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Floristic comparison of mesophytic semideciduous forests of the interior of the state of São Paulo, Southeast Brazil

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Abstract

The floristic composition (trees) of 26 forests in the state of São Paulo, Brazil, was compared using cluster analysis and Principal Coordinates Analysis (PCO) with simple Euclidean distance. The results obtained indicate the existence of two floristically distinct groups of forests. One group contains forests from higher areas (above 700 m) with a colder climate (Cfa and Cfb) and includes surveys from Angatuba, Atibaia, Guarulhos, Jundiaí, São José dos Compos and São Paulo. The second group is floristically less homogeneous and includes forests of the central and western parts of the state, usually at lower altitudes (500–700 m) and subject to hotter climatic conditions (Cwa).

Introduction

The state of São Paulo, Brazil, has a very reduced (ca. 5%) coverage of original native vegetation (CONSEMA 1985), and the remnants of this vegetation in the interior of the state have been physiognomically classified as mesophytic semideciduous forest, using the system proposed by Rizzini (1963). There is, however, no consensus on a classification scheme based on floristic composition. In spite of considerable heterogeneity, these forests have often been referred to collectively as "Planalto Forest" or as part of the "Atlantic Forest". We, however, follow Joly *et al.* (1992) in considering the "Planalto Forest" as floristically and phenologically distinct from the coastal forest. Until recently, there has been little recognition of subgroups with distinct floristic components within the "Planalto Forest", in part because of the lack of suitable data on forest structure and composition. Today, however, thre are enough data on the floristic composition of these forests to permit the use of multivariate techniques to classify forest subgroups.

Before the arrival of European settlers, the "Planalto Forest", a typical semideciduous forest interspersed by a savanna like vegetation (cerrado) and gallery forest areas, covered a large part of the interior of the state of São Paulo as well as of the states of Minas Gerais, Mato Grosso, Mato Grosso do Sul and Goiás. The forest dossel, where Anacardiaceae, Apocynaceae and Leguminosae are the most important families, lies between 20 and 25 m in height, while the emergent trees, like *Cariniana estrellensis* (Lecythidaceae), may reach up to 35m. In these strata most of the species are anemocoric. In the second stratum, 12 to 18 m, Euphorbiaceae, Lauraceae and Rutaceae play an important role. Annual rainfall is around 1500 mm, but there is a marked dry season that may last from May to September (Leitão Filho 1982). About 40% of the species are deciduous or semi-deciduous (Morellato *et al.* 1989).

In a broader sense the "Planalto Forest" is similar to those semideciduous forests occurring within or on the edges of savanna areas of Africa, Australia, Central and South America (Furley *et al.* 1992; Oliveira Filho *et al.* 1994).

The large number of species found in these forests and the complex pattern of floristic variation, as well as widely varying degrees of human disturbance, make multivariate methods almost essential in comparative studies. These techniques have not been widely used to analyse forest vegetation in Brazil, although a few studies have used them on a limited scale. Silva & Shepherd (1986) used cluster analysis with the Jaccard index for a generic-level comparison of areas of the Atlantic Rain Forest with Amazonian and Planalto Forest. The Jaccard index and cluster analysis were also used by Torres (1989) in a more extensive survey of 13 forest areas in the state of São Paulo. Results suggested three main groups of forests: the coastal Atlantic Forest; forest of the western slopes of the Serra do mar and the Serra da Mantiqueira, usually on igneous rocks; and forests in the interior of the state, usually on sedimentary rocks.

Kotchetkoff-Henriques & Joly (1994) used the Sorensen index for a species level comparison of a forest in the municpality of Itirapina and others in the state of São Paulo. They noted similarity between this area and others subject to human disturbance. Silva (1989) used the Kulczinsky index to similarly compare, at the species level, a forest in the municipality of São José dos Campos with others areas within the state of São Paulo.

In this study we use simple Euclidean distance to compare the floristic composition of 26 forest areas in the interior of the state of São Paulo, with the objective of determining floristic groupings.

Materials and Methods

Data on floristic composition were compiled from floristic and phytosociological surveys reported in the literature or available in theses or research reports. We included forests only from the interior of the state and specifically excluded the Atlantic Coastal Forest, because there are few studies of this heterogenous forest type (Silva & Shepherd 1986). The geographical locations of the stands are shown in Fig. 1 and their climatic and edaphic characteristics are summarized in Table 1, together with details of the methodology used in each survey. Only presence/absence data were used.

We included only taxa identified to species level, because it is difficult to compare taxa determined only to genus with taxa determined to species. This eliminated a large number of records, mainly in the Lauraceae and Myrtaceae. Synonymy was a time-consuming problem. In some surveys no voucher herbarium material was cited, so in these cases doubtful identifications could not be checked. We eliminated records of species which did not attain more than 1.4 m because these included many weedy pioneers which tend to be of almost universal occurrence and therefore have no value for comparison. The 276 species which were limited to a single site, considering that there was no concentration of such species in any particular site or group of sites, and the one species that occurred at all sites (*Croton floribundus* Bail., Euphorbiaceae) were eliminated because they would not provide a basis for comparison. The final data matrix contained 26 sites and 480 species. Data are on file in the library of the Royal Botanic Garden, Edinburgh, Scotland.

