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Friederichs Landim, Myrna; Barnes Proenca, Carolyn Elinore; Brito Sales, Adeline; Silveira Matos, Ilaíne

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Floristic characterization of an Atlantic Rainforest remnant in Southern Sergipe: Crasto forest

Myrna Friederichs Landim[1,4], *Carolyn Elinore Barnes Proença*[2], *Adeline Brito Sales*[2] &
Ilaíne Silveira Matos[3]

[1]*Departamento de Biologia, Universidade Federal de Sergipe, São Cristóvão, SE, Brazil.*
[2]*Departamento de Botânica, Universidade de Brasília, Brasília, DF, Brazil.*
[3]*Escola Nacional de Botânica Tropical, Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.*
[4]*Corresponding author: Myrna Friederichs Landim, e-mail: m_landim@hotmail.com*

LANDIM, M.F., PROENÇA, C.E.B., SALES, A.B., MATOS, I.S. **Floristic characterization of an Atlantic Rainforest remnant in Southern Sergipe: Crasto forest.** Biota Neotropica. 15(1): 1–16. http://dx.doi.org/10.1590/1676-06032014003613

Abstract: The state of Sergipe has suffered extreme reduction of its Atlantic Forest area in the last decades. The objective of this study is to present an inventory of the Mata do Crasto flora, the largest Atlantic Forest Remnant in Sergipe (approximately 1,000 ha), located in the Municipality of Santa Luzia do Itanhy. An intensive survey was undertaken with monthly plant collections in the study area, for four years (1995 to 1999). Additionally, collections deposited in herbaria were consulted to complete the species list. A total of 324 species were found, belonging to 84 families and 193 genera. This study adds an additional 29 genera and 96 species to the Sergipe flora as new occurrences. The four most speciose families were the Fabaceae (33 species), Rubiaceae (24 species), Myrtaceae (23 species) and Melastomataceae (15 species), that accounted for ca. 30% of the total species. The taxonomic distinction of the area is very similar to three other lowland forests in Northeastern Brazil, although its species composition is quite distinct.
Keywords: *Flora, Coastal Vegetation, Taxonomic diversity, São Francisco River.*

LANDIM, M.F., PROENÇA, C.E.B., SALES, A.B., MATOS, I.S. **Caracterização florística de um remanescente de Mata Atlântica no sul de Sergipe: Mata do Crasto.** Biota Neotropica. 15(1): 1–16. http://dx.doi.org/10.1590/1676-06032014003613

Resumo: O estado de Sergipe sofreu extrema redução da área de Mata Atlântica nas últimas décadas. Este trabalho tem como objetivo inventariar a composição florística da Mata do Crasto, maior remanescente de Mata Atlântica de Sergipe (aproximadamente 1.000 ha), situada no Município de Santa Luzia do Itanhy. Um inventário intensivo foi realizado com coletas florísticas na área de estudo por quatro anos (1995 a 1999). Adicionalmente, exsicatas depositadas em herbários foram consultadas para complementar a lista de espécies. Um total de 324 espécies foram identificadas, pertencentes a 84 famílias e 193 gêneros. Este estudo adicionou 96 espécies à flora de Sergipe como novas ocorrências. As famílias com maior número de espécies são Fabaceae (33 espécies), Rubiaceae (24 espécies), Myrtaceae (23 espécies) e Melastomataceae (15 espécies), que juntas somam cerca de 30% do total de espécies. A distinção taxonômica do remanescente é surpreendentemente similar ao de outras florestas de terras baixas no Nordeste do Brasil embora suas espécies sejam bastante distintas.
Palavras-chave: *Flora, Vegetação costeira, Diversidade taxonômica, Rio São Francisco.*

Introduction

The Brazilian Atlantic Rainforest is one of the 25 'hotspots' of the world, i.e., areas that have a high concentration of endemic species and that are liable to significant loss of habitat, containing at least 2% of known plants and vertebrates (Myers et al. 2000). Recent surveys of Atlantic Forest recognize 13,708 species and 1,782 genera in 208 families of angiosperms, of which 126 genera (7%) and 6,663 species (49%) are endemic to the forests (Stehmann et al. 2009).

Analyses of the distribution of Atlantic Forest plant species have identified two or more centers of endemism, depending upon the objectives and organisms being considered (Murray-Smith et al. 2008; Fiaschi & Pirani 2009). However, a north-south divide is agreed by most researchers, the northern part of which extends from Rio Grande do Norte to northern Espírito Santo, approximately coinciding with the Rio Doce Valley (Fiaschi & Pirani 2009).

In the northern region of the Atlantic Forest two centers of endemism are recognized: Northern Espírito Santo/Bahia and

Pernambuco (Thomas et al. 1998). However, despite the importance and high floristic diversity of the Atlantic Forest (Stehmann et al. 2009), a high percentage of the remaining forest area are still poorly studied and the geographic distribution of many taxa incomplete (Fiaschi & Pirani 2009). Studies of the extant areas are of fundamental importance to establishing hotspots within the Atlantic Forest (Giulietti et al. 2005; Murray-Smith et al. 2008), permitting better understanding of species distributions and understanding the possible effects of the São Francisco River as a geographic barrier.

It has been estimated that only 11.73% of the original Atlantic Forest remains (Ribeiro et al. 2009). The current situation may be a vicious circle; the better studied areas showing a high diversity and therefore concentrating Atlantic Forest conservation investment. In view of the accelerated rhythm of deforestation the Atlantic Forest has experienced to date (Dean 1996), specifically the northern sector (Freyre 2004), it is necessary to ensure that poorly studied areas are inventoried urgently, since many are threatened, in spite of the Brazilian legal protection instruments (Law N° 11.428/2006). Throughout the Atlantic Forest northern sector, the forest fragments are vulnerable, due to their high timber value, and extreme reduction and fragmentation (Ranta et al. 1998; Tabarelli et al. 2006).

In Sergipe, the Atlantic Forest covered the whole coastal zone, occupying a strip approximately 40 km wide. At the beginning of the 20th century, it was estimated that 41% of the state was covered by forests (Campos, 1912); recent estimates show that Atlantic Forest covers only 9% of its original area in the state (Fundação SOS Mata Atlântica/INPE 2005). In this region, forest vulnerability is increased by the gently rolling landscape and by the low social-economic level of the population which exploits forest fragments for fuelwood, building and hunting.

Sergipe was one of the last Brazilian States to have its flora investigated scientifically. In the 19th century it was visited only by George Gardner, who collected 210 samples from around the mouth of the São Francisco River, in 1838. Although some of these samples state "Bahia" as their location, he goes on to cite the Villa de Propriá (Stephen Harris, OXF, pers. comm.), and Propriá is now part of Sergipe. Herbarium specimens made available by CRIA (2013) reveal only sporadic collections in the 20th century. One collection by J.G. Kuhlmann (RB) from 1923 and some collections by D. Andrade-Lima from the 1950s and 1960s were found. Significant sampling of the Sergipe flora did not start until the 1970s, with the foundation of the ASE herbarium at the Universidade Federal de Sergipe.

The Atlantic Forest fragments of Sergipe have attracted little attention. However, investigations of these fragments have shown they are important for conservation (Landim & Siqueira 2001) because of their floristic diversity, and for harboring rare and threatened animals, such as *Callicebus coimbrai*, a recently described primate, found almost exclusively in Atlantic Forest remnants of Sergipe (Brasil/MMA 2003, Jerusalinsky et al. 2006, Veiga et al. 2008).

The southern part of Sergipe has several Atlantic Forest remnants important for conservation, and the *Litoral e complexo das matas do sul de Sergipe* region was considered one of the areas of the highest importance and urgency amongst those selected for immediate action (BRASIL/MMA 2007). The present study aimed to characterize floristically the largest Atlantic Forest fragment in southern Sergipe. Additionally, the flora of this fragment was compared to other fragments in the northern sector of the Brazilian Atlantic Forest, to find similarities between them.

Materials and methods

Study area

This study was undertaken in the *Mata do Crasto* (11°22' S, 37°25' W), an ombrophilous lowland forest remnant of ca. 1,000 ha, with altitudes from 5 to 90m, located in the Santa Luzia do Itanhy Municipality, Sergipe. The region is situated in the Piauí River basin; its climate is classified as coastal wet with strongly seasonal precipitation, with rainfall concentrated in the middle of the year. Climatic data was obtained from the Meteorological Center of the *Secretaria de Estado do Meio Ambiente e dos Recursos Hídricos* (SEMARH/SRH). The closest PCD (*Plataforma de Coleta de Dados*) weather station to the study area, in the city of Estância (ca. 10.5 km from Santa Luzia do Itanhy) registered total rainfall of 794.2 mm and an average temperature of 25.1° C in 2012. Long-term rainfall data from the region, registered an average rainfall of 2,096.2 mm between 1964 and 1985; during this period annual rainfall varied between 1,452.3 and 3,438.5 mm.

