Artigo científico

Checklist of trees at the Sao Roque campus, Federal Institute of Sao Paulo

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Abstract. Trees are important elements of ecosystems, especially in Atlantic rain forest ecosystems. At the Sao Roque campus, Federal Institute of Sao Paulo, the arboreal flora comprises indigenous species of the Atlantic biome, as well as foreign species and cultivated angiosperms. The research focused on qualitative and quantitative analyses, generating a checklist of species and their botanical families. A total amount of 34 families (3 of Gymnospermae, and 31 of Angiospermae), and 72 species were observed. The most representative families in number of species were Fabaceae, Myrtaceae, Anacardiaceae, and Bignoniaceae. The occurrence of an arboretum of native species located at the Sao Roque campus contributes to a high number of indigenous plants. Although the number of species and families might reveal a relatively high rate of vegetal biodiversity, many individuals have been purposefully introduced, thus suggesting that the area should continue to be re-vegetated.
Keywords: Trees, Sao Roque campus, survey.

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1 Introduction

Broadly, the variety of climate and topography features found throughout the Atlantic Domain (AB' SABER, 1977) has historically and geologically enhanced a wide range of environments and complex ecosystems. Various authors, such as Mantovani (1990), Leitão-Filho (1994), Ivanauskas *et al.* (2000), and Scarano (2002), relate the Atlantic rain forest, the semi-deciduous forest, the mangroves, and plateau fields to such domain. Oliveira-Filho & Fontes (2000) point out that within the Sao Paulo State, Brazil, such environmental variation is abrupt: whereas over 3,600 mm.year^{-1} of rain falls nearby the ocean-faced vegetation, an average rate of 1,350 mm.year^{-1} precipitates over the more seasonal, drier segments.

The Atlantic rain forest is one of the richest and more diverse ecosystems in the world (OLIVEIRA-FILHO & FONTES, 2000). Despite its ecological importance, over 90% of its original area has already been destroyed and deforested, and extensive areas of primary vegetation are extant only along the steep oceanic mountain ranges from Rio de Janeiro to Santa Catarina States, Brazil (MOURA *et al.*, 2007).

The best and most preserved remnants of the Atlantic rain forest are located throughout the southeastern area of Brazil, mainly in Sao Paulo and Parana States. Such particularity is due to the sharp, steep and hard-to-climb topography of Serra do Mar, which has stickled agricultural activities in those places. Thus, 2-3% of the reminiscent forest coverage surprisingly stretches exactly at the vicinities of the most developed urban centers in Brazil, e.g. the Sao Paulo municipality (SANTOS, 2001; SÃO PAULO, 1997).

Sao Roque is a medium-sized town located 65 km away from Sao Paulo city. Its typical vegetation comprises the plateau Atlantic rain forest plants. There is no published record of

checklists of trees in the municipality. Moreover, at the campus Sao Roque (Federal Institute of Sao Paulo) few research activities focusing on checklists of families and species have been made, none regarding the arboreal stratum. The present paper, then, focuses on the following questions: What trees are found in the area? Are these trees representative of the surrounding biome? What trees are indigenous, and which ones are foreign to the place?

2 Materials and methods

2.1 Study area

The arboreal layer was surveyed at the Sao Roque campus, Instituto Federal de Educação, Ciência e Tecnologia (23°33'168'' S, 47°09'005'' W), located at 2100 Rodovia Prefeito Quintino de Lima, Sao Roque, Sao Paulo State, Brazil. The campus area covers approximately 36,000 m² (3.6 ha). Its average altitude is 826 m above sea level (Figure 1).

Figure 1. Aerial view of the study area; geographical coordinates were taken with GPS at the yellow spot. Marked sites: 1 = Marshy land and water stream covered with *Eichhornia crassipes* (Mart.) Solms (Pontederiaceae); 2 = Greenhouse facilities; 3 = Laboratories complex facility; 4 = Backyard site with disturbed vegetation, organic orchard, and massive occurrence of *Leucaena leucocephala* (Lam.) de Wit (Fabaceae, Mimosoideae) individuals; 5 = Greenhouse facility and arboretum of native species; 6 = Woodland with various angiosperm families representatives; 7 = Administrative and educational complex facilities (library, classrooms etc.); 8 = Access motorway (Rodovia Prefeito Quintino de Lima – see text); 9 = Disturbed vegetation and parking facility. Image taken at the altitude of 1.11 km on July 27, 2012. Google Earth® Program, ©2013 Map Link, Digital Globe (access on May 29, 2013).