Simple Euclidean distances were calculated and cluster analysis and PCO were performed for this matrix (Clifford & Stephenson 1975, Dunn & Everitt 1982). Cluster analysis used the average linkage method (UPGMA), although other methods (results not shown) were also tested and gave similar results. Programmes "Coef" and "Cluster" from the FITOPAC package being developed by G. J. Shepherd were used for cluster analysis and NTSYS-pc v. 1.5 for PCO (Rohlf 1988).

Results and Discussion

The dendrograms and scatter diagrams from the cluster analysis and PCO (Figs. 2 and 3) show two groups of forests which are floristically distinct. The smaller and more floristically homogeneous group consists of seven surveys located in the municipalities of Angatuba, Atibaia, Guarulhos, Jundiaí, São José dos Campos and São Paulo. The second, larger and more heterogeneous group includes 19 surveys located in forests typically from the interior of the state. This is similar to the grouping reported by Torres (1989), although her study contained only 13 surveys.

It is interesting to note that while the first axis of the ordination shows a gradient from areas with seasonal and warmer climate to cooler areas with a more venly distributed rainfall, the second shows a greater influence of the degree of disturbance of the sites.

The high floristic similarity observed in the seven surveys of the first group may be linked to a number of common characteristics among these sites. They all have altitudes greater than 700 m, with a predominance of yellow-red latosols (Latossolos Vermelho-

