Nettesheim, Felipe Cito; Tavares de Menezes, Luis Fernando; Costa de Carvalho, Daniel; Menezes Silva Conde, Marilena; Somner, Genise Vieira; de Assis Rodrigues, Guilherme; Sue Dunn de Araujo, Dorothy
Tree and shrub species of the Atlantic Forest on the slopes of Marambaia Island, Rio de Janeiro, Brazil
Biota Neotropica, vol. 12, núm. 3, septiembre, 2012, pp. 213-225
Instituto Virtual da Biodiversidade
Campinas, Brasil

Tree and shrub species of the Atlantic Forest on the slopes of Marambaia Island, Rio de Janeiro, Brazil

Felipe Cito Nettesheim[1,6], Luis Fernando Tavares de Menezes[2], Daniel Costa de Carvalho[3], Marilena Menezes Silva Conde[4], Genise Vieira Somner[4], Guilherme de Assis Rodrigues[4] & Dorothy Sue Dunn de Araujo[5]

[1]Programa de Pós-graduação em Ecologia, Universidade Federal do Rio de Janeiro – UFRJ, Av. Brigadeiro Trompowsky, s/n, Prédio CCS, Bloco A, CEP 21941-590, Rio de Janeiro, RJ, Brasil. http://www.ppgecologia.biologia.ufrj.br/
[2]Departamento de Ciências Agrárias e Biológicas, Centro Universitário Norte do Espírito Santo - CEUNES, Universidade Federal do Espírito Santo - UFES, Rod. BR 101 Norte, Km 60, Bairro Litorâneo, CEP 29932-540, São Mateus, ES, Brasil. http://www.ceunes.ufes.br/#
[3]Programa de Pós-graduação em Ciências Ambientais e Florestais, Universidade Federal Rural do Rio de Janeiro – UFRRJ, Km 47 da antiga rodovia Rio-São Paulo, CEP 23890-000, Seropédica, RJ, Brasil. http://www.if.ufrrj.br/pgcaf
[4]Departamento de Botânica, Instituto de Biologia, Universidade Federal Rural do Rio de Janeiro – UFRRJ, BR 465, Km 7, CP 74582, CEP 23851-970, Seropédica, RJ, Brasil. http://www.ufrrj.br/institutos/ib/botanica/pagina.html
[5]Instituto de Pesquisas Jardim Botânico do Rio de Janeiro – JBRJ, Rua Pacheco Leão, 2040, Solar da Imperatriz, CEP 22460-036, Rio de Janeiro, RJ, Brasil. http://www.jbrj.gov.br/
[6]Corresponding author: Felipe Cito Nettesheim, e-mail: felipe@citos.net

NETTESHEIM, F.C., MENEZES, L.F.T., CARVALHO, D.C., CONDE, M. M.S., SOMNER, G.V., RODRIGUES, G.A. & ARAUJO, D.S.D. **Tree and shrub species of the Atlantic Forest on the slopes of Marambaia Island, Rio de Janeiro, Brazil**. Biota Neotrop. 12(3): http://www.biotaneotropica.org.br/v12n3/en/abstract?inventory+bn01112032012

Abstract: This study describes the tree and shrub component of the Atlantic Forest on the slopes of Marambaia Island, RJ. It further evaluates which species are found at threatened species lists and the similarity that the studied forest component has with other nearby locations with similar vegetation. Data gathering relied on the joint effort of arbitrary walks and sampling units known as Transect. The same sampling criterion was applied at both approaches (DBH greater than or equal to 5 cm). A similarity analysis, followed by a Cluster analysis, was used to compare the studied vegetation component. Similarity calculations were based in the Bray-Curtis coefficient. We detected a total of 235 species. These are divided in 134 genera and 52 families. The richest families are Myrtaceae (38 spp.), Fabaceae (20 spp.) and Rubiaceae (20 spp.). The richest genera are *Eugenia* (16 spp.), *Myrcia* (8 spp.) and *Ocotea* (6 spp.). Nineteen of the detected species are currently listed as threatened and the studied forest component is mostly resembled to the vegetation at Rio Bonito (RJ). Our evidence shows that the evaluated tree and shrub layer seems to be well preserved and represents an important area for conservational efforts. The results additionally indicate that this vegetation seems to have a greater floristic resemblance to drier and further locations, rather than to more humid and close ones.
Keywords: *dense ombrophilous forest, floristic, species richness, similarity, phytogeography.*

NETTESHEIM, F.C., MENEZES, L.F.T., CARVALHO, D.C., CONDE, M.M.S., SOMNER, G.V., RODRIGUES, G.A. & ARAUJO, D.S.D. **Espécies arbóreas e arbustivas da Floresta Atlântica sobre as encostas da Ilha da Marambaia, Rio de Janeiro, Brasil**. Biota Neotrop. 12(3): http://www.biotaneotropica.org.br/v12n3/pt/abstract?inventory+bn01112032012

Resumo: Este estudo descreve a florística do componente arbóreo e arbustivo da Floresta Atlântica sobre as encostas da Ilha da Marambaia, RJ. Também são avaliadas quais das espécies encontradas constam em listas de espécies ameaçadas e qual a semelhança deste componente da vegetação com locais próximos cobertos pelo mesmo tipo de vegetação. A coleta de dados se valeu do esforço conjunto de caminhadas arbitrárias e de unidades amostrais conhecidas como “Transect”. O critério de inclusão na amostragem foi o mesmo para ambos os métodos (DAP igual ou maior a 5 cm). O componente estudado foi comparado a outras áreas através de uma análise de similaridade, seguida de um dendrograma. Os cálculos de similaridade foram baseados no coeficiente de Bray-Curtis. Detectamos, ao todo, 235 espécies, distribuídas em 134 gêneros e 52 famílias. As famílias mais ricas são Myrtaceae (38 spp.), Fabaceae (20 spp.) e Rubiaceae (20 spp.), enquanto os gêneros mais ricos são *Eugenia* (16 spp.), *Myrcia* (8 spp.) e *Ocotea* (6 spp.). Dezenove das espécies detectadas constam em listas de espécies ameaçadas de extinção e o componente estudado tem maior similaridade com a floresta em Rio Bonito (RJ). As

evidências mostram que a vegetação estudada parece estar bem preservada e representa uma área importante para esforços conservacionistas. Os resultados indicam ainda que o remanescente florestal em questão aparenta ser mais semelhante a locais mais secos e distantes do que próximos e úmidos.
Palavras-chave: *floresta ombrófila densa, florística, riqueza de espécies, similaridade, fitogeografia.*

Introduction

The Atlantic Forest is one of the world's most threatened tropical biomes (Conservation... 2011). Such status comes as a result from the continuous exploitation during various agricultural cycles and expansion of croplands (Dean 1996, Câmara & Coimbra-Filho 2000, Tonhasca Junior 2005). As an outcome of ongoing human activities and deforestation, an increasing number of isolated forest fragments are created. This process compromises the forest´s natural dynamic, avoids the survival of many species and contributes to the segregation of many animal and plant populations. Consequently, genetic flow between individuals is hampered and biological diversity reduced both locally and regionally (Primack & Rodrigues 2001, Rocha et al. 2006). Floristic studies of these forest fragments are a way of providing important information regarding the vegetation's current conservation status and ecological role. These studies have enabled the detection of interesting phytogeography patterns, priority species for conservation, relevant restoration actions and other significant trends regarding Atlantic Forest remnants (Oliveira-Filho & Fontes 2000, Fundação... & Instituto... 2002, Rambaldi et al. 2003, Nettesheim et al. 2010).

Two defining characteristics of the Atlantic Forest are its high plant species diversity and endemism levels (Murray-Smith et al. 2009, Conservation... 2011). Though not conclusive, many recent studies linked this floristic variation to the broad latitudinal and altitudinal range that this forest covers (Oliveira-Filho & Fontes 2000, Scudeller et al. 2001, Oliveira-Filho et al. 2005, Caiafa & Martins 2010, Nettesheim et al. 2010). Such reasoning is coherent with the existence of different forest types and associated ecosystems identified among the environmentally heterogeneous landscape within the Atlantic Forest (Veloso et al. 1991, Scarano 2002, Tonhasca Junior 2005).

Most of the Atlantic Forest plant species diversity and endemism known is found in fairly large and contiguous preserved areas of Dense Ombrophilous Forest (Veloso et al. 1991, Murray-Smith et al. 2009). In Rio de Janeiro state, the most important Atlantic Forest remnants cover the Serra do Mar mountain range and the better preserved vegetation is mainly present at its southern extension (Fundação... & Instituto… 2002, Rambaldi et al. 2003). Apparently, the tree and shrub flora variation from Rio de Janeiro southern region to its center becomes greater once Serra do Mar starts to get further from the ocean (Nettesheim et al. 2010). This topographic differentiation seems to determine a clear floristic distinction among remnants over Serra do Mar mountain range and over the plain landscape in front of it, known as the Guanabara Graben (grabens are linear terrain depressions at regions that endure tensional tectonic forces – Guerra & Guerra 1997). This topographic and floristic pattern can be found at Mangaratiba Environmental Protection Area, a protected area that covers close to 22618 ha. This conservation unit withholds contiguous continental forest areas as well as several islands at Sepetiba Bay (Rambaldi et al. 2003). Marambaia Island is one of these islands. It is composed by a low mountain area and a sandy stretch with 47 km of length. While the mountain area marks the entrance of Sepetiba Bay and is covered by Submontane Dense Ombrophilous Forest (*sensu* Veloso et al. 1991), the plain area reaches the continent and is covered by well-preserved coastal dune vegetation (Menezes et al. 2005).