The study site was previously occupied with pottery activities, being heavily disturbed by anthropic actions in various periods. Most of the campus soil is compacted with rubbish

and brick waste; thus, it may be characterized as a hardened sandy clayish soil, which is occasionally waterlogged. The area is perennially moist due to the proximity to the backyard water stream and marshy spots.

According to Peel *et al*. (2007), the climatic classification of the study area is Cwa/Köppen, with two distinct seasons: dry and cool months (from April to September), and wet and warm to hot months (from October to March). Average annual rain precipitation is 1,321 mm; average precipitation during the least rainy month (August) is 38.5 mm, and average precipitation during the rainiest month (January) is 225.9 mm (CEPAGRI, 2013). Hail discharges and windy storms are rare, though invariably occurring throughout adverse weather conditions.

The surrounding vegetation encompasses typical representatives of the Sao Paulo regional plateau Atlantic rain forest (see Results and Discussion) mixed with foreign plants, and individuals of other Brazilian biomes, such as *Araucaria angustifolia* Kuntze (Araucariaceae). Degraded areas are common, as evidenced in Figure 1.

According to Bucci (2013), the municipality of Sao Roque is part of the so-called "Reserva da Biosfera do Cinturão Verde da Cidade de Sao Paulo (RBCV)", a set of vegetation fragments and green corridors engulfing both the Atlantic rain forest and the Brazilian savanna (Cerrado *lato sensu*)[1].

2.2 Survey methods

Trees were defined following the criteria adopted by Ziparro *et al*. (2005), i.e., by considering individuals $\geq$ 3 m high, with ligneous trunk and main stems, with monopodial or dichotomous up-straight growth, and/or chest-level diameter $\geq$ 5 cm wide. Species, such as *Euterpe edulis* Mart. (Arecaceae), were not fully grown to fit these criteria by the time the observation was carried out, although are trees when adult. These individuals were also considered and are part of the checklist. On the other hand, banana trees (*Musa* spp, Musaceae) – popularly, but not botanically, considered trees – were not reported for surveying purposes, as the aerial and conspicuous 'stem' is truly a sheaf of leaves.

Individuals found within spots 4, 5 and 6 (Figure 1) were photographed, registered, and identified during two weeks. Common strolling was the observation method adopted, as the area is relatively small and presents no major problems for locomotion (Figure 2).

A Nikon D3000 digital camera was used with 18-55 mm and 55-200 mm objective lenses (1:3.5-5.6G VR and 1:4-5.6 G, respectively). Images were digitally treated with the Microsoft Photo Editor® program.

Specific literature for plant identification included Barroso *et al.* (1978), Cronquist (1981), Lorenzi (1998) and The International Plant Names Index (2012). Lorenzi (2012) was used to identify angiosperms, which are currently listed based on the APG-III (Angiosperm Phylogeny Group) proposal.

[1] RBVC (in English, "Biosphere Reserve of the Sao Paulo Municipality Green Belt") was created on June 09, 1994, and certified by UNESCO in the same year. It covers 73 municipalities and roughly 1.6 million ha of Atlantic rain forest and Brazilian savanna areas.

Some reproductive organs (flowers and/or fruit) of the surveyed trees were collected with pruning shears. These materials were then dehydrated for 7-10 days in a press placed inside an oven (average temperature rate = 40±5 ºC) located at the Botany Laboratory (spot 3, Figure 1), and subsequently incorporated to the Herbarium IFSR (SANTOS & MORAES, 2012)[2].

Geographical coordinates were measured with a Garmin® eTrex 30 portable GPS device.

Figura 2. Overview of some woodland sites inside campus Sao Roque. Left photograph depicts banana trees (*Musa* spp, Musaceae) amongst other angiosperm trees (spot 6 in Figure 1); right photograph shows some of the arboretum (spot 5 in Figure 1) species, with *Senna multijuga* (L. C. Rich.) H. S. Irwin & Barneby (Fabaceae, Caesalpinioideae) on front plan (Credit of the left photograph to Leticia de Souza Quirino Pereira).

3 Results and discussion

Arboreal individuals were found neither in spot 2 (Figure 1), nor in spot 1 (Figure 1). The latter is a marshy place with the predominance of the aquatic plant *Eichhornia crassipes* (Mart.) Solms (Pontederiaceae) (Figure 3).

Although spot 9 (Figure 1) is within the campus area, it was not surveyed because it is constantly disturbed by the movement of cars, as a parking lot for students and visitors is located adjacent to it.

The total amount of families observed was 34, being three of the Gymnospermae group, and 31 of the Angiospermae group. Individuals were not counted. The total number of species was 72.

