Revista Brasil. Bot., V.33, n.4, p.639-651, out.-dec. 2010

Floristic composition and similarity analysis of an Atlantic rain forest fragment in Cananéia, São Paulo State, Brazil[1]

CATIA URBANETZ[2,4], JORGE YOSHIO TAMASHIRO[3] and LUIZA SUMIKO KINOSHITA[3]

(received: September 18, 2008; accepted: October 21, 2010)

ABSTRACT – (Floristic composition and similarity analysis of an Atlantic rain forest fragment in Cananéia, São Paulo State, Brazil). The aim of this study is to investigate the floristic composition of an Atlantic rain forest fragment located in Cananéia, São Paulo, Brazil, and to contribute to the knowledge on Atlantic forest through the comparative analysis of this and other floristic surveys both on the southern and southeastern Brazil, in different soil and relief types. We surveyed 215 species in 132 genera and 51 families. Classification and ordination analysis were applied to a binary matrix in order to analyze the similarity among 24 surveys, including the present one, of Atlantic forest from the south and southeast coast of Brazil. Higher floristic similarity was observed among this area and the ones where there was marine influence and more rugged relief. The surveys in areas with greater marine influence (sandy soil) were separated from those in other conditions, possibly indicating a species replacement gradient from the steep slopes towards the lowland and were probably related to different edaphic conditions. A latitudinal gradient was found among the surveys apparently confirming a continuous species replacement along the Atlantic forest, related to a restricted distribution of the species. This suggests that it is essential to preserve areas from the whole Atlantic coast. Atlantic forest distribution is quite complex and its composition cannot be adequately represented by small localized areas.

Key words - lowland rain forest, montane rain forest, shrubs, submontane rain forest, tree community

RESUMO – (Composição florística e análise de similaridade de um trecho de Floresta Ombrófila Densa Atlântica em Cananéia, São Paulo, Brasil). O presente trabalho teve como objetivo caracterizar a flora arbustiva e arbórea de um trecho de Floresta Ombrófila Densa Submontana localizado no Município de Cananéia, São Paulo, de modo a contribuir para o conhecimento da Mata Atlântica através de sua comparação com outros 23 inventários do Sul e Sudeste do Brasil. Foi encontrado um total de 215 espécies distribuídas em 132 gêneros e 51 famílias. Foram realizadas análises de classificação e ordenação aplicadas a uma matriz binária para avaliar a similaridade florística entre os levantamentos. Observou-se maior similaridade entre a área estudada e florestas com menor influência marinha e relevos mais acidentados. Os levantamentos de planície costeira realizados em áreas com influência marinha (solo arenoso) diferenciam-se daqueles feitos em locais com outras condições, indicando um possível gradiente de substituição de espécies da encosta para a planície, que pode estar relacionado com condições edáficas diferenciadas. Foi encontrado um gradiente latitudinal entre os levantamentos analisados, o que parece confirmar uma substituição contínua de espécies ao longo da Mata Atlântica, relacionada com uma distribuição restrita de espécies. Os resultados obtidos sugerem que é essencial a preservação de áreas ao longo de toda a distribuição da Mata Atlântica, uma vez que sua composição florística é bastante complexa e não pode ser adequadamente representada por pequenas áreas.

Palavras-chave - arbustos, comunidade arbórea, Floresta Ombrófila Densa de Terras Baixas, Floresta Ombrófila Densa Montana

Introduction

The Atlantic forest domain originally extended from the north to the south Brazilian coast with large extensions inland in the Southern and Southeastern regions (Joly *et al*. 1999, Rizzini 1997). In this domain different forest physiognomies are still present, occurring east of the dry corridor in northern Brazil, such as Dense Ombrophilous, Open Ombrophilous, Mixed Ombrophilous, Semideciduous and Deciduous Forests, mangroves, *restinga*, dunes vegetation, estuaries, lagoons and high altitude rocky fields (Joly *et al*. 1999).

This vegetation has suffered a drastic reduction by human action and only 11.4% to 16% of its area remains (Ribeiro *et al*. 2009) on the steep southern and southeastern slopes. It is considered as one of the biodiversity hotspots by The Conservation International (Myers *et al*. 2000).

The large continuous areas covered by Atlantic forest in São Paulo State, are concentrated in the southeastern region of Vale do Ribeira. Its relief, climate,

1. Part of the first author's MSc Dissertation, Programa de Pós-Graduação em Biologia Vegetal of Universidade Estadual de Campinas, Campinas, SP, Brazil.
2. Embrapa Pantanal, Rua 21 de setembro 1880, Caixa Postal 109, 79320-900 Corumbá, MS, Brazil.
3. Universidade Estadual de Campinas, Instituto de Biologia, Departamento de Biologia Vegetal, Caixa Postal 6109, 13083-970 Campinas, SP, Brazil.
4. Corresponding author: urbanetz@cpap.embrapa.br

soil and occupation process have kept it away from the development of the rest of the state, so the forest has been preserved. Several ecosystems of the Atlantic forest still remain in this site (São Paulo 1996).

In the present work we performed the floristic characterization of a fragment of submontane rain forest (Floresta Ombrófila Densa Submontana according to Veloso *et al*. 1992) localized in the Vale do Ribeira, on the continental part of Cananéia municipality, São Paulo State. This particular area is in a transitional zone of vegetation, relief and soil types. Our objective is to contribute to the knowledge of Atlantic rain forest through the comparative analysis of this and other floristic surveys on the southern and southeastern Brazil, on different soil and relief types. Therefore we aimed to answer the following questions:

1. How could the remnant be characterized? Is its woody flora closer to those which occur on the coastal plain and where there is more marine influence (sandy soil) or to those with less marine influence and more rugged relief (steep slope forests)? 2. Are the floristic samples in coastal areas of the Atlantic forest similar? Are there any obvious gradients or evidence of heterogeneities in this vegetation?

Material and methods

Study site – The floristic survey was carried out in a submontane rain forest remnant (Floresta Ombrófila Densa Submontana according to Veloso *et al*. 1992) with about 63 ha in a steep slope that belongs to Folha Larga farm, a private property where the main economic activity is fish farming. Folha Larga farm is located in the continental part of Cananéia municipality, route SP-226, km 31 (24°54' S; 47°56' W), on Vale do Rio Ribeira, southeast of São Paulo State. The area is in a transitional zone of relief, soil and vegetation types. About 1 km from the farm there is a continuous remnant of lowland rain forest (Floresta Ombrófila Densa de Terras Baixas according to Veloso *et al*. 1992) on sandy soil and plain relief. According to the farm owners, 40 years ago the lowest areas (altitude < 60 m) of the remnant were used as pasture. They were then abandoned and went through a natural regeneration process. The highest areas (between 60 and 157 m) did not suffer any severe interference because of their difficult access. The canopy is about 25 m, with emergent trees 35 m high. The altitude ranges from 30 to 157 m. The climate type is AF – tropical humid (Koeppen 1948). The climatic data (obtained from the owners) were: annual average temperature 23.4 °C, average temperature of the warmest month 30.6 °C, and the coldest 19.8 °C. The coldest temperature registered was 9.0 °C and the highest 37.0 °C. The annual precipitation was 1973.58 mm with a monthly average of 164.47 mm. The soil type is Alisol (Embrapa 2006).

Data collection – Trees and shrubs were collected for the floristic survey through assystematic sampling along existing trails (May-2003 to June-2004). Only individuals higher than 1.5 m and/or with the first branch higher than 0.5 m were considered as trees, and as shrubs those that were equal or lower than 1.5 m and/or with the first branch equal or lower than 0.5 m. The vouchers were prepared by usual methods of plant taxonomy and incorporated to UEC herbarium of Universidade Estadual de Campinas.