Data sampling and analysis

Monthly collections were made in the study area mainly between 1995 and 1999. The material was collected and dried using standard herbarium techniques (Mori et al. 1989) and deposited in the Universidade Federal de Sergipe (ASE) herbarium. Duplicates were distributed to other herbaria, particularly in northeastern Brazil, but also to Universidade de Brasília (UB), Instituto de Botânica de São Paulo (SP), Jardim Botânico do Rio de Janeiro (RB) and Arizona State University (ASU) herbaria.

Family and species circumscription, as well as spelling and authorities adopted for scientific names, followed, except when explicitly informed, the Lista de Espécies da Flora do Brasil (2014). The listed *vouchers* are those with the widest distribution in herbaria, selected from the examined material. Information on plant habits was obtained from herbarium material and, when these were missing, from the literature. A species was considered as "previously recorded from Sergipe" when it was either cited in Lista de Espécies da Flora do Brasil (2014) or in Volume 1 of Flora de Sergipe (Prata et al. 2013).

Taxonomic richness (Warwick & Clarke 1995; Clarke & Warwick 1998) of the *Mata do Crasto* fragment was compared with that of similar floristic inventories (i.e., those that included all angiosperms, independent of habit) and in similar phytophysiognomies (ombrophilous forests or semi-deciduous lowland forests) in other states of the northern sector of the Atlantic Forest. This index, calculated from presence and absence data, records the average distance between two species chosen at random (Clarke & Warwick 1998). The selected inventories had their species lists checked at the data base of the Centro de Referência em Informação Ambiental (http://www.cria.org.br/), in order to identify the existence of more recent determinations, and being afterwards standardized taxonomically, using Lista de Espécies da Flora do Brasil (2014) synonymy or The Plant List (2013).

Vouchers unidentified to species level in original lists were checked against on-line herbaria in Centro de Referência em Informação Ambiental (http://www.cria.org.br/) for possible

Table 1. List of the 321 species and morphospecies of Angiosperms found in the Atlantic Forest remnant of *Mata do Crasto*, Santa Luzia do Itanhy, Sergipe, organized in alphabetical order by family with vouchers. * = species absent from the Lista de Espécies da Flora do Brasil (2014).

Family / Species	Vouchers Collector Number (Herbaria)	Habit
ACANTHACEAE		
Aphelandra nitida Nees & Mart.	Santos 478 (ASE)	Shrub
Justicia symphyantha (Nees ex Mart.) Lindau	Santos 457 (ASE)	Herb
Lepidagathis alopecuroidea (Vahl) R.Br. ex Griseb.	Sant'Ana 457 (NY)	Shrub
ACHARIACEAE		
Carpotroche brasiliensis (Raddi) Endl.	Jardim 469 (ASE, NY)	Shrub
ANACARDIACEAE		
Astronium sp.	Landim 954 (ASE)	Tree
Schinus terebinthifolius Raddi	Landim 466 (ASE, SPF)	Tree
Tapirira guianensis Aubl.	Landim 279 (ASE, SPF)	Tree
ANNONACEAE		
Annona glabra L.	Landim 442 (ASE)	Tree
Annona pickelii (Diels) H.Rainer	Landim 940 (ASE, UFRN)	Tree
Annona salzmannii A. DC.	Landim 751 (ASE)	Tree
Annona sp.	Landim 950	Tree
Xylopia brasiliensis Spreng.	Landim 943 (ASE)	Tree
Xylopia frutescens Aubl.	Amaral 1 (ASE, JPB)	Tree
Xylopia laevigata (Mart.) R.E.Fr.	Landim 635 (ASE, HUEFS, UFRN)	Tree
APOCYNACEAE		
Himatanthus bracteatus (A. DC.) Woodson	Landim 875 (ASE)	Tree
Mandevilla scabra (Hoffmanns. ex Roem. & Schult.) K. Schum.	Amorim 1493 (NY)	Climber
Oxypetalum banksii Schult.	Landim 997 (ASE)	Climber
Apocynaceae N.I.	Landim 1277 (ASE)	Tree
ARACEAE		
Anthurium bellum Schott	Prata 2310 (ASE, JPB)	Herb
ARALIACEAE		
Schefflera morototoni (Aubl.) Maguire *et al.*	Landim 564 (ASE, UFRN)	Tree
Araliaceae N.I.	Landim 911 (ASE)	Tree
ARECACEAE		
Bactris sp.	Landim 1216 (ASE)	Shrub
Allagoptera caudescens (Mart.) Kuntze	Gomes 51 (ASE)	Tree
ARISTOLOCHIACEAE		
Aristolochia birostris Duch.	Amorim 1498 (ASE, NY)	Climber
Aristolochia labiata Willd.	Landim 919 (ASE)	Climber
ASTERACEAE		
Albertinia brasiliensis Spreng.	Landim 921 (ASE, SPF)	Climber
Centratherum punctatum Cass.	Amorim 1469 (ASE, NY)	Herb
Gochnatia oligocephala (Gardner) Cabrera	Landim 357 (ASE)	Shrub
Melanthera sp.	Landim 647 (ASE)	Shrub
BALANOPHORACEAE		
Langsdorffia hypogaea Mart.	Gomes 7 (ASE)	Herb
BIGNONIACEAE		
Adenocalymma comosum (Cham.) DC.	Landim 379 (ASE)	Climber
Bignonia corymbosa (Vent.) L. Lohmann	Landim 650 (ASE)	Climber
Fridericia chica (Bonpl.) L.G.Lohmann	Landim 335 (ASE)	Climber
Handroanthus chrysotrichus (Mart. ex DC.) Mattos	Moura 901 (ASE, HUEFS)	Tree
Jacaranda aff. *obovata* Cham	Sant'Ana 434 (ASE)	Tree
Lundia cordata (Vell.) A. DC.	Landim 231 (ASE)	Climber
BORAGINACEAE		
Cordia taguahyensis Vell.	Carvalho 4342 (ASE, NY)	Shrub
Tournefortia sp.	Landim 348 (ASE)	Shrub
BROMELIACEAE		
Aechmea mertensii (G.Mey.) Schult. & Schult.f.	Landim 434 (ASE)	Epifite
Aechmea multiflora L.B. Sm	Amorim 1480 (ASE, NY)	Herb
BURMANNIACEAE		

Continued on next page

Table 1. Continued.

