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Floristic surveys of Restinga Forests in southern Bahia, Brazil, reveal the effects of geography on community composition

Levantamento florístico de florestas de Restinga do Sul da Bahia, Brasil, revela o efeito da geografia na composição das comunidades

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Abstract

The Restinga forests of southern Bahia state, Brazil, grow on sandy coastal Quaternary sediments. As their floras are relatively poorly known, the present study assessed their floristic compositions. We surveyed four sites at Maraú and Itacaré and identified 302 angiosperm species belonging to 184 genera of 75 families. The most species rich families were: Fabaceae (35 species), Myrtaceae (25), Rubiaceae (21), Sapotaceae (13), Bromeliaceae (12), Annonaceae (11), Erythroxylaceae (10), Melastomataceae (9), and Apocynaceae (8). Local floras include elements with distributions restricted to the Atlantic Forest domain, those disjunct between the Amazon and Atlantic Forest domains, and those also occurring in moist forests and dry vegetation of central Brazil. The hypothesis that the floristic compositions of restinga forests are influenced by neighboring wet forests was tested using cluster and principal component analyses of eleven restinga forests and nine Atlantic wet forest sites. The results supported five main groups, with most of them including both restinga forests and their adjacent wet forest sites, thus corroborating the hypothesis that wet forests in geographical proximity greatly influence the floristic compositions of restinga forests.

Key-word: coastal vegetation, Atlantic Forest domain, flora, similarity.

Resumo

As florestas de Restinga do baixo-sul da Bahia, Brasil, encontram-se sobre sedimentos arenosos do Quaternário costeiro. Como sua flora é relativamente pouco conhecida, o presente estudo avaliou sua composição florística. Foram inventariadas quatro áreas nos municípios de Maraú e Itacaré e identificadas 302 espécies de angiospermas, distribuídas em 184 gêneros e 75 famílias. As famílias mais ricas em espécies foram: Fabaceae (35 espécies), Myrtaceae (25), Rubiaceae (21), Sapotaceae (13), Bromeliaceae (12), Annonaceae (11), Erythroxylaceae (10), Melastomataceae (9) e Apocynaceae (8). A flora local inclui elementos de distribuição restrita à Mata Atlântica, disjunta entre Amazônia e Mata Atlântica e florestas úmidas e a vegetação seca do Brasil central. A hipótese de que a composição florística das florestas de Restinga é influenciada pelas florestas pluviais geograficamente próximas foi testada usando análises de agrupamento e de componentes principais com onze áreas de florestas de Restinga e nove de florestas pluviais da Mata Altântica. Os resultados sustentaram cinco grupos principais, a maioria incluindo áreas de floresta de restinga e florestas pluviais adjacentes, corroborando a hipótese de que a proximidade geográfica aos estoques florísticos das florestas pluviais tem grande efeito na composição das florestas de Restinga.

Palavras-chave: vegetação costeira, Domínio Mata Atlântica, flora, similaridade.

Introduction

The word "Restinga" designates vegetation established on sandy Quaternary substrates subject to marine or fluvial-marine influences (Flexor *et al*. 1984; Sugiyama 1998). This definition encompasses a variety of plant communities that can vary greatly in terms of their physiognomic, floristic, and structural features (Assis *et al*. 2004). These vegetation complexes are organized along a sea-to-continent gradient, with positive correlations between species richness and size (Araújo 2000).

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Restinga vegetation has great ecological value, serving as shelter for plant populations that are rare in other forest types in the Atlantic Forest domain (hereinafter Atlantic domain; Scarano 2009) and for endangered animals (Rocha *et al.* 2005) - and are used by traditional coastal communities for food, medicines, and raw materials for craft work (Menezes *et al.* 2009). These vegetation forms are also responsible for the maintenance of water resources (Dorneles & Weachter 2004; Scherer *et al.* 2005).

Despite their great social and ecological importance, Restingas are some of the least-known vegetation types in Brazil in terms of their diversity and conservation status (Rocha *et al*. 2005), and basic information about areas occupied by Restinga vegetation fragments is lacking at both regional and continental scales (Rocha *et al*. 2007).

Studies encompassing Restinga vegetation are still incipient and have been unequally distributed across Brazil's geopolitical regions. Southern and southeastern Restinga sites have been more intensively studied (Lacerda *et al.* 1984; Araújo 2000; Martins *et al.* 2008; Lima *et al.* 2011), although Guedes *et al.* (2006) highlighted our lack of knowledge about the floristic and phytosociological structures of restinga vegetation in São Paulo State. Most of the works produced so far have been limited to floristic and vegetational aspects, with little emphasis on environmental patterns and processes. Bahia State has the longest coastline in the country (ca. 1200 km), but studies there have been scarce and concentrated mostly along its northern shore (e.g., Britto *et al.* 1993; Queiroz 2007; Menezes *et al.* 2009; Queiroz *et al.* 2012).

Restingas are highly diverse habitats, although they generally harbor fewer species than other forest types within the Atlantic domain (Almeida Jr. *et al* 2009; Lima *et al.* 2011). Restinga vegetation is normally established on geologically recent sediments originating from deposition by marine regressive movements during the Pleistocene and Holocene periods. The young ages of these habitats have not provided sufficient time for speciation to occur – a factor often cited as the principal explanation for their scarcity of endemic taxa (Scarano 2002; Castro *et al.* 2012). These communities are therefore composed mostly of elements from other vegetation types – with the Atlantic domain being considered the main source of their species (generally more than 50% of the total numbers of species) (Assis *et al.* 2004). However, there are also reports of contributions from Cerrado (Neotropical Savanna), Caatinga (Seasonally Dry Tropical Forests and Woodlands), and Amazonia floras (Cerqueira 2000; Sacramento *et al.* 2007; Castro *et al.* 2012).

Taking into consideration the young geological age and scarcity of endemism in Restinga vegetation, we hypothesize that the flora of Restinga forests is composed mostly of elements that have migrated from neighboring wet forest areas rather than arising from *in situ* speciation. This hypothesis can be tested by demonstrating that the floras of Restinga forests are more similar to those of geographically close rain forests than to other (more remote) Restinga forest sites, and we present here comparative analyses to that end. We also report the results of floristic studies of Restinga forests from southern Bahia that can help fill gaps in our knowledge of the floristic compositions of Restinga forests in an important center of diversity in the Atlantic domain.

Materials and Methods

Study areas

The survey areas encompassed four sites in southern Bahia State, Brazil (Fig. 1), in the municipalities of Itacaré (Mata do Santo Amaro - MAS) and Maraú (Mata do Caubi - MC; Mata da Estrada Maraú-Itacaré – MMI; and Mata da Piracanga - MP; Tab. 1). The region is part of the Atlantic domain, with a mean annual precipitation between 1,200 and 2,400 mm, with the rainy season extending from March to July, without a dry period; the mean annual temperature is approximately 25 °C, with small oscillations between the minimum and maximum mean temperatures of 20 and 26 °C - an Af climate type according to the Köppen (1948) system (C.E.I. 1993).

The Restinga Forests in the survey region grow on well-preserved coastal ridges ranging from 5 to 8 m a.s.l. The substrate is sandy, and originated from ocean regressions following the Pleistocene transgression (Martin *et al.* 1980). Forest fragments are surrounded by open, seasonally flooded grasslands (Silva & Britez 2005) that grow in lowland areas between mountain ridges, with pools forming during the rainy period. These grasslands are characterized by a well-developed herbaceous layer with sparsely distributed woody plants (Silva & Britez 2005).