Analysis of data – The tree flora of this survey was compared with other 23 in Paraná, São Paulo and Rio de Janeiro States (figure 1). Surveys that fulfilled the following criteria were compared: tree surveys located in coastal plains, *tabuleiros*, low hills or steep slopes areas in both south and southeast Brazil. At least 80% of the taxa sampled should be identified at the species level. Only the binomials identified to species and updated according to recent revisions such as Wanderley *et al*. (2002, 2003, 2005, 2007, 2009), Pennington (1990, 1997), Martins *et al*. (1996) were considered. The names of the families and species from this survey and other samples

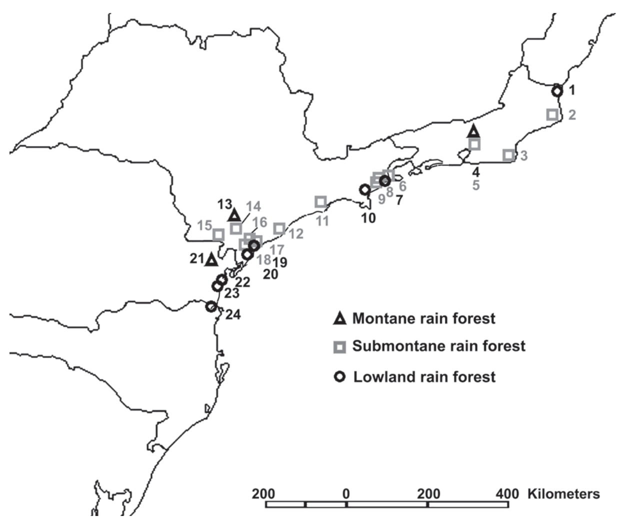

Figure 1. Localization map of the Atlantic Rain forest surveys compared with the present survey. (1 ○ = Mata do Carvão-RJ (MCa), 2 □ = Imbé-RJ (Imb), 3 □ = Macacu-RJ (Mac), 4 △ = Tinguá-RJ (Tin), 5 □ = Capoeira Grande-RJ (CGr), 6 □ = Picinguaba2-SP (Pic2), 7 ○ = Picinguaba1-SP (Pic1), 8 □ = Picinguaba3-SP (Pic3), 9 □ = Ubatuba-SP (Uba), 10 ○ = Caraguatatuba-SP (Car), 11 □ = Cubatão-SP (Cub), 12 = Juréia-SP (Jur), 13 △ = Parque Estadual de Carlos Botelho1-SP (CBo1), 14 □ = Parque Estadual de Carlos Botelho2-SP (CBo2), 15 □ = PETAR-SP (PET), 16 □ = Pariquera-Açu-SP (PAç), 17 □ = Campina do Encantado-SP (CEn), 18 □ = Folha Larga-SP (FLa; this survey), 19 ○ = Ilha do Cardoso 1-SP (ICa1), 20 ○ = Ilha do Cardoso2-SP (ICa2), 21 △ = Morretes-PR (Mor), 22 ○ = Paranaguá-PR (Par), 23 ○ = Ilha do Mel-PR (IMe), 24 ○ = Volta Velha-SC (VVe)). The localities codes are in tables 2 and 3. (RJ = Rio de Janeiro State; SP = São Paulo State; PR = Paraná State; SC = Santa Catarina State).

were standardized according to APG II (APG 2003), Plant Names Project (2004) and Solomon (2004), and the authors' names according to Brummit & Powell (1992).

Classification (cluster) and ordination analyses were applied to a matrix of binary data. Cluster was based on Jaccard (J_c) index (Mueller-Dombois & Ellenberg 1974), with arithmetic average (UPGMA), single and complete linkage as clustering methods, to verify the similarity and find possible heterogeneities among the surveys. A Correspondence Analysis (CA, Benzecri 1992) was also performed to detect floristic patterns or gradients and a Detrended Correspondence Analysis (Hill & Gaugh 1980) in the eventual presence of an arch effect of CA. All analyses were performed using FITOPAC2.1 program (Shepherd & Urbanetz 2010).

Results and discussion

Floristic survey – A total of 215 species were found in 132 genera and 51 families, of which seven were palms, 31 shrubs and 177 trees (table 1). Six morphospecies were registered only at genus level (3% of the surveyed species).

Table 1. Families and species surveyed in the Atlantic Rain forest fragment located in Folha Larga farm, Cananéia, SP (HIN = UEC herbarium identity number; N.C.F. = not collected fertile).

Family/Specie	Habit	HIN
ANNONACEAE		
Guatteria australis A. St.-Hil.	Tree	133.508
Rollinia sericea (R. E. Fr.) R. E. Fr.	Tree	132.878
Xylopia brasiliensis Spreng.	Tree	132.874
Xylopia langsdorffiana Spreng.	Tree	N.C.F.
APOCYNACEAE		
Aspidosperma olivaceum Müll. Arg.	Tree	133.534
Malouetia arborea (Vell.) Miers	Tree	132.839
AQUIFOLIACEAE		
Ilex amara (Vell.) Loes.	Tree	133.710
Ilex theezans Mart.	Tree	132.849
ARALIACEAE		
Dendropanax monogynum Seem.	Tree	133.510
Schefflera angustissima (Marchal) Frodin	Tree	–
ARECACEAE		
Astrocaryum aculeatissimum (Schott) Burret	Palm	–
Attalea dubia (Mart.) Burret	Palm	N.C.F
Bactris hatchsbachii Noblick ex A. J. Hend.	Palm	–
Bactris setosa Mart.	Palm	N.C.F
Euterpe edulis Mart.	Palm	N.C.F

continue

continuation

Family/Specie	Habit	HIN
Geonoma gamiova Barb. Rodr.	Palm	–
Syagrus romanzoffiana (Cham.) Glassman	Palm	N.C.F
ASTERACEAE		
Baccharis semiserrata DC.	Tree	133.362
Baccharis singularis (Vell.) G. M. Barroso	Shrub	133.363
Pitocarpha macropoda (DC.) Baker	Tree	132.877
Vernonia argyrotrichia Sch. Bip. ex Baker	Shrub	–
Vernonia beyrichii Less.	Shrub	–
Vernonia petiolaris DC.	Tree	132.886
Vernonia puberula Less.	Shrub	133.368
Vernonia rubriramea Mart. ex DC.	Shrub	–
Vernonia scorpioides (Lam.) Pers.	Shrub	133.367
BIGNONIACEAE		
Jacaranda puberula Cham.	Tree	132.842
Tabebuia umbellata (Sond.) Sandwith	Tree	133.529
BORAGINACEAE		
Cordia magnoliifolia Cham.	Tree	–
Cordia sellowiana Cham.	Tree	132.867
BURSERACEAE		
Protium heptaphyllum (Aubl.) Marchand	Tree	132.888
CELASTRACEAE		
Maytenus schumanniana Loes.	Tree	133.925
CHRYSOBALANACEAE		
Hirtella hebeclada Moric. ex DC.	Tree	133.541
Licania octandra (Hoffmanns. ex Roem. & Schult.) Kuntze	Tree	132.866
Parinari excelsa Sabine	Tree	133.557
CLETHRACEAE		
Clethra scabra Pers.	Tree	–
CLUSIACEAE		
Calophyllum brasiliense Cambess.	Tree	N.C.F
Clusia criuva Cambess.	Tree	132.887
Garcinia gardneriana (Planch. & Triana) Zappi	Tree	133.525
CUNONIACEAE		
Weinmannia paulliniifolia Pohl ex Ser.	Tree	–
ELAEOCARPACEAE		
Sloanea guianensis (Aubl.) Benth.	Tree	132.889
ERYTHROXYLACEAE		
Erythroxylum cuspidifolium Mart.	Tree	133.540
EUPHORBIACEAE		
Actinostemon concolor (Spreng.) Müll. Arg	Tree	133.905
Alchornea glandulosa Poepp.	Tree	132.829