A recent study showed, through a Cluster analysis, that Marambaia Island Submontane Dense Ombrophilous Forest (here treated as slope forest) seems to be more similar and grouped together to other areas on the slopes of Serra do Mar (Nettesheim et al. 2010). However, the same effort calls attention to the fact that such pattern was not so clear when the data was evaluated with a different analysis. According to the Canonical Correspondence Analysis, Marambaia Island slope forest seems to be more similar to hotter, lower and drier areas at Rio de Janeiro's Guanabara Graben (Nettesheim et al. 2010). These authors suggest that further evaluations taking into account abundance data about areas withholding the same forest type as Marambaia Island could help to clear up such discrepancies.

The floristic composition of Marambaia Island forest has already been studied (Conde et al. 2005). However, this assessment didn´t focus neither on describing a specific community layer nor on elucidating any phytogeography patterns. Therefore, the present survey aims at further describing the Marambaia Island slope forest tree and shrub layer composition and determining to which slope forest locations within Serra do Mar and Guanabara Graben (Almeida & Carneiro 1998) in Rio de Janeiro and Northern São Paulo it mostly resembles. In order to do that the present effort is guided by the following questions: (1) How many families, genera and species of trees and shrubs can there be detected in this slope forest? (2) What are the richest families and are they consistent with other nearby Atlantic Forest locations? (3) Are there threatened species? (4) When compared (based on species abundance data) to nearby slope forest studies, Marambaia Island slope forest is more resembled to areas at Serra do Mar mountain range or at the Guanabara Graben?

Methods

Study area – The study site is located in Sepetiba Bay, Mangaratiba municipality, in Southern Rio de Janeiro state (23° 04' S and 43° 53' W – Figure 1). The mountainous area soil lies over a gneiss crystalline basement terrain (Souza et al. 2005). According to the Brazilian Soil Classification System (Embrapa 2006) the soil is an association of Ultissol, Inceptsol and Entissol. The highest point at the area reaches an altitude of 641 m (Góes et al. 2005). The climate at Marambaia Island is rainy tropical. Mean monthly temperatures are over 20 °C and the annual mean is 23.7 °C . Mean annual precipitation is 1239.7 mm, 37% restricted to the summer months (rainiest season) and 15% to the winter months (driest season – Mattos 2005). Although nowadays the vegetation of Marambaia represents an important Atlantic Forest remnant, it sustained past anthropic interventions. The presence of the Brazilian Navy in the area as of the 1970's, together with its geographic isolation, guaranteed the conservation of the site during this period (Pereira et al. 1990, Conde et al. 2005, D.F. Silva, unpublished data).

Data sampling – This activity took place from January 2004 to January 2010 and relied on both a quantitative (transect method – Gentry 1982) and a qualitative approach (arbitrary walks through the area). Floristic composition presented here is the sum of the information provided by these methods. The same sampling criterion was adopted for both approaches, including trees and shrubs with diameter at breast height (dbh) equal to or greater than 5 cm.

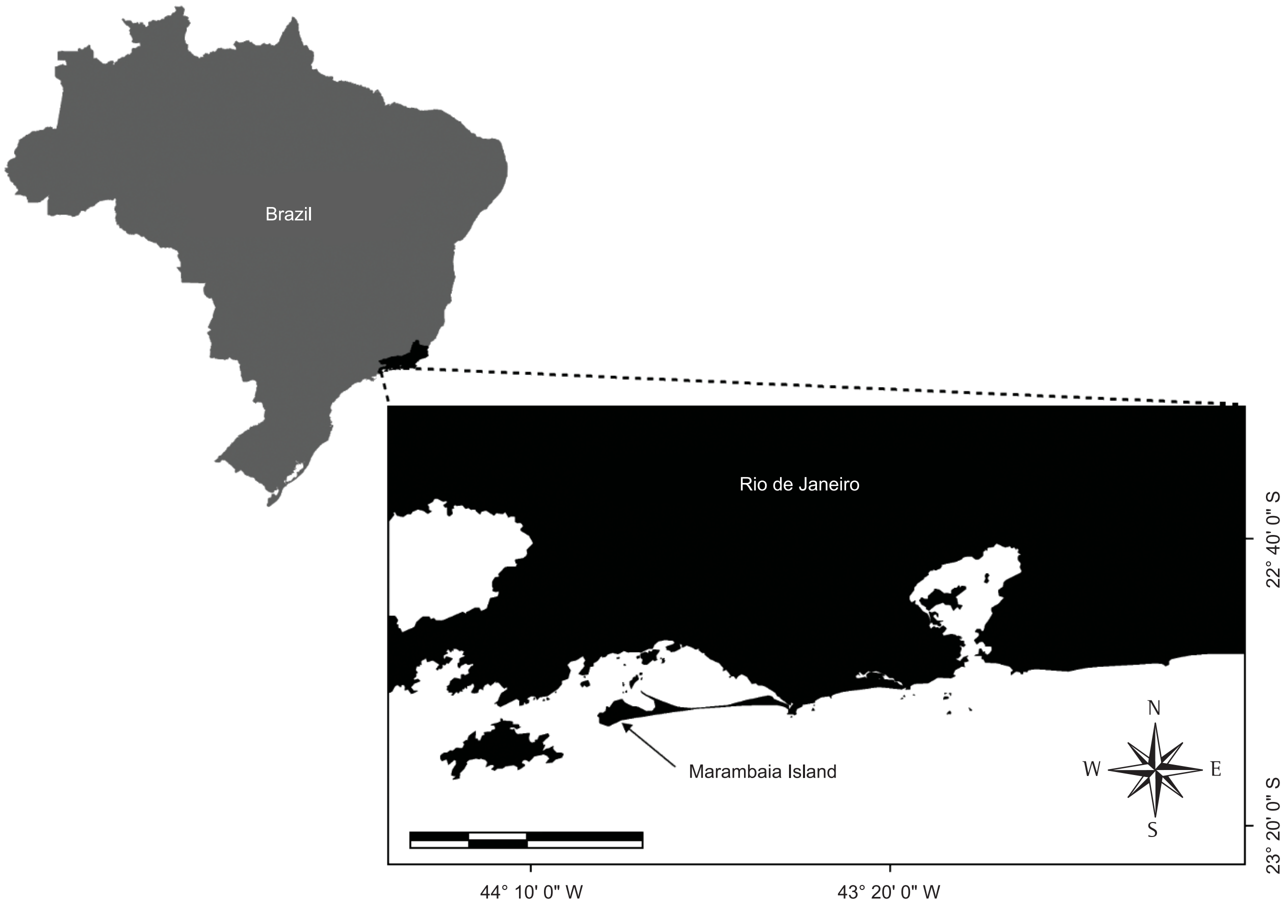

Figure 1. Location of Marambaia Island at southern Rio de Janeiro state, Brazil.

Besides the dbh restriction, only fertile individuals were included in the qualitative approach. Quantitative data was gathered at 40 sampling units, each unit with 2 × 50 m (100 m^2). The sampling units were established arbitrarily in altitudes varying from 50 to 500 m, covering a total area of 4000 m^2 (0.4 ha). Specimens of each species were collected to confirm their identity and deposited in Rio de Janeiro Federal Rural University Botany Department's Herbarium (RBR). The present effort species nomenclature follows APG III (Angiosperm… 2009). Species names and authors were checked at the Brazilian Flora Species List (*in* http://floradobrasil.jbrj.gov.br/2011) and at the International Plant Name Index site (*in* http://www.ipni.org/ipni/plantnamesearchpage.do).

Data evaluation and analysis – To determine if the richest families found at this effort are consistent with other nearby areas, we compared it with 20 Atlantic Forest studies (Table 1) at Rio de Janeiro and São Paulo states. For this comparison we emphasized forest areas at Serra do Mar mountain range and at the Guanabara Graben (Almeida & Carneiro 1998, Nettesheim et al. 2010).

To assess if any of the detected species is considered threatened we relied on two widely adopted endangered species lists. One was the Brazilian Environmental Ministry (MMA) list and the other was the Union for the Conservation of Nature (IUCN) Red List. Given that the criteria adopted to determine species conservation status varies according to the organization that develops the list, the same species may be considered endangered in one but not the other.

Six of the 20 Atlantic Forest studies initially gathered were chosen to be included in the similarity analysis. Only these studies met the criteria of providing species abundance data regarding a forest type equal and close to the one found at Marambaia Island. Five were developed in Rio de Janeiro state and one in São Paulo (Table 2). However, it´s important to note that one of the five studies from Rio de Janeiro state (at Tinguá Biological Reserve – REBIO Tinguá) seems to have been carried out at about 650 to 900 m of altitude, which would classify this forest as Montane Ombrophilous Forest (Rodrigues 1996). Still, we decided on keeping it in the analysis due to the following reasons: the work doesn't give a clear description of where samples were taken from (no coordinates); the altitude of 600 m that should define the distinction between Submontane and Montane Atlantic Forest is, though generally accepted by scientists, rather arbitrary; a good deal of REBIO Tinguá is a preserved Submontane Ombrophilous Forest; and excluding this information from the analysis would decrease even more the number of available efforts that supply quality species abundance data from near Marambaia Island. We also recognize that the compared studies relied in different sampling strategies. Nevertheless, although results must be interpreted with caution, we believe evaluating questions with abundance data may help to detect patterns that could go by unnoticed with presence/absence data.

