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Floristic inventory of a zone of ecological tension in the Atlantic Forest of Northeastern Brazil

Inventário florístico de uma área de tensão ecológica na Mata Atlântica do Nordeste do Brasil

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Abstract

The Serra de Itabaiana National Park, Sergipe, is situated in a transition area between Atlantic Forest and the Caatinga and is considered by the Ministério do Meio Ambiente to be extremely important for the conservation of the Atlantic Forest flora. The paucity of floristic information from Sergipe state and areas of ecological tension motivated this floristic survey in the only National Park in the state. Botanical collections were made from 2006 to 2009, in six expedictions, by means of random walking. A total of 552 species distributed in 99 families of angiosperms and one gymnosperm were found. Of the species collected, 187 occurred in shrubby-herbaceous, 304 in shrubby, and 247 in arborescent physiognomy, with 23 common to all physiognomies. Leguminosae (41 spp.), Cyperaceae (40 spp.), Poaceae (38 spp.), Orchidaceae (30 spp.), Euphorbiaceae (27 spp.), Rubiaceae (24 spp.), Melastomataceae (21 spp.) and Bromeliaceae (20 spp.) were the richest families. The study revealed the presence of species in common with the Caatinga, Cerrado, Seasonal Forest, campo rupestre, restinga, tabuleiro and areas of ecological tension, corroborating floristically the classification of the locality as an area of ecological tension and reasserting its importance for the conservation of biodiversity.
Key words: transition area, ecotone, national park, Sergipe, Serra de Itabaiana.

Resumo

O Parque Nacional Serra de Itabaiana, Sergipe, está situado em uma área de transição entre a Mata Atlântica e a Caatinga e é considerado pelo Ministério do Meio Ambiente como de extrema importância para a conservação da flora da Mata Atlântica. Informações florísticas escassas, referentes ao estado de Sergipe e áreas de tensão ecológica motivaram o levantamento florístico no único Parque Nacional do estado. As coletas foram realizadas no período de 2006 a 2009, em seis expedições a campo, através de caminhamento aleatório. Foram encontradas 552 espécies distribuídas em 99 famílias de Angiospermas e uma de Gimnosperma. Das espécies coletadas, 187 ocorreram na fisionomia arbustiva-herbácea, 304 na arbustiva e 247 na arbórea, sendo 23 comuns a todas as fisionomias. Leguminosae (41 spp.), Cyperaceae (40 spp.), Poaceae (38 spp.), Orchidaceae (30 spp.), Euphorbiaceae (27 spp.), Rubiaceae (24 spp.), Melastomataceae (21 spp.) e Bromeliaceae (20 spp.) foram as famílias mais ricas. Espécies comuns à Caatinga, Cerrado, floresta estacional, campo rupestre, restinga, tabuleiro e de áreas de tensão ecológica, corroboram floristicamente com a classificação do local como área de tensão ecológica, o que ressalta sua importância para a conservação da biodiversidade.
Palavras-chave: área de transição, ecótono, Parque Nacional, Sergipe, Serra de Itabaiana.

Introduction

Among the world's biodiversity hotspots, the Atlantic Forest is one of the richest and most threatened regions of the planet (Myers *et al.* 2000; Mittermeier *et al.* 2005). It shelters circa 20,000 known vegetal species, 8,000 of which are endemic, which corresponds to 2.7% of the world's endemic plants (Myers *et al.* 2000; Tabarelli *et al.* 2005a,b).

The Atlantic Forest contains many different vegetation physiognomies, as dense ombrophilous forest, Araucaria forest, and seasonal semideciduous forest, not to mention the contact zones between these vegetation types (IBGE 2008).

The latter constitute areas of ecological tension (Gonçalves & Orlandi 1983; IBGE 2008) that can be either ecotones or enclaves. In ecotones,

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transition occurs through a vegetation mix involving typologies with either similar or clearly distinct physiognomic structures. In enclaves, distinct vegetation types maintain their ecological identity (Gonçalves & Orlandi 1983; IBGE 2008). Ecotones shelter not only plants and animals characteristic of each of the overlapping communities, but also species exclusive to them and often sustain a community with features distinct from those of the adjacent ones (Odum 1988). According to Odum (1988) and Durigan *et al.* (2008), the richness and profusion of species are usually higher in an ecotone than in the adjacent communities. Despite the high biological diversity of such habitats (Durigan *et al.* 2008), they are little studied in Brazil.