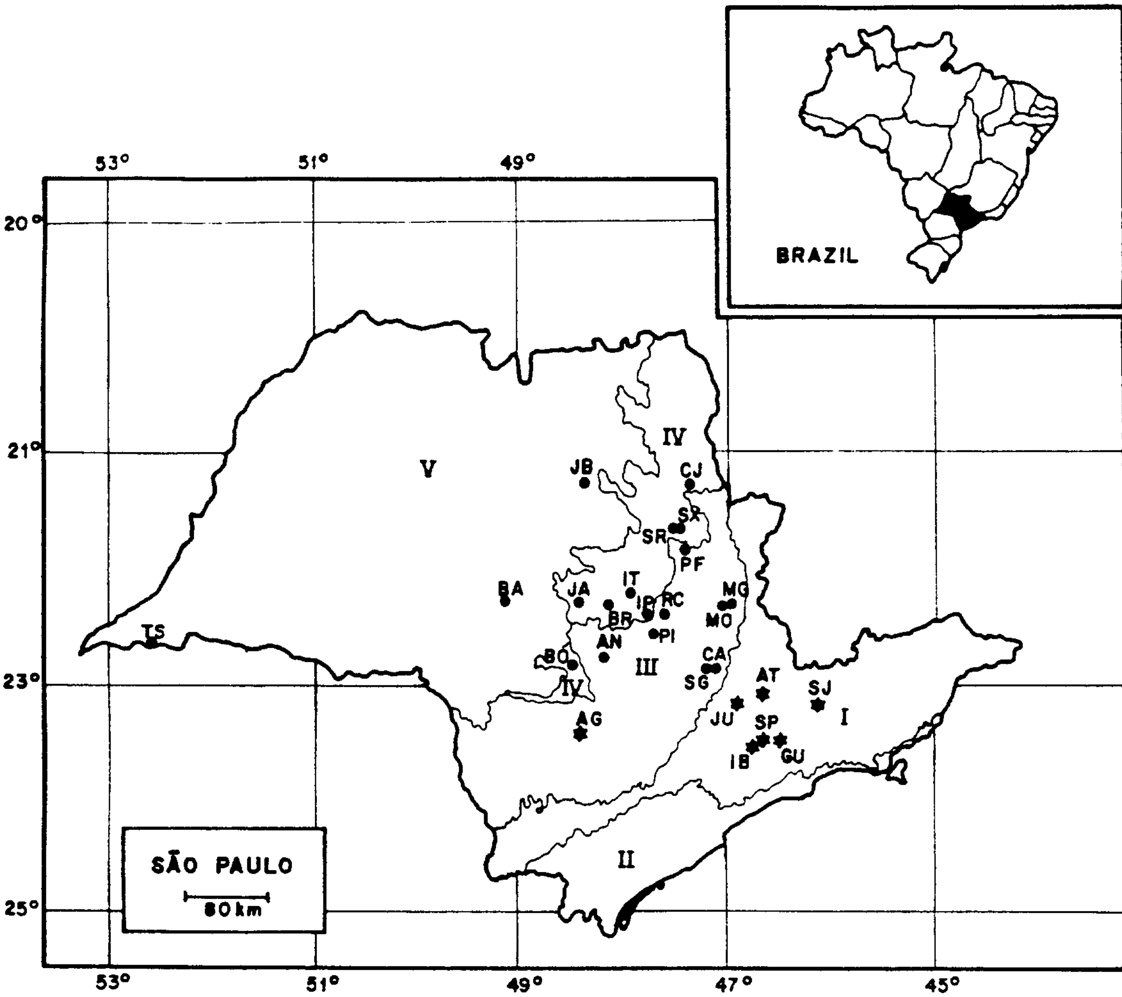

Fig. 1. São Paulo state with the geomorphological regions (adapted from Ponçano *et al.* 1981) and the locations of the floristic and/or phytosociology surveys in gallery and mesophytic semideciduous forest used in the present study. AG – Angatuba, Estação Ecológica de Angatuba (Torres 1989) AN – Anhembi, Fazenda Barreiro Rico (Cesar & Leitão Filho 1990a,b) AT – Atibaia, Parque Municpal da Grota Funda (Meira Neto *et al.* 1990) BA – Bauru, Reserva Estadual de Bauru (Cavassan *et al.* 1984) BO – Botucatu, Fazenda São José (Gabriel 1990) BR – Brotas, Fazenda Santa Elisa (Salis 1990; Salis *et al.* 1994) CA – Campinas, Bosque dos Jequitibás (Matthes *et al.* 1988) CJ – Cjuru, Fazenda Santa Carlota (Meira Neto & Bernacci 1986) GU – Guarulhos, Remnant forest of the International Airport of São Paulo (Gandolfi 1991) IB – São Paulo, Instituto de Botânica (Struffaldi-de-Vuono 1985) IP – Ipeúna, Bacia do rio Passa Cinco (Mantovani *et al.* 1986 apud Salis 1990) IT – Itirapina, Cabeceira do rio da Cachoeira (Kotchetkoff-Henriques & Joly 1994) JA – Jaú, Fazenda Santo Antonio (Nicolini 1990) JB – Jaboticabal, Reserva do Campus da UNESP (Pinto 1989) JU – Jundiaí, Serra do Japi (Rodrigues 1986) MG – Mogi Guaçu, Mata da Figueira (Gibbs & Leitão Filho 1978) MO – Mogi Guaçu, Matas do Português, Figueira e Mariana (Mantovani *et al.* 1989) PF – Porto Ferreira, Reserva Estadual de Porto Ferreira (Bertoni & Martins 1987) PI – Piracicaba, secondary residual forest areas (Catharino 1989) RC – Rio Claro, Fazenda São José (Pagano & Leitão Filho 1987) SG – Campinas, Reserva de Santa Genebra (Tamashiro *et al.* 1986 apud Salis 1990) SJ – São José dos Campos, Reserva Florestal Professor Augusto Ruschi (Silva 1989) SP – São Paulo, Reserva da Cidade Universitária (Rossi 1987) SR – Santa Rita do Passa Quatro, Parque Estadual de Vaçununga (Martins 1991) SX – Santa Rita do Passa Quatro, Parque Estadual de Vaçununga (Bertoni *et al.* 1988) TS – Teodoro Sampaio, Parque Estadual do Morro do Diabo, (Baitello *et al.* 1988). * group 1 sites: I – Atlantic Plateau; II – Costal Province. ° group 2 sites: III – Peripheral Depression; IV – Basalt Cuestas; V – Western Plateau.

Table 1. Climatic and edaphic characteristics, sampling criteria, number of tree species and size of area for the surveys utilized.

Site	Altitude	Temperature			Relative humidity	Annual precip.	Hydric deficiency (mm)	Climate type	Soil type	Total area	Sampling criterion	Tree species	
		annual average	min.	max.								sampled	used in matrix
AG	450–700	19–20	–	–	–	1300–1600	–	Cfa	red-yel. latos. lithosol and regosol	1394	FS	174	142
AT	900–1400	–	-4.3	37.6	–	–	–	–	–	–	FS	177	145
GU	734–740	18.4	-3.0	36.8	81.0	1400	no	Cfb	red-yel. latos.	52000	DBH10	139	120
IB	770–825	19.0	1.1	35.0	83.3	1318	no	Cfa/Cfb[4]	red-yel. latos.	163	FS	139	106
JU	870–1170	19.2	-0.3[8]	37.2[8]	–	1356–1450	0–8	Cfa/Cfb	red-yel. latos.	25000	DBH5	132	118
SJ	640–1040	21.3	0.5	–	–	1100	–	Cfa[5]	red-yel. latos. cambisol. podzol and alluvial	247	DBH47	162	116
SP	735–765	17.6	-4.0[1]	–	80.0	1428	–	–	–	–	FS	115	102
AN	500	21.5	-0.8[6]	37.8[6]	75.1[6]	1339	15.7[6]	Cwa	deep sand	2200	DBH3	129	114
BA	570	21.4	-2.7[1]	–	67.5	1281	17.0	Cwag	dark red latos.	200	DBH10	56	53
BO	550–730	19.2	–	–	–	1610	no	Cwa	lithosol and purple struct.	121	>1.3m	126	122
BR	530	21.8	-0.3[1]	–	–	1460	–	Cwa	dark red latos. dys. purp. latos. deep sand and alluvial	40	DBH3	108	100
CA	700	21.3	0.5[1]	–	71.3	1371	yes	Cwa	red-yel. podz.	10	DBH10	170	157
CJ	560–620	–	–	–	–	–	–	Cwa	purple latos. and red-yel. latos.	400	>2m	92	76
IP	600	20.4	–	–	–	1300	54.0	–	red-yel. latos. deep sand lithosol and red-yel. podz.	–	DBH5	108	90
IT	759–875	21.0	–	–	–	1600	–	Cwa	lithosol	1.3	DBH5	75	68
JA	556	22.3	-0.3[1]	–	–	1461	no	Cwa	cambisol. lithosol and purple struct.	190	>1.3m	155	143
JB	595	22.0	3.5[1]	–	–	1462	18.0	Cwa	purple latos. and dark red latos.	6	DBH48	71	64
MG	600	20.2	-0.7	37.2	78.8	1280	–	Cwa	–	3	DBH10	46	43

Table 1. Continued.