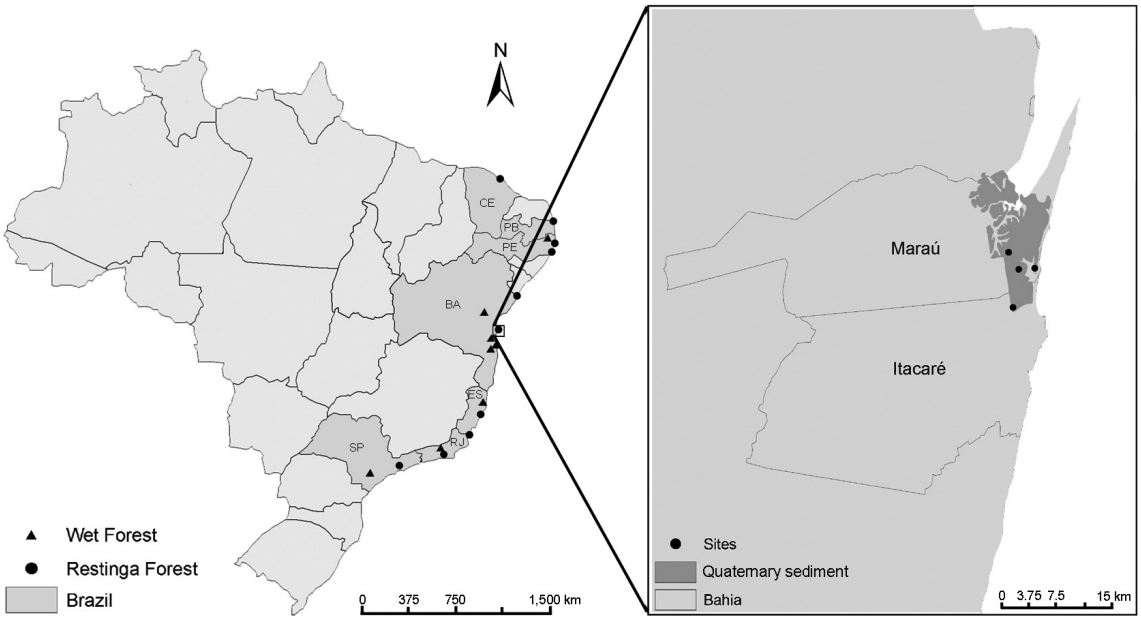

Figure 1 – Map of Brazil showing the locations of the areas used in the similarity analyses; circles indicate Restinga forests, and triangles wet forest areas. The inset shows the borders of the municipalities of Itacaré and Maraú (Bahia State), highlighting the distribution of the sandy Quaternary sediments and Restinga forest sites (circles) where the floristic surveys were conducted. Brazilian states with areas considered in the similarity and cluster analyses are indicated by darker grey shading: BA= Bahia; CE= Ceará; ES=Espírito Santo; PB=Paraíba; PE=Pernambuco; RJ= Rio de Janeiro; SP= São Paulo.

Figura 1 – Mapa do Brasil mostrando a localização das áreas comparadas nas análises de similaridade; círculos indicam áreas de florestas de Restinga e triângulos áreas de florestas pluviais. Em detalhe, limites dos municípios de Itacaré e Maraú (estado da Bahia), destacando a extensão de sedimentos arenosos do Quaternário e os sítios de florestas de Restinga (círculos) onde foram realizadas amostragem florística. Estados com áreas usadas nas análises de similaridade e agrupamento estão em cinza mais escuro: BA= Bahia; CE= Ceará; ES=Espírito Santo; PB=Paraíba; PE=Pernambuco; RJ= Rio de Janeiro; SP= São Paulo.

The four Restinga forest fragments studied here are classified as non-flooding Restinga forests, according Silva & Britez (2005), although all of them show micro-topographical variations with certain localities subject to periodic flooding. The forest canopy is approximately 15 m tall, although some emergent species may reach 22 m.

Floristic Surveys

Floristic surveys were carried out between March/2013 and February/2014 during nine field trips. The plant specimens were gathered and processed as described by Mori *et al.* (1989). Biological forms were assigned to each species following Whittaker (1975): trees (woody, ≥ 3 m tall), shrubs (woody, <3 m tall, usually multi-stemmed), herbs (self-standing, not woody), vines (climbing, woody or not woody), and epiphytes (growing on other plants). Trees and shrubs were collected even if they were not fertile, but other biological forms were sampled only when flowering and/or fruiting.

All collected materials were deposited in the State University of Feira de Santana herbarium (HUEFS). Identifications were made using taxonomic monographs and floras, by comparisons with identified specimens in the HUEFS and CEPEC (Herbário André Maurício Vieira de Carvalho, Centro de Pesquisas do Cacau) herbaria, and by consulting specialists of specific taxonomic groups. The species are arranged according the APG III (2009) system, with taxa names being updated according to the online databases of the Lista de Espécies da Flora do Brasil (<http://floradobrasil.jbrj.gov.br>) and the Missouri Botanical Gardens (<http://tropicos.org>). The occurrence of each species in specific Brazilian phytogeographical domains (Amazonia, Atlantic Forest, Caatinga, Cerrado, Pantanal, and Pampa) was determined by consulting the Lista de Espécies da Flora do Brasil

website (<http://floradobrasil.jbrj.gov.br>). Species were considered endemic to the Atlantic domain following Stehmann *et al.* (2009).

Similarity and correlation analyses

In order to test the putative effects of geographical distances from wet forests on the floristic compositions of Restinga forests, we prepared a binary matrix (presence/absence) based on the floristic lists of eleven Restinga forest and nine wet forest sites (Tab. 1; Fig. 1). All wet forest sites were within the Atlantic domain and less than 200 km from the Restinga forests sites investigated.

We excluded from the dataset any taxa identified only to the genus or family levels, or species with inaccurate identifications (*affine* [aff.] or *confer* [cf.]). Infraspecific ranks were not considered, and subspecies and different varieties were therefore regarded as the same species. The consolidated floristic list of the 20 areas comprised 2,431 species (Supplementary material).

The sites were compared by cluster analysis using Jaccard's coefficient (Mueller-Dombois & Ellenberg 1974) and the Unweighted Pair Group Method using Arithmetic averages (UPGMA) with bootstrap support calculated from 1,000 replications using Past software (Hammer *et al.* 2001). Principal Component Analysis (PCA) was also performed using the same dataset and software cited above.

The Mantel Test using XLSTAT software was employed to assess correlations between the geographic and floristic distances of all sites (Addinsoft 2007). Floristic distances were estimated using the Jaccard coefficient, calculated with Past software (Hammer *et al.* 2001). Geographical distances were assessed by considering a central coordinate for each site, and the distances between areas were then measured using the Google Earth ruler tool. The significance of the Mantel test was calculated using the Monte Carlo test, with 10,000 permutations.

Results

The floristics of restinga forests in southeastern Bahia

A total of 302 angiosperm species belonging to 184 genera and 75 families were surveyed (Tab. 2), with 295 taxa being identified to the species level. The richest families in terms

Table 1 – Restinga and wet forests in evaluated in the multivariate analyses, with their acronyms, locations, coordinates, and vegetation types.
Tabela 1 – Áreas de florestas de restinga e florestas pluviais usadas na análise multivariadas, com sigla, localização, coordenadas e tipos vegetacionais.

Sigla	Município	Estado	Latitude	Longitude	Formação	Referência
ResSGA(CE)	São Gonçalo do Amarante	CE	-3.606944444	-38.87027778	Restinga	Castro *et al.* (2012)
ResMara(PB)	Mataraca	PB	-6.486111111	-34.94166667	Restinga	Oliveira-Filho & Carvalho (1993)
OmbSVF(PE)	São Vicente Férrer	PE	-7.633333333	-35.5	Ombrófila Montana	Ferraz & Rodal (2008)
ResCSA(PE)	Cabo de Santo Agostinho	PE	-8.125	-35.01527778	Restinga	Sacramento *et al.* (2007)
ResTam(PE)	Tamandaré	PE	-8.788888889	-35.1125	Restinga	Silva *et al.* (2008)
ResCon(BA)	Conde	BA	-11.81277778	-37.64027778	Restinga	Menezes *et al.* (2009)
OmbSTe(BA)	Santa Terezinha	BA	-12.85	-39.96666667	Ombrófila Submontana	Carvalho-Sobrinho & Queiroz (2005), Neves (2005)
ResMaIt(BA)	Maraú-Itacaré	BA	-14.21694444	-38.99833333	Restinga	Este estudo
OmbBP(BA)	Barro Preto	BA	-14.76666667	-39.53333333	Ombrófila Montana	Amorim *et al.*(2009)
OmbUna(BA)	Una	BA	-15.16666667	-39.05	Ombrófila Tabuleiro	Amorim *et al.*(2008)