Family / Species	Vouchers Collector Number (Herbaria)	Habit
Apteria aphylla (Nutt.) Barnhart ex Small	Landim 625 (ASE)	Herb
Burmannia capitata (Walter ex J. F. Gmel.) Mart.	Sant'Ana 423 (ASE)	Herb
Gymnosiphon divaricatus (Benth.) Benth. & Hook.f.	Gomes 13 (ASE)	Herb
BURSERACEAE		
Protium heptaphyllum (Aubl.) Marchand subsp.*heptaphyllum*	Jardim 474 (ASE, MBM, NY)	Tree
Protium sagotianum Marchand	Jardim 482 (ASE, MBM)	Tree
Protium warmingianum Marchand	Souza 221 (ASE, SPF)	Tree
CALOPHYLLACEAE		
Calophyllum brasiliense Cambess.	Landim 375 (ASE)	Tree
Kielmeyerea neglecta Saddi	Landim 870 (ASE)	Tree
CELASTRACEAE		
Maytenus cf. *disticophylla* Mart. Ex Reissek	Landim 616 (ASE, HUEFS, UFRN)	Tree
Maytenus cf. *obtusifolia* Mart.	Sant'Ana 430 (ASE, CEPEC, MBM)	Tree
Maytenus opaca Reissek	Prata 2588 (ASE, JPB)	Tree
CHRYSOBALANACEAE		
Hirtella ciliata Mart. & Zucc.	Landim 753, 804, 867 (ASE)	Tree
Hirtella racemosa var.*hexandra* (Willd. ex Roem. & Schult.) Prance	Sant'Ana 448 (ASE, NY)	Tree
Hirtella sp	Landim 238 (ASE)	Tree
Licania octandra (Hoffmanns. ex Roem. & Schult.) Kuntze subsp. *Octandra*	Amorim 1483 (ASE, MAC, NY)	Tree
Parinari littoralis Prance	Landim 555 (ASE)	Tree
CLUSIACEAE		
Clusia nemorosa G.Mey	Landim 987 (ASE)	Tree
Clusia paralicola G.Mariz	Landim 929 (ASE)	Tree
Garcinia madruno (Kunth) Hammel	Landim917 (ASE)	Tree
COMBRETACEAE		
Buchenavia tetraphylla (Aubl.) R.A.Howard	Landim 708 (ASE)	Tree
CONNARACEAE		
Rourea cf. *pseudogardneriana* Forero *et al.*	Landim 309 (ASE, HUEFS)	Climber
CONVOLVULACEAE		
Jacquemontia blanchetii Moric.	Landim 994 (ASE)	Climber
Merremia macrocalyx (Ruiz & Pav.) O'Donell	Landim 1366 (ASE)	Climber
CUCURBITACEAE		
Gurania cf. *bignoniacea* (Poepp. & Endl.) C. Jeffrey	Landim 324 (ASE)	Climber
CYPERACEAE		
Abildgaardia ovata (Burm. f.) Kral	Carvalho 4316 (NY, UFP)	Herb
Eleocharis geniculata (L.) Roem. &Schult.	Landim 744 (ASE, HUEFS)	Herb
Rhynchospora comata (Link) Roem. &Schult.	Gomes 66 (ASE)	Herb
Scleria bracteata Cav.	Vicente 791 (ASE, HUEFS)	Climber
Scleria hirtella Sw.	Amorim 1470 (ASE)	Herb
DILLENIACEAE		
Curatella americana L.	Landim 798 (ASE)	Tree
Davilla kunthii A.St.-Hil.	Landim 909 (ASE)	Climber
Tetracera boomii Aymard	Landim 612 (ASE, HUEFS)	Climber
Tetracera cf. *breyniana* Schltdl.	Landim 440 (ASE)	Climber
EBENACEAE		
Diospyros gaultheriifolia Mart. ex Miq.	Carvalho 4328 (ASE, CEPEC)	Tree
ELAEOCARPACEAE		
Sloanea garckeana K.Schum.	Sant'Ana 470 (ASE, CEPEC, NY, UESC)	Tree
ERIOCAULACEAE		
Paepalanthus bifidus (Schrad.) Kunth	Landim 1000 (ASE, HUEFS)	Herb
ERYTHROXYLACEAE		
Erythroxylum affine A.St.-Hil.	Jardim 484 (NY)	Shrub
Erythroxylum mucronatum Benth.	Landim 300 (ASE)	Shrub
Erythroxylum mikanii Peyr.	Amorim 1462 (ASE, NY)	Shrub
Erythroxylum nobile O.E. Schulz	Amorim 1485 (ASE, NY)	SubShrub

Continued on next page

Table 1. Continued.

Family / Species	Vouchers Collector Number (Herbaria)	Habit
Erythroxylum squamatum Sw.	Landim 1205 (ASE, IPA)	Tree
EUPHORBIACEAE		
Croton lundianus (Didr.) Müll.Arg.	Landim 1209 (ASE, IPA)	Herb
Croton sellowii Baill.	Gomes 69 (ASE)	Shrub
Dalechampia cf. *brasiliensis* Lam.	Landim 750 (ASE, HUEFS)	Climber
Dalechampia sp.	Landim 659 (ASE, HUEFS)	Climber
FABACEAE		
Abarema cochliacarpos (Gomes) Barneby & J.W. Grimes	Landim 752 (ASE, HUEFS)	Tree
Aeschynomene marginata Benth.	Landim 543 (ASE, HUEFS)	SubShrub
Andira fraxinifolia Benth.	Sant'Ana 468 (ASE)	Tree
Bowdichia virgilioides Kunth.	Landim 730 (ASE, HUEFS)	Tree
Calopogonium mucunoides Desv.	Gomes 11 (ASE)	Climber
Centrosema bifidum Benth.	Landim 756 (ASE, HUEFS)	Climber
Centrosema virginianum (L.) Benth.	Landim 559 (ASE, HUEFS)	Climber
Chamaecrista nictitans var. *disadena* (Steud.) H.S. Irwin & Barneby	Landim 656 (ASE, HUEFS)	Herb
Clitoria laurifolia Poir.	Landim 761 (ASE)	Shrub
Crotalaria retusa L.	Landim 552 (ASE, HUEFS)	SubShrub
Crotalaria stipularia Desv.	Landim 553 (ASE)	SubShrub
Dioclea lasiophylla Mart. ex Benth.	Sant'Ana 383 (ASE, NY)	Climber
Dioclea violacea Mart. ex Benth.	Landim 464 (ASE)	Climber
Dioclea virgata (Rich.) Amshoff.	Landim 529 (ASE, HUEFS)	Climber
Inga bollandii Sprague & Sandwith	Amorim 3454 (HUEFS)	Tree
Inga capitata Desv.	Landim 729 (ASE, HUEFS)	Tree
Inga cayennensis Sagot ex Benth.	Gomes 14 (ASE)	Tree
Inga ciliata Presl. var.*ciliata*	Landim 327(ASE, HUEFS)	Shrub
Inga subnuda Salzm. Ex Benth. subsp. *subnuda*	Landim 754 (ASE, HUEFS)	Tree
Inga tenuis (Vell.) Mart.	Landim 915 (ASE, HUEFS)	Tree
Leptolobium bijugum (Spreng.) Vogel	Landim 376 (ASE, HUEFS)	Tree
Machaerium hirtum (Vell.) Stellfeld	Landim 795 (ASE, HUEFS)	Tree
Mimosa sensitiva L.	Landim 862 (HUEFS)	Herb
Mimosa somnians Humb. & Bonpl. exWilld.	Landim 554 (ASE, HUEFS)	SubShrub
Phanera outimouta (Aubl.) L.P.Queiroz	Sant'Ana 464 (ASE, NY)	Climber
Senna macranthera (DC. ex Collad.) H.S. Irwin & Barneby	Landim 801 (ASE, HUEFS)	Climber
Senna phlebadenia H.S. Irwin & Barneby	Landim 868 (ASE, HUEFS)	Tree
Senna spectabilis (DC.) H.S. Irwin & Barneby	Landim 1204 (ASE, IPA)	Shrub
Senna splendida (Vogel) H.S. Irwin & Barneby	Landim 550 (HUEFS)	Shrub
Stryphnodendron pulcherrimum (Willd.) Hochr.	Landim 802 (ASE, HUEFS)	Tree
Stylosanthes cf. *scabra* Vog.	Landim 536 (ASE)	Herb
Swartzia apetala Raddi var. *apetala*	Landim 290 (ASE, HUEFS)	Tree
Tachigali densiflora (Benth.) L.F. Gomes da Silva & H.C. Lima	Landim 660 (ASE, HUEFS, UB)	Tree
GENTIANACEAE		
Chelonanthus purpurascens (Aubl.) Struwe *et al.*	Landim 701 (ASE)	Herb
Coutoubea spicata Aubl.	Sant'Ana 385 (ASE, NY)	Herb
Schultesia guianensis (Aubl.) Malme	Landim 618 (ASE, HUEFS, UB, UFRN)	Herb
Voyria caerulea Aubl.	Jardim 475 (ASE, NY)	Herb
Voyria obconica Progel	Landim 1214 (ASE)	Herb
HERNANDIACEAE		
Sparattanthelium botocudorum. Mart	Fonseca ASE62 (ASE, JBRJ)	Tree
HUMIRIACEAE		
Sacoglottis guianensis Benth. var.*guianensis*	Carvalho 4346 (NY, MO,CEPLAC)	Tree
HYPERICACEAE		
Vismia guianensis (Aubl.) Choisy	Landim 435 (ASE)	Shrub
HYPOXIDACEAE		
Hypoxis decumbens L.	Landim 453 (ASE, HUEFS)	Herb
IRIDACEAE		
Cipura paludosa Aubl.	Landim 451 (ASE)	Herb

Continued on next page

Table 1. Continued.