continue

continuation

Family/Specie	Habit	HIN
Alchornea triplinervia (Spreng.) Müll. Arg.	Tree	132.838
Aparisthmium cordatum (A. Juss.) Baill.	Tree	133.547
Maprounea guianensis Aubl.	Tree	133.499
Pera glabrata (Schott) Poepp. ex Baill.	Tree	133.530
Tetrorchidium rubrivenium Poepp.	Tree	132.879
FABACEAE		
Andira fraxinifolia Benth.	Tree	133.522
Balizia pedicellaris (DC.) Barneby & J. W. Grimes	Tree	N.C.F
Centrolobium tomentosum Guill. ex Benth.	Tree	–
Copaifera trapezifolia Hayne	Tree	N.C.F
Dahlstedtia pinnata (Benth.) Malme	Tree	133.527
Hymenaea courbaril L.	Tree	–
Inga bullata Benth.	Tree	132.883
Inga edulis Mart.	Tree	132.832
Inga lanceifolia Benth.	Tree	133.482
Inga sessilis (Vell.) Mart.	Tree	132.834
Inga striata Benth.	Tree	–
Inga vera Willd.	Tree	133.484
Ormosia arborea Harms	Tree	132.880
Pterocarpus rohrii Vahl	Tree	132.884
Schizolobium parahyba (Vell.) S. F. Blake	Tree	133.713
Sclerolobium denudatum Vogel	Tree	133.936
Senna multijuga (Rich.) H. S. Irwin & Barneby	Tree	133.514
Senna silvestris (Vell.) H. S. Irwin & Barneby	Tree	–
Swartzia submarginata (Benth.)	Tree	–
Mansano	Tree	N.C.F
Tachigali paratyensis (Vell.) H. C. Lima		
Zollernia ilicifolia (Brogn.) Vogel	Tree	N.C.F
HUMIRIACEAE		
Vantanea compacta (Schnizl.) Cuatrec.	Tree	–
LACISTEMATACEAE		
Lacistema lucidum Schnizl.	Tree	133.903
LAMIACEAE		
Vitex polygama Cham.	Tree	133.494
LAURACEAE		
Aniba firmula (Nees & Mart.) Mez	Tree	133.512
Aniba viridis Mez	Tree	N.C.F
Cryptocarya saligna Mez	Tree	133.707
Endlicheria paniculata (Spreng.) J. F. Macbr	Tree	N.C.F
Licaria armeniaca (Nees) Kosterm.	Tree	133.543
Nectandra aff. nitidula Nees	Tree	N.C.F
Nectandra oppositifolia Nees & Mart.	Tree	133.898
Ocotea aciphylla (Nees) Mez	Tree	–
Ocotea brachybotra Mez	Tree	N.C.F
Ocotea daphnifolia (Meisn.) Mez	Tree	133.706
Ocotea diospyrifolia (Meisn.) Mez	Tree	133.372
Ocotea dispersa Mez	Tree	N.C.F
Ocotea elegans Mez	Tree	N.C.F
Ocotea nectandrifolia Mez	Tree	133.371
Ocotea silvestris Vattimo-Gil	Tree	132.830
Ocotea venulosa (Ness) Baitello	Tree	N.C.F
Rhodostemonodaphne macrocalyx (Meisn.) Rohwer ex Madriñán	Tree	133.370
LECYTHIDACEAE		
Cariniana estrellensis (Raddi) Kuntze	Tree	N.C.F
MALPIGHIACEAE		
Byrsonima ligustrifolia A. Juss.	Tree	132.892
MALVACEAE		
Pseudobombax grandiflorum (Cav.) A. Robyns	Tree	–
MELASTOMATACEAE		
Leandra australis Cogn.	Shrub	–
Leandra melastomoides Raddi	Shrub	133.477
Leandra scabra DC.	Shrub	–
Leandra cf. *dasytricha* (A. Gray) Cogn.	Tree	–
Leandra cf. *dubia* DC.	Shrub	133.361
Leandra cf. *nianga* Cogn.	Shrub	–
Miconia cabucu Hoehne	Tree	–
Miconia cinerascens Miq.	Tree	–
Miconia cinnamomifolia (DC.) Naudin	Tree	133.476
Miconia cubatanensis Hoehne	Tree	–
Miconia dodecandra Cogn.	Tree	–
Miconia hymenonervia (Raddi) Cogn.	Tree	–
Miconia rigidiuscula Cogn.	Tree	–
Miconia saldanhaei Cogn.	Shrub	133.475
Ossaea brachystachya Triana	Shrub	133.478
Tibouchina arborea Cogn.	Tree	–
Tibouchina mutabilis Cogn.	Tree	–
Tibouchina weddelii Cogn.	Tree	–
MELIACEAE		
Cabralea canjerana (Vell.) Mart.	Tree	132.873
Cedrela fissilis Vell.	Tree	133.552
Guarea macrophylla Vahl	Tree	132.831

continue

continuation

Family/Specie	Habit	HIN
MONIMIACEAE		
Mollinedia schottiana (Spreng.) Perkins	Shrub	133.496
Mollinedia boracensis Peixoto	Shrub	132.841
MORACEAE		
Brosimum glaziovii Taub.	Tree	–
Brosimum guianensis (Aubl.) Huber	Tree	–
Ficus pulchella Schott ex Spreng.	Tree	133.373
Sorocea bonplandii Baill.	Tree	N.C.F
MYRISTICACEAE		
Virola bicuhyba (Schott ex Spreng.) Warb.	Tree	132.868
Virola gardneri (A. DC.) Warb.	Tree	133.941
MYRSINACEAE		
Ardisia guianensis (Aubl.) Mez	Tree	133.532
Myrsine ferruginea (Ruiz & Pav.) Spreng.	Tree	133.708
Myrsine guianensis (Aubl.) Kuntze	Tree	132.847
MYRTACEAE		
Blepharocalyx salicifolius (Kunth) O. Berg.	Shrub	133.516
Calyptranthes fusiformis M. L. Kawas.	Tree	133.723
Calyptranthes grandifolia O. Berg	Tree	133.722
Calyptranthes lucida Mart. ex DC.	Tree	133.517
Calyptranthes strigipes O. Berg	Tree	–
Campomanesia guaviroba (DC.) Kiaersk.	Tree	133.725
Eugenia acutata Miq.	Tree	133.731
Eugenia bocainensis Mattos	Shrub	133.726
Eugenia brasiliensis Lam.	Tree	133.963
Eugenia copacabanensis Kiaersk.	Tree	133.962
Eugenia cuprea Nied.	Shrub	133.486
Eugenia melanogyna (D. Legrand) Sobral	Tree	133.729
Eugenia mosenii (Kausel) Sobral	Tree	133.732
Eugenia multicostata D. Legrand	Tree	133.727
Eugenia neoaustralis Sobral	Tree	–
Eugenia umbelliflora O. Berg	Tree	–
Gomidesia flagellaris D. Legrand	Tree	133.716
Gomidesia schaueriana O. Berg	Tree	133.720
Gomidesia spectabilis (DC.) O. Berg	Tree	–
Gomidesia tijucensis (Kiaersk.) D. Legrand	Tree	–
Marlierea eugeniopsoides (D. Legrand & Kausel) D. Legrand	Tree	133.956
Marlierea tomentosa Cambess.	Tree	133.721
Myrcia heringii D. Legrand	Shrub	–
Myrcia multiflora (Lam.) DC.	Tree	133.966

continue

continuation

Family/Specie	Habit	HIN
Myrcia pubipetala Miq.	Tree	133.969
Myrcia splendens (Sw.) DC.	Tree	132.855
Myrcia cf. *isaiana* G. M. Barroso & Peixoto	Shrub	132.882
Myrcia stictophylla (O. Berg) N. J. E. Silveira	Tree	133.968
Psidium cattleianum Sabine	Tree	133.728
NYCTAGINACEAE		
Guapira opposita (Vell.) Reitz	Tree	133.498
Neea schwackeana Heimerl	Shrub	133.535
OCHNACEAE		
Ouratea parviflora (DC.) Baill.	Tree	133.938
OLACACEAE		
Heisteria silvianii Schwacke	Tree	132.871
Tetrastylidium grandifolium (Baill.) Sleumer	Tree	133.553
PHYLLANTHACEAE		
Hyeronima alchorneoides Allemão	Tree	133.536
Richeria grandis Vahl	Tree	132.863
PIPERACEAE		
Ottonia martiana Miq.	Shrub	133.554
Piper cernuum Vell.	Shrub	133.944
Piper aduncum L.	Shrub	133.953
POLYGONACEAE		
Coccoloba mosenii Lindau	Tree	132.852
Coccoloba sp.	Tree	N.C.F
QUIINACEAE		
Quiina glaziovii Engl.	Tree	N.C.F
ROSACEAE		
Prunus myrtifolia (L.) Urb.	Tree	132.885
RUBIACEAE		
Amaioua intermedia Mart.	Tree	N.C.F
Bathysa australis K. Schum.	Tree	N.C.F
Chomelia catharinae (L. B. Sm. & Downs) Steyerm.	Shrub	133.524
Faramea montevidensis (Cham. & Schltdl.) DC.	Tree	133.358
Faramea multiflora A. Rich. ex DC.	Tree	133.380
Ixora heterodoxa Müll. Arg.	Tree	133.523
Posoqueria latifolia (Rudge) Roem. & Schult.	Tree	133.489
Psychotria birotula L. B. Sm. & Downs	Shrub	133.378
Psychotria carthargenensis Jacq.	Tree	–
Psychotria gracilenta Müll. Arg.	Shrub	–
Psychotria hoffmannseggiana Müll. Arg.	Shrub	132.860
Psychotria laciniata Vell.	Tree	133.558
Psychotria leiocarpa Cham. & Schltdl.	Tree	133.375
Psychotria mapourioides DC.	Tree	132.891