Sigla	Município	Estado	Latitude	Longitude	Formação	Referência
OmbAra(BA)	Arataca	BA	-15.16666667	-39.33333333	Ombrófila Montana	Amorim *et al.*(2009)
OmbCam(BA)	Camaca	BA	-15.38333333	-39.55	Ombrófila Montana	Amorim *et al.*(2009)
OmbLin(ES)	Linhares	ES	-19.2	-40.03333333	Ombrófila Tabuleiro	Peixoto *et al.* (2008)
ResVit(ES)	Vitória	ES	-20.25833333	-40.275	Restinga	Pereira & Assis (2000)
ResSJB(RJ)	São João da Barra	RJ	-21.73333333	-41.03333333	Restinga	Assumpção & Nascimento (2000)
OmbCMa(RJ)	Cachoeiras de Macaú	RJ	-22.48333333	-42.88333333	Ombrófila Submontana	Kurtz & Araújo (2000)
ResMar(RJ)	Maricá	RJ	-22.91805556	-42.81694444	Restinga	Lemos *et al.* (2001)
ResBer(SP)	Bertioga	SP	-23.75083333	-45.97	Restinga	Martins *et al.* (2008)
ResBer2(SP)	Bertioga	SP	-23.75083333	-45.97	Restinga	Martins *et al.* (2008)
OmbSBa(SP)	Sete Barras	SP	-24.23555556	-48.07833333	Ombrófila Submontana	Ziparro *et al.* (2005)

of their numbers of species were: Fabaceae (35 species), Myrtaceae (25), Rubiaceae (21), Sapotaceae (13), Bromeliaceae (12), Annonaceae (11), Erythroxylaceae (10), Melastomataceae (9), and Apocynaceae (8). Together, these families comprised 47.7% of the total number of species sampled. The richest genera were *Myrcia* (12 species), *Erythroxylum* (10), *Aechmea* (8), *Miconia* (8), and *Psychotria* (7).

Among biological forms, trees were the most abundant (213 species / 70.5%), followed by shrubs (39 / 12.9%), vines (24 / 7.9%), herbs (19 / 6.3%), and epiphytes (7 / 2.3%).

Phytogeographical domain assignments resulted in 144 species (47.7%) identified as being endemic to the Atlantic domain, 34 species (11.2%) disjunct between the Atlantic and Amazonia domains, 72 species (23.8%) continuously distributed throughout the Atlantic and Amazonian domains, and 45 (14.9%) throughout the Atlantic, Caatinga, and Cerrado domains. Among the species endemic to the Atlantic domain, 58 (19.2%) were restricted to the area between southern Bahia and northern Espírito Santo.

Five species encountered in the study area are probably endemic to Restinga vegetation: *Abarema turbinata* (Benth.) Barneby & J.W.Grimes, *Leptolobium bijugum* (Spreng.) Vogel, *Parkia bahiae* H.C.Hopkins (Fabaceae), *Pagamea harleyi* Steyerm. (Rubiaceae), and *Schefflera selloi* (Marchal) Frodin & Fiaschi (Araliaceae).

Similarity and correlation analyses

Similarity analysis indicated the formation of five groups (A – E) with low similarity values, but with high support values, except group A (Fig. 2). Four groups include Restinga and wet forests, with: Group A comprising the sites in Rio de Janeiro and southern Espírito Santo states; group B comprising the sites located in Bahia State north of Todos os Santos Bay to Paraíba State; group C comprising the only site examined in Ceará State; group D comprising sites in southern Bahia and northern Espírito Santo states; and group E comprising the sites in São Paulo State.

PCA axis 1 and 2 (accounting for 34.4% of the observed variance) supported the separation of groups D and E from a group formed by the A, B and C sites. The Mantel test indicated a significant negative correlation between geographic distance and floristic similarities ($r = -0.452$; $p < 0.0001$).

Discussion

The floras of the southern Bahia Restinga forests

The species richness of the study areas were found to be similar to those of other Restinga forest surveys (Martins *et al.* 2008; Castro *et al.* 2012), but approximately three times lower than neighboring wet forest formations of the Atlantic domain (Amorim *et al.* 2008; Amorim *et al.* 2009). The low diversities of Restinga forests have been

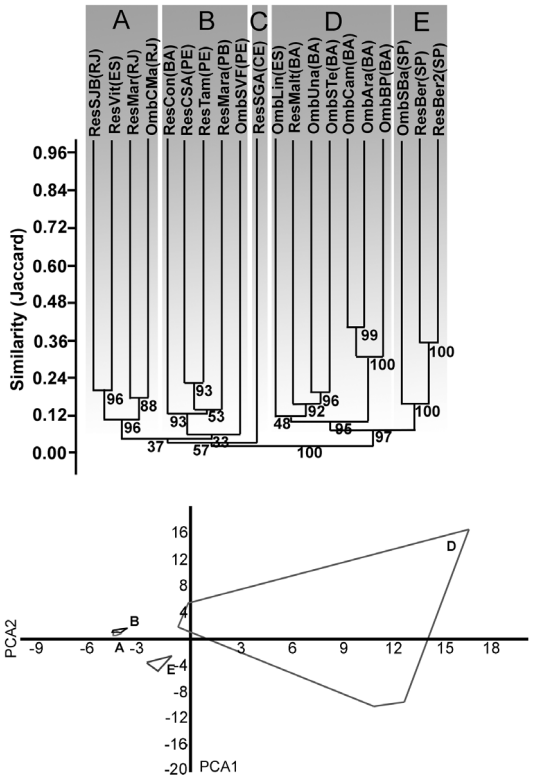

Figure 2 –Results of the UPGMA cluster analysis that considered areas of Restinga and wet forests of the Atlantic domain (above), showing the formation of five major groups according to their Jaccard similarity indices. The numbers associated with the groups are bootstrap support values (1,000 replications). Principal component analysis (PCA) using the same 20 areas is indicated below, highlighting the four major groups (A, B, D and E) in the first two axes (34.4% of total variance). The only area of group C (São Gonçalo do Amarante, Ceará) is included within the polygons formed by groups A and B.

Figura 2 – Resultado da análise de agrupamento (UPGMA) entre áreas de florestas de Restinga e florestas pluviais do domínio Mata Atlântica (acima) mostrando a formação de cinco grupos principais de acordo com índice de similaridade de Jaccard. Números nos grupos são valores de suporte de bootstrap (1.000 replicações). Análise de componentes principais (PCA) entre as mesmas 20 áreas é mostrada abaixo ressaltando os quatro grupos maiores (A, B, D e E) nos dois primeiros eixos (34,4% da variância total). A única área do grupo C (São Gonçalo do Amarante, Ceará) está incluída nos polígonos formados pelos grupos A e B.

highlighted by Guedes *et al.* (2006) and Lima *et al.* (2011), and seem to be determined by factors related to their nutrient-poor and well-drained sandy soils (Almeida Jr. *et al.* 2009). Edaphic conditions are therefore presumed to act as environmental filters that limit the establishment of lineages not adapted to the unique conditions of Restinga habitats.

The most species rich families encountered in our surveys (Fabaceae, Myrtaceae, Sapotaceae, and Rubiaceae) were also among the most important families reported in other Restinga forest sites (Assumpção & Nascimento 2000; Assis *et al.* 2004; Martins *et al.* 2008; Silva *et al.* 2008). Myrtaceae taxa are typically found on soils with low fertility (Berry 1915) and are important components of Restinga vegetation along the entire coast of Brazil. Erythroxylaceae and Melastomataceae, on the other hand, generally contribute very few species to the Restinga forest floras, although they are well-represented in wet forests of the Atlantic domain (Stehmann *et al.* 2009); Erythroxylaceae also shows high richness in the Cerrado domain (Ratter *et al.* 2003). Bromeliaceae was among the five richest families in the Restinga forests studied. This family is highly diverse in eastern Brazil (Smith & Downs 1979) and is the most diverse family of epiphytes in the Atlantic domain (Borgo & Silva 2003; Giongo & Weachter 2004) – but has relatively little importance in sites along the northern coast of Brazil (Castro *et al.* 2012). Thus, the high richness of families such Melastomataceae, Erythroxylaceae, and Bromeliaceae is probably idiosyncratic in southern Bahia Restinga forests.