With the information present in these six studies and the present effort, we assembled a Q matrix based on the abundance of each species within each location. Species not identified to specific level and synonyms were excluded of the data. We decided on keeping in the analysis species that occurred only once at any of the seven areas and that were represented by less than five individuals. This was made because we also ran the cluster analysis subtracting these "unwanted" species and the pattern found was the same as if they were kept in the

Table 1. Atlantic Forest study sites used to compare the richest families with the present effort.

Study area	Reference	Forest type
Campos dos Goytacazes – RJ	Carvalho et al. (2006a)	Low land Semideciduous Seasonal Forest
Mata do Carvão – RJ	Silva & Nascimento (2001)	Low land Semideciduous Seasonal Forest
Serra da Capoeira Grande – RJ	Peixoto et al. (2004)	Low land Dense Ombrophilous Forest
Poço das Antas baixada – RJ	Guedes-Bruni et al. (2006a)	Low land Dense Ombrophilous Forest
Região do Imbé – RJ	Moreno et al. (2003)	Submontane Dense Ombrophilous Forest
Praia do Sul, Ilha Grande – RJ	Oliveira (2002)	Submontane Dense Ombrophilous Forest
Imbaú – RJ	Carvalho et al. (2006b)	Submontane Dense Ombrophilous Forest
Represa de Ribeirão das Lages – RJ	Peixoto et al. (1995)	Submontane Dense Ombrophilous Forest
Poço das Antas morrote – RJ	Guedes-Bruni et al. (2006b)	Submontane Dense Ombrophilous Forest
Cachoeiras de Macacu – RJ	Kurtz & Araujo (2000)	Submontane Dense Ombrophilous Forest
Maciço da Tijuca – RJ	Oliveira et al. (1995)	Submontane Dense Ombrophilous Forest
Rio Bonito – RJ	Carvalho et al. (2007)	Submontane Dense Ombrophilous Forest
Juréia – Itatins – SP	Mamede et al. (2004)	Submontane Dense Ombrophilous Forest
Peruíbe – SP	Oliveira et al. (2001)	Submontane Dense Ombrophilous Forest
Picinguaba – SP	Sanchez et al. (1999)	Submontane Dense Ombrophilous Forest
Ubatuba – SP	Silva & Leitão Filho (1982)	Submontane Dense Ombrophilous Forest
Pindamonhangaba – SP	Gomes et al. (2005)	Montane Dense Ombrophilous Forest
Macaé de Cima secundária – RJ	Pessoa et al. (1997)	Montane Dense Ombrophilous Forest
Macaé de Cima preservada – RJ	Guedes-Bruni et al. (1997)	Montane Dense Ombrophilous Forest
Reserva Biológica Tinguá – RJ	Rodrigues (1996)	Montane Dense Ombrophilous Forest

Table 2. Methodological and environmental characteristics of the Submontane Dense Ombrophilous Forests areas evaluated in the similarity analysis. Alt. – predominant sampling altitude (m.); Precip. – mean annual precipitation (mm); Temp. – mean annual temperature (°C); Met. – study methodology (P = plot, T = transect, PQ = quadrant point); Crit. – sampling inclusion criterion (DBH in cm); Bs. Ar. – total sampled basal area ($m^2.ha^{-1}$); Area – total sampled area (m^2 – plots and transects methods) or number of points (quadrant point method); Abd. – total sampled abundance; S – total number of sampled species.

Code	Study area	Alt.	Precip.	Temp.	Met.	Crit.	Bs. Ar.	Area	Abd.	S
UBA, SP	Ubatuba[1]	120	2448	22.6	PQ	≥ 10	----	160	640	123
IGR, RJ	Praia do Sul, Ilha Grande[2]	165	1975	22.5	P	≥ 2.5	57.90	7800	2332	236
PAM, RJ	Poço das Antas morrote[3]	115	2118	24.5	P	≥ 5	25.59	10000	580	174
PAR, RJ	Cachoeiras de Macacu[4]	200	2558	23.0	PQ	≥ 5	57.30	150	592	138
RBT, RJ	Rio Bonito[5]	100	1750	26.0	P	≥ 5	29.00	4000	776	106
TIN, RJ	Reserva Biológica Tinguá[6]	650	2099	21.6	PQ	≥ 2.5	----	200	800	189
IMA, RJ	Ilha da Marambaia[7]	130	1239	23.7	T	≥ 5	55.68	4000	941	169

[1]Silva & Leitão Filho (1982); [2]Oliveira (2002); [3]Guedes-Bruni et al. (2006b); [4]Kurtz & Araujo (2000); [5]Carvalho et al. (2007); [6]Rodrigues (1996); [7]this study.

analysis (with a slight increase of the similarity values). Besides, we understand that rare species are common in the Atlantic Forest and may provide important clues about floristic differentiation patterns. Therefore, the final matrix listed the abundance of 528 species distributed at seven different slope forest locations. This matrix was standardized dividing the species abundance value recorded in each location by the total abundance recorded in that location. Following matrix standardization we calculated a similarity matrix between each pair of evaluated areas based on the Bray-Curtis coefficient distance measure. Once Bray-Curtis is a dissimilarity measure, we subtracted the resulting dissimilarity values from 1 in order to determine the areas similarities. Then we used these Bray-Curtis similarity values to build a similarity dendrogram synthesizing the relationship among the compared locations. The dendrogram was elaborated using the Unweighted Pair Group with Arithmetic Mean – UPGMA – clustering method (McCune & Grace 2002, Gotelli & Ellison 2004).

Results

A total of 235 species were detected. These are distributed in 134 genera and 52 families (Table 3). Eighteen families (34.6%) and 113 genera (84.3%) are represented by only one species. The richest families are Myrtaceae (38 spp.), Fabaceae (20 spp.), Rubiaceae (20 spp.), Lauraceae (14 spp.), Sapotaceae (12 spp.) and Euphorbiaceae (11 spp.). The most expressive genera are *Eugenia* (16 spp.), *Myrcia* (8 spp.), *Ocotea* (6 spp.), *Ficus* (6 spp.), *Inga* and *Psychotria* (5 spp.).

Nineteen of the 235 detected species (about 8%) are included on threatened species lists (Table 3). Sixteen of them appear at the IUCN Red List (International... 2010) and the other three at the Brazilian Environmental Ministry list (Brasil 2008). Sapotaceae is the family with the greatest number of species (5) at the threatened species lists considered.

The plant community at this study has greater floristic similarity (20.2%) with the slope forest in Rio Bonito (RJ – Table 4). This resemblance is the second highest found by the analysis, after Rio Bonito and Poço das Antas (RJ), with 21.6%. On the other hand, Marambaia slope forest is least resembled to Ubatuba (SP – 8,3%). The lowest value of similarity was found between Rio Bonito and Ilha Grande (3.4%). When the similarity information regarding the areas was summarized by the Cluster, it was possible to distinguish three groups (Figure 2): the first one formed by Ubatuba and Ilha

Table 3. Tree and shrub species from Marambaia slope forest. Voucher – specimen collector and researcher sample number. Species sampled qualitatively are preceded by an asterisk. Threatened species are identified by its conservation status in superscript and bold: LR1 – low risk, least concern; LR2 – low risk, conservation dependent; V – vulnerable; E – endangered (according to IUCN Red List status) or DD – deficient data; TE – threatened with extinction (according to Brazilian Environmental Ministry status).

