TREE STRUCTURE OF A SMALL NATIVE FRAGMENT AS AN AID TO CONSERVATION OF URBAN GREEN AREAS IN SALTO DE PIRAPORA, SÃO PAULO, BRAZIL

ESTRUTURA ARBÓREA DE UM PEQUENO FRAGMENTO NATIVO COMO FERRAMENTA PARA A CONSERVAÇÃO DE ÁREAS VERDES URBANAS EM SALTO DE PIRAPORA, SÃO PAULO

Paulo Henrique Gaem-Barbosa[1]*, Nicolli Bruna Cabello de Almeida[1], Laíne Silveira Corrêa[2], Eliana Cardoso-Leite[3]

[1] Engenharia Florestal, Universidade Federal de São Carlos – Sorocaba
[2] Programa de Pós-Graduação em Biologia Vegetal, Universidade Estadual de Campinas
[3] Departamento de Ciências Ambientais, Universidade Federal de São Carlos – Sorocaba
* Autor para correspondência: phgaem@gmail.com

ABSTRACT

We aimed to show information about the tree structure of a small remnant of native vegetation and indicate possible measures to its conservation. We sampled trees which diameter at breast height was equal to or greater than 5 cm in twelve plots of 10×10 m size. We verified low diversity (H'=1.825 nats/ind.) and low evenness (J'=0.620) values, pioneer species prevalence with high dominance of *Lithrea molleoides* and *Moquiniastrum polymorphum* and 58% of species with zoochoric seed dispersal. Our results demonstrated early stage of the area due to high degradation history. The results represented the first step towards conservation actions. We suggested that local authorities isolate the fragment from external degradation factors and promote enrichment plantation with native species.

Keywords: Phytosociology. Management. Ecological succession. Semideciduous Seasonal Forest.

RESUMO

O objetivo deste trabalho foi apresentar informações sobre a estrutura arbórea de um fragmento de floresta nativa e indicar possíveis ações para sua conservação. Árvores com diâmetro à altura do peito igual ou superior a 5 cm foram amostradas em 12 parcelas de tamanho 10×10 m. Verificamos baixos números para diversidade (H'=1,825 nats/ind.) e equabilidade (J'=0,620), predomínio de espécies pioneiras com alta dominância de *Lithrea molleoides* e *Moquiniastrum polymorphum* e 58% de espécies zoocóricas. Os valores encontrados indicaram estágio inicial de sucessão devido ao histórico de intensa degradação. Os resultados representaram o primeiro passo à tomada de ações voltadas à conservação. Sugerimos o isolamento da área e o enriquecimento com espécies nativas.

Palavras-chaves: Fitossociologia. Manejo. Sucessão ecológica. Floresta Estacional Semidecidual.

The Brazilian State of São Paulo is historically known for the devastation of natural vegetation, especially in the 20th century. It is estimated that 81.8% of its territory was primitively covered by natural formations (forests and savannahs) of which only 13.9% remained in the beginning of the second millennium (KRONKA, NALON; MATSUKUMA, 2005). Semideciduous Seasonal Forest is the most degraded Mata Atlântica physiognomy in the State due to soil fertility and favourable relief to agriculture and farming activities (LOPES et al., 2012). It comprises of mainly secondary fragmented forests that usually differ from one another in diversity and occurring species (LIEBSCH; MARQUES; GOLDENBERG, 2008). Then, losing these interior forests completely might cause extinction of some of its unique species.

Sorocaba Administrative Region has the second biggest area of original vegetation cover in the State and still important Semideciduous Seasonal Forest remaining fragments (KRONKA; NALON; MATSUKUMA, 2005). Salto de Pirapora, a small city included within this region, was incorporated into recently created Sorocaba Metropolitan Area. This new scenario implies changes in infrastructure planning and expansion of urban areas and it may be a threat to the region's so important but even though insufficiently protected biodiversity.

In this context, actions taken by local governments to preserve small remnants without consolidated legal protection at State or national levels are crucial to contribute to the quality of these small fragments and improve interconnection among them. Thus, this survey aims to present information about a tree community of a natural remnant in Salto de Pirapora and indicate possible actions municipal government can make not to only protect its remaining natural vegetation but also contribute to preservation of biodiversity in the entire region. The city is inserted in an ecotone between Semideciduous Seasonal Forest and Savannah. Local elevation is 630 meters above sea level, average annual precipitation is 1261 mm and climate is Cwa according to Köppen classification, with hot and rainy summers and dry winters (CEPAGRI, n.d.). The area of study is a municipal green area entitled "Parque Natural de Preservação Ambiental Olésio dos Santos" (figure 1) and was created by municipal law N° 008/2015 dated April 27th, 2005 (SALTO DE PIRAPORA, 2005). Covering 67,680.88 m², this place is directly connected to Pirapora river permanent preservation areas, so its conservation is strategical and relevant in terms of decrease of fragmentation and improvement of species flow. Nevertheless, this area present a degradation history with factors such as selective harvesting, cattle treading and trail clearing, causing damages in adult plants and preventing natural regeneration potential of the community to advance in succession (BRANCALION; GANDOLFI; RODRIGUES, 2015).

