant species in Sergipe State, Brazil.

Only ten species (30.3%) were recorded in protection areas, and nine of them occurred in Atlantic Forest areas and only one species was observed in the *Caatinga* (Figure 4). Only 20% of forests in Sergipe State are distributed in protected areas (SFB, 2017), and it can justify the high rate of species recorded outside these areas. Although some endangered species like *Zanthoxylum unifoliolatum* and *Manilkara decrescens* occur within protection areas, these areas are classified as Sustainable Use Units and it does not guarantee full protection for these species (Siqueira-Filho et al., 2012). It is so because these areas combine biodiversity conservation to sustainable use of natural resources in order to allow human presence in them (Meiado; Almeida, 2022).

## Conclusion

Data collected from botanical materials in herbaria showed 32 endangered vascular plant species in Sergipe State categorized as vulnerable or endangered. Some of these species do not have confirmed geographic distribution in Sergipe State based on Reflora Virtual Herbarium and the Centro Nacional de Conservação da Flora. Thus, assumingly this number is larger given limitations in properly identifying exsiccate, and outdated data observed in virtual herbaria.

The sampling effort for botanical collections in forest remnants must be expanded in order to assess new endangered species records and to elaborate an official list of endangered species in Sergipe State. Furthermore, systematic investment in field research, in training botanical specialists and in updates in virtual herbarium databases are necessary. The urgency of managerial and conservation actions focused on endangered species is highlighted, especially those limited to a single location. It is paramount creating and implementing fully protected areas, so that they can hold a larger number of endangered species, particularly in municipalities with a high concentration of threatened species. Licensing authorities must assess the impacts of developments in areas that host threatened species with restricted distributions.

**Table 2.** Endangered vascular plant species by municipality in Sergipe State, Brazil (BSC: Brazilian Sandy Coastal; BSDF: Brazilian Seasonal Dry Forest).