Family/species	Voucher
ANACARDIACEAE	
Astronium graveolens Jacq.	M.S. Conde 646
Tapirira guianensis Aubl.	D. Araujo 10542
ANNONACEAE	
**Anaxagorea dolichocarpa* Sandwith & Sandwith	F.C. Nettesheim 18
Guateria candolleana Schltdl.	F.C. Nettesheim 177
Guateria cf. *villosissima* A.St.-Hil.	F.C. Nettesheim 127
**Xylopia brasiliensis* Spreng.	H.P. Lima 347
Xylopia langsdorffiana A.St.-Hil. & Tul.	F.C. Nettesheim 225
Xylopia sericea A.St.-Hil.	M.S. Conde 476
APOCYNACEAE	
Aspidosperma pyricollum Müll. Arg.	H.F. Baylão 87
Malouetia cestroides (Nees *ex* Mart.) Müll.Arg.	F.C. Nettesheim 140
Tabernaemontana laeta Mart.	G.M. Siqueira 25
AQUIFOLIACEAE	
Ilex integerrima (Vell.) Reissek	L.F. Menezes 757
ARALIACEAE	
Schefflera angustissima (Marchal) Frodin	F.C. Nettesheim 216
ARECACEAE	
Astrocaryum aculeatissimum (Schott) Burret $^{\mathbf{LR1}}$	L.F. Menezes 417
**Syagrus romanzoffiana* (Cham.) Glassman	F.C. Nettesheim 294
ASTERACEAE	
Vernonanthura discolor (Spreng.) Less.	F.C. Nettesheim 169
BIGNONIACEAE	
Cybistax antisyphilitica (Mart.) Mart.	F.C. Nettesheim 31
Handroanthus heptaphyllus Mattos	F.C. Nettesheim 223
**Jacaranda puberula* Cham.	R.S. Nunes 1
Sparattosperma leucanthum (Vell.) K.Schum.	L.F. Menezes 1065
**Tabebuia cassinoides* (Lam.) DC. $^{\mathbf{DD}}$	F.C. Nettesheim 295
BORAGINACEAE	
**Cordia sellowiana* Cham.	D.C. Carvalho 29
Cordia trichoclada DC.	L.F. Menezes 592
**Cordia trichotoma* (Vell.) Arráb. *ex* Steud.	F.C. Nettesheim 203
BURSERACEAE	
Protium brasiliense (Spreng.) Engl.	M.S. Conde 648
Protium heptaphyllum (Aubl.) Marchand	G.A. Rodrigues sem nº
Tetragastris breviacuminata Swart	F.C. Nettesheim 81
CANNABACEAE	
Celtis iguanaea (Jacq.) Sarg.	F.C. Nettesheim 228
**Trema micrantha* (L.) Blume	M.C. Souza 13
CHRYSOBALANACEAE	
Hirtella hebeclada Moric. *ex* DC.	F.C. Nettesheim 141
Licania kunthiana Hook.f.	F.C. Nettesheim 221
Licania riedeli Prance	F.C. Nettesheim 37
Parinari excelsa Sabine	M.S. Conde 634
CLETHRACEAE	
Clethra scabra Pers.	F.C. Nettesheim 52
CLUSIACEAE	
**Garcinia brasiliensis* Mart.	F.C. Nettesheim 246
Garcinia gardneriana (Planch. & Triana.) Zappi	F.C. Nettesheim 1
**Kielmeyera lathrophyton* Saddi	D.C. Carvalho 56
COMBRETACEAE	

Table 3. Continued...

Family/species	Voucher
Terminalia januariensis DC. VU	F.C. Nettesheim 234
CUNNONIACEAE	
Lamanonia ternata Vell.	F.C. Nettesheim 22
ELAEOCARPACEAE	
Sloanea guianensis (Aubl.) Benth.	F.C. Nettesheim 76
ERYTHROXYLACEAE	
**Erythroxylum passerinum* Mart.	F.C. Nettesheim 112
Erythroxylum pulchrum A.St.-Hil.	A. Melo 13
Erythroxylum subsessile (Mart.) O.E.Schulz.	D.C. Carvalho 02
EUPHORBIACEAE	
Actinostemon concolor (Spreng.) Müll.Arg.	D.C. Carvalho 58
Actinostemon communis (Müll.Arg.) Pax.	L.F. Menezes 718
Alchornea triplinervia (Spreng.) Müll.Arg.	L.F. Menezes 244
Algernonia brasiliensis Baill.	F.C. Nettesheim 84
Aparisthmium cordatum (A.Juss.) Baill.	M.C. Souza 11
**Croton compressus* Lam.	A. Melo 12
Croton floribundus Lund. *ex* Didr.	F.C. Nettesheim 60
Croton sphaerogynus Baill	L.F. Menezes 783
**Joannesia princeps* Vell.	D.C. Carvalho 72
**Sebastiania gaudichaudii* (Müll. Arg.) Müll. Arg.	G.M. Siqueira 15
Senefeldera verticillata (Vell.) Croizat	F.C. Nettesheim 147
FABACEAE	
**Albizia polycephala* (Benth.) Killip *ex* Record	R. Facre 08
**Andira anthelmia* (Vell.) Benth.	R.S. Nunes 2
**Andira fraxinifolia* Benth.	L.F. Menezes 1110
Copaifera lucens Dwyer	F.C. Nettesheim 35
**Dalbergia frutescens* (Vell.) Britton	R. Facre 13
Inga capitata Desv.	F.C. Nettesheim 105
**Inga edulis* Mart.	F.C. Nettesheim 299
Inga lanceifolia Benth. EN	F.C. Nettesheim 104
**Inga laurina* (Sw.) Willd.	M.S. Conde 650
Inga subnuda Salzm. *ex* Benth.	M.S. Conde 486
Myrocarpus frondosus Allemão DD	F.C. Nettesheim 103
Ormosia arborea (Vell.) Harms	D. Araujo 10549
Piptadenia gonoacantha (Mart.) J.F.Macbr.	D.C. Carvalho 57
Pseudopiptadenia contorta (DC.) G.P.Lewis & M.P.Lima	H.P. Lima 343
Pseudopiptadenia leptostachya (Benth.) Rauschert	F.C. Nettesheim 106
**Schizolobium parahyba* (Vell.) Blake	A.S. Medeiros 120
**Tachigali pilgeriana* (Harms) Oliveira-Filho EN	F.C. Nettesheim 116
**Senna silvestris* (Vell.) H.S.Irwin & Barneby	M.C. Souza 108
**Swartzia langsdorffii* Raddi	F.C. Nettesheim 164
**Zolernia ilicifolia* (Brongn.) Vogel	R.S. Nunes 4
LAURACEAE	
Aniba firmula (Nees & Mart.) Mez	L.F. Menezes 658
Beilschmiedia rigida (Mez) Kosterm. TE	F.C. Nettesheim 194
Endlicheria glomerata Mez	F.C. Nettesheim 193
**Endlicheria paniculata* (Spreng.) J.F.Macbr.	G.A. Rodrigues 3
Licaria armeniaca (Nees) Kosterm.	L.F. Menezes 822
**Nectandra membranacea* (Sw.) Griseb.	L.F. Menezes 1064
Nectandra oppositifolia Nees	M.S. Conde 484
**Nectandra puberula* (Schott) Ness	G.A. Rodrigues 4
**Ocotea aciphylla* (Ness & Mart.) Mez LR1	G.A. Rodrigues 5
**Ocotea divaricata* (Ness) Mez	D.C. Carvalho 130
Ocotea elegans Mez	F.C. Nettesheim 130
Ocotea lancifolia (Schott) Mez	R.S. Nunes 5

Table 3. Continued...

Family/species	Voucher
Ocotea notata (Nees & Mart.) Mez	D. Araújo 9762
Ocotea teleiandra (Meisn.) Mez	F.C. Nettesheim 04
LECYTHIDACEAE	
**Cariniana estrellensis* (Raddi) Kuntze	F.C. Nettesheim 296
Cariniana legalis (Mart.) Kuntze [VU]	M.S. Conde 463
MALVACEAE	
Ceiba speciosa (A.St.-Hil) Ravenna	F.C. Nettesheim 224
Erioteca penthaphylla (Vell. & K.Schum.) A.Robyns	F.C. Nettesheim 25
Luehea divaricata Mart. & Zucc.	F.C. Nettesheim 28
Pseudobombax grandiflorum (Cav.) A.Robyns	L.F. Menezes 533
Quararibea turbinata (Sw.) Poir.	F.C. Nettesheim 200
MALPIGHIACEAE	
**Byrsonima crispa* A.Juss.	G.A. Rodrigues 11
Byrsonima laxiflora Griseb.	F.C. Nettesheim 62
**Byrsonima sericea* DC.	J.P. Junior 46
MELASTOMATACEAE	
**Huberia ovalifolia* DC.	M.S. Conde 470
**Miconia calvescens* DC.	H.P. Lima 340
**Miconia chartacea* Triana	G.A. Rodrigues 6
Miconia cinnamomifolia (DC.) Naudin	M.S. Conde 478
**Miconia dodecandra* Cogn.	K.C. Silva 14
Miconia prasina (Sw.) DC.	H.P. Lima 348
**Tibouchina estrellensis* (Raddi) Cogn.	F.C. Nettesheim 190
**Tibouchina granulosa* (Desr.) Cogn.	R.S. Nunes 6
**Tibouchina trichopoda* (DC.) Baill	K.C. Silva 25
MELIACEAE	
**Guarea guidonia* (L.) Sleumer	F.C. Nettesheim 179
Guarea macrophylla Vahl	F.C. Nettesheim 16
**Trichilia casarettoi* C.DC. [VU]	F.C. Nettesheim 188
Trichilia elegans A.Juss.	L.F. Menezes 586
Trichilia lepidota Mart.	D.C. Carvalho 54
MONIMIACEAE	
Mollinedia oligantha Perkins	M.S. Conde 474
MORACEAE	
Brosimum guianense (Aubl.) Huber	M.C. Souza 92
Ficus adhatodifolia Schott *ex* Spreng.	L.F. Menezes 594
Ficus arpazusa Casar.	F.C. Nettesheim 138
**Ficus clusiifolia* Schott.	F.C. Nettesheim 183
**Ficus cyclophylla* (Miq.) Miq.[EN]	A.C.C. Moreira 11
Ficus gomelleira Kunth	L.F. Menezes 1001
Ficus luschnathiana (Miq.) Miq.	M.C. Souza 10
Sorocea guilleminiana Gaudich.[VU]	G.A. Rodrigues 10
**Sorocea hilarii* Gaudich.	L.F. Menezes 229
MYRISTICACEAE	
Virola gardneri (A.DC.) Warb.	F.C. Nettesheim 149
MYRSINACEAE	
**Myrsine coriacea* (Sw.) R.Br. *ex* Roem & Schult.	L.F. Menezes 596
Myrsine venosa A.DC.	L.F. Menezes 583
MYRTACEAE	
Calyptranthes lanceolata O.Berg	L.F. Menezes 1093
Calyptranthes lucida Mart. *ex* DC.	F.C. Nettesheim 111
Campomanesia guazumifolia (Cambess.) O.Berg	F.C. Nettesheim 14
**Campomanesia guaviroba* (DC.) Kiaersk.	L.F. Menezes 999
Eugenia bahiensis DC.	F.C. Nettesheim 198

Table 3. Continued...