Phytosociological survey was completed using continuous plot method (MÜELLER-DOMBOIS; ELLENBERG, 1974). Three groupings of plots (figure 1) were set within Parque

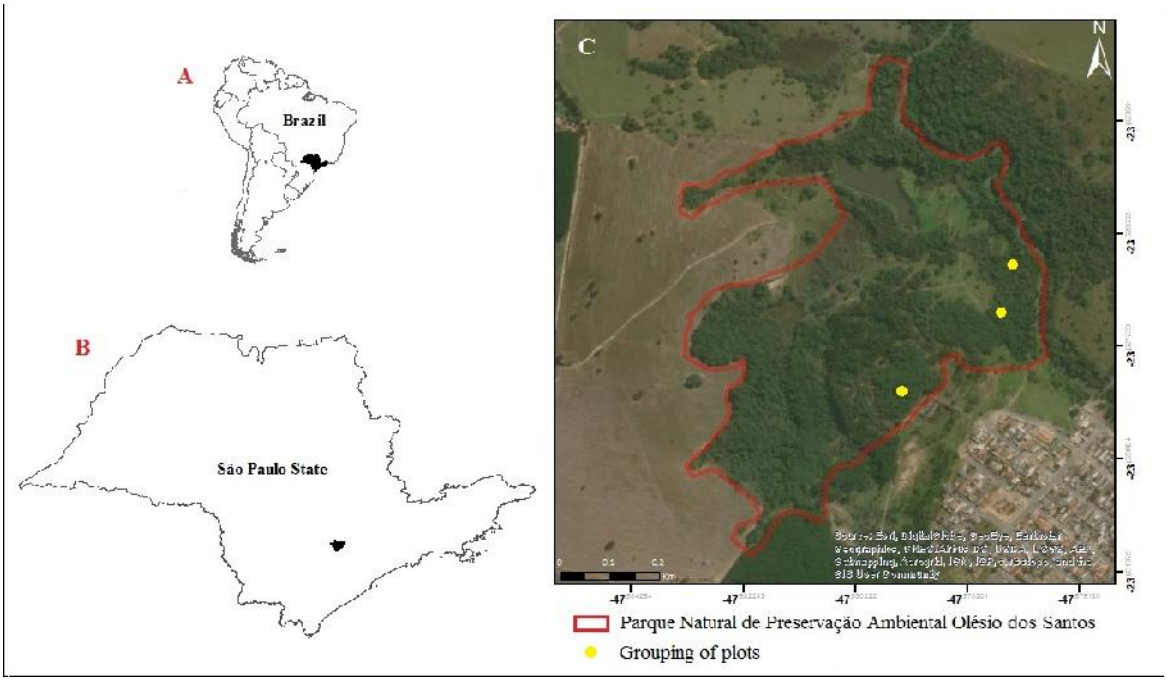

Figure 1. Location of small remnant of native vegetation under anthropic impact in Salto de Pirapora, São Paulo, Brazil. A) Position of São Paulo State in Brazil; B) Position of Salto de Pirapora municipality in São Paulo; C) The area of study boundaries in local scale

Natural de Preservação Ambiental Olésio dos Santos, where a total of twelve plots of size 10×10 meters were delimited. Information about total height and diameter at breast height (DBH) was recorded for all woody plants which DBH were equal to or greater than 5 cm. Botanical samples were collected for further identification and plants were named according to Flora do Brasil 2020 [em construção] (n.d.). Each collected species was classified according to seed dispersal syndrome and successional group according to Swaine and Whitmore (1988) classification. Phytosociological parameters were calculated using Fitopac 2.1 software (SHEPHERD, 2009).

Altogether, 148 individual samples were collected, belonging to 19 native species and 16 botanical families. Phytosociological and ecological parameters are shown in tables 1 and 2.