Site	Altitude	Temperature			Relative humidity	Annual precip.	Hydric deficiency (mm)	Climate type	Soil type	Total area	Sampling criterion	Tree species	
		annual average	min.	max.								sampled	used in matrix
MO	–	21.0	–	–	–	1059–2269	–	Cwa	red-yel. latos. and hydromorphic	–	DBH25	139	115
PF	540–608	20.9	–	–	73.4	1347	–	Cwa	red-yel. podz. dark red latos. hydromorphic and alluvial	611	>1.3m	130	119
PI	400–700	–	–	–	–	1200–1300	yes	Cwa	podzol, lithosol, latosol and alluvial	–	FS	164	130
RC	630	19.6	–	–	–	1360	no	Cwa	red-yel. latos. and dark red latos.	230	>1.3m	167	157
SG	700[7]	21.3[7]	0.5[1]	–	71.3[7]	1371[7]	15.0	Cwa	dys. pur. latos	200	DBH48	95	89
SR	–	20.8	-3.3	38.9	–	1525	23.8	Cwag	purple latos.	–	DSL48	96	93
SX	580–700	20.8	-3.3[2]	–	–	1525	yes[2]	Cwag	dyst. purp. latos. and dark red latos.	132	DBH10	58	52
TS	–	22.3[3]	-1.4[3]	41.6	–	1130	yes[3]	Cwa	dark red latos.	3000	FS	113	98

[1] Lacativa (1983); [2] Martins (1991); [3] Schlittler (1990); [4] Struffaldi de Vuono (1986); [5] Setzer (1966); [6] Cesar (1988); [7] Matthes *et al.* (1988); [8] Morellato *et al.* (1989).

Sample criteria: DBH25 – all individuals with DBH $\geq$ 25 cm; DBH3 – all individuals with DBH $\geq$ 3 cm; DBH47 – all individuals with DBH $\geq$ 4.7 cm; DBH48 – all individuals with DBH $\geq$ 4.8 cm; DSL48 – all individuals with diameter at soil level $\geq$ 4.8 cm; DBH5 – all individuals with DBH $\geq$ 5 cm; DBH10 – all individuals with DBH $\geq$ 10 cm; >1.3 m – all individuals > 1.3 m height >1.5 m – all individuals > 1.5 m height; > 2.0 m – all individuals > 2 m height; FS – Floristic survey

Soil type: red-yel. latos. – red-yellow latosol; dark red latos. – dark red latosol purple latos. – purple latosol; dys. pur. latos. – dystrophic purple latosol red-yel. podz. – red-yellow podzol; purple structr. – purple structured.