Myrcia and *Psychotria* were among the most species rich genera in the study sites, and have likewise been reported as being highly diverse genera in Restinga forests (Martins *et al.* 2008) and other forest types in the Atlantic domain (Amorim *et al.* 2009; Stehmann *et al.* 2009). *Aechmea*, *Erythroxylum,* and *Miconia* were recorded here for the first time as being among the most diverse genera of Restinga forests.

Epiphytes are poorly represented in southern Bahia Restinga forests, in agreement with reports from coastal forests in the neighboring Espírito Santo State (Pereira *et al.* 1998).

The presence of species disjunct between Atlantic and Amazonian wet forests reinforces the hypothesis of past connections between these two forest blocks. It has been hypothesized that connections were possible during the wetter periods of the Quaternary due to the expansion of those wet forests and/or the emergence of ecological corridors (Bigarella & Andrade-Lima 1982). About 8% of the species found in forests in southern Bahia have this distribution pattern (Mori *et al.*

1981; Amorim *et al.* 2008), but less than 4% of Restinga species in Rio de Janeiro State (Araújo 2000). These findings indicate that proximity to southern Bahia wet forests ("Hileia Baiana") accounts for higher proportions of species from Restinga forests in South Bahia showing Atlantic-Amazonia disjunction patterns than those in other areas (Pereira & Araújo 2000).

Some species encountered in the Restinga forests studied here occur from Atlantic domain forests through to the Caatinga and Cerrado domains, occasionally reaching the Amazon region. Oliveira-Filho & Ratter (1995) concluded that these distribution patterns could have been established through two distinct processes: by interchanges of species between deciduous and semi-deciduous forests (requiring the presence of high to medium fertility soils); or the expansion of species from gallery forests (that could have acted as ecological corridors for wet forests trees across central Brazil).

Southern Bahia and northern Espírito Santo State show high levels of endemism and diversity (Thomas *et al.* 1998; Murray-Smith *et al.* 2008) – which has been attributed to the environmental stability of a putative ecological refuge during the climatic fluctuations of the Quaternary period (Carnaval & Moritz 2008). The few endemic species observed in Restinga vegetation (Lima *et al.* 2011) probably reflect the more recent origin of its geological substrate (Scarano 2002).

Are Restinga forests a subset of Atlantic wet forests?

Multivariate analyzes demonstrated (with high bootstrap support) that Restinga forest sites did not group together, yielding instead mixed groups of Restinga forests and neighboring Atlantic wet forest sites. The Mantel test results reinforced the influence of geography on the similarities between areas, demonstrating that geographically closer areas tend to be more similar – even though they did not necessarily share similar ecological conditions (as with Restinga and wet forests).

The low similarity values observed are the result of only small numbers of species being shared between sites, and reflect the fact that different areas had floristic particularities that are probably the result of the environmental heterogeneity that characterizes Brazilian Restinga sites (Araújo & Henriques 1984; Magnago *et al.* 2011).

The fact that Restinga forests: (1) have few endemic species; (2) are of recent geological origin; and (3) most species (~94%) also occur in wet forests in the Atlantic domain (Stehmann 2009), reinforce the hypothesis that Restingas are marginal habitats and that their floras are subsets of the floras of adjacent wet forest areas (Scarano 2009). These wet forests thus serve as sources of species able to overcome environmental filters imposed by unique restinga soil conditions (Assis *et al.* 2011). The proximity of wet forests that serve as sources of propagules should have strong influences on community assemblages and diversity patterns in Restinga forests (Assumpção & Nascimento 2000; Almeida Jr *et al.* 2009; Santos *et al.* 2012). This floristic continuity, together with evidence that tropical forest trees can disperse pollen over long distances (up to 20 km; see Ward *et al.* 2005 for a review), suggests that gene flow can occur between Restinga forest plants and populations in adjacent wet forests – and would account for low speciation rates and low endemism.

The Restinga forest sites of Bahia State clustered into two groups: 1) sites north of Todos os Santos Bay in group B and other sites from northeastern Brazil; and 2) sites in southern Bahia in group D and sites from northern Espírito Santo State. This finding reinforces previous reports that the Restinga vegetation of Bahia State forms two blocks – with sites located in the southern portion of that state being more similar to Restinga sites in Espírito Santo and Rio de Janeiro than to sites located in northern Bahia (Araújo 2000). The differentiation of these floristic blocks could reflect distinct climate types (a moist tropical climate with no dry season in the southern region, and a seasonal tropical climate with a dry winter in the northern region) (Peel *et al.* 2007; Alvares *et al.* 2013). Seasonality thus represents another factor that can influence the floristic composition of Restinga forests located north of Todos os Santo Bay, and this is corroborated by the presence of species that are typical of seasonal environments in group B sites, such as *Commiphora leptophloeos* (Mart.) J.B.Gillett (Burseraceae), *Jatropha mollissima* (Pohl) Baill. (Euphorbiaceae), and *Syagrus coronata* (Mart.) Becc (Arecaceae).

Substructuring according to elevation was noted in group D, with one group being formed by lowland areas ("tabuleiros") and Restinga, and another group formed by montane and submontane forests. Despite the environmental heterogeneity attributable to elevation, this group is well-supported (95% bootstrap). Even though geographically distant, the inclusion of the Linhares area into this group was expected because of an apparent floristic

gradient between the forests of northern Espírito Santo and those of southern Bahia State (Oliveira-Filho & Fontes 2000).

The areas located in the states of Rio de Janeiro and São Paulo formed two distinct groups by cluster analysis (groups A and E respectively). These two groups are located on the southeastern coast of Brazil (Villwock *et al.* 2005) an area that is characterized by the presence of the Serra do Mar mountain range. Coastal geology therefore also seems to influence the floristic composition of Restinga vegetation (Pereira & Araújo 2000). Despite their geological affinities, groups A and E are subjected to different climatic regimes (Peel *et al.* 2007; Alvares *et al.* 2013), which justifies their separation.

The isolated position of the Restinga forest located in Ceará State reinforces the importance of contiguous vegetation areas as propagule sources in the constitution of Restinga forest floras. The Restinga forest in this area is close to Caatinga (dryland) vegetation and shares many species that predominantly occur in the latter, such as *Cereus jamacaru* DC. (Cactaceae), *Croton blanchetianus* Baill. (Euphorbiaceae), *Margaritopsis carrascoana* (Delprete & E.B.Souza) C.M.Taylor & E.B.Souza (Rubiaceae), and *Sideroxylon obtusifolium* (Humb. ex Roem. & Schult.) T.D. Penn. (Sapotaceae).

Supplementary material

Supplementary material is available at (<http://dx.doi.org/10.6084/m9.figshare.1246794>).

Table 2 – List of the Angiosperm species collected at Maraú-Itacaré: MC= Mata do Caubi; MMI= Mata estrada Maraú--Itacaré; MP= Mata Piracanga; MAS= Mata do Santo Amaro. Brazilian phytogeographic domains: AM= Amazonian, CA= Caatinga, CE= Cerrado, MA= Atlantic Forest, PAM=Pampa, PAN= Pantanal. Collectors: EM= Eloína Neri de Matos; MF= Moabe Ferreira Fernandes. *= Species endemic to southeastern Bahia and northern Espírito Santo.
Tabela 2 – Lista das espécies de Angiospermas amostradas nas florestas de Restinga da região de Maraú-Itacaré: MC= Mata do Caubi; MMI= Mata estrada Maraú-Itacaré; MP= Mata Piracanga; MAS= Mata do Santo Amaro. Domínios fitogeográficos: AM=Amazônia, CA=Caatinga, CE=Cerrado, MA=Mata Atlântica, PAM=Pampa, PAN=Pantanal. Coletores: EM= Eloína Neri de Matos; MF= Moabe Ferreira Fernandes. *=Endêmicas do sul da Bahia e norte do Espírito Santo.