| Species | Municipalities in Sergipe State | Phytophysiognomy |
|---|---|---|
| *Allagoptera brevicalyx* Moraes | Areia Branca, Estância, Indiaroba, Itabaiana, Itaporanga d'Ajuda, Santo Amaro das Brotas | Semideciduous Seasonal Forest, *Restinga* (BSC) |
| *Anemia dentata* Gardner | Capela, Gararu, Nossa Senhora da Glória, Porto da Folha | *Caatinga* (BSDF) |
| *Apuleia leiocarpa* (Vogel) J.F.Macbr. | Cristinápolis, Indiaroba, Itaporanga d'Ajuda, Japaratuba, Santa Luzia do Itanhy, Santo Amaro das Brotas, São Cristóvão | Semideciduous Seasonal Forest, *Restinga* (BSC) |
| *Calycolpus legrandii* Mattos | Barra dos Coqueiros, Estância, Indiaroba, Itabaiana, Itaporanga d'Ajuda, Japaratuba, Pirambu, Santa Luzia do Itanhy, Santo Amaro das Brotas, São Cristóvão | Semideciduous Seasonal Forest, *Restinga* (BSC) |
| *Campylocentrum pernambucense* Hoehne | Capela | Semideciduous Seasonal Forest |
| *Cattleya labiata* Lindl. | Poço Redondo (Serra da Guia) | Altitude Swamp - Ombrophylous Forest |
| *Cattleya tigrina* A.Rich. | Riachão do Dantas | Semideciduous Seasonal Forest |
| *Cedrela fissilis* Vell. | Japoatã, Poço Verde | *Caatinga* (BSDF), Semideciduous Seasonal Forest |
| *Cedrela odorata* L. | Carira, Itabaiana, Poço Verde, Porto da Folha | *Caatinga* (BSDF) |
| *Chamaecrista unijuga* (Benth.) Conc., L.P. Queiroz & G.P. Lewis | Itabaiana, Pirambu, Santo Amaro das Brotas | *Restinga* (BSC) |
| *Cryptanthus zonatus* (Vis.) Vis. | Areia Branca | *Campo Rupestre* Landscape |
| *Eriope blanchetii* (Benth.) Harley | Estância, Japaratuba, Pirambu | *Restinga* (BSC) |
| *Erythroxylum nordestinum* Costa-Lima, Loiola & M.Alves | Canindé de São Francisco, Lagarto, Porto da Folha | *Caatinga* (BSDF) |
| *Griffinia espiritensis* Ravenna | Itabaiana, Nossa Senhora da Glória | *Campo Rupestre* Landscape, *Caatinga* (BSDF) |
| *Guettarda blanchetiana* Müll.Arg. | Estância, Itabaiana, Itaporanga d´Ajuda | Semideciduous Seasonal Forest, *Restinga* (BSC) |
| *Inga suborbicularis* T.D.Penn. | Itaporanga d´Ajuda, São Cristóvão | Semideciduous Seasonal Forest |
| *Licania cymosa* Fritsch | Barra dos Coqueiros, Itaporanga d´Ajuda, Santo Amaro das Brotas | *Restinga* (BSC) |
| *Manilkara decrescens* T.D. Penn. | Siriri | Semideciduous Seasonal Forest |
| *Manilkara maxima* T.D.Penn. | Japaratuba, Santa Luzia do Itanhy | Semideciduous Seasonal Forest, *Restinga* (BSC) |
| *Melocactus violaceus* Pfeiff. | Itabaiana, Pacatuba, Pirambu | *Campo Rupestre* Landscape, *Restinga* (BSC) |
| *Neomitranthes obtusa* Sobral & Zambom | Barra dos Coqueiros, Estância, Ilha das Flores, Pirambu, Santa Luzia do Itanhy | *Restinga* (BSC) |
| *Ouratea pycnostachys* (Mart.) Engl. | Itaporanga d'Ajuda, Nossa Senhora do Socorro, São Cristóvão | Semideciduous Seasonal Forest |
| *Ouratea robusta* F.O.Silva & M.R.V.Barbosa | Barra dos Coqueiros, Estância, Itabaiana, Itabaianinha, Itaporanga d´Ajuda, Japaratuba, Lagarto, Laranjeiras, Pirambu, Salgado, Santa Luzia do Itanhy, São Cristóvão | Semideciduous Seasonal Forest, *Restinga* (BSC) |
| *Paubrasilia echinata* (Lam.) Gagnon, H.C.Lima & G.P.Lewis | Aracaju, Boquim, Capela, Nossa Senhora do Socorro, São Cristóvão | Semideciduous Seasonal Forest |
| *Phyllanthus gladiatus* Müll.Arg. | Areia Branca, Itabaiana | *Campo Rupestre* Landscape |
| *Pouteria macahensis* T.D.Penn. | Areia Branca, Barra dos Coqueiros, Estância, Indiaroba, Itabaiana, Itaporanga d´Ajuda, Maruim, Santa Luzia do Itanhy | Ombrophylous Forest, *Restinga* (BSC) |
| *Pradosia restingae* Terra-Araujo | Barra dos Coqueiros, Santo Amaro das Brotas | *Restinga* (BSC) |
| *Protium bahianum* Daly | Estância, Indiaroba, Itaporanga d'Ajuda, Pirambu, Santa Luzia do Itanhy, Santo Amaro das Brotas | *Restinga* (BSC) |
| *Protium occhionii* Rizzini | Santo Amaro das Brotas | *Restinga* (BSC) |
| *Solanum jabrense* Agra & M.Nee | Canindé de São Francisco | *Caatinga* (BSDF) |
| *Swartzia alagoensis* R. B. Pinto, Torke & Mansano | Japaratuba, Pirambu | *Restinga* (BSC) |
| *Zanthoxylum unifoliolatum* Groppo & Pirani | Capela, Carmópolis, Maruim, Nossa Senhora do Socorro, Pirambu | Ombrophylous Forest |