Table 1. Phytosociological parameters (H' – Shannon-Wiener diversity index; J' – Pielou species evenness index) and successional group and seed dispersal syndrome percentage for species (P – pioneer; NP – non-pioneer; ZOO – zoochoric; ANE – anemochoric; AUT – autochoric) found in a small remnant of native vegetation under anthropic impact in Salto de Pirapora, São Paulo, Brazil

Phytosociological parameters		**Ecological proportions**[1]				
H'	**J'**	**P**	**NP**	**ZOO**	**ANE**	**AUT**
1.825 nats/ind.	0.620	42%	37%	58%	16%	5%

[1]Unclassified species (such as dead individuals and morphospecies) were present in this survey but are not represented in this table

The diversity index found is lower than that raised in other studies made in the same region (CARDOSO-LEITE; RODRIGUES, 2008; COELHO; CARDOSO-LEITE; CASTELLO, 2016) and even lower than those considered low by the authors at the same phytophysiognomy (DONADIO; PAULA; GALBIATTI, 2009; FONSECA; RODRIGUES, 2000). Low diversity values may indicate that local the community was recently established or some external factors are preventing ecological succession processes to occur properly. The proportion of pioneer species corroborates the hypothesis that succession is in initial stages as defined by Swaine and Whitmore (1988) and is smaller than in results found in studies nearby (CORRÊA et al., 2014, COELHO; CARDOSO-LEITE; CASTELLO, 2016). The evenness index value is also low, evidencing that individuals are not well distributed equally in species. In fact, species *Aloysia virgata* (Ruiv e Pav.) Juss. (Verbenaceae), *Cecropia pachystachya* Trécul (Urticaceae), *Cupania vernalis* Cambess. (Sapindaceae), *Tabernaemontana catharinensis* A.DC. (Apocynaceae) and *Tapirira obtusa* (Benth.) J.D.Mitch. (Anacardiaceae) were represented by only one individual.

The Importance Value (IV) for species is displayed in figure 2 and in table 2. The two species with the biggest IV values represent 40% of its totality, showing that there is dominance in representation of some species and others are underrepresented in local community. This result may indicate that the study area is suitable for a few species – a typical aspect of situations of initial succession (BUDOWSKI, 1965; GANDOLFI, 2000). However, the dominant species *Lithrea molleoides* (Vell.) Engl. (Anacardiaceae) and *Moquiniastrum polymorphum* (Less.) G. Sancho (Asteraceae) may respectively play important roles related to fauna attraction and soil conservation

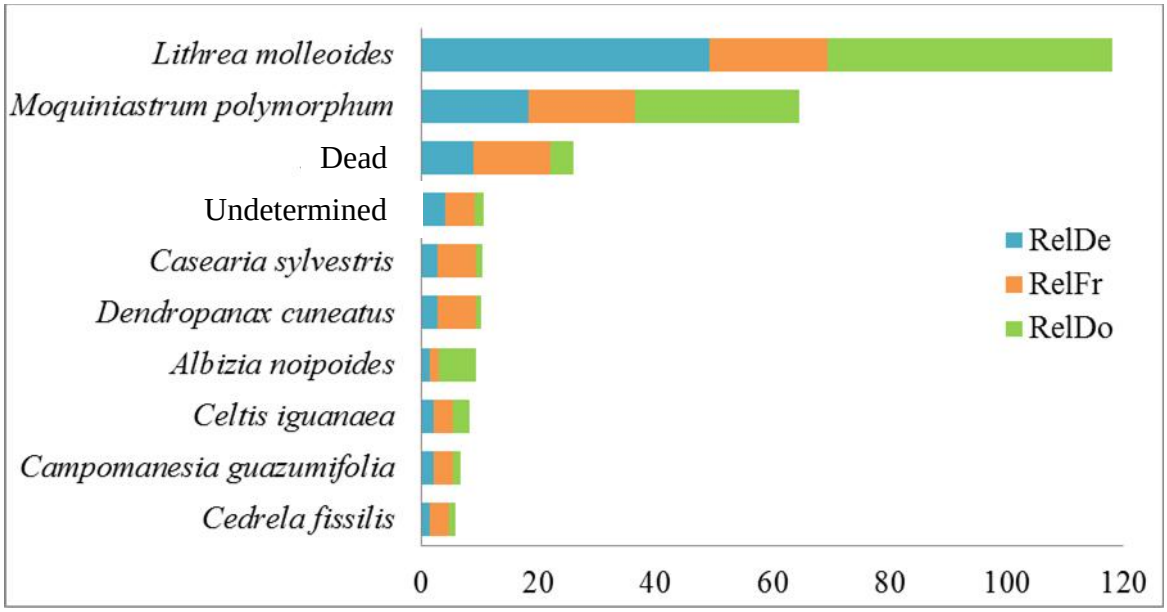

Figure 2. Importance Value for the ten most representative species in RelDe – relative density; RelFr – relative frequency; RelDo – relative dominancy in a small remnant of native vegetation under anthropic impact in Salto de Pirapora, São Paulo, Brazil

(NAPPO et al., 2004; GLUFKE, 1999). Furthermore, species sampled in this study were also found in other studies of the same physiognomy (ALBUQUERQUE; RODRIGUES, 2000; KORTZ et al., 2014; CORRÊA et al., 2014; COELHO; CARDOSO-LEITE; CASTELLO; 2016).