continue

continuation

Family/Specie	Habit	HIN
Psychotria nuda (Cham. & Schltdl.) Wawra	Tree/Shrub	–
Rudgea recurva Müll. Arg.	Tree	133.383
RUTACEAE		
Esenbeckia grandiflora Mart.	Tree	132.869
Zanthoxylum rhoifolium Lam.	Tree	133.561
SALICACEAE		
Casearia obliqua Spreng.	Tree	N.C.F
Casearia sylvestris Sw.	Tree	133.715
SAPINDACEAE		
Cupania oblongifolia Camb.	Tree	133.902
Matayba guyanensis Aubl.	Tree	–
Matayba intermedia Radlk.	Tree	133.556
Matayba sp.	Tree	N.C.F
SAPOTACEAE		
Chrysophyllum flexuosum Mart.	Tree	133.354
Diploon cuspidatum (Hoehne) Cronquist	Tree	133.497
Ecclinusa ramiflora Mart.	Tree	133.493
Manilkara subsericea (Mart.) Dubard	Tree	–
Pouteria beaurepairei (Glaz. & Raunk.) Baehni	Tree	–
Pouteria caimito Radlk.	Tree	–
Pradosia lactescens (Vell.) Radlk.	Tree	–
SOLANACEAE		
Brunfelsia pauciflora (Cham. & Schltdl.) Benth.	Shrub	133.342
Cestrum sessiliflorum Schott ex Sendt	Shrub	133.531
Solanum pseudo-quina A. St.-Hil.	Tree	133.555
Solanum undulatum Dunal	Shrub	132.837
Solanum swartzianum Roem. & Schultz	Tree	133.488
SYMPLOCACEAE		
Symplocos laxiflora Benth.	Tree	133.520
Symplocos variabilis Mart. ex Miq.	Tree	132.890
THYMELAEACEAE		
Daphnopsis schwackeana Taub.	Shrub	132.850
URTICACEAE		
Cecropia glaziovi Snethl.	Tree	–
Cecropia pachystachia Trécul	Tree	–
Coussapoa microcarpa (Schott.) Rizzini	Tree	132.864
Pourouma guyanensis Aubl.	Tree	133.932
VERBENACEAE		
Aegiphila sellowiana Cham.	Tree	N.C.F
Citharexylum myrianthum Cham.	Tree	133.500
VOCHYSIACEAE		
Callisthene kuhlmmanii H. F. Martins	Tree	133.940
Vochysia bifalcata Warm.	Tree	133.943

The richest families were Myrtaceae (28 species), Fabaceae (21), Melastomataceae (18), Lauraceae (17), Rubiaceae (16), Asteraceae (9), Arecaceae (7), Euphorbiaceae (7), Sapotaceae (7), and Solanaceae (5) (63% of total number of species). The other families presented from four to one species.

Those 10 families were among the richest ones on woody floras of 102 Atlantic rain forest surveys of southeast Brazil analyzed by Oliveira Filho & Fontes (2000). Asteraceae was among the richest families in high altitudes according to these authors, but six of the Asteraceae species found in Folha Larga farm were shrubs, that highlights the importance of collecting plants of other habits besides trees in a forest thus improving the characterization of a site.

The richest genera were *Eugenia* (10 species), *Ocotea* (9), *Miconia* and *Psychotria* (8), *Myrcia* (6), *Inga*, *Leandra*, and *Vernonia* (6).

Similarity analysis – The list of the samples analyzed, codes of the samples, references, localities, sample methods, habits, inclusion criteria and vegetation types (according to Veloso *et al*. 1992) are shown in table 2. The localization map of the surveys is shown in figure 1. Table 3 presents the environmental characteristics of those surveys. Geographic coordinates were obtained from the corresponding municipality where not provided by the authors. A presence/absence matrix was obtained from 24 samples (including the present survey) with 915 binomials, of which 458 were not taken into account because they were present in only one survey.

More than 95% of the obtained Jaccard's indexes ware $J_c < 0.3$ which indicates a high floristic heterogeneity among the localities. According to this index, the study area FLa (Folha Larga-SP) presents more floristic similarity to PAç (Pariquera-Açu-SP; $J_c = 0.42$), Jur (Juréia-SP; $J_c = 0.37$), VVe (Volta Velha-SC; $J_c = 0.31$), CBo1 (Carlos Botelho 1-SP) and Cub (Cubatão-SP; $J_c = 0.26$), ICa2 (Ilha do Cardoso-SP) and CEn (Campina do Encantado-SP; $J_c = 0.25$).

The lowland samples (Floresta Ombrófila Densa de Terras Baixas according to Veloso *et al*. 1992) of São Paulo and Paraná: Car (Caraguatatuba), ICa1 and ICa2 (Ilha do Cardoso), Pic1 (Picinguaba), IMe (Ilha do Mel), Par (Paranaguá) formed a group in all dendrograms, isolated from those in the steep slopes and low hills (group 2 – figure 2). The survey VVe (coastal plain of Santa Catarina) occupied an intermediate position, near the steep slopes samples in the complete match and in the UPGMA dendrogram (figure 2) and near the lowland surveys in the simple match, which indicate it could bear

Table 2. Analyzed surveys comparing floristic studies of Atlantic forest areas of South and Southeast Brazil. (PR = Paraná State; RJ = Rio de Janeiro State; SC = Santa Catarina State; SP = São Paulo State; LRF = lowland rain forest (Floresta Ombrófila Densa de Terras Baixas); MRF = montane rain forest (Floresta Ombrófila Densa Montana); SRF = submontane rain forest (Floresta Ombrófila Densa Submontana); H = habit; a = trees; b = trees and shrubs; c = trees, shrubs, herbs, lianas and epiphytes; M = survey method; as = assistematic; p = plots; q = quadrates; t = transect. DAP = diameter at breast height; PAP = perimeter at breast height. A/Np = surveyed area or number of points; NS = number of species surveyed; NF = number of families surveyed).

Code	State, municipality, locality	Geograhic coordinate	Vegetation type	H	M	Inclusion criteria	A (ha)/Np	NS	NF	References
Car	SP, Caraguatatuba	23°37' S; 45°24' W	LRF	c	–	DAP 10	–	147	53	Mantovani (1992)
CBo1	SP, Carlos Botelho State Park	24°08' S; 48°02' W	MRF	a	–	–	–	176	51	Custodio Filho *et al*. (1992)
CBo2	SP, Carlos Botelho State Park	24°13' S; 47°96' W	SRF	a	p	DAP 4,8	10,24	200	51	Rodrigues (2006)
CEn	SP, Pariquera-Açu, Campina do Encantado State Park	24°40' S; 47°48' W	SRF	a	p	DAP 4,8	0,54	112	40	Sztutman & Rodrigues (2002)
CGr	RJ, Rio de Janeiro, Serra Capoeira Grande Environmental Protection Area	22°59' S; 43°38' W	SRF	a	q	PAP 15	200	68	29	Peixoto *et al*. (2004)
Cub	SP, Cubatão, Vale do rio Pilões	23°53' S; 46°25' W	SRF	a	p	PAP 20	0,4	145	42	Leitão Filho (1993)
FLa	SP, Cananéia, Folha Larga farm	24°54' S; 47°56' W	SRF	b	as	–	63	188	47	the present survey
ICa1	SP, Cananéia, Ilha do Cardoso	25°18' S; 47°53' W	LRF	a	p	DAP 2,5	0,37	64	25	Sugiyama (1998)
ICa2	SP, Cananéia, Ilha do Cardoso	25°18' S; 47°53' W	LRF	a	p	DAP 4,8	10,24	117	41	Sampaio *et al*. (2005)
Imb	RJ, Campo dos Goytacazes, Imbé	21°48' S; 41°40' W	SRF	a	p	DAP 10	1,2	210	43	Moreno *et al*. (2003)
IMe	PR, Paranaguá, Ilha do Mel	25°53' S; 48°34' W	LRF	c	p	DAP 5	–	127	55	Silva (1990)
Jur	SP, Iguape, Juréia-Itatins Ecological Station	24°32' S; 47°30' W	SRF	c	as	–	–	630	84	Mamede *et al*. (2004)
Mac	RJ, Cachoeiras de Macacu, Paraíso Ecological Station	22°31' S; 42°56' W	SRF	a	q	DAP 5		138	42	Kurtz & Araújo (2000)
MCa	RJ, São Francisco do Itabapoana, Mata do Carvão Ecological Station	21°24' S; 41°04' W	LRF	a	p	DAP 10	1	84	34	Silva & Nascimento (2001)
Mor	PR, Morretes, Marumbi State Park	25°30' S; 48°38' W	MRF	a	q	DAP 4,8	80	70	31	Silva (1994)
PAç	SP, Pariquera-Açu, Pariquera-Açu	24°40' S, 47°53' W	SRF	c	p	PAP 15	1,2	484	104	Ivanauskas *et al*. (2001)
Par	PR, Paranaguá, Palmito State Park	25°35' S; 48°32' W	LRF	a	p	DAP 5	0,3	37	21	Rotta *et al*. (1992)
PET	SP, Iporanga, P.E.T.A.R. State Park	24°31' S; 48°41' W	SRF	a	t	PAP 15	0,1	87	34	Aidar *et al*. (2001)
Pic1	SP, Ubatuba, Picinguaba	23°22' S; 44°48' W	LRF	a	p	PAP 15	0,52	74	29	Cesar & Monteiro (1995)
Pic2	SP, Ubatuba, Picinguaba	23°35' S; 44°83' W	SRF	a	p	DAP 5	1	51	25	Assis (1999)
Pic3	SP, Ubatuba, Picinguaba	23°22' S; 44°48' W	SRF	a	p	PAP 20	0,4	120	37	Sanchez *et al*. (1999)
Tin	RJ, Nova Iguaçu, Tinguá Nature Reserve	22°39' S; 43°34' W	MRF	a	a	–	–	109	35	Braz *et al*. (2004)
Uba	SP, Ubatuba	23°27' S; 45°04' W	SRF	a	q	DAP 10	160	123	41	Silva & Leitão Filho (1982)
VVe	SC, Itapoá, Volta Velha	26°04' S; 48°38' W	LRF	c	q	DAP 5, DAP 8, DAP 10	1	398	99	Negrelle (2002)