The national park (PARNA) Serra de Itabaiana is located in a contact zone between Atlantic Forest and *caatinga*. It constitutes a mosaic of plants in which fauna and flora species coexist in open and closed physiognomies (Carvalho & Vilar 2005; Vicente *et al.* 2005). According to the Area of Application Map for Law 11.428/06 (IBGE 2008), the PARNA Serra de Itabaiana is located in a Savanna/seasonal forest contact zone. Considering it as is "extremely important" to preserve the Atlantic Forest biodiversity, this Law recommends that environmental inventories be conducted in it (MMA & SBF 2007).

The State of Sergipe lacks studies on its vegetal diversity (Souza & Siqueira 2001). Local works include Carvalho & Vilar (2005), Vicente *et al.* (1997, 2005) and Sobral *et al.* (2007), who published reports on different aspects of the biota and on the existing impacts, as well as environmental diagnoses.

Considering the importance of this area and the scarcity of information on the local flora and on that of the state of Sergipe as a whole, this work inventoried the phanerogamic flora growing in the national park Serra de Itabaiana. The data presented will allow to widen the knowledge on the flora of Atlantic Forest/*caatinga* contact zones in the Atlantic Forest of northeastern Brazil.

Material and methods

Study area

This work was conducted in the national park Serra de Itabaiana (10º45'07"S and 37º20'28"W, 200–660 m), circa 40 km from Aracaju. It is located in the mesoregion of the Agreste, in the State of Sergipe. Its 7,966 ha stretch over the townships of Areia Branca, Itabaiana, Campo do Brito, Itaporanga D'ajuda and Laranjeiras (Federal Decree 15/06/2005)(Fig. 1). In June 2005, the *Estação Ecológica* –area setup for environment protection– of Serra de Itabaiana (created in 1990) was reclassified to constitute the first and only national park (PARNA) in that state (Sobral *et al.* 2007).

It comprises three geomorphological units: the ridges Cajueiro, Comprida and Itabaiana (Carvalho & Vilar 2005). For the present study, most collections were made in the latter, which is more preserved. In fact, the Ridges Cajueiro and Comprida are subject to more anthropic pressure, as constant fires, and have huge areas used for agriculture and pastures.

The Serra de Itabaiana (3.421 ha, 195–680 m) is located in the townships of Areia Branca and Itabaiana. It is crisscrossed by small waterways: Coqueiros, Água Fria, dos Negros e Vermelho creeks, which all rise locally (Vicente *et al.* 1997). Its different soils include quartzose sands, lithosols and eutrophic red-yellow podsols (Embrapa Solos 2006). According to Gonçalves & Orlandi (1983) and the IBGE (2008), this area is considered a savanna/seasonal forest contact zone. Its mosaic of plants reflects such contact. As the classification adopted in this work considers only physiognomic aspects, the area was divided into herbaceous-shrub, shrub and tree vegetations. The herbaceous-shrub physiognomy corresponds to the vegetation in gravelly sandy soil at altitudes between 210–680 m. The shrub physiognomy occurs on the foothills, usually in white sand soils, at an altitude below 210 m. And the tree physiognomy is present on the ridge slopes and valleys, along waterways and in small vegetation islands at the ridge top, amid herbaceous-shrub vegetation.

Data collection

Collections were carried out in six expeditions during both dry and rainy seasons –between April 2006 and January of 2009– totaling 17 days (or 136 hours) of sampling effort. Of these, only two were dedicated to the ridges Comprida and Cajueiro. Collections followed the random walking method in the three existing physiognomies and the usual methodology (Mori *et al.* 1985).

The species growing in the study area were identified using specific bibliography, comparisons with the collection of herbaria ASE, HUEFS, IPA, UFP, SP, SPF and consultation with specialists. In order to complement the floristic list, species collected by other botanists in the PARNA Serra de Itabaiana and available in the collection of the herbaria ASE, IPA, MAC, NY, SP were included.