Family / Species	Vouchers Collector Number (Herbaria)	Habit
Trimezia martinicensis (Jacq.) Herb.	Landim 654 (ASE, HUEFS)	Herb
LAMIACEAE		
Aegiphila verticillata Vell.	Landim 368 (ASE)	Shrub
Hyptis atrorubens Poit.	Landim 621 (ASE, HUEFS, UFRN)	Herb
LAURACEAE		
Cassytha filiformis L.	Landim 534 (ASE)	Parasite
Ocotea duckei Vattimo-Gil	Landim 1276 (ASE)	Tree
Ocotea glomerata (Nees) Mez	Jardim 479 (ASE, NY)	Herb
LECYTHIDACEAE		
Eschweilera ovata (Cambess.) Miers	Landim 240 (ASE)	Tree
Lecythis lurida (Miers) S.A. Mori	Amorim 1471 (ASE, NY)	Tree
Lecythis pisonis Cambess.	Landim 790 (ASE)	Tree
Lecythis sp.	Landim 947 (ASE)	Tree
LORANTHACEAE		
Psittacanthus robustus (Mart.) Mart.	Amorim 1487 (ASE, NY)	Parasite
Struthanthus flexicaulis Mart.	Landim 378 (ASE)	Parasite
Struthanthus syringifolius (Mart.) Mart.	Amorim 1472 (ASE, NY)	Parasite
LYTHRACEAE		
Cuphea racemosa (L. f.) Spreng.	Landim 619 (HUEFS)	Herb
MALPIGHIACEAE		
Byrsonima sericea DC.	Landim 206 (ASE)	Tree
Heteropterys nordestina Amorim	Landim 874 (ASE)	Climber
Heteropterys sericea (Cav.) A. Juss.	Carvalho 4335 (ASE, SP, NY)	Climber
Heteropterys sp.	Landim 810 (ASE)	Tree
Peixotoa hispidula A. Juss.	Landim 999 (ASE)	Climber
Stigmaphyllon blanchetii C.E. Anderson	Amorim 1495 (ASE, NY)	Climber
Tetrapterys phlomoides Nied.	Jardim 470 (ASE, NY)	Shrub
Tetrapterys sp.	Landim 788 (ASE)	Climber
MALVACEAE		
Briquetia spicata (Kunth) Fryxell	Landim 993 (ASE)	Shrub
Luehea ochrophylla Mart.	Landim 295 (ASE, JPB, RB)	Tree
Sida cordifolia L.	Amaral 3 (ASE)	Herb
Sida linifolia Cav.	Landim 996 (ASE)	Climber
Waltheria americana L.	Landim 530 (ASE, MAC)	Herb
Waltheria viscosissima A.St.-Hil.	Sant'Ana 469 (ASE, NY)	Herb
MARANTACEAE		
Monotagma plurispicatum (Körn.) K. Schum	Sant'Ana 447 (ASE, NY)	Herb
Stromanthe porteana Griseb.	Landim 558 (ASE, UFRN)	Herb
MELASTOMATACEAE		
Clidemia capitellata (Bonpl.) D.Don	Sant'Ana 417 (ASE, NY)	SubShrub
Clidemia hirta (L.) D.Don	Landim 323 (ASE, HUEFS)	SubShrub
Clidemia rubra (Aubl.) Mart.	Viana ASE275 (ASE)	Shrub
Comolia ovalifolia (DC.) Triana	Sant'Ana 380 (ASE, JBRJ, MO, NY, UPCB)	SubShrub
Leandra sp.	Landim 538 (ASE)	Herb
Miconia albicans (Sw.) Triana	Landim 1474 (ASE)	Shrub
Miconia amoena Triana	Carneiro 457 (ASE)	Shrub
Miconia ciliata (Rich.) DC.	Landim 1289 (ASE)	Shrub
Miconia elegans Cogn.	Viana 378 (ASE)	Shrub
Miconia holosericea (L.) DC.	Landim 317 (ASE, HUEFS)	Shrub
Miconia minutiflora (Bonpl.) DC.	Landim 527 (ASE)	Tree
Miconia pileata DC.	Sant'Ana 415	Shrub
Miconia prasina (Sw.) DC.	Prata 2274 (ASE)	Shrub
Nepsera aquatica (Aubl.) Naudin	Gomes 33 (ASE)	Herb
Pterolepis trichotoma (Rottb.) Cogn.	Landim 641 (ASE, HST, NY)	Herb
Tibouchina asperifolia Cogn.*	Landim 759 (ASE)	Shrub

Continued on next page

Table 1. Continued.

Family / Species	Vouchers Collector Number (Herbaria)	Habit
MELIACEAE		
Trichilia lepidota Mart. subsp. f*erruginea* T.D. Penn.*	Amorim 1484 (ASE, NY)	Tree
Trichilia lepidota Mart. subsp. l*epidota* T. D. Penn.	Landim 710 (ASE, JPB, MBM)	Tree
MENISPERMACEAE		
Cissampelos glaberrima A.St.-Hil.	Landim 653, 655 (ASE)	Climber
MORACEAE		
Ficus guianensis Desv.	Amorim 1491 (ASE, NY)	Tree
Ficus insipida Willd.	Landim 952 (ASE)	Tree
MYRTACEAE		
Calyptranthes brasiliensis Spreng.	Landim 800 (ASE, HUEFS)	Tree
Campomanesia aromatica (Aubl.) Griseb.	Landim 354 (ASE, MBM)	Tree
Campomanesia dichotoma (O. Berg) Mattos	Landim 920 (ASE)	Tree
Campomanesia guaviroba (DC.) Kiaersk.	Landim 346 (ASE, JPB)	Tree
Campomanesia ilhoensis Mattos	Landim 1202 (ASE, JPB)	Shrub
Eugenia brejoensis Mazine	Gomes 118 (ASE)	Tree
Eugenia candolleana DC.	Landim 1139 (ASE, UB)	Tree
Eugenia excelsa O. Berg.	Landim 404 (ASE, UB)	Tree
Eugenia hirta O. Berg	Sant'Ana 459 (ASE, NY, RB, SP)	Tree
Eugenia punicifolia (Kunth) DC.	Carvalho 4339 (ASE, MBM, RB, SP)	Shrub
Marlierea excoriata Mart.	Gomes 73 (ASE)	Tree
Myrcia amazonica DC.	Sant'Ana 438 (ASE, RB)	Shrub
Myrcia decorticans DC.	Landim 637 (ASE, HUEFS, JPB, UB)	Tree
Myrcia polyantha DC.	Landim (ASE, UB)	Shrub
Myrcia hirtiflora DC.	Landim799 (ASE, UB)	Tree
Myrcia racemosa (O. Berg) Kiaersk	Amorim 1466 (ASE, NY, RB, SP, UB)	Tree
Myrcia rosangelae NicLugh. & Lucas	Landim 237 (ASE, UB)	Tree
Myrcia splendens (Sw.) DC.	Landim 341, 362 (ASE, UB)	Tree
Myrcia sylvatica (Mey.) DC.	Landim 303 (ASE, UB)	Shrub
Myrcia verrucosa Sobral	Landim 623 (ASE, HUEFS, UB)	Tree
Myrciaria ferruginea O. Berg	Sant'Ana 421 (ASE, NY)	Shrub
Psidium guineense Sw.	Landim 643 (ASE, HUEFS, UB)	Shrub
Psidium oligospermum Link ex DC.	Pirani 2664 (K, NY, RB, SP, SPF)	Shrub
NYCTAGINACEAE		
Guapira noxia (Netto) Lundell	Gomes 62 (ASE)	Tree
Guapira opposita (Vell.) Reitz	Gomes 130 (ASE)	Shrub
Guapira pernambucensis (Casar.) Lundell	Landim 310 (ASE, JPB)	Shrub
Guapira sp.	Landim 299 (ASE, HUEFS, RB)	Tree
Pisonia cordifolia Mart. ex J.A.Schmidt*	Landim 306 (ASE, IPA)	Shrub
OCHNACEAE		
Ouratea crassa Tiegh.	Landim 871 (ASE)	Tree
Sauvagesia erecta L.	Landim 620 (ASE, HUEFS, JPB, UFRN)	Herb
OLACACEAE		
Heisteria perianthomega (Vell.) Sleumer	Amorim 1474 (ASE, MO, NYBG)	Tree
ONAGRACEAE		
Ludwigia cf. *octovalvis* (Jacq.) P.H.Raven	Landim 216 (ASE)	Climber
Ludwigia sp.	Landim 743 (ASE)	Shrub
ORCHIDACEAE		
Alatiglossum barbatum (Lindl.) Baptista	Carvalho 4334 (ASE, NY)	Epifite
Habenaria pratensis (Salzm. ex Lindl.) Rchb.f.	Landim 707 (ASE)	Herb
Liparis nervosa (Thumb.) Lindl.	Landim 439 (ASE)	Herb
OXALIDACEAE		
Oxalis puberula Nees & Mart.	Landim 455 (ASE, JPB)	SubShrub
PASSIFLORACEAE		
Passiflora contracta Vitta	Landim 872 (ASE, HUEFS)	Climber
Passiflora misera Kunth.	Landim 991 (ASE, HUEFS)	Climber
Passiflora silvestris Vell.	Landim 205 (ASE, HUEFS)	Climber

Continued on next page

Table 1. Continued.