Table 3. Analyzed surveys comparing floristic studies of Atlantic forest areas of south and southeast Brazil and their environmental characteristics. (PR = Paraná State; RJ = Rio de Janeiro State; SC = Santa Catarina State; SP = São Paulo State. Relief: LH = low hill; Pl = coastal plain; SS=steep slopes; T = *tabuleiros*. Soil type (Embrapa 2006): C= calcareous soil; Ca = cambisol; La = latosol *amarelo*; Lv= latosol *vermelho-amarelo*; Lva = latosol *vermelho-amarelo álico;* N = neosol; Pa = argisol; Pva= alisol; S = spodosol; SH = spodosol hydromorphic. AAT = annual average temperature. AAP = annual average precipitation).

Code	State, municipality, locality	Relief	Soil type	Altitude (m)	AAT (°C)	AAP (mm)	References
Car	SP, Caraguatatuba	Pl	N	5-7	–	1700	Mantovani (1992)
CBo1	SP, Carlos Botelho State Park	SS	Pva/Lv/Lva/N	30-1003	–	2028	Custodio Filho *et al*. (1992)
CBo2	SP, Carlos Botelho State Park	SS	–	–	–	–	Rodrigues (2006)
CEn	SP, Pariquera-Açu, Campina do Encantado State Park	LH	Pva	18	20,9	1688	Sztutman & Rodrigues (2002)
CGr	RJ, Rio de Janeiro, Serra Capoeira Grande Environmental Protection Area	Pl	–	60 – 150	23,6	1027	Peixoto *et al*. (2004)
Cub	SP, Cubatão, Pilões river valley	SS	–	50-140	23	2767	Leitão Filho (1993)
FLa	SP, Cananéia, Folha Larga farm	SS	Pva	30-157	20,9	1974	the present survey
ICa1	SP, Cananéia, Ilha do Cardoso	Pl	N	–	20,9	–	Sugiyama (1998)
ICa2	SP, Cananéia, Ilha do Cardoso	Pl	N	–	–	–	Sampaio *et al*. (2005)
Imb	RJ, Campo dos Goytacazes, Imbé	SS	–	50/250	19,0/17,0-25,0	1300	Moreno *et al*. (2003)
IMe	PR, Paranaguá, Ilha do Mel	Pl	SH	75	21,09	1959	Silva (1990)
Jur	SP, Iguape, Juréia-Itatins Ecological Station	SS	–	5-300	21,4	2278	Mamede *et al*. (2004)
Mac	RJ, Cachoeiras de Macacu, Paraíso Ecological Station	SS	Ca	200	23	2558	Kurtz & Araújo (2000)
MCa	RJ, São Francisco do Itabapoana, Mata do Carvão Ecological Station	T	Pa	–	–	1084	Silva & Nascimento (2001)
Mor	PR, Morretes, Marumbi State Park	SS	–	485	20,5	1887	Silva (1994)
PAç	SP, Pariquera-Açu, Pariquera-Açu	LH	La/Pa	30-40	20,9	1521	Ivanauskas *et al*. (2001)
Par	PR, Paranaguá, Palmito State Park	Pl	SH	–	21,9	1950	Rotta *et al*. (1992)
PET	SP, Iporanga, Alto do Ribeira State Park	SS	C	500-600	17,0-19,0	1800	Aidar *et al*. (2001)
Pic1	SP, Ubatuba, Picinguaba	Pl	N	–	21,2	2624	Cesar & Monteiro (1995)
Pic2	SP, Ubatuba, Picinguaba	LH	–	25	19	–	Assis (1999)
Pic3	SP, Ubatuba, Picinguaba	SS	N/S/Ca	100	21,9	2624	Sanchez *et al*. (1999)
Tin	RJ, Nova Iguaçu, Tinguá Nature Reserve	SS	–	150-900	22,3	2099	Braz *et al*. (2004)
Uba	SP, Ubatuba, Ubatuba	SS	N/Ca/Pa	160-190	–	–	Silva & Leitão Filho (1982)
VVe	SC, Itapoá, Volta Velha	Pl	S/N	9	20,3	2170	Negrelle (2002)

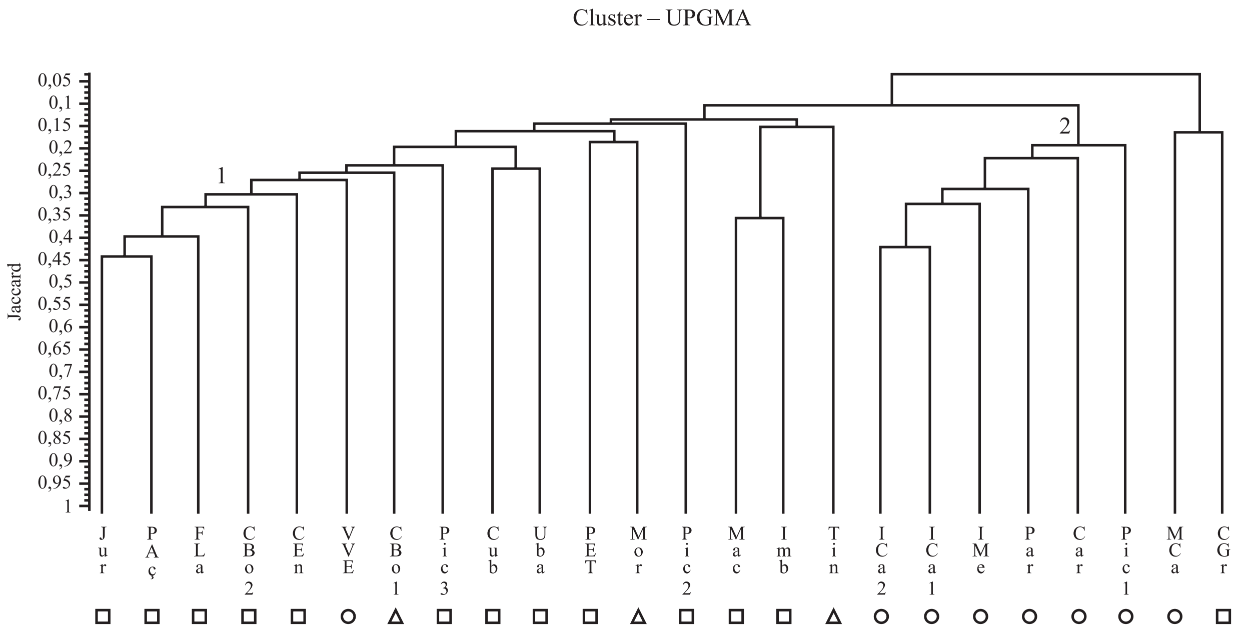

Figure 2. Cluster analysis by Jaccard index and UPGMA group linkage method applied to a binary matrix of tree species surveyed in 24 analyzed areas of Atlantic Rain forest (cofenetic correlation = 0,87). (△ = montane rain forest, □ = submontane rain forest, ○ = lowland rain forest). The localities codes are in figure 1 and tables 2 and 3.

a transitional flora. Only the UPGMA dendrogram are presented since it better represented the floristic patterns found in all the analyses.