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Acanthaceae							
Aphelandra nitida Nees & Mart.	Herb	MA	MF513	x	x	x	x
Ruellia affinis (Schrad.) Lindau*	Shrub	MA	MF130	x			x
Achariaceae							
Carpotroche brasiliensis (Raddi) A Gray	Tree	CE, AM, MA	MF464				x
Anacardiaceae							
Tapirira guianensis Aubl.	Tree	CA, CE, AM, MA	MF90	x	x	x	x
Thyrsodium spruceanum Benth.	Tree	AM, MA	MF460		x	x	x
Annonaceae							
Annona acutiflora Mart.	Tree	MA	MF540		x	x	
Annona bahiensis (Maas & Westra) H.Rainer	Tree	MA	MF541	x	x	x	x
Annona salzmannii A.DC.	Tree	MA	MF211	x	x	x	x
Duguetia restingae Maas*	Tree	MA	EM3535				x
Guatteria australis A.St.-Hil.	Tree	MA	MF98	x	x	x	x
Guatteria oligocarpa Mart.	Tree	MA	MF152	x	x	x	x

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Guatteria tomentosa Rusby	Tree	AM, MA	MF299	x			x
Unonopsis riedeliana R.E.Fr.	Tree	MA	MF317			x	x
Xylopia ochrantha Mart.	Tree	MA	MF420			x	x
Xylopia sericea A.St.-Hil.	Tree	CE, AM, MA	MF138		x		
Xylopia sp.	Tree	-	MF355			x	
Apocynaceae							
Aspidosperma discolor A.DC.	Tree	CA, CE, AM, MA	MF270	x	x		x
Couma rigida Müll.Arg.*	Tree	CA, MA	MF283	x		x	
Ditassa crassifolia Decne.	Vine	CE, MA	MF227	x	x	x	
Himatanthus bracteatus (A.DC.) Woodson	Tree	AM, MA	MF248		x	x	x
Mandevilla scabra (Hoffmanns. ex Roem. & Schult.) K.Schum.	Vine	CA, CE, AM, MA	MF79	x	x		
Rauvolfia grandiflora Mart.	Tree	MA	MF122			x	x
Tabernaemontana flavicans Willd. ex Roem. & Schult.	Tree	CE, AM, MA	MF364		x		x
Tabernaemontana salzmannii A.DC.	Tree	CE, MA	MF112				x
Aquifoliaceae							
Ilex floribunda Reissek ex Maxim.	Tree	MA	MF430	x	x	x	x
Araceae							
Anthurium gladiifolium Schott	Herb	MA	MF345				x
Heteropsis oblongifolia Kunth	Herb	CE, AM, MA	MF91	x	x	x	x
Rhodospatha latifolia Poepp.	Herb	CA, CE, AM, MA	EM3543				x
Araliaceae							
Schefflera selloi (Marchal) Frodin & Fiaschi*	Tree	MA	MF261	x	x	x	
Arecaceae							
Attalea funifera Mart. ex Spreng.	Tree	MA	MF542	x	x	x	x
Bactris hirta Mart.	Shrub	AM, MA	MF408		x	x	
Bactris horridispatha Noblick ex A.J.Hend.*	Shrub	MA	MF343	x			x
Euterpe edulis Mart.	Tree	CE, MA	MF543	x	x	x	x
Geonoma pauciflora Mart.	Shrub	MA	EM3536			x	
Geonoma pohliana Mart.	Shrub	MA	MF292		x		
Asteraceae							
Piptocarpha riedelii (Sch.Bip.) Baker*	Vine	MA	MF479	x	x		
Vernonanthura divaricata (Spreng.) H.Rob.	Shrub	CE, MA	MF417	x			x
Vernonanthura vinhae (H.Rob.) H.Rob.*	Shrub	MA	MF213	x	x	x	

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Bignoniaceae							
Anemopaegma chamberlaynii (Sims) Bureau & K.Schum.	Vine	CA, CE, MA	MF140		x		x
Handroanthus umbellatus (Sond.) Mattos	Tree	CA, CE, MA	MF390		x		x
Jacaranda obovata Cham.	Tree	CA, CE, MA	MF500	x	x	x	x
Lundia cordata (Vell.) DC.	Vine	CA, MA	MF95	x			x
Tabebuia elliptica (DC.) Sandwith	Tree	CA, CE, MA	MF77	x	x	x	x
Tabebuia stenocalyx Sprague & Stapf	Tree	MA	MF74	x	x	x	x
Boraginaceae							
Cordia glabrifolia M.Stapf*	Tree	MA	EM3554				x
Bromeliaceae							
Aechmea amorimii Leme*	Epiphyte	MA	MF357				x
Aechmea andersonii H.Luther & Leme*	Epiphyte	MA	EM3534				x
Aechmea aquilega (Salisb.) Griseb.	Herb	CA, CE, AM, MA	EM3540	x	x		
Aechmea bicolor L.B.Sm.*	Epiphyte	MA	MF296				x
Aechmea blanchetiana (Baker) L.B.Sm.*	Herb	MA	MF134	x	x	x	
Aechmea bromeliifolia (Rudge) Baker	Herb	CA, CE, AM, MA	MF133	x	x		x
Aechmea marauensis Leme	Herb	MA	MF110			x	x
Aechmea mertensii (G.Mey.) Schult. & Schult.f.	Epiphyte	AM, MA	MF450				x
Guzmania lingulata (L.) Mez	Epiphyte	AM, MA	EM3537	x	x	x	x
Vriesea duvaliana E.Morren*	Epiphyte	MA	EM3544			x	
Vriesea ensiformis (Vell.) Beer	Epiphyte	MA	EM3552			x	
Vriesea procera (Mart. ex Schult. & Schult.f.) Wittm.	Herb	CA, CE, MA	MF224	x	x	x	
Burseraceae							
Protium bahianum Daly*	Tree	MA	MF478		x	x	x
Protium heptaphyllum (Aubl.) Marchand	Tree	CA, CE, AM, MA	MF359	x	x	x	x
Tetragastris occhionii (Rizzini) Daly*	Tree	MA	MF318			x	x
Callophylaceae							
Kielmeyera itacarensis Saddi *	Tree	MA	MF537	x			
Cannabaceae							
Trema micrantha (L.) Blume	Tree	AM, CA, CE, MA, PAN, PAM	MF358				x
Caricaceae							
Jacaratia heptaphylla (Vell.) A.DC.	Tree	MA	MF83	x		x	x
Caryocaraceae							

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Anthodiscus amazonicus Gleason & A.C.Sm.	Tree	AM, MA	MF342		x		x
Celastraceae							
Maytenus distichophylla Mart. ex Reissek	Tree	MA	MF256	x	x	x	x
Chrysobalanaceae							
Couepia belemii Prance*	Tree	MA	MF129	x	x	x	x
Couepia ovalifolia (Schott) Benth. ex Hook.f.	Tree	CE, MA	MF223		x	x	
Licania hoehnei Pilg.	Tree	CE, MA	MF531	x			x
Licania hypoleuca Benth.	Tree	AM, MA	MF454	x	x	x	x
Licania lamentanda Prance*	Tree	MA	EM3553				x
Licania littoralis Warm.	Tree	MA	EM3559				x
Licania sp.	Tree	-	MF356		x		
Parinari alvimii Prance*	Tree	MA	MF240			x	
Clusiaceae							
Clusia nemorosa G.Mey.	Tree	CA, CE, AM, MA	MF415	x	x	x	x
Clusia sellowiana Schltdl.	Tree	MA	MF491			x	x
Garcinia gardneriana (Planch. & Triana) Zappi	Tree	CA, CE, AM, MA	MF305	x	x	x	x
Garcinia macrophylla Mart.	Tree	AM, MA	MF333	x			
Symphonia globulifera L.f.	Tree	AM, MA	MF281	x	x	x	x
Combretaceae							
Buchenavia hoehneana N.F.Mattos	Tree	MA	MF389		x		x
Conocarpus erectus L.	Tree	AM, MA	MF243				x
Terminalia glabrescens Mart.	Tree	CA, CE, AM, MA	MF353	x	x	x	x
Comelinaceae							
Dichorisandra procera Mart. ex Schult & Schult.f.	Herb	MA	MF286	x	x	x	x
Cucurbitaceae							
Cayaponia petiolulata Cogn.*	Vine	MA	MF 103				x
Gurania lobata (L.) Pruski	Vine	AM, MA	MF398	x		x	x
Cyclanthaceae							
Evodianthus funifer (Poit.) Lindm.	Herb	AM, MA	MF105	x	x	x	x
Dichapetalaceae							
Tapura sp.	Tree	-	MF336			x	
Dilleniaceae							
Davilla flexuosa A.St.-Hil.	Vine	MA	MF477	x	x	x	x