Family / Species	Vouchers Collector Number (Herbaria)	Habit
PENTAPHYLACACEAE		
Ternstroemia brasiliensis Cambess.	Landim 760 (ASE)	Tree
PERACEAE		
Chaetocarpus echinocarpus (Baill.) Ducke	Landim 233 (ASE, HUEFS, UFRN)	Tree
Chaetocarpus myrsinites Baill.	Landim 454 (ASE, HUEFS)	Tree
Pera glabrata (Schott) Poepp. ex Baill.	Landim 869 (ASE, HUEFS)	Tree
PHYLLANTHACEAE		
Amanoa guianensis Aubl.	Landim 624 (ASE, HUEFS)	Tree
Phyllanthus corcovadensis Müll. Arg.	Sant'Ana 428 (ASE, NY)	Shrub
Phyllanthus tenellus Roxb.	Landim 208 (ASE, UFRN)	Shrub
PICRAMNIACEAE		
Picramnia andrade-limae Pirani	Landim 528 (ASE, JPB, MBM, SPF)	Tree
Picramnia glazioviana Engl. subsp. *glazioviana* Pirani	Jardim 451 (NY, SPF)	Tree
PIPERACEAE		
Piper divaricatum G. Mey	Sant'Ana 406 (ASE, NY, RB)	Shrub
Piper sp.	Gomes 569 (ASE)	Shrub
POACEAE		
Aristida longifolia Trin.	Viana 1291 (ASE)	Herb
Gymnosiphon divaricatus (Benth.) Benth. & Hook.f.	Landim 1278 (ASE)	Herb
Ichnanthus calvescens Nees	Costa 589 (ASE)	Herb
Ichnanthus leiocarpus (Spreng.) Kunth	Landim 706 (ASE, HUEFS, JPB)	Herb
Ichnanthus nemoralis (Schrad. ex Schult.) Hitchc. & Chase	Carvalho 4323 (ASE, NY)	Herb
Parodiolyra micrantha (Kunth) Davidse & Zuloaga	Landim 630 (ASE, HUEFS)	Herb
POLYGALACEAE		
Polygala galioides Poir.	Sant'Ana 374 (NY)	Herb
Polygala paniculata L.	Landim 992 (ASE, HUEFS)	Herb
POLYGONACEAE		
Coccoloba declinata (Vell.) Mart.	Carvalho 4336 (ASE, NY)	Tree
Coccoloba laevis Casar.	Landim 702 (ASE, HUEFS)	Shrub
Coccoloba mollis Casar.	Prata 2613 (ASE)	Tree
Coccoloba parimensis Benth.	Souza 231 (ASE)	Climber
Coccoloba rosea Meisn.	Landim 1368 (ASE, HUEFS, UB)	Tree
RHAMNACEAE		
Gouania blanchetiana Miq.	Landim 547 (ASE)	Climber
Gouania sp.	Landim 908 (ASE, MBM)	Shrub
RUBIACEAE		
Alseis floribunda Schott	Carvalho 4343 (ASE, SP, NY)	Tree
Alseis pickelii Pilg. & Schmale	Landim 1367 (ASE, JPB)	Tree
Borreria capitata (Ruiz &Pav.) DC.	Amorim 3463 (NY)	Herb
Borreria humifusa Mart.	Landim 705 (ASE, JPB)	Herb
Borreria scabiosoides Cham. & Schltdl.	Landim 539 (JPB)	SubShrub
Borreria verticillata (L.) G.Mey.	Landim 446 (ASE, JPB)	SubShrub
Chomelia anisomeris Müll.Arg.	Landim 811 (ASE)	Shrub
Chomelia obtusa Cham. &Schltdl.	Landim 369 (ASE, JPB)	Tree
Cordiera myrciifolia (K.Schum.) C.H.Perss. & Delprete	Gomes 31 (ASE)	Shrub
Coutarea hexandra (Jacq.) K. Schum.	Landim 957 (ASE, JPB, MBM)	Tree
Emmeorhiza umbellata (Spreng.) K.Schum.	Landim 995 (ASE)	Climber
Guettarda platyphylla Müll.Arg.	Carvalho 4326 (ASE, NY)	Tree
Guettarda viburnoides Cham. & Schltdl.	Landim 469 (ASE, JPB, MBM)	Tree
Malanea macrophylla Bartl. ex Griseb.	Amorim 1473 (ASE, NY)	Tree
Margaritopsis chaenotricha (DC.) C.M.Taylor	Landim 629 (ASE, HUEFS)	Shrub
Psychotria bracteocardia (DC.) Müll.Arg.	Landim 526 (ASE, JPB)	Shrub
Psychotria capitata Ruiz &Pav.	Landim 304 (ASE, JPB, RB)	Shrub
Psychotria carthagenensis Jacq.	Amorim 1504 (ASE, NY, SP)	Shrub
Psychotria hoffmannseggiana (Willd. ex Schult.) Müll.Arg.	Landim 928 (ASE, JPB)	Shrub
Psychotria platypoda DC.	Carvalho 4329 (ASE, NY)	Shrub

Continued on next page

Table 1. Continued.

Family / Species	Vouchers Collector Number (Herbaria)	Habit
Psychotria subtriflora Müll.Arg.	Gomes 48 (ASE)	Shrub
Psychotria sp.	Landim 740 (ASE, JPB)	Shrub
Sabicea grisea Cham. &Schltdl.	Landim 657 (ASE)	Climber
Salzmannia nitida DC.	Landim 614 (ASE, HUEFS, UB)	Shrub
RUTACEAE		
Ertela trifolia (L.) Kuntze	Landim 649 (ASE, JPB, SPF)	Herb
SALICACEAE		
Casearia decandra Jacq.	Landim 407 (ASE, HUEFS)	Tree
Casearia javitensis Kunth	Landim 792 (ASE)	Tree
Casearia sylvestris Sw.	Landim 935 (ASE)	Tree
SANTALACEAE		
Phoradendron chrysocladon A. Gray	Landim 463 (ASE)	Parasite
Phoradendron strongyloclados Eichler	Landim 444 (ASE)	Parasite
Phoradendron quadrangulare (Kunth) Griseb.	Landim 998 (ASE)	Parasite
SAPINDACEAE		
Allophylus edulis (A.St.-Hil. et al.) Hieron. ex Niederl.	Landim 429 (ASE, UB)	Tree
Cupania impressinervia Acev.-Rodr.	Landim 636 (ASE, HUEFS, UFRN)	Tree
Cupania racemosa (Vell.) Radlk.	Jardim et al. 461 (ASE, NY)	Tree
Cupania sp.	Landim 948 (ASE)	Tree
Paullinia racemosa Wawra	Landim 1275 (ASE, HUEFS)	Climber
Paullinia trigonia Vell.	Landim 374 (ASE)	Climber
Serjania paradoxa Radlk.	Landim 371 (ASE, HUEFS)	Climber
Serjania salzmanniana Schltdl.	Landim 352 (ASE, IPA, JPB)	Climber
SAPOTACEAE		
Chrysophyllum rufum Mart.	Gomes 177 (ASE)	Tree
Ecclinusa ramiflora Mart.	Landim 276 (ASE)	Tree
Manilkara maxima T.D.Penn.	Gomes 24, 76 (ASE)	Tree
Manilkara salzmannii (A.DC.) H.J.Lam	Landim 398 (ASE)	Tree
Micropholis compta Pierre in Urb.	Sant'Ana 454 (ASE, NY)	Tree
Micropholis gardneriana (A.DC.) Pierre	Landim 932 (ASE, EAC, HUEFS, JPB)	Tree
Pouteria grandiflora (A.DC.) Baehni	Jardim 472 (ASE, CEPEC, MO, RB)	Tree
Pouteria macahensis T.D.Penn.	Gomes 121 (ASE)	Tree
Pouteria macrophylla (Lam.) Eyma	Prata 2615 (ASE)	Tree
Pouteria venosa (Mart.) Baehni	Landim 349 (ASE, HUEFS)	Tree
Pradosia lactescens (Vell.) Radlk.	Landim 1281(ASE)	Tree
SCHOEPFIACEAE		
Schoepfia brasiliensis A. DC.	Landim 462 (ASE, UFRN)	Tree
SIMAROUBACEAE		
Simarouba versicolor A.St.-Hil.	Fonseca ASE184 (ASE)	Tree
SMILACACEAE		
Smilax rufescens Griseb.	Landim 562 (ASE)	Shrub
Smilax sp.	Landim 340 (ASE)	Climber
SOLANACEAE		
Cestrum salzmannii Dunal	Sant'Ana 449 (ASE)	Shrub
Cestrum sp.	Landim 1138 (ASE, JPB)	Shrub
Schwenckia americana Rooyen ex L.	Landim 642 (ASE, HUEFS, IPA)	Herb
Solanum capsicoides All.	Landim 565 (ASE)	Herb
Solanum paludosum Moric.	Landim 796 (ASE, JPB)	Shrub
Solanum polytrichum Moric.	Landim 292 (ASE, UB)	Shrub
Solanum stenandrum Sendtn.	Landim 566 (ASE)	Shrub
Solanum stipulaceum Willd. ex Roem. & Schult.	Sant'Ana 461 (ASE, NYBR_BR)	Shrub
TRIGONIACEAE		
Trigonia nivea Cambess. var. *nivea*	Sant'Ana 424 (ASE, NY)	Climber
Trigonia sp.	Landim 931 (ASE)	Climber
URTICACEAE		
Cecropia pachystachya Trécul	Amorim 1475 (ASE, NY)	Tree

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Table 1. Continued.