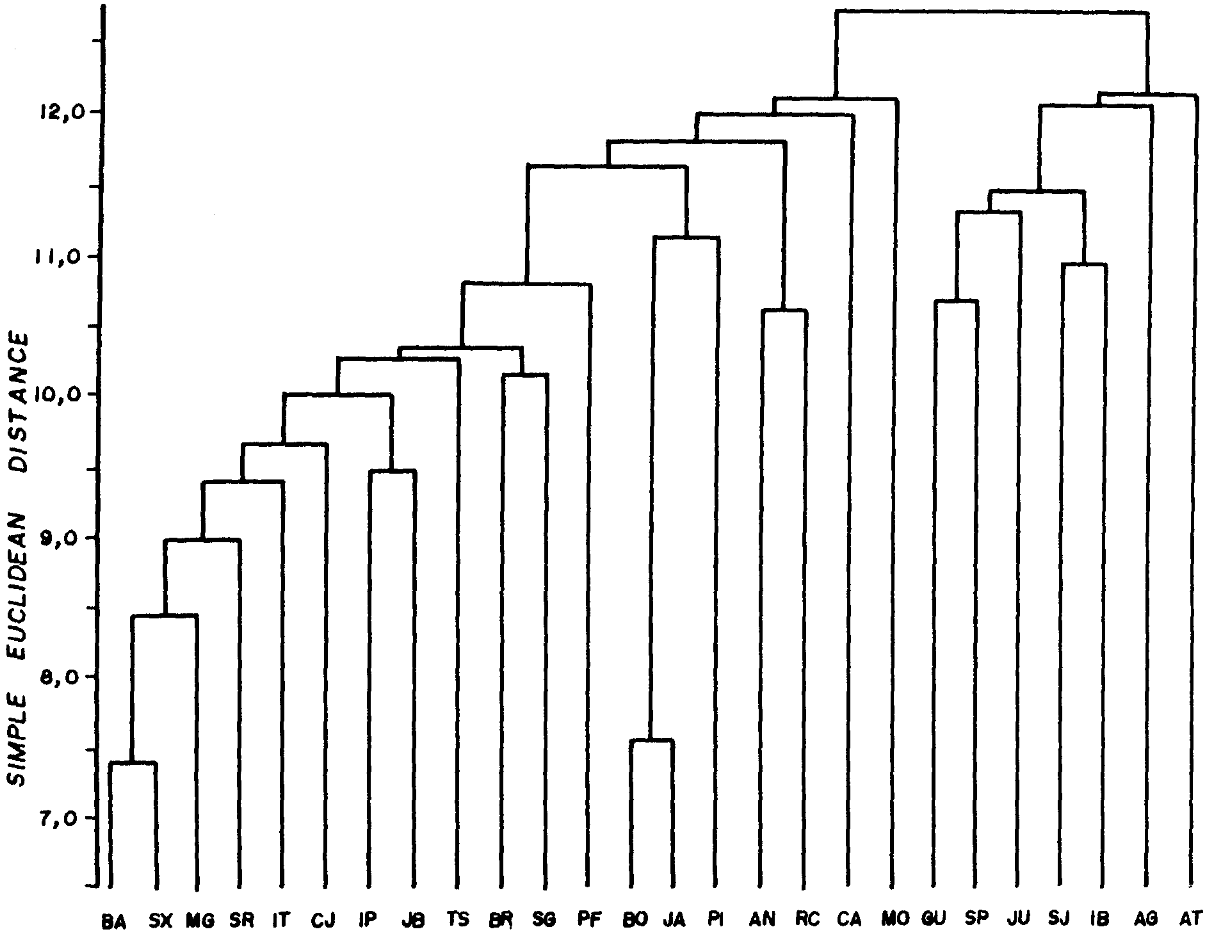

Fig. 2. Dendrogram showing the groups obtained using the Euclidean distance coefficient and average linkage method (UPGMA), for floristic studies of forests in São Paulo state. See Fig. 1 for symbols and abreviations.

Amarelo), a colder climate (Koppen's Cfa and Cfb) and an average relative humidity above 70%. The exception is the site of São José dos Campos, where Silva (1989) cited an Aw-type climate. The climatic data utilized by this author, however, are from the meteorological station at São José dos Campos, within the urban perimeter, at a lower altitude and drier climate than the area studied. An examination of the climatic maps of São Paulo state provided by Setzer (1966) suggests that the climate of this study area may be closer to Cfa.

The floristic similarity among forests in areas at higher elevations has already been noted by: (a) Rodrigues (1986), who compared data from the Serra do Japi in Jundiaí with those from the Instituto de Botânica in São Paulo; (b) Rossi (1987), who compared two surveys within the municipality of São Paulo (Cidade Universitária Reserve and Instituto de Botânica); and (c) Silva (1989), who compared his data from the Professor Augusto Ruschi Forest Reserve in São José dos Campos with those from Serra do Japi and Instituto de Botânica. Our study confirms the existence of a floristically distinct group of forests which includes most of those from higher altitudes from the south and east of the state.

Species that occurred exclusively in sites at higher altitude and/or with cooler, more humid climates included *Alchornea sidaefolia* Muell. Arg., *Anadenanthera colubrina* (Vell.) Mart. ex Benth., *Clethra scabra* Pers., *Dalbergia brasiliensis* Vog., *Didymopanax angustissimum* March., *Eugenia dodoneaefolia* Camb., *Eugenia uvalha* Camb., *Guatteria aus-*