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Doliocarpus validus Kubitzki*	Vine	MA	MF360		x		x
Elaeocarpaceae							
Sloanea guianensis (Aubl.) Benth.	Tree	CE, AM, MA	MF285	x	x		
Ericaceae							
Agarista revoluta (Spreng.) J.D. Hook. ex Nied.	Shrub	MA	MF380	x	x		x
Erythroxylaceae							
Erythroxylum compressum Peyr.*	Shrub	MA	MF216				x
Erythroxylum cuspidifolium Mart.	Tree	MA	EM3562				x
Erythroxylum martii Peyr.*	Shrub	MA	MF73	x	x		
Erythroxylum mattos-silvae Plowman*	Tree	MA	MF344	x	x	x	
Erythroxylum mikanii Peyr.	Shrub	MA	EM3545			x	
Erythroxylum nobile O.E.Schulz	Tree	MA	EM3567		x		
Erythroxylum passerinum Mart.	Tree	MA	EM3539	x	x		
Erythroxylum splendidum Plowman*	Tree	MA	MF78	x			x
Erythroxylum squamatum Sw.	Tree	CA, CE, AM, MA	MF87	x			
Erythroxylum tenue Plowman*	Shrub	MA	MF320	x	x		
Euphorbiaceae							
Actinostemon concolor (Spreng.) Müll. Arg.	Tree	CA, CE, AM, MA	MF372			x	x
Alchornea glandulosa subsp. *iricurana* (Casar.) Secco	Tree	MA	MF298	x			
Astraea sp.	Tree	-	MF225		x	x	
Croton macrobothrys Baill.	Tree	MA	MF447		x	x	
Croton sellowii Baill.	Shrub	CA, MA	MF271	x	x	x	x
Microstachys corniculata (Vahl) Griseb.	Herb	CA, CE, AM, MA	MF350	x			
Microstachys heterodoxa (Müll.Arg.) Esser*	Shrub	CA, MA	MF379		x		
Fabaceae							
Abarema filamentosa (Benth.) Pittier	Tree	MA	MF88	x	x	x	x
Abarema jupunba (Willd.) Britton & Killip	Tree	AM, MA	MF93			x	x
Abarema turbinata (Benth.) Barneby & J.W.Grimes*	Tree	MA	MF104	x	x	x	
Albizia pedicellaris (DC.) L.Rico	Tree	CE, AM, MA	MF113				x
Andira marauensis N.F.Mattos*	Tree	MA	MF76		x	x	
Andira nitida Mart. ex Benth.	Tree	MA	MF323	x	x	x	x
Arapatiella psilophylla (Harms) R.S.Cowan*	Tree	MA	MF128				x

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Chamaecrista ensiformis (Vell.) H.S.Irwin & Barneby	Tree	CA, CE, AM, MA	MF157				x
Clitoria falcata Lam.	Vine	CE, AM, MA	MF337		x		x
Copaifera lucens Dwyer	Tree	MA	MF384				x
Dalbergia nigra (Vell.) Allemão ex Benth.	Tree	MA	MF403				x
Diplotropis incexis Rizzini & A.Mattos	Tree	MA	MF228	x	x	x	
Harleyodendron unifoliolatum R.S.Cowan	Tree	MA	MF468				x
Hymenolobium alagoanum Ducke	Tree	MA	MF141	x	x		
Inga capitata Desv.	Tree	AM, MA	MF99	x	x	x	x
Inga edulis Mart.	Tree	CA, CE, AM, MA	MF348		x		x
Inga pleiogyna T.D.Penn.*	Tree	MA	MF151	x	x		x
Inga tenuis (Vell.) Mart.	Tree	MA	MF392	x		x	x
Inga thibaudiana DC.	Tree	CA, CE, AM, MA	MF86	x			x
Leptolobium bijugum (Spreng.) Vogel	Tree	MA	MF275	x			
Machaerium salzmannii Benth.	Shrub	MA	MF102				x
Macrolobium latifolium Vogel*	Tree	MA	MF101	x	x		x
Mimosa ceratonia L.	Vine	CE, MA	MF207				x
Moldenhawera blanchetiana Tul.*	Tree	MA	MF162				x
Ormosia fastigiata Tul.	Tree	CE, MA	MF255	x	x	x	x
Parkia bahiae H.C.Hopkins*	Tree	MA	MF81	x	x	x	x
Parkia pendula (Willd.) Benth. ex Walp.	Tree	AM, MA	MF206			x	x
Piptadenia adiantoides (Spreng.) J.F.Macbr.	Vine	CA, CE, MA	MF125				x
Pterocarpus rohrii Vahl	Tree	CE, AM, MA	MF385		x	x	
Senna pinheiroi H.S.Irwin & Barneby	Shrub	CA, MA	MF144	x			x
Swartzia apetala Raddi	Tree	CA, CE, MA	MF80	x		x	x
Swartzia polita (R.S.Cowan) Torke*	Tree	MA	MF302	x	x	x	x
Swartzia simplex (Sw.) Spreng.	Tree	MA	MF346	x	x		
Tachigali densiflora (Benth.) L.G.Silva & H.C.Lima	Tree	MA	MF282	x			x
Zollernia glabra (Spreng.) Yakovlev	Tree	MA	MF273	x	x	x	
Gentianaceae							
Chelonanthus purpurascens (Aubl.) Struwe et al.	Herb	CA, CE, AM, MA	MF118				x
Heliconiaceae							
Heliconia psittacorum L.f.	Herb	AM, CA, CE, MA, PAN	EM3566				x
Humiriaceae							

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Humiria balsamifera (Aubl.) J.St.-Hil.	Tree	CA, CE, AM, MA	MF136	x	x	x	x
Sacoglottis mattogrossensis Malme	Tree	CE, AM, MA	MF485	x			
Vantanea bahiaensis Cuatrec.*	Tree	MA	MF301		x		
Hypericaceae							
Vismia guianensis (Aubl.) Choisy	Tree	CA, CE, AM, MA	MF100	x	x	x	x
Vismia macrophylla Kunth	Tree	AM, MA	MF149				x
Icacinaceae							
Emmotum affine Miers	Tree	MA	MF316	x	x	x	x
Lacistemataceae							
Lacistema robustum Schnizl.	Tree	MA	MF117	x			x
Lamiaceae							
Aegiphila integrifolia (Jacq.) Moldenke	Vine	CA, CE, AM, MA	MF470		x		
Aegiphila macrantha Ducke	Vine	AM, MA	MF525				x
Vitex polygama Cham.	Tree	CA, CE, AM, MA	MF242	x	x	x	
Lauraceae							
Endlicheria glomerata Mez	Tree	CA, CE, MA	MF544	x			
Nectandra membranacea (Sw.) Griseb.	Tree	CA, CE, AM, MA	MF352	x	x		
Ocotea canaliculata (Rich.) Mez	Tree	AM, MA	MF276	x			
Ocotea notata (Nees & Mart.) Mez	Tree	MA	MF326	x	x	x	x
Ocotea nutans (Nees) Mez	Tree	CE, MA	MF295	x		x	
Persea caesia Meisn.	Tree	MA	MF309		x		
Lecythidaceae							
Eschweilera ovata (Cambess.) Mart. ex Miers	Tree	CA, CE, AM, MA	MF165	x	x	x	x
Lecythis lurida (Miers) S.A.Mori	Tree	AM, MA	MF373			x	
Lecythis pisonis Cambess.	Tree	AM, MA	MF394				x
Malpighiaceae							
Byrsonima cacaophila W.R.Anderson*	Tree	MA	MF289		x		x
Byrsonima sericea DC.	Tree	CA, CE, MA	MF250	x	x	x	x
Heteropterys imperata Amorim*	Vine	MA	MF347	x		x	x
Stigmaphyllon blanchetii C.E.Anderson	Vine	CA, CE, MA	MF147		x		x
Malvaceae							
Apeiba tibourbou Aubl.	Tree	CA, CE, AM, MA	MF121				x
Eriotheca macrophylla (K.Schum.) A.Robyns	Tree	MA	MF510	x	x	x	x
Melastomataceae							