Family / Species	Vouchers Collector Number (Herbaria)	Habit
VERBENACEAE		
Lantana camara L.	Landim 548 (ASE)	Shrub
Lantana canescens Kunth	Landim 546 (ASE)	SubShrub
Lantana fucata Lindl.	Landim 646 (ASE)	Shrub
Lantana lucida Schauer	Landim 615 (ASE)	SubShrub
Stachytarpheta cayennensis (Rich.) Vahl	Landim 370 (ASE, HUEFS)	Herb
Stachytarpheta maximiliani Schauer	Amorim 3461 (HUEFS)	Herb
Stachytarpheta sp. 1	Amaral 2 (ASE)	Herb
Stachytarpheta sp. 2	Landim 567 (ASE)	Herb
Tamonea juncea Schauer	Landim 535 (ASE, HUEFS)	Herb
VIOLACEAE		
Hybanthus calceolaria (L.) Oken	Jardim 467 (ASE, CEPEC)	Herb
Rinorea guianensis Aubl.	Gomes 81 (ASE)	Shrub
VITACEAE		
Cissus erosa Rich.	Landim 648 (ASE, HUEFS, MAC)	Climber
VOCHYSIACEAE		
Vochysia lucida C.Presl	Landim 320 (ASE, UEFS)	Tree
XYRIDACEAE		
Xyris jupicai Rich.	Amorim 1486 (ASE, NY)	Herb

new determinations. The Taxonomic Distinction Index (Δ^+) was calculated using PAST, version 2.14 (Hammer et al. 2001). Four taxonomic levels (order, family, genus and species) were adopted and the same step length (=1) was used to attribute weight to distances between the different levels (Clarke & Warwick 1999).

Results and discussion

Floristic composition

The Mata do Crasto floristic list recorded 324 species of which 21 (6.5%) were identified only to genus and two (0.6%) only to family (Tabel 1). The floristic list recorded 84 families and 193 genera. Over a third of the species were new occurrences for Sergipe: 129 (30%) new species occurrences, 29 new generic occurrences and four new family occurrences (Humiriaceae, Onagraceae, Smilacaceae and Vochysiaceae) according to data available in the Lista de Espécies da Flora do Brasil (2014).

Although species accepted in the Lista de Espécies da Flora do Brasil (2014) were adopted as the taxonomic standard, three species not recognized by this list (not even as synonyms) were accepted: *Trichilia lepidota* Mart. subsp. *ferruginea* T.D. Penn. (Amorim 1484) was maintained since it is an isotype; *Tibouchina asperifolia* Cogn. (Landim 759) is accepted by The Plant List (2013) and by Melastomataceae.Net (2013); and *Pisonia cordifolia* Mart. ex J.A.Schmidt is an unresolved name in The Plant List (2013) (http://www.theplantlist.org/tpl/record/kew-2552380).

The most speciose families (Figure 1), Fabaceae (33 species), Rubiaceae (24 species), Myrtaceae (23 species) and Melastomataceae (15 species), account for 30% of the species in the *Mata do Crasto*. These four families are amongst the nine most diverse families in the Atlantic Forest (Stehmann et al. 2009). In a study of Atlantic Forest in southern Bahia, Ubatuba (SP) and Porto Alegre (Rio Grande do Sul) these families were also important but the Fabaceae are more speciose in the *Mata do Crasto* than in either of these areas and the Myrtaceae, proportionally, less important (Leitão Filho, 1987). However, in a wider and more recent survey of Atlantic Forest, Oliveira-Filho & Fontes' (2000) conclusions were more similar to those reported here. According to their results, the four most speciose families in the *Mata do Crasto* are also the five most speciose families in lowland pluvial Atlantic forests, considering the Fabaceae as a single family (*sensu* APG III, Reveal & Chase 2011). The apparent similarity of the *Mata do Crasto* to other areas should be interpreted with caution since the database used by Oliveira-Filho & Fontes (2000) did not consider areas north of southern Bahia. Differences in collection effort and subtle alterations in methodologies, together with differential attention to forest strata can also influence richness results and bias comparisons of family richness.

In the *Mata do Crasto*, there are 33 species in 20 genera in the Fabaceae, the second most speciose family in the Atlantic Forest domain (Stehmann et al. 2009), corresponding to 26% and 36%, respectively, of the total numbers of species and genera known in Sergipe (Lima et al. 2013). In surveys of the northeast (Rodal et al. 2005, Barbosa et al., 2011) and in the southeast (Ivanauskas & Rodrigues 2000, Peixoto et al. 2004, Zipparro et al. 2005, Rolim et al. 2006) regions of the Atlantic Forest, the Fabaceae is usually the most speciose family.

The most speciose genera of Fabaceae in the *Mata do Crasto* were *Inga* and *Senna* (four and six species, respectively). *Inga* is the eighth most speciose genus in lowland pluvial Atlantic forest (Stehmann et al. 2009) and one of the two Fabaceae genera included in the 21 most diverse genera in these communities by Oliveira-Filho & Fontes (2000). Physiognomically, *Tachigali densiflora* (Benth.) L.F. Gomes da Silva & H.C. Lima, a large emergent tree very characteristic of the Sergipe Atlantic Forest remnants is a prominent component; this Caesalpinoid Legume occurs in Minas Gerais and then northwards in all the coastal states up to northeastern Paraíba (Lima et al. 2013).

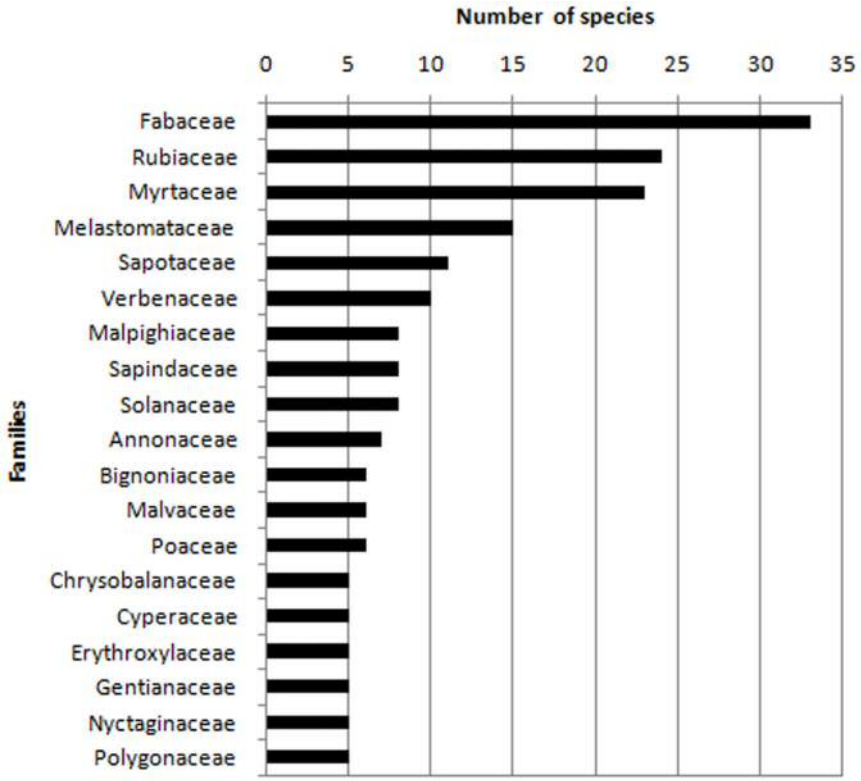

Figure 1. Angiosperm families with five or more species found in the *Mata do Crasto* Atlantic Rainforest remnant, Santa Luzia do Itanhy, Sergipe, Brazil.