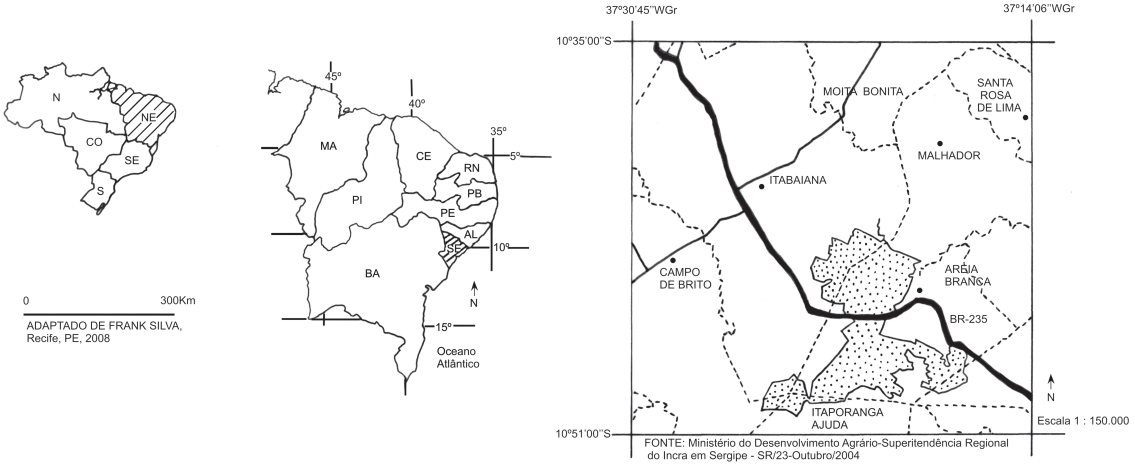

Figure 1 – Map of the Parque Nacional Serra de Itabaiana (PARNA) – Sergipe, Brazil. Left, location of the State of Sergipe, northeastern Brazil. Right, the expanse of the PARNA (dotted area), of the cities (hatched lines) and of the roads (continuous lines). Based on Lucena (2009).

The collected samples were incorporated to the collection of the UFP and duplicates were donated, mostly to ASE, RB, MO, HUEFS and SP. Taxonomic arrangement is based on the proposal of phylogenetic position of the APG III (2009) and the herbarium abbreviations follow Thiers (2009).

Results and Discussion

Approximately 2,100 samples were collected. The floristic list includes 518 taxa identified at specific level, distributed in 99 angiosperm and one gymnosperm (Podocarpaceae) families (Appendix). Of the collections performed, 33 samples (6%) are only identified at the generic level. Leguminosae (41 spp.), Cyperaceae (40 spp.), Poaceae (38 spp.), Orchidaceae (30 spp.), Euphorbiaceae (27 spp.), Rubiaceae (24 spp.), Melastomataceae (21 spp.) and Bromeliaceae (20 spp.) were the most abundant families in the study area. Of the 300 genera, the most represented were *Rhynchospora* Vahl (Cyperacae) with 12 spp., *Aechmea* Ruiz & Pav. (Bromeliaceae) with 10 spp., *Chamaecrista* Moench (Leguminosae) and *Passiflora* L. (Passifloraceae), with 9 spp. each.

These data add 420 new specific taxa to the preliminary floristic list established for the PARNA Serra de Itabaiana (Vicente *et al.* 2005), which included 166 specific taxa. It is worth emphasizing that the present study was restricted to Serra de Itabaiana and that some of the names used are synonymed or were reviewed.

As for physiognomies, the families most abundant in species were Leguminosae (17 spp.), Orchidaceae (14 spp.), Cyperaceae and Poaceae (12 spp. each) and Bromeliaceae (9 spp.) in the herbaceous-shrub physiognomy. In the shrub physiognomy, they were: Leguminosae (28 spp.), Cyperaceae (26 spp.), Poaceae (19 spp.), Euphorbiaceae (15 spp.) and Orchidaceae (14 spp.). And in the tree physiognomy: Leguminosae and Cyperaceae (18 spp. each), Euphorbiaceae (15 spp.) and Melastomataceae and Rubiaceae (11 spp. each).