Table 2. Species sampled and its phytosociological values (RelDe – relative density; RelFe – relative frequency; RelDo – relative dominance), as well as its and successional group (SG: P – pioneer; NP – non-pioneer; NC – no classification) and seed dispersal syndrome (SDS: ZOO – zoochoric; ANE – anemochoric; AUT – autochoric; NC – no classification) in a small remnant of native vegetation under anthropic impact in Salto de Pirapora, São Paulo, Brazil

Family	**Species**	**RelDe**	**RelFr**	**RelDo**	**IVI**	**SG**	**SDS**
Anacardiaceae	*Lithrea molleoides*	49.32	20.00	48.78	118.10	P	ZOO
	Tapirira obtusa	0.68	1.67	0.10	2.44	NP	ZOO
Apocynaceae	*Tabernaemontana catharinensis*	0.68	1.67	0.42	2.76	P	ZOO
Araliaceae	*Dendropanax cuneatus*	2.70	6.67	0.85	10.22	P	ZOO
Asteraceae	*Moquiniastrum polymorphum*	18.24	18.33	27.94	64.52	P	ANE
Cannabaceae	*Celtis iguanaea*	2.03	3.33	2.74	8.10	P	ZOO
Fabaceae	*Albizia noipoides*	1.35	1.67	6.16	9.18	NP	AUT
	Fabaceae sp2	0.68	1.67	1.78	4.12	NC	NC
Meliaceae	*Cedrela fissilis*	1.35	3.33	1.17	5.85	NP	ANE
Myrtaceae	*Campomanesia guaviroba*	1.35	3.33	0.60	5.28	NP	ZOO
	Campomanesia guazumifolia	2.03	3.33	1.34	6.70	NP	ZOO
Rubiaceae	Rubiaceae sp1	0.68	1.67	0.59	2.93	NC	NC
Salicaceae	*Casearia sylvestris*	2.70	6.67	0.91	10.28	P	ZOO
Sapindaceae	*Cupania vernalis*	0.68	1.67	0.15	2.49	NP	ZOO
Sapotaceae	*Chrysophyllum marginatum*	1.35	3.33	0.56	5.25	NP	ZOO
Urticaceae	*Cecropia pachystachya*	0.68	1.67	0.21	2.55	P	ZOO
Verbenaceae	*Aloysia virgata*	0.68	1.67	0.32	2.66	P	ANE
Undetermined	Undetermined	4.05	5.00	1.48	10.53	NC	NC
Dead	Dead	8.78	13.33	3.90	26.01	NC	NC
Total		**100.00**	**100.00**	**100.00**	**300.00**	**-**	**-**

Thus, the studied environment consists of poor structure because of high degradation history. Even so, the presence of a well-structured canopy and important late species such as *Cedrela fissilis* Vell. (Meliaceae) and *Campomanesia guazumifolia* (Cambess.) O.Berg (Myrtaceae) attending within the species with biggest IV numbers suggest that this small fragment may follow the successional trajectory if negative impacts are interrupted immediately. Therefore, it is recommended that local authorities isolate the area from external degradation factors and promote enrichment plantation with native species so local community advance in succession faster.

Considering the local importance of the forest fragment studied to maintenance of local biodiversity as well as soil and water quality, the results found represent a first step to actions towards conservation in this important urban green area.

REFERENCES

KRONKA, F.J.N.; NALON, M.A.; MATSUKUMA, C.K. **Inventário florestal da vegetação natural do Estado de São Paulo**. São Paulo: Instituto Florestal, 2005. 200p.

LOPES, S.F; SCHIAVINI, I; OLIVEIRA, A.P.; VALE, V.S. An Ecological Comparison of Floristic Composition in Seasonal Semideciduous Forest in Southeast Brazil: Implications for Conservation. **International Journal of Forestry Research**, v.2012, p.1-14, 2012.

LIEBSCH, D; MARQUES, M.C.M.; GOLDENBERG, R. How long does the Atlantic Rain Forest take to recover after a disturbance? Changes in species composition and ecological features during secondary sucession. **Biological Conservation**, v.141, n.6, p.1717-1725, 2008.