The Rubiaceae is the second most speciose family in the *Mata do Crasto*, with 24 species in 12 genera; 61% and 46% of the total number of Rubiaceae species and genera, respectively, recorded from Sergipe (Barbosa et al. 2013). This family is the ninth most speciose in Atlantic Forest (Stehmann et al. 2009) and the third most speciose in lowland Atlantic pluvial forest (Oliveira-Filho & Fontes 2000). *Psychotria* and *Borreria* were the richest genera (seven and four species, respectively).

Seven genera and 23 species of Myrtaceae were recorded from the *Mata do Crasto*. Although eight genera and 35 species of Myrtaceae are cited from Sergipe in the Lista de Espécies do Brasil (Sobral et al. 2013), recent compilations increase these numbers up to ten genera and 60 species (Proença et al. 2013) . The 23 species of Myrtaceae recorded in this forest remnant correspond to 38% of this latter total. *Myrcia* (nine species), *Eugenia* (five species) and *Campomanesia* (four species) are the most diverse genera. Amongst the genera with most species in lowland pluvial Atlantic forests, *Eugenia* and *Myrcia* are two of the most speciose (70 and 37 species, respectively). *Marlierea*, represented in the *Mata do Crasto* by a single species, *M. excoriata*, is the sixth most speciose (22 species; Oliveira-Filho & Fontes 2000).

Myrtaceae is the third most speciose family in the *Mata do Crasto*, although it was the sixth most speciose family in the Atlantic Forest domain (Stehmann et al. 2009) and the most speciose in lowland pluvial Atlantic Forest (Oliveira-Filho & Fontes 2000). This family appears to be most important in the Southeastern Atlantic forests (Tabarelli & Mantovani 1999, Zipparro et al. 2005, Ivanauskas & Rodrigues, 2000, Peixoto et al. 2004, Rolim et al. 2006).

In the northern sector, Myrtaceae seems to be less important: it was forth most speciose family in a seasonal lowland forest near the coast of Pernambuco (Rodal et al. 2005) and was not even listed amongst the six most speciose families in a survey in coastal Paraíba (Pereira & Alves 2006) or in a study in Alagoas (Oliveira et al. 2005), and it was only seventh in three areas of montane Atlantic forest in southern Bahia (Amorim et al. 2009). However, a survey of an area of lowland Atlantic Forest in Pernambuco (Amorim & Alves 2011) reported the same number of species of Myrtaceae as in this study. Although the distance between the two areas is less than 600 km, these two areas together have 35 species of Myrtaceae, of which 11 were shared.

In a study using *Myrcia* as an indicator genus of local biodiversity hotspots within the Atlantic Forest domain (Murray-Smith et al. 2008), the Atlantic Forest was subdivided in squares of 1° latitude x 1° longitude, to which nine levels of richness were allocated, based on the number of *Myrcia* species present, with level 1 the poorest (“0-1 species”) and level 9 the richest (“29-49 species”). Although the square in which the *Mata do Crasto* is found (11-12° S x 37-38° W) was classified in their study as level 3 (“5-8 species”), our data, associated with additional collections from the ASE herbarium, have shown that this square actually has at least 13 species of *Myrcia* and should have been classified in the intermediate level 5 (“12-14 species”). These findings reinforce the relevance of the present study results for the current analyses of the biodiversity distribution pattern in the Brazilian Atlantic Rainforest.

Habits

Most of the species collected in the *Mata do Crasto* belong to the tree/shrub layer, followed by the subshrub/herb layer. Higher percentages of species in the tree layer were registered in

Atlantic Forest fragments in north-eastern and south-eastern Brazil (Table 2), accounting for over half the species in Pernambuco and São Paulo. In a study carried out in another type of forest found in the Brazilian northeast, a fragment of montane forest in the municipality of Brejo da Madre de Deus, in Pernambuco (Nascimento, Rodal & Silva 2012), the tree habit was also the best represented (50% of all species).

It was proposed by Gentry & Dodson (1987) that trees contribute relatively little towards the high species diversity in tropical forests, and that is partially confirmed by the significant percentage of lianas, herbaceous climbers and herbs found in this study. Richards (1996) emphasizes the preponderance of woody phanerophytes in tropical rainforests (includes trees as well as shrubs and climbers) and the importance of epiphyte species over ground herbs, stressing, however, the difficulties in comparing life-form spectra from different studies.

A smaller comparative importance of climbers and epiphytes might be expected in the *Mata do Crasto*, and in forests of the northeast, in general, due to the smaller total rainfall, higher seasonality and high inter-annual variation in precipitation. In fact, the importance of epiphytes in the *Mata do Crasto* is lower than in almost all other areas with which it was compared in Table 2, suggesting that the quantity and annual distribution of rainfall may limit establishment of epiphytes in this forest fragment. On the other hand, percentages of climbers and lianas are similar to those of forest fragments in Bahia. Although species of epiphytes are sometimes eliminated from the forests with increased disturbance by man, some species may flourish under these conditions (Hietz et al. 2006). Likewise, lianes may be favored by the more open forest canopy that often results from selective cutting and other forms of disturbance (Schnitzer & Bongers 2002).

However, it is possible that the relative importance of non arboreal species may still remain underestimated in many floristic surveys (Linares-Palomino et al. 2009). Although collecting tall trees may be a difficult task, the difficulty in identifying vegetative stage of lianas and epiphytes specimens in the field, and, sometimes, the requirement of specialized equipment to collect them, it is possible that these life forms are yet insufficiently sampled in the *Mata do Crasto*. Future efforts should concentrate on this layer to strengthen conservation planning that covers the whole diversity of tropical forests, and not only of the tree stratum (Gentry, 1992).

Taxonomic diversity and distinction. Few published floristic studies are comparable to the *Mata do Crasto* study, encompassing the whole Angiosperm community of a significant remnant of lowland ombrophilous Forest. Most floristic inventories found in Northeastern states include only woody plants and/or were undertaken in different forest types, such as montane, caducifolius and/or inland forests. Only three comparable studies have been found in states of Pernambuco (Rodal et. al 2005) and Alagoas (Oliveira et al. 2005), both north of the São Francisco River, and one in Bahia (Amorim et al. 2008), that is South of the São Francisco River.

A total of 1,457 angiosperm species were recorded across the four sites. The Bahia and Alagoas studies were both the most species-rich and comprehensive, with more than one fragment and several different phytophysiognomies included (Table 3). The Bahia study, undertaken in 9,000 ha of protected area in the *REBIO de Una*, included adjacent *florestas de tabuleiro* (*restingas litorâneas,* a kind of maritime forest). The Alagoas site covered 8,000 ha, including dozens of Atlantic Forest fragments of various sizes and different degrees of human perturbation (Oliveira et al. 2005). Our study in the *Mata do Crasto*, covering a single fragment of 1,000 ha, ranked third in number of species, while the smallest fragment (81 ha), in Pernambuco (Santos et al. 2001 cited by Rodal et al. 2005), was the one in which the smallest number of species was recorded. The large differences in sampled area amongst three of these studies likely influence the numbers of species recorded. Study area size is strongly correlated with the number of species recorded as large areas are more likely to include

Table 2. Comparison between habit distributions of Angiosperm species in the *Mata do Crasto*, Santa Luzia do Itanhy, Sergipe, and in other Atlantic Forest studies. Values are in percentages. BA = Bahia; PE = Pernambuco; SE = Sergipe; SP = São Paulo.

Locality, State	Environment (altitude)	Tree	Shrub	Sub-shrub	Herb	Epiphyte	Climber	Parasite/ Saprophyte	Reference
Mata do Toró, PE	Lowland seasonal Forest (<140 m.s.m.)	59,9	18,3	2,0	9,4	2,0	8,4		Rodal et al. 2005
Usina Serra Grande, PE	Open ombrophilous forest	38,4	14,6	6,8	24,5	3,2	12,0	0,5	Oliveira, Grillo, Tabarelli 2005
Crasto, SE	**Lowland ombrophilous forest**	**39,3**	**21,2**	**4,0**	**18,4**	**0,6**	**15,6**		**This study**
REBIO Una, BA	Submontane and lowland pluvial forest	40,7	9,1	0,0	19,2	12,3	17,3	1,4	Amorim et al. 2008
Serra Bonita, BA	Montane ombrophilous forest	43,7		-	20,4	21,1	14,8		Amorim et al. 2009
Pedra Lascada, BA	Montane ombrophilous forest	49,6		-	18,2	24,0	8,2		Amorim et al. 2009
Serra das Lontras, BA	Montane ombrophilous forest (400-1000 m.s.m.)	49,5		-	16,2	22,3	12		Amorim et al. 2009
Intervales, SP	Submontane ombrophilous forest	57,1	9,2	-	9,4	12,6	10,3		Zipparro et al. 2005

Table 3. Angiosperm taxa richness and distribution in selected floristic inventories in lowland Atlantic Forest remnants in Northeastern Brazil. AL = Alagoas; BA = Bahia; PE = Pernambuco; SE = Sergipe.