The samples Jur (Juréia), PAç (Pariquera-Açu), FLa (Folha Larga), CBo2 (Carlos Botelho 2) and CEn (Campina do Encantado) (group 1 – figure 2) and MCa (Mata do Carvão) and CGr (Capoeira Grande) formed two isolated groups in all dendrograms. The other surveys did not form any floristic pattern, varying their position according to the clustering method applied. In MCa (Mata do Carvão-RJ) the climate could be a determining factor in the differentiation of its flora because this sample was situated in a *tabuleiros* area (coastal table land with low altitude) with seasonal climate, and comparatively low annual average precipitation (1,084 mm). This climatic characteristic is due to the relief in the north of Rio de Janeiro where the mountain chains reach the seacoast, so the rainfall changes in this direction. The CGr (Capoeira Grande) area was surveyed in a coastal plain area with low altitude (60-150 m) and comparatively low annual average precipitation (1,027 mm).

In all dendrograms, the survey Pic2 (Picinguaba-SP) is more similar to the steep slopes samples of São Paulo and Rio de Janeiro States than to the lowland adjacent sample Pic1 (Picinguaba-SP). That might be explained by the fact that Pic2 sample was located in a low isolated hill, probably with low marine influence on the soil, different from Pic1 in a sandy soil.

An arch was formed in Correspondence Analysis (CA, figure 3), indicating an unimodal distribution of species along an existing gradient. However, all the lowland areas appeared in an extremity of the arch (figure 3), with the samples of Rio de Janeiro State in the opposite end.

Since an arch was found in CA, Detrended Correspondence Analysis (DCA) was performed to

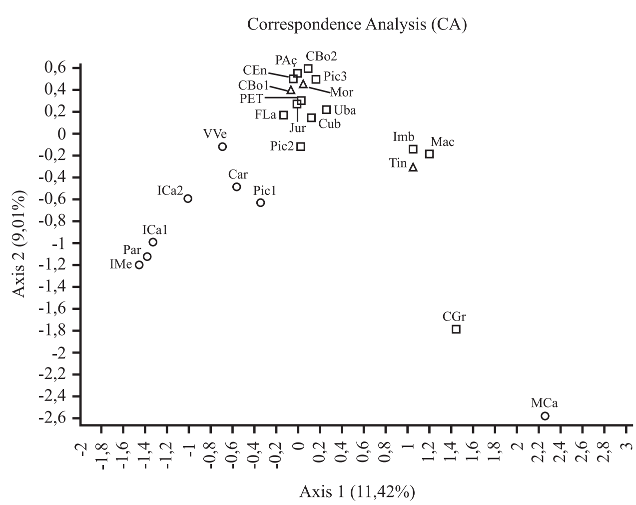

Figure 3. Axis 1 and 2 of Correspondence Analysis (CA) from a binary matrix of tree species surveyed in 24 analyzed areas of Atlantic Rain forest. (△ = montane rain forest, □ = submontane rain forest, ○ = lowland rain forest). The localities codes are in figure 1 and tables 2 and 3.

correct this effect. The lowland rain forest samples are separated from submontane and montane rain forest on the left of the first axis of DCA (figure 4), not in a isolated floristic block but in a gradient. A latitudinal gradient could be noted also in the axis 1. The surveys of Rio de Janeiro State are on the right position in axis 1 and the steep slopes and low hills samples of São Paulo together with the sample Mor (Morretes-PR) are in the middle (figure 4). The survey Pic2 (Picinguaba-SP, coastal plain) is closer to the steep slopes samples than to the adjacent lowland sample Pic1 (Picinguaba-SP) which also confirms the results of cluster analysis.

According to all analyses, the tree flora of Folha Larga farm presents more similarity to the samples collected in the nearest areas with low marine influence, even though the area is located on the edge between a sandy coastal plain and the steep slopes. This confirms the results obtained by Scudeller *et al*. (2001), where the highest similarities are among samples geographically closer. That could be related to a low proportion of wide distributed species on the Atlantic rain forest.

A latitudinal gradient was found and the surveys of Rio de Janeiro, which were in the north of the analysed samples, were separated from the others. According to Oliveira Filho & Fontes (2000), annual average temperature is probably the most important factor to north-south differentiation of coastal areas of Atlantic forest. The gradient changes due to temperature decline in this direction. According to Scudeller *et al*. (2001), besides temperature, altitude is also one of the most important factors related to species distribution. The low similarity among the analyzed samples and the high number of exclusive species (about 50%) also strengthen the hypothesis of a restrict species distribution in Atlantic forest.

No clear separation was found between the north and the south samples of São Paulo State as Leitão Filho (1982) proposed. The results were in accordance with Scudeller *et al*. (2001), who observed a long non linear gradient along the Atlantic rain forests of São Paulo, without any distinct floristic blocks. According to these authors this is related to a restricted species distribution in the Atlantic rain forest as 77% of species occur in less than 20% of the analyzed surveys in São Paulo.

The lowland rain forest areas (Floresta Ombrófila Densa de Terras Baixas according to Veloso *et al*. 1992), with the highest marine influence, could be differentiated, in floristic terms, from the submontane and montane rain forest areas in the steep slopes and low hills (Floresta Ombrófila Densa Submontana and Montana, respectively according to Veloso *et al*. 1992), since in cluster analysis these samples appeared separate from each other. However, this separation was not abrupt to form floristic blocks because of the obvious gradient found in CA

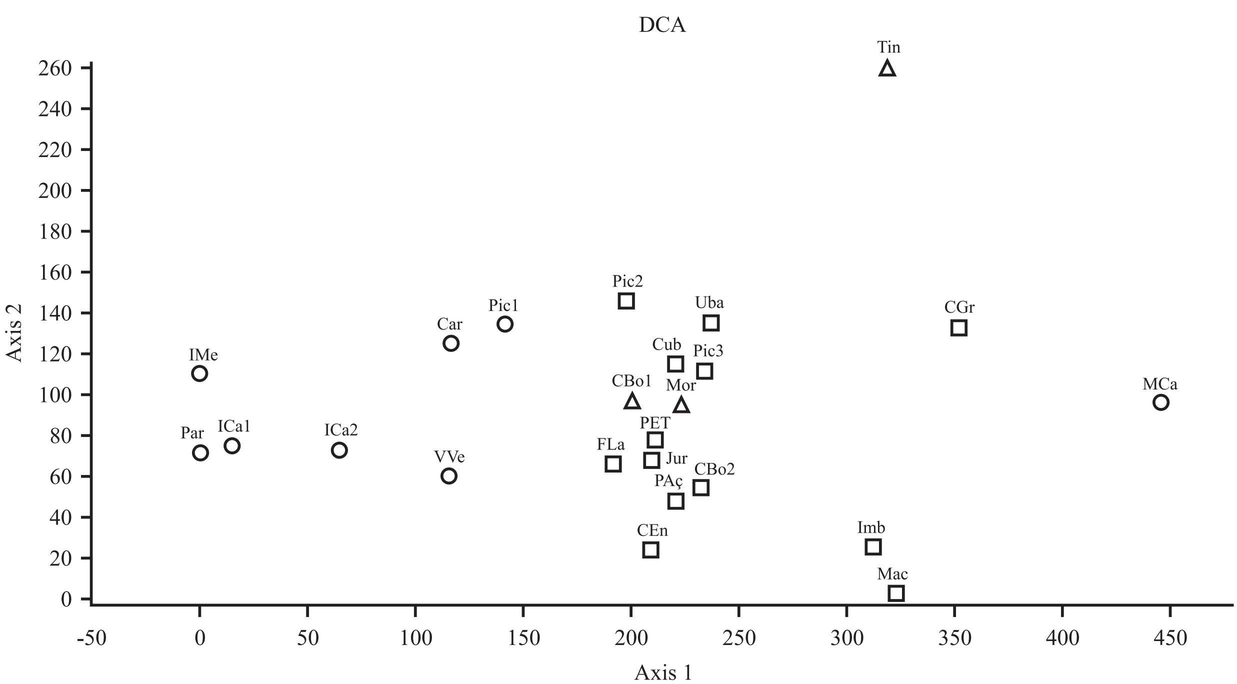

Figure 4. Axis 1 and 2 of Detrended Correspondence Analysis (DCA) from a binary matrix of tree species surveyed in 24 analyzed areas of Atlantic Rain forest. (△ = montane rain forest, □ = submontane rain forest, ○ = lowland rain forest). The localities codes are in figure 1 and tables 2 and 3.

analysis. According to Rizzini (1997) there is probably a species gradient from the steep slopes to the seashore. The results of CA and DCA analysis seem to confirm this observation. The gradient could be related to differential conditions of soil according to its origin. A possible hypothesis is that there are two gradients, an edaphic one in the steep slopes-sea direction, and a latitudinal one in the north-south direction. This division indicates a continuous gradient of species replacement, apparently related to differential edaphic conditions (associated with the degree of marine influence) and the restriction of the species distribution. However, a detailed analysis of the abiotic conditions is necessary, specially of the soil characteristics, to confirm this hypothesis.