CENTRO DE PESQUISAS METEOROLÓGICAS E CLIMÁTICAS APLICADAS À AGRICULTURA – CEPAGRI. **Universidade Estadual de Campinas**. Available at: <http://www.cpa.unicamp.br/outras-informacoes/clima_muni_511.html>. Acessed on: 14 Mar. 2017.

SALTO DE PIRAPORA. Lei complementar nº 008, de 27 de abril de 2005. Dispõe a criação de Parque Natural de Preservação Ambiental e dá outras providências. 13ª legislature, Salto de Pirapora, 2005.

BRANCALION, P.S.; GANDOLFI, S.; RODRIGUES, R.R. **Restauração Florestal**. São Paulo: Oficina de Textos, 2015. 431p.

MÜELLER-DOMBOIS, D.; ELLENBERG, H. **Aims and methods of vegetation ecology**. New York: Wiley, 1974. 547p.

FLORA DO BRASIL 2020 [em construção]. **Jardim Botânico do Rio de Janeiro**. Available at: <http://floradobrasil.jbrj.gov.br/>. Accessed on: 14 Mar. 2017.

SWAINE, M.D.; WHITMORE, T.C. On the definition of ecological species groups in tropical forests. **Vegetatio**, v.75, p.81-86, 1988.

SHEPHERD, G.D. **FITOPAC 2.1**. Campinas: Departamento de Biologia Vegetal, Universidade Estadual de Campinas, 2009.

CARDOSO-LEITE, E; RODRIGUES, R.R. Phytosociology and successional characterization of a fragment of tropical seasonal forest in Southeastern Brazil. **Árvore**, Viçosa, v.32, n.3, p.583-595, 2008.

COELHO, S; CARDOSO-LEITE, E; CASTELLO, A.C.D. Floristic and successional characterization as a support for conservation and management of PNMCBio, Sorocaba/SP. **Ciência Florestal**, Santa Maria, v.26, n.1, p.331-334, 2016.

DONADIO, N.M.M.; PAULA, R.C.; GALBIATTI, J.A. Florística e estrutura da comuidade arbórea de um remanescente florestal ripário no município de Guariba, Estado de São Paulo, Brasil. **Revista do Instituto Florestal**, São Paulo, v.21, n.1, p.1-17, 2009.

FONSECA, R.C.B.; RODRIGUES, R.R. Structural analysis and aspects of the successional mosaic of semi-deciduous forest, in Botucatu (São Paulo State, Brazil). **Scientia Forestalis**, n.57, p.27-43, 2000.

CORRÊA, L.S.; CARDOSO-LEITE, E.; CASTELLO, A.C.D.; COELHO, S.; KORTZ, A.R.; VILLELA, F.N.J.; KOCH, I. Structure, floristic composition and successional characterization of fragments of Semideciduous Seasonal Forest in Southeast Brasil. **Árvore,** Viçosa, v.38, n.5, p.799-809, 2014.

BUDOWSKI, G. Distribuition of tropical American forest species in a light of sucessional process. **Turrialba**: revista interamericana de ciencias agricolas, San José, v. 15**,** n.1, p. 40-42, 1965.

GANDOLFI, S. **História natural de uma floresta estacional Semidecidual no município de Campinas, São Paulo, Brasil**. 2000. 520 f. Tese (Doutorado) – Instituto de Biologia, Universidade Estadual de Campinas, Campinas, 2000.

NAPPO, M. E.; GRIFFITH, J. J.; MARTINS, S. V.; MARCO JÚNIOR, P.; SOUZA, A. L.; OLIVEIRA FILHO, A. T. Dinâmica da estrutura fitossociológica da regeneração natural em sub-bosque de *Mimosa scabrella* Bentham em área minerada, em Poços de Caldas, MG. **Árvore**, Viçosa, v.28, n.6, p.811-829, 2004.

GLUFKE, C. **Espécies Florestais Recomendadas para Recuperação de Áreas Degradadas**. 1. ed. Porto Alegre, Fundação Zoobotânica do Rio Grande do Sul, 1999. 48p.

ALBUQUERQUE, G.B.; RODRIGUES, R.R. The vegetation of the Araçoiaba Mountain, Ipanema National Forest, Iperó (SP). **Scientia Forestalis**, n.58, p.145-159, 2000.

KORTZ, A.R.; COELHO, S.; CASTELLO, A.C.D.; KOCH, I. Wood vegetation in Atlantic rain forest remnants in Sorocaba (São Paulo, Brazil). **Check List**, v.10, n.2, p.344-354, 2014.