The family Leguminosae was the most represented in all the physiognomies. Queiroz (2009) mentions that this family is well represented in practically all terrestrial habitats due to an efficient association with nitrogen fixing bacteria in their root nodules and to the great diversity of habits and morphological adaptations it presents. Among the Poaceae, Cyperaceae and Orchidaceae specimens found at the PARNA, many are common to *cerrado*, *caatinga*, *restinga* and *campo rupestre* environments. Harley (1995) and Giulietti *et al.* (2005) also highlighted the representativeness of these families in such habitats, in Brazil. In addition, the five most represented families in the tree physiognomy are also among the most abundant families in seasonal forests of northeastern Brazil (Souza & Siqueira 2001; Funch *et al.* 2005; Alves-Araújo *et al.* 2008).

The herbaceous-shrub physiognomy shelters 187 species, 88 (47.3%) of which are exclusive to it. The families restricted to this physiognomy are: Alstroemeriaceae, Droseraceae and Orobanchaceae.

Most species found in this physiognomy also grow in *campo rupestre*, as *Drosera montana* A.St.-Hil.; *Habenaria fluminensis* Hoehne, *Panicum soderstromii* Luloaga & Send., *Psyllocarpus laricoides* Mart. ex Mart. & Zucc., *Vellozia dasypus* Seub., *Xyris seubertii* Nilsson (Alves *et al.* 2007; Mendonça *et al.* 2008); or *cerrado*, as *Byrsonima dealbata* Griseb., *Mesosetum loliiforme* (Steud.) Chase, *Piriqueta cistoides* (L.) Griseb., *Sacoila lanceolata* (Aubl.) Garay and *Xyris fallax* Malme (Mendonça *et al.* 2008), among others. Although less numerous, we also encountered species common to *caatinga*, as *Angelonia cornigera* Hook., *Centrosema pascuorum* Mart. ex Benth. and *Mimosa tenuiflora* (Willd.) Poir. (Alves *et al.* 2009; Queiroz 2009); to *tabuleiro arenoso*, as *Hymenolobium alagoanum* Ducke and *Serjania salzmanniana* Schltr. (Barbosa 2009; Peixoto *et al.* 2009; Araujo *et al.* 2009); and to *restinga*, *Allagoptera arenaria* (Gomes) Kuntze and *Croton klotzschii* (Didr.) Baill. (Henderson *et al.* 1995; Lucena 2009).

With 304 species, the shrub physiognomy was the richest. Out of these, 148 (48.7%), as well as 10 families, among which Krameriaceae (2 spp.), Amaranthaceae (1 sp.) and Hypericaceae (1 sp.), were exclusive to this physiognomy. It presented species that also occur in *caatinga*, as *Ipomoea bahiensis* Willd. ex Roem. & Schult., *Guettarda angelica* Mart. ex Müll. Arg., *Hypenia salzmannii* (Benth.) Harley, *Paspalum scutatum* Nees ex Trin. and *Zornia leptophylla* (Benth.) Pittiu (Barbosa & Zappi 2002; Queiroz 2009; Alves 2009); in *cerrado*, *Rhynchospora albiceps* Kunth, *R. tenuis* Willd. ex Link, *Piriqueta cistoides* (L.) Griseb., *P. rosea* (*A. St.-Hil*., A. Juss. & Cambess.) Urb., *Polystachya estrellensis* Rchb.f., *Syngonanthus nitens* (Bong.) Ruhland, *Trachypogon spicatus* (L. f.) Kuntze (Mendonça *et al.* 2008); and in *tabuleiro arenoso*, *Coccoloba laevis* Casar., *Lecythis lurida* (Miers) S.A. Mori, *Manilkara salzmannii* (A. DC.) H.J Lam, *Piriqueta racemosa* Jacq. Sweet and *Salzmannia nitida* DC. (Barbosa 2009; Pontes & Barbosa 2009).