Only 13 tree species (less than 10% of the total) were found just in this survey (exclusive species). The distribution of these exclusive species placed the local area either in the south or north limits of their distribution. The distribution of *Ardisia guyanensis* (Myrsinaceae) is from North of Brazil to Santa Catarina State (Bernacci & Jung-Mendaçolli 2000). *Bactris hatchsbachii* (Arecaceae) occurs in São Paulo and Paraná States and according to Henderson *et al*. (1995) it is considered a rare and probably endangered species. *Callisthene kuhlmannii* (Vochysiaceae) occurs in São Paulo, Paraná and Santa Catarina, and the south of São Paulo is its northern limit (Martins 1988). The occurrence of *Coccoloba mosenii* (Polygonaceae) reaches Bahia, Espírito Santo, Rio de Janeiro and São Paulo States (Melo & Marcondes-Ferreira 2009). *Cordia magnoliifolia* (Boraginaceae) occurs in Rio de Janeiro, Minas Gerais, São Paulo and Paraná (Ranga & Silva 2002). According to Pennington (1997), *Inga lanceifolia* only occurs in Rio de Janeiro but its distribution was extended towards São Paulo. *Ixora heterodoxa* (Rubiaceae) occurs from Bahia to Rio Grande do Sul, in the coastal region (Anderson 1992). *Maytenus schumanniana* (Celastraceae), according to Carvalho-Okano (2005), occurs in Bahia, Espírito Santo, São Paulo and Paraná States, with the most samples in São Paulo and Paraná. *Rhodostemonodaphne macrocalyx* (Lauraceae) occurs from south of Bahia to Paraná (Baitello 2003). *Tibouchina arborea* (Melastomataceae) occurs on the coastal plain from Espírito Santo to São Paulo State according to Guimarães & Oliveira (2009). *Vernonia petiolaris* (Asteraceae) occurs in Minas Gerais, Rio de Janeiro, São Paulo, Paraná and Santa Catarina (J. Semir unpublished data).

Despite the biological coherence of the data analysis, its interpretation must still be made carefully, since it is noteworthy that the distribution of those exclusive species is not restricted. Therefore the surveys are still not representative of the Brazilian Atlantic rain forest flora, and more floristic studies are necessary to improve the knowledge of this biome.

The results of the present study suggest that it is essential to preserve areas from the whole distribution of the Atlantic rain forest as its composition is quite complex along its range and it is not adequately represented by small localized areas.

Acknowledgements – We thank Capes for the grant received by the first author, the landowners of Fazenda Folha Larga, Mr. Max Ramos Lucas and Ms. Mariuza Lindemberg, for their inconditional support, G.J. Shepherd for the FITOPAC2.1 software, and the following taxonomists for the identifications: A.B. Martins (Melastomataceae), E. Lucas (Myrtaceae), I. Cordeiro (Euphorbiaceae), J.B. Baitello, P.L.R. Moraes and T.D.M. Barbosa (Lauraceae), J.E.C. Meireles (Fabaceae), J. Semir (Asteraceae), L.C. Bernacci (Myrsinaceae and Arecaceae), M. Moraes (Asteraceae), M. Sobral (Myrtaceae), S. Jung-Mendaçolli (Rubiaceae), S. Romaniuc Neto (Moraceae).

References

AIDAR, M.P.M., GODOY, J.R.L., BERGMANN, J. & JOLY, C.A. 2001. Atlantic Forest succession over calcareous soil, Parque Estadual Turístico do Alto Ribeira – Petar, SP. Revista Brasileira de Botânica 24:455-469.

ANDERSON, L. 1992. A provisional checklist of neotropical Rubiaceae. Scripta Botanica Belgica 1:1-130.

APG. 2003. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG II. Botanical Journal of Linnean Society 141:399-436.

ASSIS, M.A. 1999. Florística e caracterização das comunidades vegetais da Planície Costeira de Picinguaba, Ubatuba – SP. Tese de doutorado, Universidade Estadual de Campinas, Campinas.

BAITELLO, J.B. 2003. Lauraceae. *In* Flora Fanerogâmica do Estado de São Paulo (M.G.L. Wanderley, G.J. Shepherd, A.M. Giulietti & T.S. Melhem, coords.). Fapesp/RiMa, São Paulo, v.3, p.149-223.

BENZECRI, P.J. 1992. Correspondence analysis handbook. Marcel Dekker, New York.

BERNACCI, L.C. & JUNG-MENDAÇOLLI, S.L. 2000. Considerações taxonômicas e novas combinações em *Ardisia* Swartz (Myrsinaceae) do sudeste do Brasil. Acta Botanica Brasilica 14:243-249.

BRAZ, D.M., MOURA, M.V.L.P.M. & ROSA, M.M.T. 2004. Chave de identificação para as espécies de Dicotiledôneas arbóreas da Reserva Biológica do Tinguá, RJ, com base em caracteres vegetativos. Acta Botanica Brasilica 18:225-240.

BRUMMIT, R.K. & POWELL, C.E. 1992. Authors of plant names. Royal Botanic Gardens, Kew.

CARVALHO-OKANO, R.M. 2005. Celastraceae. *In* Flora Fanerogâmica do Estado de São Paulo (M.G.L. Wanderley, G.J. Shepherd, T.S. Melhem & A.M. Giulietti, coords.). Fapesp/RiMa, São Paulo, v.4, p.185-194.

CESAR, O. & MONTEIRO, R. 1995. Florística e fitossociologia de uma floresta de Restinga em Picinguaba (Parque Estadual da Serra do Mar), Município de Ubatuba – SP. Naturalia 20:89-105.

CUSTODIO FILHO, A., NEGREIROS, O.C., DIAS, A.C. & FRANCO, G.A.D.C. 1992. Composição florística do estrato arbóreo do Parque Estadual de Carlos Botelho, SP. Revista do Instituto Florestal 4:184-191.

EMBRAPA. 2006. Sistema Brasileiro de Classificação de Solos. Embrapa Solos, Rio de Janeiro.

GUIMARÃES, P.J.F. & OLIVEIRA, C.M.S. 2009. Tibouchina. *In* Flora Fanerogâmica do Estado de São Paulo (M.G.L. Wanderley, G.J. Shepherd, T.S. Melhem & A.M. Giulietti, coords.). Fapesp/Instituto de Botânica, São Paulo, v.6, p.127-149.

HENDERSON, A., GALEANO, G. & BERNAL, R. 1995. Field guide to the palms of the Americas. Princeton University, New Jersey.

HILL, M.O. & GAUCH, H.G. 1980. Detrended Correspondence Analysis: an improved ordination technique. Vegetatio 42:47-58.

IVANAUSKAS, N.M., MONTEIRO, R. & RODRIGUES, R.R. 2001. Levantamento florístico de trecho de Floresta Atlântica em Pariquera-Açu, São Paulo, Brasil. Naturalia 26:97-129.

JOLY, C.A., AIDAR, M.P.M. & KLINK, C.A. 1999. Evolution of the Brazilian phytogeography classification systems: implications for biodiversity conservation. Ciência e Cultura 51:331-348.

KOEPPEN, W. 1948. Climatologia: com um estudio de los climas de la terra. Fundo de Cultura Economica, México.

KURTZ, B.C. & ARAÚJO, 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. Rodriguesia 51:69-111.

LEITÃO FILHO, H.F. 1982. Aspectos taxonômicos das florestas do estado de São Paulo. Silvicultura em São Paulo 1:206-297.