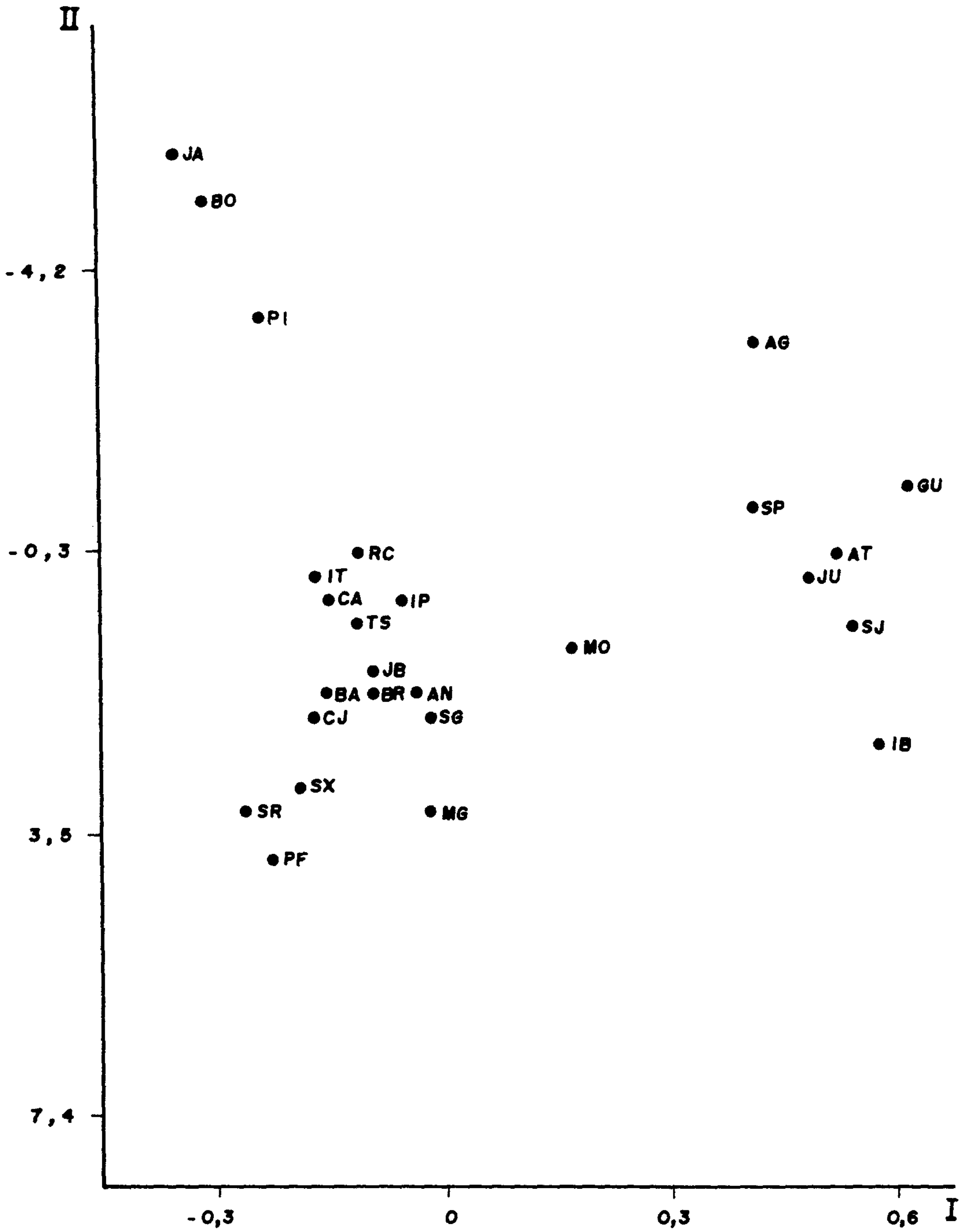

Fig. 3. Scatter diagram showing the positions of the sites on the first two axes of the PCO using the Euclidean distance coefficient. See Fig. 1 for symbols and abreviations.

tralis St. Hil., *Ilex dumosa* Reiss., *Matayba juglandifolia* (Camb.) Radlk., *Miconia sellowiana* Naud., *Mollinedia uleana* Perk., *Nectandra gradiflora* Nees, *Nectandra rigida* Nees, *Ocotea lanata* (Nees) Mez, *Ouratea semiserrata* (Mart. & Nees) Engl., *Phoebe stereophylla* Meissn., *Pimenta pseudocaryophyllus* (Gomez) Landrum, *Pithecelobium incuriale* (Vell.) Benth., *Sapium glandulatum* (Vell.) Pax, *Solanum rufescens* Sendtn., *Solanum variable* Cham., *Vochysia magnifica* Warm. and *Vitex polygama* Cham. These samples lacked a large number of species (around 150) which may be unable to withstand the climatic conditions that include fairly regular occurrence of frosts.

According to Silva (1989) these forests at higher elevation show a greater similarity with the coastal forest, although the amount of data for the coastal forest is still too limited to make a detailed comparison.

The remaining 19 sites are semideciduous and riparian forests and comprise a very heterogeneous group. Torres (1989) also noted a low level of similarity among forests of the interior of the state and concluded that these forests consist of a mosaic of floristically distinct patches.

The sites from the interior of the state have very diverse edaphic and rainfall conditions (Table 1) in spite of belonging to a single climatic type: Cwa – hot and humid with a well defined dry season. Typical species from these forests occurring in at least 70% of the sites include *Acacia polyphylla* DC., *Arecastrum romanzoffianum* (Cham.) Becc, *Aspidosperma polyneuron* Muell. Arg., *Astronium graveolens* Jacq., *Casearia gossypiosperma* Briq., *Casearia sylvestris* Sw., *Cariniana estrellensis* (Raddi) Kuntze, *Cedrela fissilis* Vell., *Centrolobium tomentosum* Guill. ex Benth., *Chorisia speciosa* St. Hil., *Chrysophyllum gonocarpum* (Mart. & Eichl) Engl., *Copaifera langsdorffii* Desf., *Machaerium stipitatum* (DC.) Vog. and *Trichilia catigua* A. Juss.

The consistent close linkage between the Botucatu and Jaú sites is probably a result of the sampling method in which all woody individuals at least 1.3 m high were included. Although we attempted to remove shrubby species from the data matrix, species which vary in habit from shrubs to small trees were maintained. These included several species of Solanaceae, Piperaceae and Asteraceae that are generally early successional species and are well represented in these two sites. The Piracicaba site also contained pioneer species. It is possible that further exclusion of early successional species would clarify floristic relationships, but it is difficult to establish consistent criteria for elimination of these species, especially given the diversity of methodologies in the original studies.

It should be noted that the riparian forests included here – Mogi Guaçu, Porto Ferreira, Ipeúna and Brotas (Salis *et al.* 1994) – are not separated as a distinct group. In most of these cases, the strictly riparian vegetation was confined to a relatively narrow strip and a large proportion of the area sampled consisted of drier semideciduous forest, masking any similarity that might exist among riparian areas.

The apparently intermediate position of the "MO" site in Fig. 3 is possibly due to the composite nature of this sample because the authors grouped data from a number of forest remnants along the River Mogi Guaçu in a single list. It does not show a very strong similarity to the Mogi Guaçu survey of Gibbs & Leitão Filho (1978).