As for the tree physiognomy, its 247 species presented the highest percentage of species (59.5%, 147 spp.) and families (15) exclusive to it in the area of the PARNA, with a special highlight on families Piperaceae and Urticaceae (5 spp. each), Moraceae and Salicaceae (2 spp. each). Most of the species growing in this physiognomy are common to *tabuleiro arenoso*, as *Blepharodon nitidum* (Vell.) J.F. Machr., *Cordia nodosa* Lam. *Gouania blanchetiana* Miq., *Monotagma plurispicatum* (Körn.) K. Schum, *Sacoglottis mattogrossensis* Malbe, *Protium giganteum* Engl. (Barbosa 2009; Cestaro & Soares 2009); to seasonal forest, as *Aechmea multiflora* L.B. Sm., *Aparisthmium cordatum* (Juss.) Baill., *Bactris acanthocarpa* var. *acanthocarpa* Mart., *Cordia superba* Cham., *Pogonophora schomburgkiana* Miers ex Benth., *Siparuna guianensis* Aubl., *Urera baccifera* (L.) Gaudich. ex Wedd. (Cardoso *et al.* 2009; Lucena 2009, Ramos *et al.* 2008); and to *cerrado*, *Bulbostylis junciformis* (Kunth) C.B. Clarke, *Kielmeyera rugosa* Choisy, *Vitex rufescens* A. Juss., *Xyris fallax* Malme, *X. savanensis* Miq. (Mendonça *et al.* 2008).

Approximately 4% (23 spp.) of the taxa are common to all the physiognomies. They include specimens with a wide geographical distribution as *Euphorbia heterophylla* L., *Centrosema virginianum* (L.) Benth., *Miconia ciliata* (Rich.) DC., *Microstachys corniculata* (Vahl) Griseb., *Psittacanthus dichrous* Mart. and *Rhynchospora barbata* (Vahl.) Kunth.

Although it has no areas with *caatinga* physiognomy, the PARNA shelters some species of that biome, as those mentioned above for the herbaceous-shrub and shrub areas. It is worth stressing that most species occurring in this park and reported as growing in *caatinga* are also found in *caatinga/cerrado* contact zones (Queiroz 2009; Mendonça *et al.* 2008), as *Aeschynomene histrix* var. *incana* (Vog.) Benth., *Chamaecrista ramosa* (Vogel) H.S. Irwin & Barneby, *Hypenia salzmannii* (Benth.) Harley, *Krameria bahiana* B.B. Simpson, *Oldenlandia filicaulis* K. Schum., *Rhaphiodon echinus* Schauer or are widely distributed as *Aristida longifolia* Trin., *Chamaecrista acosmifolia* (Benth.), *Croton glandulosus* L., *Paspalum melanospermum* Desv. ex Poir., *Pavonia cancellata* (L.) Cav., *Senna macranthera* (DC. ex Collad.) H.S. Irwin & Barneby and *Stylosanthes scabra* Vogel (Alves. 2009; Queiroz 2009; Thomas *et al.* 2009).

The occurrence of other taxa corroborates the characterization of this PARNA as a zone of ecological tension. This group includes species described in habitats of savanna/forest contact (Guilherme & Nakajima 2007; Durigan *et al.* 2008; Mendonça *et al.* 2008; Pinheiro & Monteiro 2008), as *Coccoloba mollis* Casar., *Guettarda platypoda* DC., *Gomidesia blanchetiana* O. Berg, *Lafoensia pacari* A.St.-Hil., *Myrcia multiflora* (Lam.) DC.,

Pavonia malacophylla (Link & Otto) Garcke, *Pera glabrata* (Schott) Poepp. ex Baill., *Protium heptaphyllum* (Aulb.) Marchand, *Rapanea umbellata* G. Don and *Tapirira guianensis* Aubl. Both *Protium heptaphyllum* and *Tapirira guianensis* are common in seasonal forests (Ramos *et al.* 2008) and *cerrado* (Mendonça *et al.* 2008) and occur in both tree (border and interior) and shrub physiognomies. Since they present biological features of pioneer species, both can facilitate the occupation of habitats where shrubs prevail, corroborating Pinheiro & Monteiro (2008).