Family/species	Voucher
**Eugenia brasiliensis* Lam.	L.F. Menezes 632
Eugenia excelsa O.Berg	F.C. Nettesheim 101
**Eugenia florida* DC.	G.A. Rodrigues 7
Eugenia microcarpa O.Berg	F.C. Nettesheim 218
**Eugenia neolanceolata* Sobral	R.S. Nunes 11
**Eugenia neonitida* Sobral	M.C. Souza 134
**Eugenia neosilvestris* Sobral	F.C. Nettesheim 108
Eugenia oblongata Mattos & D.Legrand	F.C. Nettesheim 197
Eugenia prasina O.Berg ^{VU}	F.C. Nettesheim 220
Eugenia punicifolia (Kunth) DC.	F.C. Nettesheim 80
Eugenia riedeliana O.Berg	F.C. Nettesheim 15
Eugenia rostrata O. Berg	F.C. Nettesheim 47
**Eugenia sulcata* Spring *ex* Mart.	L.F. Menezes 627
Eugenia tinguyensis Cambess.	F.C. Nettesheim 79
**Eugenia uniflora* L.	R.S. Nunes 12
Marlierea excoriata Mart.	F.C. Nettesheim 6
Marlierea obscura O.Berg	F.C. Nettesheim 110
Marlierea suaveolens Cambess.	F.C. Nettesheim 24
Marlierea tomentosa Cambess.	F.C. Nettesheim 100
Myrceugenia myrcioides (Cambess.) O. Berg	F.C. Nettesheim 61
Myrcia acuminatissima O.Berg	F.C. Nettesheim 134
Myrcia laxiflora Cambess.	F.C. Nettesheim 40
Myrcia multiflora (Lam.) DC.	L.F. Menezes 672
Myrcia pubipetala Miq.	L.F. Menezes 521
**Myrcia selloi* (Spreng.) N.Silveira	L.F. Menezes 992
Myrcia spectabilis DC.	M.S. Conde 468
Myrcia splendens (Sw.) DC.	F.C. Nettesheim 30
**Myrcia tijucensis* Kiaersk.	H.P. Lima 355
**Myrciaria floribunda* (H.West *ex* Willd.) O.Berg.	R.S. Nunes 13
**Myrciaria tenella* (DC.) O.Berg	A. Melo 25
Neomitranthes aff. *glomerata* (D.Legrand) D.Legrand	F.C. Nettesheim 41
Plinia rivularis (Cambess.) Rotman	F.C. Nettesheim 245
Psidium cattleianum Sabine	F.C. Nettesheim 44
NYCTAGINACEAE	
Guapira opposita (Vell.) Reitz	H.P. Lima 322
OCHNACEAE	
**Ouratea cuspidata* (A.St.-Hil.) Engl.	R.S. Nunes 14
Ouratea miersii (Planch.) Engl.	M.S. Conde 674
**Ouratea oliviformis* (A.St.-Hil.) Engl.	D.C. Carvalho 70
**Ouratea parviflora* (A.DC.) Baill.	F.C. Nettesheim 226
OPILIACEAE	
Agonandra excelsa Griseb.	F.C. Nettesheim 85
PERACEAE	
Pera glabrata (Schott) Poepp. *ex* Baill.	D. Araujo 9886
PHYTOLACACEAE	
**Gallesia integrifolia* (Spreng.) Harms	F.C. Nettesheim 292
PIPERACEAE	
**Piper arboreum* Aubl.	G.M. Siqueira 78
**Piper mollicomum* Kunth	R.S. Nunes 15
Piper rivinoides Kunth	F.C. Nettesheim 195
PROTEACEAE	
Roupala aff. *meisneri* Sleumer	F.C. Nettesheim 26
QUIINACEAE	
**Quiina glazovii* Engl.	F.C. Nettesheim 143

Table 3. Continued...

Family/species	Voucher
RHAMNACEAE	
Colubrina glandulosa Perkins	F.C. Nettesheim 157
RUBIACEAE	
Amaioua intermedia Mart. *ex* Schul & Schult.f.	L.F. Menezes 585
Alseis floribunda Schott	F.C. Nettesheim 89
Bathysa stipulata (Vell.) C.Presl	F.C. Nettesheim 10
Coussarea accedens Müll.Arg.	F.C. Nettesheim 248
**Coussarea meridionalis* (Vell.) Müll.Arg.	D. Hottz 66
Coussarea nodosa (Benth.) Müll.Arg.	F.C. Nettesheim 97
Coutarea hexandra (Jacq.) K.Schum.	F.C. Nettesheim 50
**Faramea calyciflora* A.Rich. *ex* DC.	F.C. Nettesheim 236
Faramea occidentalis (L.) A.Rich.	F.C. Nettesheim 153
Guettarda viburnoides Cham. & Schltdl.	M.S. Conde 460
Ixora gardneriana Benth.	F.C. Nettesheim 159
Posoqueria latifolia (Rudge) Schult.	F.C. Nettesheim 51
Psychotria carthagenensis Jacq.	F.C. Nettesheim 91
Psychotria mapourioides DC.	F.C. Nettesheim 247
Psychotria pubigera Schltdl.	D. Hottz 25
Psychotria racemosa Rich.	D. Hottz 29
Psychotria stenocalyx Müll.Arg.	G.M. Siqueira 81
Randia armata (Sw.) DC.	D.C. Carvalho 62
**Rudgea nobilis* Müll.Arg. [DD]	D. Hottz 91
Simira pikia (K.Schum.) Steyerm.	F.C. Nettesheim 232
RUTACEAE	
Almeidea rubra A.St.-Hil.	F.C. Nettesheim 2
**Dictyoloma vandellianum* A.Juss	G.A. Rodrigues 2
**Esenbeckia grandiflora* Mart.	R.S. Nunes 7
Zanthoxylum rhoifolium Lam.	M.C. Souza 12
SALICACEAE	
Casearia arborea (Rich.) Urb.	A. Melo 08
**Casearia commersoniana* Cambess.	L.F. Menezes 209
**Casearia decandra* Jacq.	R.S. Nunes 10
Casearia sylvestris Sw.	F.C. Nettesheim 17
Xylosma prockia (Turcz.) Turcz.	F.C. Nettesheim 82
SAPINDACEAE	
**Allophylus heterophyllus* (Cambess.) Radlk.	R.S. Nunes 8
Allophylus petiolulatus Radlk.	F.C. Nettesheim 117
Cupania concolor Radlk.	M.S. Conde 477
**Cupania emarginata* Cambess.	H.P. Lima 321
Cupania oblongifolia Mart.	D. Araujo 1607
**Cupania racemosa* (Vell.) Radlk.	L.F. Menezes 526
Matayba guianensis Aubl.	F.C. Nettesheim 219
**Sapindus saponaria* L.	L.F. Menezes 1042
SAPOTACEAE	
Chrysophyllum flexuosum Mart. [LR2]	F.C. Nettesheim 173
Chrysophyllum aff. *lucentifolium* Cronquist.	F.C. Nettesheim 230
Chrysophyllum paranaense T.D.Penn. [VU]	F.C. Nettesheim 146
Ecclinusa ramiflora Mart. [LR2]	L.F. Menezes 517
**Manilkara subsericea* (Mart.) Dubard	R.S. Nunes 9
Micropholis cf. *cuneata* Pierre *ex* Glaz.	F.C. Nettesheim 67
**Micropholis crassipedicellata* (Mart. & Eichler) Pierrie [LR2]	G.A. Rodrigues 12
Pouteria bangii (Rusby) T.D.Penn.	F.C. Nettesheim 36
Pouteria caimito (Ruiz & Pav.) Radlk.	L.F. Menezes 1505
**Pouteria* cf. *durlandii* (Standl.) Baehni	F.C. Nettesheim 229

Table 3. Continued...

Family/species	Voucher
**Pouteria* cf. *torta* (Mart.) Radlk.	F.C. Nettesheim 131
Pradosia kuhlmannii Toledo[EN]	L.F. Menezes 1090
SIPARUNACEAE	
Siparuna guianensis Aubl.	R. Facre 10
SOLANACEAE	
Solanum argenteum Dunal	L.F. Menezes 597
TERNSTROEMIACEAE	
**Ternstroemia brasiliensis* Cambess.	G.A. Rodrigues 9
URTICACEAE	
Cecropia pachystachya Trécul	F.C. Nettesheim 291
VERBENACEAE	
**Cytharexyllum myrianthum* Cham.	M.C. Souza 79
VIOLACEAE	
Rinorea guianensis Aubl.	F.C. Nettesheim 148
Rinorea laevigata (Sol. *ex* Ging.) Hekking	F.C. Nettesheim 231
VOCHYSIACEAE	
Vochysia oppugnata (Vell.) Warm.	M.S. Conde 469
**Qualea gestasiana* A.St.-Hil.	G.A. Rodrigues 13

Table 4. Bray-Curtis distance values among sites listed at Table 2 and included in the similarity analysis.