In conclusion, the results obtained in this study indicate that the socalled "Planalto Forests" in the state of São Paulo can be divided into two major groups: one relatively homogeneous, with a smaller number of tree species and occuring in higher and colder and more humid regions in the south and east of the state, the other floristically richer and more heterogeneous and found in the lower, drier, warmer and more seasonal regions of the interior. Very little is known about the causes of the heterogeneity of the second group, but the edaphic and microclimatic conditions of each forest remnant (Leitão Filho 1982), historical factors such as disturbances and differences in the floristic composition before fragmentation took place (Catharino 1989), and sampling methodology could explain such discrepancies.

Our synthesis study also reaffirmed that it is highly desirable for researchers to cite voucher herbarium material for all surveys and thereby reduce taxonomic problems. Moreover, common sampling methodology should be adopted, whenever possible, to permit more meaningful comparisons between different areas surveyed by different researchers.

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References

Baitello, J. B., Pastore, J. A., Aguiar, O. T., Sério, F. C. & Silva, C. E.F. 1988. A vegetaçãoo arbórea do Parque Estadual do Morro do Diabo, Municipio de Teodoro Sampaio, Estado de São Paulo. Acta Bot. Brasil 1: 221–230.

Bertoni, J. E. A. & Martins, F. R. 1984. Composição florística de uma floresta ripária na Reserva Estadual de Porto Ferreira. Acta Bot. Brasil 1: 17–26.

Bertoni, J. E. A., Martins, F. R., Mores, J. L. de & Shepherd, G. J. 1988. Composiçaão florística e estrutura fitossociológica do Parque Estadual de Vaçununga, Santa Rita do Passa Quatro, SP – Gleba Praxedes. Bol. Téc. I. Florest. 42: 149–170.

Catharino, E. R. M. 1989. Estudos fisionômicos-florísticos e fitossociológico em matas residuais secundárias do municipio de Piracicaba, SP. MSc Thesis, State University of Campinus/UNICAMP, Campinas.

Cavassan, O., Cesar, O. & Martins, F. R. 1984. Fitossociologia da vegetação arbórea da Reserva Estadual de Bauru, Estado de São Paulo. Revta. Brasil Bot. 7: 91–106.

Cesar, O. 1988. Composição florística, fitossociologia e ciclagem de nutrientes em mata mesófila semidicidua (Fazenda Barreiro Rico, Município de de Anhembi, SP). DSc Thesis, State University "Julio de Mesquita Filho"/UNESP, Rio Claro.

Cesar, O. & Leitão Filho, H. F. 1990a. Estudo floristico quantitativo da mata mesófila semidecidua da Fazenda Barreiro Rico, município dde Anhembi, SP. Revta. Brasil. Biol. 50(1): 133–147.

Cesar, O. & Leitão Filho, H. F. 1990b. Estudo fitossociológico da mata mesófila semidecidua da Fazenda Barreiro Rico, município de Anhembi, SP. Revta. Brasil. Biol. 50(2): 443–452.

Clifford, H. T. & Stephenson, W. 1975. An introduction to numerical classification. Academic Press, London.

CONSEMA (Conselho Estadual de Meio Ambiente) 1985. Áreas naturais do estado de São Paulo. State Secretary of Environment, São Paulo.

Dunn, G. & Everitt, B. S. 1982. An introduction to mathematical taxonomy. Cambridge University Press, Cambridge.

Furley, P. A., Proctor, J. & Ratter, J. A. 1992. Nature and dynamics of forestsavanna boundaries. Chapman & Hall, London.

Gabriel, J. L. C. 1990. Composição florística e estrutura fitossociológica do estrato arbóreo de mata mesófila semidecidua de encosta no município de Botucatu, SP. MSc Thesis, State University "Julio de Mesquita Filho"/UNESP, Rio Claro.

Gandolfi, S. 1991. Estudo florístico e fitossociológico de uma floresta residual na área de Aeroporto Internacional de Guarulhos, SP. MSc Thesis, State University of Campinas/UNICAMP, Campinas.

Gibbs, P. E. & Leitão Filho, H. F. 1978. Floristic composition of an area of gallery forest near Mogi Guaçu, state of São Paulo, S. E. Brazil. Revta. Brasil. Bot. 1: 151–156.

Joly, C. A., Leitão Filho, H. F. & Silva, S. M. 1992. The floristic heritage. In Cânara, I. G. (Coord.), Atlantic Rain Forest, Editora Index Ltda. & Fundação S.O.S. Mata Atlântica, Rio de Janeiro, pp. 95–125.

Kotchetkoff-Hendriques, O. & Joly, C. A. 1994. Estudo florístico e fitossociológico em uma mata mesófila semidecídua na Serra do Itaqueri, Itirapina, Estado de São Paulo. Revta. Brasil. Biol. 54(3): 477–487.

Lacativa, A. Z. 1983. Ocorrência de geada no Estado de S. Paulo. MSc Thesis, State University of São Paulo/USP, São Paulo.

Leitão Filho, H. F. 1982. Aspects taxonômicos das florestas do Estado de São Paulo. Silv. S. Paulo 16A (Anals of the National Congress of Native Species), pp. 197–206.

Mantovani, W., Rossi, L., Romaniuc Neto, S. Assadd-Ludewiges, I. Y., Wanderley, M. G. L., Melo, M. M. R. F. de & Toledo, C. B. 1989. Estudo fitossociológico de áreas de mata ciliar em Mogi Guaçu, SP, Brasil. Anals Symp. Gallery Forest, pp. 235–267.