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Henriettea succosa (Aubl.) DC.	Tree	AM, MA	MF123	x	x		x
Miconia albicans (Sw.) Triana	Shrub	CA, CE, AM, MA	MF509		x		
Miconia amoena Triana	Tree	MA	MF215			x	x
Miconia ciliata (Rich.) DC.	Tree	CA, CE, AM, MA	MF114	x			
Miconia cinnamomifolia (DC.) Naudin	Tree	MA	MF461	x	x		x
Miconia compressa Naudin	Shrub	MA	MF108		x	x	x
Miconia holosericea (L.) DC.	Tree	CE, AM, MA	MF418	x	x		
Miconia prasina (Sw.) DC.	Tree	CA, CE, AM, MA	MF458	x			x
Miconia tomentosa (Rich.) D.Don	Tree	CE, AM, MA	MF284				x
Meliaceae							
Guarea guidonia (L.) Sleumer	Tree	CA, CE, AM, MA	MF322	x	x	x	x
Trichilia lepidota Mart.	Tree	MA	MF232	x	x	x	x
Trichilia ramalhoi Rizzini	Tree	MA	MF145			x	x
Moraceae							
Brosimum rubescens Taub.	Tree	AM, MA	EM3560	x	x	x	x
Ficus bahiensis C.C.Berg & Carauta	Tree	CA, CE, MA	MF257	x	x	x	
Ficus gomelleira Kunth	Tree	CA, CE, AM, MA	MF204	x	x	x	x
Ficus hirsuta Schott	Tree	CA, MA	MF97		x		x
Sorocea racemosa Gaudich.	Tree	MA	MF452			x	x
Myristicaceae							
Virola officinalis Warb.	Tree	MA	MF367				x
Myrtaceae							
Calycolpus legrandii Mattos	Tree	MA	MF205				x
Calyptranthes restingae Sobral	Tree	MA	MF274		x	x	
Campomanesia dichotoma (O.Berg) Mattos	Tree	CA, CE, MA	MF307	x		x	x
Eugenia astringens Cambess.	Tree	MA	MF545		x	x	x
Eugenia candolleana DC.	Tree	CA, CE, MA	MF547			x	
Eugenia hirta O.Berg	Tree	MA	MF221		x		
Eugenia itacarensis Mattos*	Tree	MA	MF436		x		
Eugenia longifolia DC.*	Tree	MA	EM3568	x	x		x
Eugenia sp.	Tree	-	MF131	x			
Marlierea glabra Cambess.	Tree	MA	EM3550	x	x	x	
Marlierea obscura O.Berg	Tree	MA	MF539	x	x		
Marlierea obversa D.Legrand	Tree	MA	MF506	x			x

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Myrcia bergiana O.Berg	Tree	CA, MA	MF107	x	x	x	x
Myrcia grazielae NicLugh.*	Tree	MA	MF546	x			x
Myrcia guianensis (Aubl.) DC.	Tree	CA, CE, AM, MA	MF212	x	x	x	x
Myrcia micropetala (Mart.) Nied. *	Tree	MA	MF550			x	x
Myrcia ramuliflora (O.Berg) N.Silveira*	Tree	MA	MF234	x	x		
Myrcia salzmannii O.Berg	Tree	MA	MF538		x		x
Myrcia silvatica (G.Mey.) DC.	Tree	CE, AM, MA	MF115	x			x
Myrcia sp.	Tree	-	EM3541				x
Myrcia sp.2	Tree	-	MF425	x			
Myrcia spectabilis DC.	Tree	MA	MF312	x	x	x	x
Myrcia splendens (Sw.) DC.	Tree	AM, CA, CE, MA, PAN	MF132	x	x	x	x
Myrcia tomentosa (Aubl.) DC.	Tree	CA, CE, AM, MA	MF168			x	x
Psidium bahianum Landrum & Funch*	Tree	MA	MF388				x
Nyctaginaceae							
Guapira areolata (Heimerl) Lundell	Tree	CE, MA	MF246	x	x		x
Guapira opposita (Vell.) Reitz	Tree	CA, CE, AM, MA	MF226	x	x	x	x
Guapira pernambucensis (Casar.) Lundell	Tree	MA	MF492		x	x	
Guapira venosa (Choisy) Lundell	Tree	AM, MA	MF401			x	x
Neea floribunda Poepp. & Endl.	Tree	AM, MA	MF167			x	x
Neea macrophylla Poepp. & Endl.	Tree	CE, AM, MA	MF288	x	x	x	x
Ochnaceae							
Ouratea bahiensis Sastre*	Shrub	MA	MF89	x			x
Ouratea castaneifolia (DC.) Engl.	Tree	CA, CE, AM, MA	MF368				x
Ouratea gigantophylla (Erhard) Engl.*	Tree	MA	MF374	x	x	x	x
Ouratea longipes Sastre*	Shrub	MA	MF303			x	
Ouratea platicaulis Sastre*	Tree	MA	MF497	x	x	x	x
Ouratea rotundifolia (Gardner) Engl.*	Shrub	MA	MF249		x		
Olacaceae							
Cathedra bahiensis Sleumer*	Tree	MA	MF222			x	
Heisteria perianthomega (Vell.) Sleumer	Tree	CA, CE, AM, MA	MF210		x	x	x
Orchidaceae							
Epistephium lucidum Cogn.	Herb	CA, CE, AM, MA	MF376				x
Koellensteinia florida (Rchb.f.) Garay	Herb	MA	MF109		x		
Passifloraceae							

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Passiflora sidifolia M.Roem.	Vine	MA	MF96		x		
Passiflora silvestris Vell.	Vine	CE, MA	MF328	x			
Passiflora watsoniana Mast.	Vine	MA	MF457			x	
Peraceae							
Pera glabrata (Schott) Poepp. ex Baill.	Tree	CA, CE, AM, MA	MF251	x	x	x	x
Pogonophora schomburgkiana Miers ex Benth.	Tree	CA, CE, AM, MA	MF370	x	x	x	x
Phyllantaceae							
Richeria grandis Vahl	Tree	CA, CE, AM, MA	MF164	x	x	x	x
Piperaceae							
Piper aduncum L.	Tree	AM, CA, CE, MA, PAN, PAM	MF396				x
Piper amplum Kunth	Shrub	CE, MA	MF399				x
Piper ilheusense Yunck.	Shrub	MA	MF75	x	x	x	
Poaceae							
Parodiolyra ramosissima (Trin.) Soderstr. & Zuloaga*	Herb	MA	MF382		x		
Polygalaceae							
Bredemeyera disperma (Vell.) J.F.B.Pastore	Vine	MA	MF92	x		x	
Polygonaceae							
Coccoloba laevis Casar.	Tree	CA, MA	MF244	x			x
Coccoloba marginata Benth.	Tree	CE, AM, MA	MF209	x	x		
Coccoloba oblonga Lindau*	Shrub	MA	MF218	x		x	
Coccoloba parimensis Benth.	Shrub	CA, CE, AM, MA	MF279				x
Coccoloba rosea Meisn.	Tree	MA	MF119	x	x	x	x
Primulaceae							
Cybianthus amplus (Mez) G.Agostini	Tree	AM, MA	MF438		x	x	
Cybianthus densiflorus Miq.	Tree	AM, MA	MF245	x	x	x	x
Rubiaceae							
Amaioua intermedia Mart. ex Schult. & Schult.f.	Tree	CE, MA	MF208	x	x	x	
Chiococca alba (L.) Hitchc.	Shrub	AM, CA, CE, MA, PAN	MF427	x	x	x	x
Coussarea graciliflora (Mart.) Müll.Arg.	Shrub	MA	MF407		x		
Faramea coerulea (Nees & Mart.) DC.	Shrub	MA	MF280		x		
Faramea nocturna J.G.Jardim & Zappi*	Tree	MA	MF349		x	x	x
Margaritopsis chaenotricha (DC.) C.M.Taylor	Shrub	MA	MF217	x			