	PAM, RJ	PAR, RJ	TIN, RJ	IMA, RJ	RBT, RJ	UBA, SP	IGR, RJ
PAM, RJ	–						
PAR, RJ	11.8	–					
TIN, RJ	19.5	19.6	–				
IMA, RJ	18.4	15.0	16.9	–			
RBT, RJ	**21.6**	5.7	9.6	**20.2**	–		
UBA, SP	8.8	9.3	10.7	8.3	12.9	–	
IGR, RJ	7.7	10.7	10.5	8.7	3.4	18.7	–

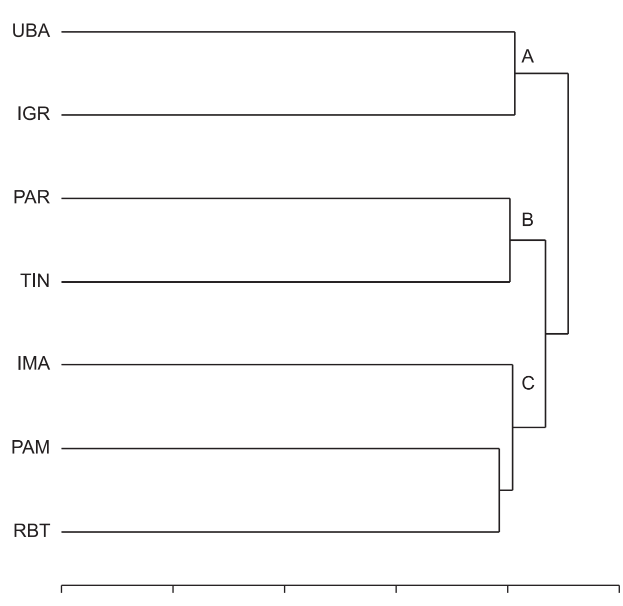

Figure 2. Similarity Cluster based on Bray-Curtis distance measure and UPGMA method. The areas considered in this Cluster are listed at Table 2 and the three similarity groups are designated by the letters A, B and C.

Grande (A), the second one composed of Cachoeiras de Macacu and Tinguá (B) and the third one formed by Marambaia, Poço das Antas and Rio Bonito (C).

Discussion

Relative to the previous study of Conde et al. (2005), the present effort represents a detection increase of 104.3% species, 44.1% genera and 26.8% families. The number of new occurrences to the area helps to ensure a more accurate description of the Marambaia slope forest flora community.

A high number of families and genera are represented by only one species. This trend has also been observed in studies at Rio de Janeiro state and other forest fragments along the Atlantic Forest extension (Silva & Nascimento 2001, Moreno et al. 2003, Peixoto et al. 2004). Some studies have pointed out that this fact is probably related to the Atlantic Forest´s diverse flora and high number of endemic species. This diversity would favor high species turnover rates, consequently diminishing the number of families and genera with more than one species (Oliveira-Filho & Fontes 2000, Scudeller et al. 2001, Oliveira-Filho et al. 2005, Nettesheim et al. 2010, Caiafa & Martins 2010).

On the other hand, the six richest families represent 48.9% of all recorded species at the area. When compared to the other 20 Atlantic Forest studies shown at Table 1, it is evident that these six families are usually the richest at Rio de Janeiro and northern São Paulo states.

Particularly prominent among these studies are Myrtaceae, Fabaceae, Lauraceae and Rubiaceae. The first two appear in 19 of the 21 areas, occupying the first or second richest status in 13 of them, while the latter two appear among the richest families respectively at 18 and 14 locations. Therefore, the high species richness found in these families at Marambaia slope forest is consistent with other nearby Atlantic Forest locations (Kurtz & Araujo 2000, Oliveira 2002, Guedes-Bruni et al. 2006a, b, Carvalho et al. 2007, 2009). These results are corroborated by a meta-analysis of 125 Atlantic Forest remnants in the Brazilian Southeastern Ombrophilous and Seasonal Forests (Oliveira-Filho & Fontes 2000). This study emphasizes Myrtaceae, Rubiaceae, Euphorbiaceae and Melastomataceae as usual detainers of the highest numbers of species at the vegetation in this region.

This same study also shows *Eugenia*, *Myrcia*, *Ocotea* and *Miconia* as the richest genera in these forests (Oliveira Filho & Fontes 2000). Therefore, given our results, the richness patterns of the genera at Marambaia slope forest seems to be consistent with the local and regional patterns detected for the Atlantic Forest at Southeastern Brazil (Peixoto & Gentry 1990, Moreno et al. 2003, Carvalho et al. 2006b, Nettesheim et al. 2010). It is thus reasonable to assume that, despite man's interference in the past, with all these richest families and genera, the Submontane Dense Ombrophilous Forest on Marambaia Island is an important remnant and its preservation must be guaranteed. A comparison of the basal area at this study (55.68 m^2) with the value at the well preserved Cachoeiras de Macacu slope forest (57.30 m^2) (Kurtz & Araujo 2000), gives support to this reasoning. This seems especially true if we consider that when four sites with different disturbance histories were evaluated at Ilha Grande (RJ), the "climax" area presented a basal area of 57.90 m^2 (Table 2). Though these last two comparisons must be seen with caution due to the different sampling methods (Table 2), the lack of studies with standardized methods led us to use the available data.

The number of species found at threatened species lists is another evidence that the Marambaia slope forest is an important Atlantic Forest remnant despite past interference. It does not have as many threatened species as the nearby Serra do Mar State Park. Gomes et al. (2011) found 35 threatened species (14% of the 251 species detected) at this location. Nevertheless, Marambaia slope forest still detains a high percentage of threatened species, especially if considering that it is not a protected area. This remnant's importance increases when taken into account the relevance of this site to the conservation of Sapotaceae. Other species that shows why this is an interesting area for conservation efforts and tree population studies are *Beilschmiedia rigida* (Mez) Koslerm., *Inga lanceifolia* Benth., *Tachigali pilgenianum* Harms, *Ficus cyclophylla* (Miq.) Miq. and *Pradosia kuhlmannii* Toledo (Table 3). According to the IUCN and MMA criteria, they are threatened of extinction and have a high risk of disappearing in the wild in the near future (Brasil 2008, International... 2010).

When compared to other studies that evaluated the floristic similarity in Atlantic Forest areas (Peixoto et al. 2004, Rolim et al. 2006, Carvalho et al. 2006b, Nettesheim et al. 2010), the similarity among the seven areas analyzed can be considered low (Table 4). This calls attention to the high tree and shrub floristic variation particularly within Submontane Dense Ombrophilous Forests. The floristic differentiation that this type of forest presents may play an important role at increasing Atlantic Forest overall vegetation diversity. These similarity results are consistent with the elevated heterogeneity highlighted in other Atlantic Forest comparison studies (Oliveira-Filho & Fontes 2000, Peixoto et al. 2004, Oliveira-Filho et al. 2005, Carvalho et al. 2006b, Rolim et al. 2006, Nettesheim et al. 2010).

Our Cluster analysis based in these similarities yielded some interesting results. Though grouped with Poço das Antas and Rio Bonito (both about 150 km distant from Marambaia Island), Marambaia slope forest is closer to Ilha Grande (~20 km) and Ubatuba (~100 km) and was initially expected to be more similar to them. According to the environmental data of the seven compared areas, Marambaia and the other locations in group C have the highest mean annual temperatures, lowest sampled altitudes and seem to present a trend toward lower rain incidence (Table 2). It appears logical to assume these characteristics also suggest that the areas in group C are drier than the other evaluated locations. Thus, it seems that the floristic resemblance of the areas in this group is most likely a consequence of environmental resemblance than geographical proximity. Such hypothesis should be further tested by future efforts, but group B represents an additional evidence to support it. At this group, Cachoeiras de Macacu appears together with Tinguá even though they are 80 km apart, and Rio Bonito is actually only 30 km away from Cachoeiras de Macacu. Of the seven evaluated locations, both Cachoeiras de Macacu and Tinguá exhibit the highest sampled altitudes and an elevated rain level. Although recent studies have highlighted that the environment is important to understand Atlantic Forest floristic patterns in Southeastern Brazil, the extent to which random processes are relevant to structure this forest is still an unanswered question (Oliveira-Filho & Fontes 2000, Oliveira-Filho et al. 2005, Nettesheim et al. 2010).

Such results suggest that, considering floristic composition, the Marambaia Island slope forest tree and shrub community is closer to slope forests at the Guanabara Graben than to the Serra do Mar Mountain range, like first suggested by the Cluster provided by Nettesheim et al. (2010). However, this difference may be a consequence of the Cluster analysis itself. As Nettesheim et al. (2010) took into consideration 32 areas, the different grouping of Marambaia slope forest at their work may be due to more available data regarding its floristic similarity with other places (including areas with different forest types). Consistently with this reasoning, when we ran the Cluster analysis with presence/absence regarding the same seven areas evaluated here, the groups formed didn't change. Thus the difference among our results and the ones at Nettesheim et al. (2010) is not necessarily a consequence of using abundance data. To ideally tackle the discrepancy between our results and those found by Nettesheim et al. (2010) it would be preferable to have quality abundance data regarding at least the 32 areas considered in their analysis.