The tree physiognomy distributed in fragments along waterways at the entrance of the PARNA suffers great anthropic pressure from visitors. In these areas, we observed the presence of *Casearia sylvestris* Sw., *Cecropia pachystachiya* Trécul, *Heliconia psittacorum* L. f., *Miconia minutiflora* (Bonpl.) DC., *Psychotria carthagenensis* Jacq., species common to regenerating areas and forest gaps (Baider *et al.* 1999; Tabarelli & Mantovani 1999; Pinheiro & Monteiro 2008). Conversely, in areas located on the slopes and in the valleys of the *serra*, we encountered taxa that suggest they are well preserved, as *Cryptanthus sergipensis* I.Ramírez (Bromeliaceae), common in understories and reported as endemic to the State of Sergipe (Martinelli *et al.* 2008) and *Guzmania lingulata* (L.) Mez var. *lingulata* (Bromeliaceae), common to humid places in woods with preserved understory (Leme & Siqueira-Filho 2006).

We also observed a great population of *Podocarpus sellowii* Klotzsch *ex* Endl. (Podocarpaceae), usually related to paleoclimates milder than the current one (Andrade-Lima 1982), that is reported in enclaves of Atlantic Forest of northeastern Brazil, especially those treated as *brejos de altitude* (Sales *et al.* 1998; Andrade-Lima 1982). Its occurrence in forest islands surrounded by herbaceous-shrub vegetation, at the top of the Serra de Itabaiana, suggests that seasonal forest probably used to be much more representative in that place. Nevertheless, the occurrence of periodical fires in the *serra*, especially before the park was created, and the strong anthropic pressure (Vicente *et al.* 1997) can have favored the establishment of savanna species tolerant the high light intensity. A similar situation is reported by Pinheiro & Monteiro (2008) for an area of forest/savanna ecotone in southeastern Brazil. The first mention to this species in northeastern Brazil was based on specimens collected in the Serra de Itabaiana by Andrade-Lima in the beginning of the 80s, but it had never been collected again since.

The last known report of species *Simarouba versicolor* A. St.-Hil. (Simaroubaceae), *Marlierea parviflora* O. Berg (Myrtaceae), *Racinaea spiculosa* (Griseb.) M.A. Spencer & L.B. Sm. (Bromeliaceae), *Senna macranthera* (DC. ex Collad.) H.S. Irwin & Barneby (Leguminosae) and *Passiflora miersii* Mart. (Passifloraceae) in the PARNA area, dates from the 70s and beginning of the 80s, and they have not been collected again, which suggests a possible extinction of these species there.

According to the list of Brazilian flora species in danger of extinction made by the Fundação Biodiversitas (2005), *Cryptanthus zonatus* (Vis.) Beer (Bromeliaceae) is critically threatened of extinction and *Tetragastris occhionii* (Rizzini) D.C. Daly (Burseraceae), *Byrsonima bahiana* W.R. Anderson (Malpighiaceae) and *Ichthyothere connata* S.F. Blake (Asteraceae) are vulnerable to extinction. Nevertheless, according to the MMA (2008), data to support their position as vulnerable species are inadequate. This reinforces the role of PARNA to preserve these taxa. PARNA also shelters species considered rare and exclusive to herbaceous-shrub physiognomies (Giulietti *et al.* 2009), as *Ichthyothere connata*, *Chamaecrista cytisoides* (Collad.) H.S. Iwin & Barneby (Leguminosae), *Piriqueta dentata* Arbo (Turneraceae) and *Habenaria meeana* Toscano (Orchidaceae), the latter being known only from punctual collections in the States of Bahia and Minas Gerais (Berg & Azevedo 2005; Brito & Cribb 2005; Batista *et al.* 2009).

The presence of typical species common to *caatinga*, *cerrado*, seasonal forest, *campo rupestre*, *restinga*, *tabuleiro* and to areas of ecological tension demonstrates the high floristic heterogeneity of this place. This corroborates its typification as a zone of ecological tension and highlights its importance to conserve biodiversity.

This study adds information on species distribution, by considerably widening the floristic list available, until then, for the only national park of the state of Sergipe. It also contributes to the knowledge on diversity in a zone of ecological tension in the Atlantic Forest of northeastern Brazil.

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