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Melanopsidium nigrum Colla	Tree	CE, MA	MF453	x	x		
Mitracarpus salzmannianus DC.	Herb	CA, CE, AM, MA	MF71			x	x
Pagamea guianensis Aubl.	Shrub	CA, CE, AM, MA	MF377	x	x	x	x
Pagamea harleyi Steyerm.*	Tree	MA	MF262		x	x	
Palicourea guianensis Aubl.	Tree	CE, AM, MA	MF146	x	x	x	x
Psychotria bahiensis DC.	Shrub	CA, CE, MA	MF70	x	x	x	x
Psychotria cupularis (Müll.Arg.) Standl.	Tree	AM, MA	MF362		x		
Psychotria jambosioides Schltdl.*	Shrub	MA	MF137	x	x	x	x
Psychotria mapourioides DC.	Tree	AM, MA	MF426	x	x	x	x
Psychotria schlechtendaliana (Müll.Arg.) Müll.Arg.	Shrub	CA, MA	MF124	x			
Psychotria stachyoides Benth.	Shrub	CA, CE, MA	MF300	x			
Psychotria vellosiana Benth.	Tree	CA, CE, MA	MF383		x		
Randia calycina Cham.	Tree	CE, AM, MA	MF321			x	x
Rudgea interrupta Benth.	Shrub	MA	MF465	x	x		
Salzmannia nitida DC.	Shrub	MA	MF214	x	x	x	
Rutaceae							
Rauia nodosa (Engl.) Kallunki	Tree	MA	MF455				x
Salicaceae							
Casearia arborea (Rich.) Urb.	Tree	CE, AM, MA	MF435	x	x	x	x
Casearia commersoniana Cambess.	Tree	CA, CE, AM, MA	MF85	x	x	x	x
Sapindaceae							
Cupania oblongifolia Mart.	Tree	CE, AM, MA	MF325				x
Cupania racemosa (Vell.) Radlk.	Tree	CA, CE, AM, MA	MF126	x	x		
Matayba discolor (Spreng.) Radlk.	Tree	MA	MF84			x	
Paullinia racemosa Wawra	Vine	MA	MF230	x	x	x	x
Serjania salzmanniana Schltdl.	Vine	CE, AM, MA	MF94	x	x	x	x
Talisia macrophylla (Mart.) Radlk.	Tree	AM, MA	MF429				x
Sapotaceae							
Chrysophyllum flexuosum Mart.	Tree	MA	MF519	x		x	
Diploon cuspidatum (Hoehne) Cronquist	Tree	AM, MA	MF369	x	x		
Ecclinusa guianensis Eyma	Tree	AM, MA	MF351	x	x	x	x
Manilkara salzmannii (A.DC.) H.J.Lam	Tree	MA	MF315	x	x	x	x
Micropholis crassipedicellata (Mart. & Eichler) Pierre	Tree	MA	MF366				x
Micropholis emarginata T.D.Penn.*	Tree	CA, CE, MA	MF445			x	

Family/Species	Habit	Phytogeographic domains	Voucher	MC	MMI	MP	MSA
Micropholis gardneriana (A.DC.) Pierre	Tree	CA, CE, AM, MA	MF294	x	x		
Pouteria butyrocarpa (Kuhlm.) T.D.Penn.*	Tree	MA	MF330				x
Pouteria coelomatica Rizzini	Tree	MA	MF329	x	x		x
Pouteria cuspidata (A.DC.) Baehni	Tree	CE, AM, MA	MF304		x		
Pouteria guianensis Aubl.	Tree	AM, MA	MF331		x	x	
Pouteria macahensis T.D.Penn.	Tree	MA	MF 414	x			
Pradosia lactescens (Vell.) Radlk.	Tree	MA	MF332		x	x	x
Schoepfiaceae							
Schoepfia brasiliensis A.DC.	Tree	CE, AM, MA	MF265		x		
Siparunaceae							
Siparuna cymosa Tolm.	Tree	AM, MA	MF291				x
Smilacaceae							
Smilax campestris Griseb.	Vine	CA, CE, MA, PAM	MF441	x	x	x	
Solanaceae							
Cestrum salzmannii Dunal	Shrub	MA	MF405	x		x	x
Solanum asperum Rich.	Shrub	CA, CE, AM, MA	MF404			x	x
Solanum rupincola Sendtn.	Vine	MA	MF375		x	x	
Stemonuraceae							
Discophora guianensis Miers	Tree	AM, MA	MF127		x		x
Thymaelaeceae							
Daphnopsis racemosa Griseb.	Tree	CE, MA	MF269		x	x	x
Triuridaceae							
Peltophyllum luteum Gardner	Herb	MA	MF72	x			x
Urticaceae							
Cecropia pachystachya Trécul	Tree	AM, CA, CE, MA, PAN	MF397	x	x	x	
Verbenaceae							
Lippia macrophylla Cham.*	Shrub	CE, MA	MF339	x	x	x	
Violaceae							
Paypayrola blanchetiana Tul.	Tree	MA	MF386	x			
Rinorea bahiensis (Moric.) Kuntze	Tree	MA	MF148	x		x	

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Supplementary material

S1 - Presence-absence matrix based on the species lists of all of the sites used in the similarity and cluster analyses, with their respective occurrences in each area (Word format).
S1 - Matriz de presença-ausência contendo a lista de espécies em todas as áreas utilizadas nas análises de similaridade e agrupamento com suas respectivas ocorrências em cada local, em formato Word.

S2 - Presence-absence matrix based on the species lists of all of the sites used in the similarity and cluster analyses, with their respective occurrences in each area (TXT format).
S2 - Matriz de presença-ausência contendo a lista de espécies em todas as áreas utilizadas nas análises de similaridade e agrupamento com suas respectivas ocorrências em cada local, em formato TXT.

S3 - List of the Angiosperm species sampled at Maraú-Itacaré: MC= Mata do Caubi; MMI= Mata estrada Maraú-Itacaré; MP= Mata Piracanga; MAS= Mata do Santo Amaro. Brazilian phytogeographic domains: AM= Amazonian, CA= Caatinga, CE= Cerrado, MA= Atlantic Forest, PAM=Pampa, PAN= Pantanal. Collectors: EM= Eloína Neri de Matos; MF= Moabe Ferreira Fernandes. *= Species endemic to southeastern Bahia and northern Espírito Santo states.
S3 - Lista das espécies de Angiospermas amostradas nas florestas de Restinga da região de Maraú-Itacaré: MC= Mata do Caubi; MMI= Mata estrada Maraú-Itacaré; MP= Mata Piracanga; MAS= Mata do Santo Amaro. Domínios fitogeográficos: AM=Amazônia, CA=Caatinga, CE=Cerrado, MA=Mata Atlântica, PAM=Pampa, PAN=Pantanal. Coletores: EM= Eloína Neri de Matos; MF= Moabe Ferreira Fernandes. *=Endêmicas do sul da Bahia e norte do Espírito Santo.

S4 - Photographs of the four sites surveyed in the present study: A-B: Mata do Santo Amaro; C-D: Mata do Caubi; E-F: Mata da Estrada Maraú-Itacaré; G-H: Mata da Piracanga.
S4 – Fotografias dos quatro sítios inventariados neste estudo: A-B: Mata do Santo Amaro; C-D: Mata do Caubi; E-F: Mata da Estrada Maraú-Itacaré; G-H: Mata da Piracanga.

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