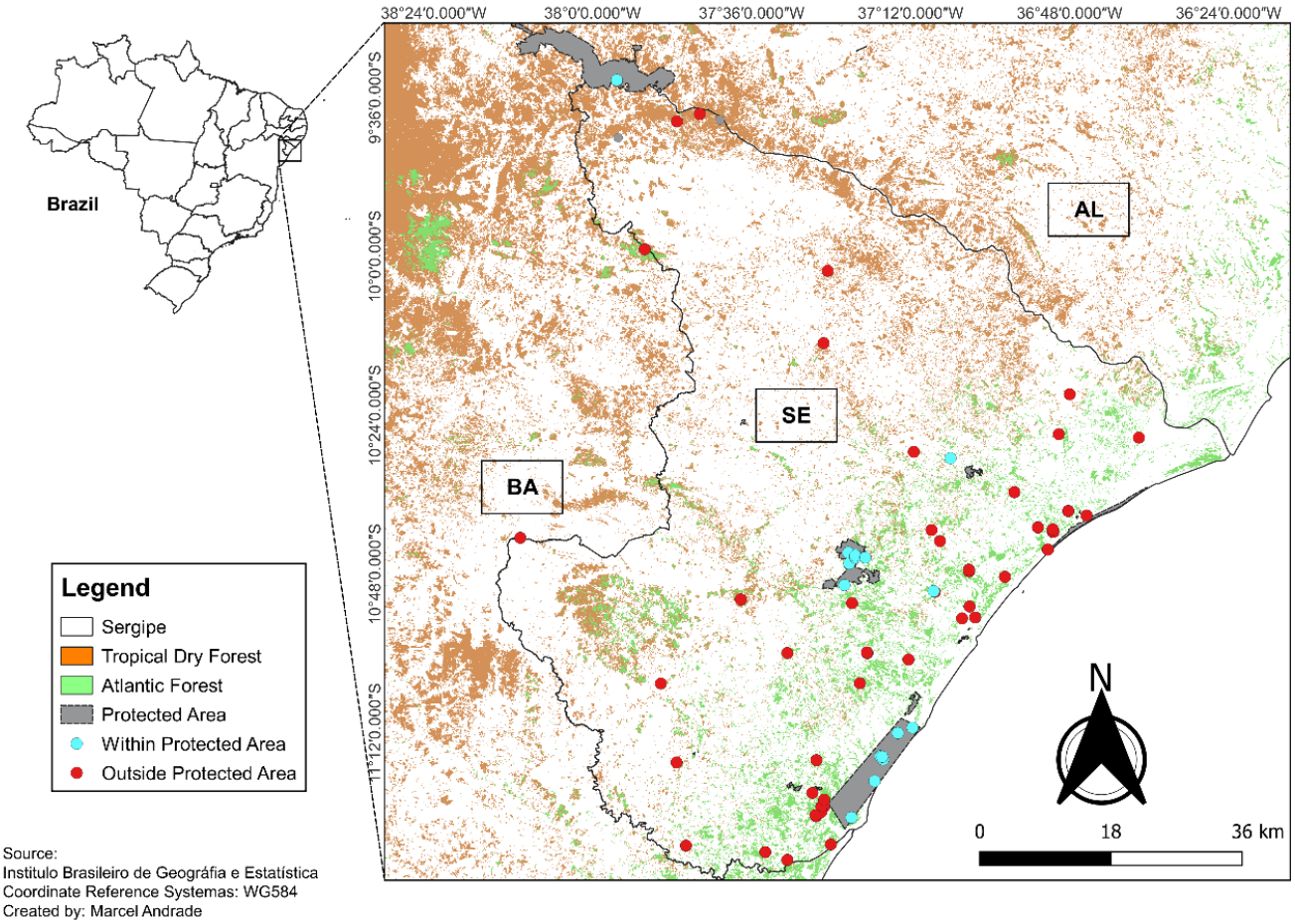



**Figure 4.** Geographic distribution of endangered vascular plant species in and outside protected areas in Sergipe State, Brazil. (AL: Alagoas State; SE: Sergipe State; BA: Bahia State).

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### Authorship Contributions

Conceptualization: ACCS, WJM, MIUO. Data curation: ACCS, WJM, MIUO, MFBA, TTS, MVSB, ARB. Formal Analysis: ACCS, WJM, MIUO, MFBA. Funding acquisition: ACCS, WJM. Investigation: ACCS, WJM, MIUO. Methodology: ACCS, WJM. Project administration: ACCS, WJM. Resources: ACCS, WJM. Software: MFBA. Supervision: ACCS, WJM. Validation: ACCS, WJM. Visualization: ACCS, WJM. Writing – original draft: ACCS. Writing – review & editing: ACCS, WJM, MIUO.

### Conflict of Interest

The authors declare that there are no conflicts of interest to report.

### Data Availability

The complete set of data analyzed during the current study are presented in the body of the manuscript and can be accessed at speciesLink (https://specieslink.net/).

### Ethical Compliance

Not applicable.

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