Despite these inconsistencies, the greater resemblance of Marambaia Island slope forest and the apparently drier areas at Guanabara Graben is reasonable given our field observations. The studied vegetation seems rather dry and doesn't exhibit the conspicuous epiphytic stratum nor the dense pteridophyte community typically found at wetter forests. Given its low mean annual precipitation (Table 2), this may be a consequence of the local topography, which is not a prominent barrier to rain coming from the ocean. This same situation may be true at the other slope forests present at the Guanabara Graben and could explain why these areas, though far from each other, have a similar flora.

The present effort represents a significant update of the Marambaia slope forest tree and shrub community description. It adds a substantial amount of new species, genera and families occurrences at the area. Also, the comparison of its richest families and genera with other Atlantic Forest studies, together with the recorded basal area, seem like a robust evidence that this remnant is, despite of past interference, presently well preserved. This conclusion is further supported by the 19 endangered species detected at the area. Their detection is reasonable evidence that there can be viable and restricted populations of these species at Marambaia Island slope forest, strongly requiring the conservation of this vegetation. Our results also show that the Marambaia Island slope forest seems to be more related to Submontane Dense Ombrophilous Forests at the Guanabara Graben. Nevertheless, though similarity patterns among Atlantic Forest areas are important evidence of trends like this vegetation's high heterogeneity, there are still unanswered questions that need to be properly addressed. To efficiently give light into this discussion it would be interesting that future contributions sample standardized abundance biological and environmental data across a wide number of Atlantic Forest remnants.

Acknowledgements

To the UFRRJ Biology Institute for supporting this and other studies conducted in Marambaia; to the Marambaia Island Training Centre – CADIM, for the area access permissions and logistic backup during field activities; to the taxonomists Ariane L. Peixoto, Haroldo C. de Lima, Maria de Fátima Freitas, Alexandre Quinet, Carine Quinet, Marcelo C. Souza, Genise V. Somner, Lucy S. Vale, Elsie F. Guimarães, Fernando Regis Di Maio, Ronaldo Marquete and Inês Cordeiro for the kindness in identifying botanic materials; to the colleagues who helped in the field and in the lab; to the anonymous referees who provided valuable insights and critics that greatly improved this manuscript quality.

References

ALMEIDA, F.F.M. & CARNEIRO, C.D.R. 1998. Origem e evolução da Serra do Mar. Rev. Bras. Geocienc. 8:135-150.

ANGIOSPERM PHYLOGENY GROUP - APG III. 2009. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Bot. J. Linn. Soc. 161:105-21. http://dx.doi.org/10.1111/j.1095-8339.2009.00996.x

BRASIL. Ministério do Meio Ambiente – MMA. 2008. Lista Nacional das espécies da flora brasileira ameaçadas de extinção. http://www.mma.gov.br/estruturas/179/_arquivos/179_05122008033615.pdf (último acesso em 15/07/2011).

CAIAFA, A.N. & MARTINS, F.R. 2010. Forms of rarity of tree species in the southern Brazilian Atlantic rainforest. Biodivers. Conserv. 19:2597-2618. http://dx.doi.org/10.1007/s10531-010-9861-6

CÂMARA, I.G. & COIMBRA-FILHO, A.F. 2000. Proposta para uma política de conservação ambiental para o Estado do Rio de Janeiro. In A Fauna ameaçada de extinção do Estado do Rio de Janeiro (H.G. Bergallo, C.F.D. Rocha, M.A.S. Alves & M. Van Sluys, orgs.). Editora da Universidade do Estado do Rio de Janeiro, Rio de Janeiro, p.137-143.

CARVALHO, F.A., BRAGA, J.M.A. & NASCIMENTO, M.T. 2009. Estrutura da comunidade arbórea de fragmentos de floresta atlântica ombrófila submontana na região de Imbaú. Rodriguésia 60(3):695-710.

CARVALHO, F.A., BRAGA, J.M.A., GOMES, J.M.L., SOUZA, J.S. & NASCIMENTO, M.T. 2006a. Comunidade arbórea de uma floresta de baixada aluvial no Município de Campos dos Goytacazes, RJ. Cerne 12:157-166.

CARVALHO, F.A., NASCIMENTO, M.T. & BRAGA, J.M.A. 2006b. Composição e riqueza florística do componente arbóreo da Floresta Atlântica submontana na região de Imbaú, Município de Silva Jardim, RJ. Acta Bot. Bras. 20(3):727-740. http://dx.doi.org/10.1590/S0102-33062006000300022

CARVALHO, F.A., NASCIMENTO, M.T. & BRAGA, J.M.A. 2007. Estrutura e composição florística do estrato arbóreo de um remanescente de Mata Atlântica Submontana no município de Rio Bonito, RJ, Brasil (Mata Rio Vermelho). Rev. Árvore 31(4):717-730.

CONDE, M.M.S., LIMA, H.R.P. & PEIXOTO, A.L. 2005. Aspectos florísticos e vegetacionais da Marambaia, Rio de Janeiro, Brasil. In História Natural da Marambaia (L.F.T. Menezes, A.L. Peixoto & D.S.D. Araujo, eds.). Editora da Universidade Federal Rural do Rio de Janeiro, Seropédica, p.133-168.

CONSERVATION INTERNATIONAL – CI. 2011. The Biodiversity Hotspots. http://www.conservation.org/where/priority_areas/hotspots/Pages/hotspots_main.aspx (último acesso em 10/07/2011).

DEAN, W. 1996. A ferro e fogo: a história e a devastação da Mata Atlântica brasileira. Editora Companhia das Letras, São Paulo.

EMBRAPA. 2006. Sistema brasileiro de classificação de solos. 2. ed. Editora Embrapa Solos, Rio de Janeiro.

FUNDAÇÃO SOS MATA ATLÂNTICA & INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS – INPE. 2002. Atlas dos remanescentes florestais da Mata Atlântica no período de 1995-2000: relatório final. Fundação SOS Mata Atlântica, INPE, São Paulo.

GENTRY, A. 1982. American neotropical floristic diversity phytogeographical connections between Central and South America Pleistocene climatic flutuations or an accident of the Andean orogeny? Ann. Mo. Bot. Gard. 69:557-593.

GÓES, M.H.B., SILVA, J.X., RODRIGUES, A.F., CAVALCANTE, S.G., RONCARATTI, H., CRAVO, C.D., MENEZES, L.F.T., ANJOS, L.C., VALADARES, G.S.V. & PEREIRA, M.G. 2005. Modelo digital para a restinga e paleoilha da Marambaia, Rio de Janeiro. In História Natural da Marambaia (L.F.T. Menezes, A.L. Peixoto & D.S. D. Araujo, eds.). Editora da Universidade Federal Rural do Rio de Janeiro, Seropédica, p.231-384.

GOMES, E.P.C.G., FISCH, S.T.V. & MANTOVANI, W. 2005. Estrutura e composição do componente arbóreo na Reserva Ecológica do Trabiju, Pindamonhangaba, SP, Brasil. Acta Bot. Bras. 19(5):451-464. http://dx.doi.org/10.1590/S0102-33062005000300005

GOMES, J.A.M.A., BERNACCI, L.C. & JOLY, C.A. 2011. Floristic and structural differences, between two altitudinal quotas, of the Submontane Atlantic Rainforest within the Serra do Mar State Park, municipality of Ubatuba/SP, Brazil. Biota Neotrop. 11(2): http://www.biotaneotropica.org.br/v11n2/en/abstract?article+bn0261102 (último acesso em 13/04/2012).

GOTELLI, N.J. & ELLISON, A.M. 2004. A primer of ecological statistics. Sinauer Press, Massachusetts.

GUEDES-BRUNI, R.R., PESSOA, S.V.A. & KURTZ, B.C. 1997. Florística e estrutura do componente arbustivo-arbóreo de um trecho preservado de floresta Montana na R. E. de Macaé de Cima. In Serra de Macaé de Cima: diversidade, florística e conservação em Mata Atlântica (H.C. Lima & R.R. Guedes-Bruni, eds.). Jardim Botânico do Rio de Janeiro, Rio de Janeiro, p.127-145.

GUEDES-BRUNI, R.R., SILVA NETO, S.J., MORIM, M.P. & MANTOVANI, W. 2006a. Composição florística e estrutura de trecho de Floresta Ombrófila Densa Atlântica Aluvial na Reserva Biológica de Poço das Antas, Silva Jardim, Rio de Janeiro, Brasil. Rodriguésia 57(3):413-428.

GUEDES-BRUNI, R.R., SILVA NETO, S.J., MORIM, M.P. & MANTOVANI, W. 2006b. Composição florística e estrutura de dossel em trecho de floresta ombrófila densa atlântica sobre morrote mamelonar na REBIO de Poço das Antas, Silva Jardim, Rio de Janeiro, Brasil. Rodriguésia 57(3):429-442.