	PE[1]	AL[2]	SE[3]	BA[4]
No. of morphoespecies*	195	627	321	932
No. of species#	179	529	295	830
Determination to species level (%)	91.8	84.4	91.1	89.1
No. of genera	136	100	83	114
No. of families	57	372	188	429
No. of species/No. of genera	1.3	5.3	3.6	7.3
No. of species/No. of families	3.1	1.4	1.6	1.9
No. of exclusive species	85	306	151	629
% of exclusive species	47.5	57.8	51.0	75.8
Average Taxonomic Distinctness (?+)	3.882	3.907	3.882	3.899
Confidence interval Δ^+ – upper limit	3.883	3.893	3.888	3.895
Confidence interval Δ^+ – lower limit	3.916	3.909	3.913	3.907

[1]Rodal et al. 2005; [2]Oliveira, Grillo & Tabarelli 2005; [3]This study; [4]Amorim et al. 2008
* taxa listed in the selected articles; # taxa determined to species level

different habitats, thereby increasing species richness (Primack & Rodrigues 2001).

Little difference in average taxonomic distinction between the four selected lowland Northeastern Atlantic Forest studies was found, values of Δ^+ found varying between 3.88 and 3.91 (Table 3). Unfortunately, there are no other Atlantic Forest studies in which measures of taxonomic diversity have been calculated for the complete list of angiosperm species of a region, what may hinder further comparisons. Webbs (2000) study was apparently the first to apply measures of taxonomic diversity and distinctness to angiosperms, analyzing tree species of tropical forests in Borneo. But, with the exception of the work of Dominguez et al. (2010), comparing angiosperm floras in the Hawaiian and Canarian archipelagos, no other study was found encompassing the whole angiosperm flora present in an area.

Measures of diversity that incorporate phylogenetic distance among species are thought to be better than more traditional measures (Cianciaruso, Silva & Batalha 2009). Measures of taxonomic diversity and distinction include a dimension of phylogenetic diversity that is more closely related to functional diversity than species richness. Such indices are apparently less sensitive to sample size than conventional ecological indices, such as richness and equitability. They also appear independent of sampling effort, permitting comparisons among studies with different degrees of sampling effort. However, identification influences all indices and it is critical that care is taken that this is done as completely and as accurately as possible (Clarke & Warwick 1998, 1999). Identification is a problem in families where species are notoriously hard to distinguish (e.g., Myrtaceae) and incomplete identification of such families is frequent in floristic studies due to the cryptic nature of distinguishing characters (McVaugh 1968, Landrum and Kawasaki 1997), what did not happen is this study, where all Myrtaceae taxa are identified at species level.

Our values of Δ^+ are, however, close to those calculated (3.73 - 3.77) by Gorenstein (2009) for trees in a submontane ombrophilous forest, at altitudes between 30 and 1,003 m, within the Atlantic Forest domain in São Paulo. Lower Δ^+ values were found in four Ugandan phytophysiognomies, varying from 2.41, in dry woodland, to 2.79, in dry thicket woodland (Gwali et al. 2010); these data were also based only on the woody flora, using three taxonomic levels (Family, Genus and Species).

The high similarity among the Taxonomic Distinctiness indices between these four areas was unexpected, especially since they differ to each other in total number of families, genera and species, and that all four had many exclusive species (47-75%). Given its intermediate position, both geographically and in size, between the larger (and richer) Bahia and Alagoas sites, the relatively high proportion (51%) of species uniqueness at the *Mata do Crasto* site is striking. Although physiognomically similar, this data suggests Northeastern Atlantic forests are not floristically uniform.

Usually, large areas have a greater proportion of species per genus and species per family than small areas. In our study, however, the highest proportions of species per family (3.1) were found in Pernambuco, the smallest area; conversely, the number of species per genera (1.3) in this fragment was much lower than elsewhere. Values of species per family for our study (1.6) were between the Alagoas (1.4) and Bahia (1.9) studies; this value thus follows a geographic gradient diminishing northwards. In species per family, however, the *Mata do Crasto* value (3.6) was lower than either the Bahia (7.3) or Alagoas studies (5.3) that included more than one fragment and forest type.

Shared species between studies was surprisingly low: only 15 species (1%) were common to all four studies, even when possible synonyms were accounted for. Conversely, the number of species exclusive to a single study was very high varying from 85 exclusive species (47%) in Pernambuco to 629 (76%) in Bahia. The Alagoas study and our study showed intermediate values; Alagoas had a higher number of exclusive species (306) than the *Mata do Crasto* (151), but the percentages of exclusive species were similar (58 and 51%, respectively). Exclusive species thus seem to diminish approximately northwards.

The results were also analyzed considering the São Francisco River (SF) as a potential dispersal barrier. Two hundred and fifteen species (15%) had distributions that crossed the São Francisco river (i.e., that are shared between all, three or two studies that crossed the river). The percentage of exclusive species in the studies south of the São Francisco River (Alagoas and Bahia) is nearly twice (822 species, 56%) that of those North of the river (420 species, 29%); however, these results may be influenced by the different number of fragment and forest types included in these studies (Oliveira, Grillo, & Tabarelli 2005, Amorim et al. 2008). A quantitative association

analysis is beyond the scope of this study but it is noteworthy that although Fabaceae was the most speciose family in the three distribution classes (widespread, SF-south, and SP-south), Rubiaceae was the second most important family only amongst the SF-south species (55) and widespread species (19), and was substituted by the Orchidaceae (33 species) in the SF-north species. It was also observed that SF-south species were distributed in more families (114) than either SF-north species (90 families) or widespread species (67 families).

Conclusion

This study has contributed an additional 96 species to the Sergipe flora, and increased knowledge of their geographic distribution and that of other species in the Atlantic forests of the Northeast. Northeastern Atlantic Forest fragments subject to somewhat similar environmental characteristics may have significantly different floristic compositions, and a high proportion of exclusive species, although taxonomic diversity appears to be relatively stable. Considering the strong level of anthropogenic pressure on the northeastern Atlantic Forest remnants, it is possible that much of its native diversity has already been lost, particularly rare species and the ones that are most sensitive to habitat alteration, thus creating false "disjunctions" in their distributions. Other possibilities are that many species have spatial or temporal casuistic mosaic-like distribution patterns, or that the existence of many continuous, but regional, species is responsible for the observed pattern. Additional floristic inventories in Atlantic Forest fragments, particularly, but not exclusively, in the Northeast are needed to clarify individual species' distribution patterns and also forest type distribution patterns.

Studies that increase comprehension of structure, function and environmental causes are necessary to ensure the effective conservation of Atlantic forests. To be effective, these should occur at a rate that preempts the accelerating rates of deforestation. Many threats, and their synergies, lead to a decline in populations of Neotropical tree species, which can produce chains of events that influence ecological services (Tabarelli, Silva & Gascon 2004). Such considerations have lead to some authors questioning the conservation value of small forest fragments for long-term Atlantic Forest preservation (Tabarelli, Mantovani & Peres 1999). In Pernambuco, for example, almost half of the fragments analyzed in the south of the state had an area above 10 ha, but only 7% were above 100 ha (Ranta et al. 1998). This highlights the importance of the *Mata do Crasto*, an Atlantic Forest fragment of ca. 1,000 ha, for the effective conservation of the floristic and faunistic diversity of the northeastern Atlantic Forest.

Therefore, the first of the recommendations made by Landim & Landrum (2002) regarding the knowledge of Sergipe's flora, increasing sampling effort, remains valid, but the last two ones must not be forgotten: the urgent need to study Brazil's Northeastern flora, including herbarium material, and a simultaneous investment in taxonomic training. In this context, the first volume of the Flora de Sergipe (Prata et al. 2013) is an important contribution. In order to understand species richness and distribution in Sergipe, other rainforest fragments (in the municipalities of Indiaroba, Itaporanga d'Ajuda, São Cristóvão and Japaratuba) are also being studied and inventoried.

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