LEITÃO FILHO, H.F. (coord.) 1993. Ecologia da Mata Atlântica em Cubatão. Universidade Estadual Paulista/ Universidade Estadual de Campinas, Campinas.

MAMEDE, M.C., 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.). Holos, Ribeirão Preto, p.115-132.

MANTOVANI, W. 1992. A vegetação sobre restinga em Caraguatatuba, SP. Revista do Instituto Florestal 4:139-144.

MARTINS, A.B., SEMIR, J., GOLDEMBERG, R. & MARTINS, E. 1996. O gênero *Miconia* Ruiz and Pav. (Melastomataceae) no Estado de São Paulo. Acta Botanica Brasilica 10:267-316.

MARTINS, H.F. 1988. Duas novas espécies de *Callisthene* (Vochysiaceae). Bradea 5:149.

MELO, E. & MARCONDES-FERREIRA, W. 2009. Polygonaceae. *In* Flora Fanerogâmica do Estado de São Paulo (M.G.L. Wanderley, G.J. Shepherd, T.S. Melhem & A.M. Giulietti, coords.). FAPESP/Instituto de Botânica, São Paulo, v.6, p.169-193.

MORENO, M.R., NASCIMENTO, M.T. & KURTZ, B.C. 2003. Structure and floristic composition of tree communities in two altitudinal zones in an Atlantic forest in the Imbé Region, RJ, Brazil. Acta Botanica Brasilica 17:371-386.

MUELLER-DOMBOIS, D. & ELLENBERG, H. 1974. Aims and methods of vegetation ecology. John Wiley, New York.

MYERS, N., MITTERMEIER, R.A., MITTERMEIER, C.G., FONSECA, G.A.B. & KENT, J. 2000. Biodiversity hotspots for conservation priorities. Nature 403:853-858.

NEGRELLE, R.R.B. 2002. The Atlantic Forest in the Volta Velha Reserv: a tropical rain forest site outsite the tropics. Biodiversity and Conservation H:887-919.

OLIVEIRA FILHO, A.T. & FONTES, M.A. 2000. Patterns of floristic differentiation among Atlantic Forests in southern Brazil and the influence of the climate. Biotropica 32:793-810.

PEIXOTO, G.L., MARTINS, S.V., SILVA, A.F. & SILVA, E. 2004. Floristic survey of the tree layer in an area of Atlantic Rain forest in Serra da Capoeira Grande Environmental Protection Area, Rio de Janeiro State, Brazil. Acta Botanica Brasilica 18:151-160.

PENNINGTON, T.D. 1990. Flora Neotropica – Sapotaceae. The New York Botanical Garden, New York.

PENNINGTON, T.D. 1997. The genus *Inga* botany. The Royal Botanic Gardens, Kew.

PLANT NAMES PROJECT. 2004. The International Plant Names Index. http://www.inpi.org. (accessed 2004 Dec 12).

RANGA, N.T. & SILVA, L.C. 2002. Boraginaceae. *In* Flora fanerogâmica da Ilha do Cardoso (M.R.F.M. Melo, F. Barros, S.A.C. Chiea, M. Kirizawa, S. Jung-Mendaçolli & M.G. Wanderley, eds.). Instituto de Botânica, São Paulo, v.9, p.105-114.

RIBEIRO, M.C., METZGER, J.P., MARTENSEN, A.C., PONZONI, F.J. & HIROTA, M.M. 2009. The Brazilian Atlantic Forest: How much is left, and how is the remaining forest distributed? Implications for conservation. Biological Conservation 142:1141-1153.

RIZZINI, C.T. 1997. Tratado de fitogeografia do Brasil: aspectos ecológicos, sociológicos e florísticos. Âmbito Cultural Edições, Rio de Janeiro.

RODRIGUES, R.R. 2006. II Relatório Parcelas Permanentes. http://www.lerf.esalq.usp.br/parcelas. (accessed 2006 Jun 7).

ROTTA, E., BOEGER, M.R. & GRODZKI, L. 1992. Levantamento florístico e fitossociológico de um trecho de Floresta Ombrófila Densa das terras baixas no Parque Estadual do Palmito, Paranaguá, PR. Boletim de Pesquisas Florestais 24/25:21-28.

SAMPAIO, D., SOUZA, V.C., OLIVEIRA, A.A., PAULA-SOUZA, J. & RODRIGUES, R.R. 2005. Árvores da restinga: guia ilustrado para a identificação das espécies da Ilha do Cardoso. Neotropica, São Paulo.

SANCHEZ, M., PEDRONI, F., LEITÃO FILHO, H.F. & CÉSAR, O. 1999. Composição florística de um trecho de floresta ripária na Mata Atlântica em Picinguaba, Ubatuba, SP. Revista Brasileira de Botânica 22:31-42.

SÃO PAULO – Secretaria de Estado do Meio Ambiente, 1996. Regulamentação da APA Cananéia-Iguape-Peruíbe: plano de gestão – unidade de gestão – ZEE preliminar. Secretaria do Meio Ambiente do Estado de São Paulo/Ibama, São Paulo.

SCUDELLER, V.V., MARTINS, F.R. & SHEPHERD, G.J. 2001. Distribution and abundance of arboreal species in the Atlantic Ombrophilous Dense Forest in southern Brazil. Plant Ecology 152:185-199.

SHEPHERD, G.J. & URBANETZ, C. 2010. FITOPAC2.1: Manual do usuário. Departamento de Biologia Vegetal, Universidade Estadual de Campinas, Campinas.

SILVA, A.F.S. & LEITÃO FILHO, H.F. 1982. Composição florística e estrutura de um trecho de Mata Atlântica de Encosta no Município de Ubatuba (São Paulo, Brasil). Revista Brasileira de Botânica 5:43-52.

SILVA, F.C. 1994. Composição florística e estrutura fitossociológica da floresta tropical ombrófila da encosta Atlântica no Município de Morretes, estado do Paraná. Acta Biológica Paranaense 23:1-54.

SILVA, G.C. & NASCIMENTO, M.T. 2001. Phytosociological studies in a remnant lowland forest on tertiary tabuleiros in the north Rio de Janeiro State. Revista Brasileira de Botânica 24:51-62.

SILVA, S.M. 1990. Composição Florística e Estrutura Fitossociológica de um Trecho de Floresta de Restinga na Ilha do Mel, Município de Paranaguá, PR. Dissertação de mestrado, Universidade Estadual de Campinas, Campinas.

SOLOMON, J. 2004. W^{3}Tropicos. http://www.mobot.org/W3T/Search/vast.html (accessed 2004 Dec 12).

SUGIYAMA, M. 1998. Estudo de florestas da restinga da Ilha do Cardoso, Cananéia, São Paulo, Brasil. Boletim do Instituto de Botânica 11:119-159.

SZTUTMAN, M. & RODRIGUES, R.R. 2002. Vegetational mosaic of contiguous forest area in a coastal plain, Campina do Encantado State Park, Pariquera-Açu, SP. Revista Brasileira de Botânica 25:161-176.

VELOSO, H.P., OLIVEIRA FILHO, L.C., VAZ, A.M.S.F., LIMA, M.P.M., MARQUETE, R. & BRAZÃO, J.E.M. (orgs.) 1992. Manual técnico da vegetação brasileira. IBGE, Rio de Janeiro, v.1.

WANDERLEY, M.G.L., SHEPHERD, G.J. & GIULIETTI, A.M. (coords.) 2002. Flora Fanerogâmica do Estado de São Paulo. Fapesp/Hucitec, São Paulo, v.2.

WANDERLEY, M.G.L., SHEPHERD, G.J., GIULIETTI, A.M. & MELHEM, T.S. (coords.) 2003. Flora Fanerogâmica do Estado de São Paulo. Fapesp/RiMa, São Paulo, v.3.

WANDERLEY, M.G.L., SHEPHERD, G.J., MELHEM, T.S. & GIULIETTI, A.M. (coords.) 2005. Flora Fanerogâmica do Estado de São Paulo. Fapesp/RiMa, São Paulo, v.4.

WANDERLEY, M.G.L., SHEPHERD, G.J., MELHEM, T.S. & GIULIETTI, A.M. (coords.) 2007. Flora Fanerogâmica do Estado de São Paulo. Fapesp/Instituto de Botânica, São Paulo, v.5.

WANDERLEY, M.G.L., SHEPHERD, G.J., MELHEM, T.S. & GIULIETTI, A.M. (coords.) 2009. Flora Fanerogâmica do Estado de São Paulo. Fapesp/Instituto de Botânica, São Paulo, v.6.