GUERRA, A.T. & GUERRA, A.J.T. 1997. Novo Dicionário geológico-geomorfológico. 5. ed. Bertrand Brasil, Rio de Janeiro.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE – IUCN. 2010. IUCN Red List of Threatened Species - version 2010.4. http://www.iucnredlist.org/ (último acesso em 15/07/2011).

KURTZ, B.C. & ARAUJO, D.S.D. 2000. Composição florística e estrutura do componente arbóreo de um trecho de Mata Atlântica na Estação Ecológica Estadual do Paraíso, Cachoeiras de Macacu, Rio de Janeiro, Brasil. Rodriguésia 51(78/79):69-112.

MAMEDE, M.C.H., CORDEIRO, I., ROSSI, L., MELO M.M.R.F. & OLIVEIRA, R.J. 2004. Mata Atlântica. In Estação Ecológica Juréia-Itatins Ambiente Físico, Flora e Fauna (O.A.V. Marques & W. Duleba, eds). Editora Holos, São Paulo, p.115-132.

MATTOS, C.L.V. 2005. Caracterização Climática da Restinga da Marambaia. In História Natural da Marambaia (L.F.T. Menezes, A.L. Peixoto & D.S.D. Araujo, eds.). Editora da Universidade Federal Rural do Rio de Janeiro, Seropédica, p.55-66.

MCCUNE, B. & GRACE, J.B. 2002. Analysis of Ecological Communities. MjM Software Design, Oregon.

MENEZES, L.F.T., PEIXOTO, A.L. & ARAUJO, D.S.D. 2005. História Natural da Marambaia. Editora da Universidade Federal Rural do Rio de Janeiro, Seropédica.

MORENO, M.R., NASCIMENTO, M.T. & KURTZ, B.C. 2003. Estrutura e composição florística do estrato arbórea em duas matas altitudinais na mata atlântica de encosta da região do Imbé, RJ. Acta Bot. Bras. 17(3):371-386.

MURRAY-SMITH C., BRUMMITT N.A., OLIVEIRA-FILHO A.T., BACHMAN S., MOAT J., LUGHADHA E.M.N. & LUCAS E.J. 2009. Plant Diversity Hotspots in the Atlantic Coastal Forests of Brazil. Conserv. Bio. 23(1):151-163.

NETTESHEIM, F.C., MENEZES, L.F.T., CARVALHO, D.C., CONDE, M.M.S. & ARAUJO, D.S. 2010. Influence of environmental variation on Atlantic Forest tree-shrub-layer phytogeography in southeast Brazil. Acta Bot. Bras. 24(2):369-377. http://dx.doi.org/10.1590/S0102-33062010000200007

OLIVEIRA, R. DE J., MANTOVANI, W & MELO, M. M. R. F. 2001. Estrutura do componente arbustivo-arbóreo da floresta atlântica de encosta, Peruíbe, SP. Acta Bot. Bras. 15(3):391-412. http://dx.doi.org/10.1590/S0102-33062001000300009

OLIVEIRA, R.R., ZAÚ, A.S., LIMA, D.F., SILVA, M.B.R., VIANNA, M.C., SODRÉ, D.O. & SAMPAIO, P.D. 1995. Significado ecológico da orientação de encostas no maciço da Tijuca, Rio de Janeiro. Oecol. Bras. 1:523-541.

OLIVEIRA, R.R. 2002. Ação antrópica e resultantes sobre a estrutura e composição da Mata Atlântica na Ilha Grande, RJ. Rodriguésia 53(82):33-58.

OLIVEIRA-FILHO, A.T. & FONTES, M.A.L. 2000. Patterns of floristic diferentiation among Atlantic Forest in southeastern Brazil and the influence of climate. Biotropica 32(4b):793-810. http://dx.doi.org/10.1111/j.1744-7429.2000.tb00619.x

OLIVEIRA-FILHO, A.T., TAMEIRÃO-NETO, E., CARVALHO, W.A.C., WERNECK, M., BRINA, A.E., VIDAL, C.V., REZENDE, S.C. & PEREIRA, J.A.A. 2005. Análise florística do compartimento arbóreo de áreas de floresta atlântica *sensu lato* na região das bacias do leste. Rodriguésia 56(87):185-235.

PEIXOTO, A.L. & GENTRY, A. 1990. Diversidade e composição florística da mata de tabuleiro na Reserva Florestal de Linhares (Espírito Santo, Brasil). Rev. Bras. Bot. 13:19-25.

PEIXOTO, A.L., ROSA, M.M.T. DA, BARBOSA, M.R.V. & RODRIGUES, H.C. 1995. Composição florística da área em torno da represa de Ribeirão das Lajes, Rio de Janeiro, Brasil. Rev. Univ. Rural, Sér. Ciênc. vida 17:51-74.

PEIXOTO, G.L., MARTINS, S.V., SILVA, A.F. & SILVA, E. 2004. Composição florística do componente arbóreo de um trecho de Floresta Atlântica na Área de Proteção Ambiental da Serra da Capoeira Grande, Rio de Janeiro, RJ, Brasil. Acta Bot. Bras. 18(1):151-160. http://dx.doi.org/10.1590/S0102-33062004000100013

PEREIRA, L.A., XEREZ, R. & PEREIRA, A.M.C. 1990. Ilha da Marambaia (baia de Sepetiba, RJ): resumo fisiográfico, histórico e importância ecológica atual. Ciênc. Cult. 42:384-389.

PESSOA, V.A., GUEDES-BRUNI, R. & KURTZ, B.C. 1997. Florística e estrutura do componente arbustivo-arbóreo de um trecho preservado de floresta Montana na Reserva Ecológica de Macaé de Cima. In Serra de Macaé de Cima: diversidade, florística e conservação em Mata Atlântica (H.C. Lima & R.R. Guedes-Bruni, eds.). Instituto de Pesquisas Jardim Botânico do Rio de Janeiro, Rio de Janeiro, p.1147-1167.

PRIMACK, R.B. & RODRIGUES, E. 2001. Biologia da Conservação. Editora Planta, Londrina.

RAMBALDI, D.M., MAGNANI, A., ILHA, A., LARDOSA, E., FIGUEIREDO, P. & OLIVEIRA, R.F. 2003. A Reserva da Biosfera da Mata Atlântica no Estado do Rio de Janeiro. Instituto Florestal, São Paulo.

ROCHA, C.F.D., BERGALLO, H.G., VAN SLUYS, M. & ALVES, M.A.S. 2006. Biologia da Conservação: Essências. Editora Rima, São Carlos.

RODRIGUES, H.C. 1996. Composição florística e fitossociológica de um trecho de Mata Atlântica na Reserva Biológica do Tinguá, Nova Iguaçu, Rio de Janeiro. Dissertação de Mestrado, Universidade Federal Rural do Rio de Janeiro, Rio de Janeiro.

ROLIM, S.G., IVANAUSKAS, N.M., RODRIGUES, R.R., NASCIMENTO, M.T., GOMES, J.M.L., FOLLI, D.A. & COUTO, H.T.Z. 2006. Composição Florística do estrato arbóreo da Floresta Estacional Semidecidual na Planície Aluvial do rio Doce, Linhares, ES, Brasil. Acta Bot. Bras. 20(3):549-561. http://dx.doi.org/10.1590/S0102-33062006000300005

SANCHEZ, M., PEDRONI, F., LEITÃO-FILHO, H.F. & CÉSAR, O. 1999. Composição floristica de um trecho de floresta ripária na Mata Atlântica em Picinguaba, Ubatuba, SP. Rev. Bras. Bot. 22(1):31-42. http://dx.doi.org/10.1590/S0100-84041999000100006

SCARANO, F.R. 2002. Structure, Function and Floristic Relatioships of Plant Communities in Stressful Habitats Marginal to the Brazilian Atlantic Rainforest. Ann. Bot.-London 990:517-524.

SCUDELLER, V.V., MARTINS, F.R. & SHEPHERD, G.J. 2001. Distribution and abundance of arboreal species in the Atlantic ombrophilous dense forest in Southeastern Brazil. Plant Ecol. 152(1-2):185-199. http://dx.doi.org/10.1023/A:1011494228661

SILVA, A.F. & LEITÃO-FILHO, H.F. 1982. Composição florística e estrutura de um trecho de mata atlântica de encosta no município de Ubatuba (SP). Rev. Bras. Bot. 5(1):43-52.

SILVA, G.C. & NASCIMENTO M.T. 2001. Fitossociologia de um remanescente de mata sobre tabuleiros no norte do estado do Rio de Janeiro. Rev. Bras. Bot. 24(1):51-62.

SOUZA, C.R.G., SUGUIO, K., OLIVEIRA, A.M.S. & OLIVEIRA, P.E. 2005. Quaternário do Brasil. Editora Holos, Ribeirão Preto.

TONHASCA JUNIOR, A. 2005. Ecologia e História Natural da Mata Atlântica. Editora Interciência, Rio de Janeiro.

VELOSO, H.P., RANGEL FILHO, A.L.R. & LIMA, J.C.A. 1991. Classificação da vegetação Brasileira adaptada a um sistema universal. Instituto Brasileiro de Geografia e Estatística, Rio de Janeiro.

Received 14/11/2011
Revised 24/07/2012
Accepted 31/07/2012