Fabaceae was the most diverse family (13 species), followed by Myrtaceae (six species), Anacardiaceae (five species), and Bignoniaceae (four species). Three families (Lauraceae, Meliaceae and Moraceae) have three species each. Eight families (Annonaceae, Arecaceae, Boraginaceae, Euphorbiaceae, Malvaceae, Polygonaceae, Sapindaceae and Verbenaceae) have two species each. Nineteen families (Adoxaceae, Araucariaceae, Bixaceae, Clusiaceae, Cupressaceae, Flacourtiaceae, Lecythidaceae, Lythraceae, Melastomataceae, Phytolaccaceae, Pina-

[2] The Herbarium is hosted at the electronic site: http://www.fernandosantiago.com.br/hifsr.htm (last access on May 30, 2013).

ceae, Proteaceae, Rhamnaceae, Salicaceae, Rosaceae, Rubiaceae, Rutaceae, Sterculiaceae and Solanaceae) have only one species each.

Table 1 shows all of the botanical families and species surveyed, and Figure 4 relates most diverse families in terms of species.

Figure 3. *Eichhornia crassipes* (Mart.) Solms (Pontederiaceae) growing massively on the surface of the backyard water stream. Front plan shows *Typha angustifolia* L. (Typhaceae); a remnant of the Atlantic forest and a disturbed area are shown on the background plan.

For a relatively small place such as the Sao Roque campus, the number of families and species is relatively high, when comparing data with other papers dealing with similar ecosystems, such as that of Joly *et al.* (1991). Yet, it is remarkable to notice that many of these species have been introduced into the site with various purposes: didactic and pedagogical uses, research for organic experimentation, and even the implementation of an arboretum of native species (MORAES & SANTOS, 2012)[3]. The arboretum currently holds 31 species of native (indigenous) representatives of the Atlantic rain forest and Brazilian savanna biomes (thus, 54.5% of the total amount of indigenous plants found in the site).

The ratio between exotic and indigenous species is approximately 1:4 (20.8% of exotic species, and 79.2% of indigenous species).

Myrtaceae, the second richest family in number of species, is the only botanical group with no exotic representatives, being almost all surveyed species commonly found in Atlantic rain forest formations. In other research works, the family is well represented (CARVALHO *et al.,* 2006; CERVI *et al.,* 2007; LANDRUM, 1986).

[3] Information about the arboretum is available at: http://www.fernandosantiago.com.br/arboreto.htm

Table 1. Checklist of botanical families, species and origin (I = indigenous; E = exotic/foreign) at the Sao Roque campus, Federal Institute of Sao Paulo.

Botanical family	Species	Origin
Adoxaceae	*Sambucus nigra* L.	E
Anacardiaceae	*Lythraea molleoides* (Vell.) Engl.	I
	Mangifera indica L.	E
	Myracrodruon urundeuva M. Allemao	I
	Schinus molle L.	I
	Schinus terebinthifolius Raddi	I
Annonaceae	*Annona coriacea* Mart.	I
	Guatteria olivacea R. E. Fries	I
Araucariaceae	*Araucaria angustifolia* Kuntze	I
Arecaceae	*Euterpe edulis* Mart.	I
	Syagrus romanzoffiana (Cham.) Glassman	I
Boraginaceae	*Cordia trichotoma* (Vell.) Arrabida ex Steudel	I
	Cordia superba Cham.	I
Bignoniaceae	*Jacaranda micrantha* Cham.	I
	Tabebuia avellanedae Lorentz ex Griseb.[4]	I
	Tabebuia roseoalba (Ridl.) Sandwith	I
	Tabebuia serratifolia (Vahl) G. Nicholson	I
Bixaceae	*Bixa orellana* L.	I
Clusiaceae	*Calophyllum brasiliense* Camb.	I
Cupressaceae	*Cupressus lusitanica* Miller	E
Euphorbiaceae	*Croton floribundus* Spreng.	I
	Mabea fistulifera Mart.	I
Fabaceae	*Acacia mangium* Wild.	E
	Albizia inundata (Mart.) Barneby & J. W. Grimes	I
	Anadenanthera macrocarpa (Benth.) Brenan	I
	Bauhinia forficate Link	I
	Caesalpinia echinata Lam.	I
	Caesalpinia peltophoroides Benth.	I
	Copaifera langsdorffii Desf.	I
	Enterolobium contortisiliquum (Vell.) Morong	I
	Hymenaea courbaril Hayne	I
	Inga vera Wild (cf. *affinis*)	I
	Leucaena leucocephala (Lam.) de Wit.	E
	Piptadenia gonoacantha (Mart.) J. F. Macbr.	I
	Schizolobium parahyba (Vell.) Blake	I
Flacourtiaceae	*Carpotroche brasiliensis* Endl.	I
Lauraceae	*Ocotea puberula* (Rich.) Nees	I
	Persea Americana Mill.	E
	Persea pyrifolia Ness & Mart.	I
Lecythidaceae	*Cariniana legalis* (Mart.) Kuntze	I
Lythraceae	*Lafoensia glyptocarpa* Koehne	I
Malvaceae	*Apeiba tiborbou* Aubl.	I
	Ceiba speciosa (A. St. Hill) Ravenna	I
Melastomataceae	*Tibouchina pulchra* (Cham.) Cogn.	I
Meliaceae	*Cedrela fissilis* Vell.	I