Martins, F. R. 1991. Estrutura de uma floresta mesófila. UNICAMP Ed., Series Thesis, Campinas.

Matthes, L. A. F., Leitão Filho, H. F. & Martins, F. R. 1988. Bosque dos Jequitibás (Campinas, SP): composição florística e estrutura fitossociológica do estrato arbóreo. Anals V Congress Botany Society of São Paulo, pp. 55–76.

Meira Neto, J. A. A. & Bernacci, L. C. 1986. Levantamento das Angiospermas arbóreas na Fazenda Santa Carlota, Município de Cajurú, SP. BSc Thesis, State University of São Paulo/USP, Ribeirão Preto.

Meira Neto, J. A. A., Bernacci, L. C., Grombone, M. T., Tamashiro, J. Y. Leitão Filho, H. F. 1990. Composição florística da mata semidecídua de altitude do Parque Municipal da Grota Funda (Atibaia – Estado de São Paulo). Acta Bot. Brasil. 3: 51–74.

Morellato, L. P. C., Rodrigues, R. R., Leitão Filho, H. F. & Joly, C. A. 1989. Estudo comparativo da fenologia de espécies arbóreas de altitude e floresta mesófila semidecídua na Serra do Japi, Jundiaí, São Paulo. Revta. Brasil. Bot. 12: 85–98.

Nicolini, E. M. 1990. Composição florística e estrutura fitossociológica do estrato arbórea em mata mesófila semidecídua no município de Jahu, SP. MSc Thesis, State University "Julio de Mesquita Filho"/UNESP, Rio Claro.

Pagano, S. N. & Leitão Filho, H. F. 1987. Composição florística do estrato arbóreo da mata mesófila semidecidua, no município de Rio Claro (Estado de São Paulo). Revta. Brasil. Bot. 10: 37–47.

Oliveira Filho, A. T., Vilela, E. A., Gavilanes, M. L. & Carvalho, D. A. 1994. Effect of flooding regime and understorey bamboos on the physiognomy and tree species composition of a tropical semideciduous forest in Southeastern Brazil. Vegetatio 113: 99–124.

Pinto, M. M. 1989. Levantamento fitossociológico de uma mata residual: campus de Jaboticabal da UNESP. MSc Thesis, State University "Julio de Mesquita Filho"/UNESP, Jaboticabal.

Ponçano, W. L., Carneiro, C. D. R., Bistrichi, C. A., Almeida, F. F. M. & Prandini, F. L. 1981. Mapa geomorfológico do Estado de São Paulo. Inst. Tecnol. Res. S. Paulo, São Paulo.

Rizzini, C. T. 1963. Nota prévia sobre a divisão fitogeográfica (florístico-sociológica) do Brasil. Revta. Brasil. Geog. 25: 3–64.

Rodrigues, R. R. 1986. Levantamento florístico e fitossociológico das matas da Serra do Japi, Jundiaí, SP. MSc Thesis, State University of Campinas/UNICAMP, Campinas.

Rohlf, F. J. 1988. NTSYS-pc-User's manual. Exeter Publishing, New York.

Rossi, L. 1987. A flora arbóreo-arbustiva da mata de Reserva da Cidade Universitária "Armando de Salles Oliveira", São Paulo, SP. MSc Thesis, State University of São Paulo/USP, São Paulo.

Salis, S. M. 1990. Composição florística e estrutura de um remanescente de mata ciliar do rio Jacaré-Pepira, Brotas, SP. MSc Thesis, State University of Campinas/UNICAMP, Campinas.

Salis, S. M., Tamashiro, J. Y. & Joly, C. A. 1994. Florística e fitossociológia do estrato arbóreo de um remanescente de mata ciliar do rio Jacaré-Pepira, Brotas, SP. Revta. Brasil. Bot. 17(2): in press.

Schlitter, F. H. M. F. 1990. Fitossociológia e ciclagem de nutrientes na floresta tropical do Parque Estadual do Morro do Diabo (região do Pontal do Paranapanema). PhD Thesis, State University "Julio de Mesquita Filho"/UNESP, Rio Claro.

Setzer, J. 1966. Atlas Climático e Ecológico do Estado de São Paulo. Comissão Interestadual da Bacia Paraná-Uruguai, São Paulo.

Silva, A. F. 1989. Composição florística e estrutura fitossociológica do estrato arbóreo da Reserva Florestal Professor Augusto Ruschi, São José dos Campos – SP. PhD Thesis, State University of Campinas/UNICAMP, Campinas.

Silva, A. F. & Shepherd, G. J. 1986. Comparações florísticas entre algumas matas brasileiras utilizando análise de agrupamento. Revta. Brasil. Bot. 9: 81–86.

Struffaldi-de-Vuono, Y. 1985. Fitossociológia do estrato arbóreo do Instituto de Botânica (São Paulo, SP). PhD Thesis, State University of São Paulo/USP, São Paulo.

Struffaldi-de-Vuono, Y. & Marzolla, M. C. 1986. Decomposição de serrapilheira nas proximidades de uma siderúrgica. Anals V Congress Botany Society of São Paulo, pp. 83–86.

Torres, R. B. 1989. Estudos florísticos em mata secundária Estação Ecológica de Angatuba, Angatuba (São Paulo). MSc Thesis, State University of Campinas/UNICAMP, Campinas.