[4] Some authors place it as *Handroanthus impetiginosus* (Mart. Ex DC.) Mattos; however, there is great debate among taxonomists.

	Melia azedarach L.	E
	Tooana ciliate M. Roemer	E
Moraceae	*Artocarpus heterophyllus* Lam.	E
	Ficus guaranitica Chodat & Vischer	I
	Morus nigra L.	E
Myrtaceae	*Eugenia pyriformis* Cambess	I
	Eugenia uniflora L.	I
	Plinia trunciflora (O. Berg) Kaussel	I
	Psidium cattleianum Sabine	I
	Psidium guajava L.	I
	Psidium rufum Mart. ex DC.	I
Phytolaccaceae	*Gallesia integrifolia* (Spreng.) Harms	I
Pinaceae	*Pinus elliottii* Engel.	E
Polygonaceae	*Seguieria langsdorffii* Moq.	I
	Triplaris Americana L.	I
Proteaceae	*Euplassa cantareirae* Sleumer	I
Rhamnaceae	*Hovenia dulcis* Thumb.	E
Salicaceae	*Casearia sylvestris* Sw.	I
Rosaceae	*Eriobotrhya japonica* (Thumb.) Lindl.	E
Rubiaceae	*Coffea Arabica* L.	E
Rutaceae	*Citrus* x *Limon*	E
Sapindaceae	*Allophylus edulis* (A. St. Hill & Cambess) Radlk	I
	Dodonaea viscose Jacq.	I
Sterculiaceae	*Guazuma ulmifolia* Lam.	I
Solanaceae	*Solanum paniculatum* L.	I
Verbenaceae	*Citharexylum myrianthum* Cham.	I
	Vitex polygama Cham.	I

Fabaceae, the third largest family amongst the Angiospermae (POLHILL & RAVEN, 1981) – being inferior only to Orchidaceae and Asteraceae in number of genera and species (JOLY, 1966) –, is well represented at the study area; in fact, it is the family with more species. Curiously, Melastomataceae and Rubiaceae, two commonly found families in rain forests (THOMAS, 2008), poorly occur at the surveyed site, with only one species each.

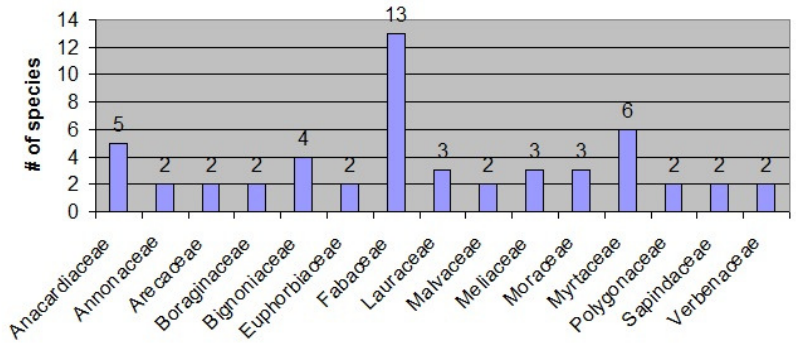

Figure 4. Families with more than one species surveyed at the Sao Roque campus.

4 Final considerations

The present checklist of botanical families and species of phanerogamous plants is the first qualitative and quantitative survey of this kind carried out at the study area. Lack of research on similar types of study throughout the Sao Roque region, however, does not allow deeper comparisons in terms of regional arboreal flora.

Currently, the campus is still under construction, with many projects being developed and new buildings being planned. Future remodeling of the extant flora might change the information in the present paper.

Field trips and consistent research inside areas that surround the campus, which are part of broader forest remnants, might supply forthcoming studies with comparable materials.

By knowing the species that occur in a certain place, one can understand part of the local biodynamics and contribute to the maintenance of its trees.

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