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Floristic, structure and ecological groups of a tree community in the Atlantic Rainforest at Serra do Mar, SP, Brazil

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ABSTRACT: The present study evaluated the floristic and structural composition of a tree community in a Lowland Atlantic Rainforest along a forest continuum in Brazilian southeast, assessing the species distribution among ecological groups. For this purpose, we sampled all trees with PBH≥15 cm, including palm trees and tree ferns, in a total area of one hectare, divided into subplots of 10x10 m. The studied community was also analyzed through the Shannon diversity index and Pielou equability, and its species distribution among dispersal syndromes and successional classes. We recorded 1,120 living individuals distributed in 131 species of 40 families. The richest families were Myrtaceae (32 species), Fabaceae (12) and Rubiaceae (11), and *Euterpe edulis* was the most abundant species (11.1% of the total). In the study area, there were found four species on the Livro Vermelho da Flora do Brasil and recorded a dominance of zoochoric species (86.7% of species classified) and non-pioneers (71.6%). The general results of the community structure and species composition were similar with other surveys carried out in the same region of this study. Finally, our results corroborate the great diversity of trees and a dominance of zoochoric and non-pioneer species in the Atlantic Rainforest continuous.
Keywords: dispersal syndromes, diversity, ombrophilous dense forest, successional groups.

Florística, estrutura e grupos ecológicos de uma comunidade arbórea na Floresta Atlântica, Serra do Mar, SP, Brasil

RESUMO: Neste trabalho, avaliamos a composição florística e estrutural de uma comunidade arbórea em um contínuo da Floresta Atlântica das Terras Baixas no sudeste brasileiro, acessando a distribuição das espécies entre grupos ecológicos. Para tanto, foram amostrados todos os indivíduos arbóreos com PAP≥15 cm, incluindo palmeiras e samambaias arborescentes, em um hectare, dividido em sub-parcelas de 10x10 m. A comunidade foi analisada por meio do índice de diversidade de Shannon e equabilidade de Pielou, e distribuição de suas espécies entre síndromes de dispersão e classes sucessionais. Registramos 1.120 indivíduos vivos distribuídos em 133 espécies de 41 famílias. As famílias mais ricas em espécies foram Myrtaceae (32 espécies), Fabaceae (12) e Rubiaceae (11), e *Euterpe edulis* a espécie mais abundante (11,1% do total). Na área de estudo, foram encontradas quatro espécies na lista espécies ameaçadas do Livro Vermelho da Flora do Brasil, e registrada uma dominância de espécies Zoocóricas (86,7% das espécies classificadas) e Não Pioneiras (73,5%). Os resultados gerais da estrutura e composição de espécies da comunidade foram similares à de outros levantamentos realizados na mesma região deste estudo. Por fim, nossos resultados corroboram a grande diversidade arbórea e uma dominância de espécies Zoocóricas e Não-Pioneiras em contínuos de Floresta Atlântica.
Palavras-chave: classe sucessional, floresta ombrófila densa, diversidade, síndrome de dispersão.

1. INTRODUCTION

Tropical Forests, especially those located in the Neotropical region, are characterized by a great biological diversity and high degree of endemism (LEIGH et al., 2004; MITTERMEIER et al., 2011). In this regard, the Atlantic Forest has a high floristic richness, presenting more than 15,004 vascular species, of which 49.5% are exclusive to the phytogeographic domain (BFG, 2015). This phytogeographic domain has been established in the Brazilian territory about 70 million years ago, and it is undoubtedly the oldest forest formation in the country (FIASCHI; PIRANI, 2009).

In general, the Atlantic Forest domain presents two main vegetation types (MORELLATO; HADDAD, 2000), the Seasonal Semideciduous Forest and the Ombrophilous Dense Forest. Due to more pronounced processes of fragmentation and deforestation in areas with high anthropogenic pressure (LAURANCE, 2009; TURNER, 1996), as observed in the coastal regions of Brazil, now has only remained 11% of its original forest cover, and a large part of the remnant is situated in southeastern Brazil (RIBEIRO et al., 2009).

Among the Neotropical Forests, the Atlantic Rainforest is considered one of the most threatened hotspots (LAURANCE, 2009; MYERS et al., 2000). Although, the species composition studies and structural surveys of the Atlantic Rainforest has been highly developed in the last two decades (e.g. OLIVEIRA-FILHO; FONTES 2000; TABARELLI; MANTOVANI 1999), remains a demand to new surveys for comprehend the complexity and diversity of this biome

(EISENLOHR; OLIVEIRA-FILHO, 2015; SAITER et al., 2015). Hence, there is also a lack of studies for tree communities in certain physiognomies of the Brazilian southeast, mainly, in areas that have undergone an exhaustive human occupation, as Lowland Atlantic Rainforest. (EISENLOHR; OLIVEIRA-FILHO, 2015; JOLY et al., 2012; LAURANCE, 2009; OLIVEIRA-FILHO; FONTES, 2000; SANCHEZ et al., 2013).

The floristic and phytosociological surveys are pointed out as effective tools to describe tree communities and analyze the conservation status of vegetation (EISENLOHR; OLIVEIRA-FILHO, 2015; JOLY et al., 2012). This type of studies, associated with the assessment of ecological groups, can provide an improvement in the understanding about the communities' structure and species distribution (TABARELLI; PERES, 2002; WIJDEVEN; KUZEE, 2000).

Thus, we assessed the floristic composition and structure of a preserved tree community in the Lowland Atlantic Rainforest of southeastern Brazil. Furthermore, we described the tree community by species distribution among ecological groups (dispersal syndrome and successional categories) and the contribution of each group in the community structure.

2. MATERIALS AND METHODS

2.1. Study area

This study was conducted in one hectare of Atlantic Rainforest in the Núcleo Picinguaba, Parque Estadual da Serra do Mar, Ubatuba, Brazil (Figure 1). The plot surveyed is located in the Lowland Atlantic Rainforest according to the IBGE (2012), at coordinates 23°20'8"S 44°50'4"W between 41 and 63 meters of altitude. The climate is tropical rainforest (AF according to the Koppen system, 1948) with a mean value of annual rainfall exceeding 2,200 mm.

The plot surveyed (100x100 m) integrates a sample (plot "C") of a project entitled, "Floristic composition, structure and functioning of the Atlantic Rainforest of Picinguaba and Santa Virginia Nucleus in Serra do Mar State Park." In total, the project sampled 14 ha along an altitudinal gradient in the Atlantic Rainforest (JOLY et al., 2012). The plots were divided into 100 subplots (10x10 m), georeferenced and delimited with PVC stakes.

2.2. Sampling and ecological classification

We sampled all trees with PBH (perimeter at breast height) ≥15 cm, including palm trees and tree ferns, per the protocol established by Joly; Martinelli (2008). The materials were identified using specialized bibliographies and, when possible, by consulting taxonomic specialists. The botanic material was deposited in the collections of Herbaria UEC, IAC, and HRCB. The distribution of taxa by families followed the proposal of the Angiosperm Phylogeny Group IV (APG, 2016). For phytosociological analysis, we recorded the PBH values and the height of each tree individual sampled. The categorization of species in ecological groups was obtained using specific literature (CATHARINO et al. 2006; GRESSLER et al. 2006; SÃO PAULO, 2008) and the analysis of diasporas when collected. The species were classified in the dispersal syndromes according to the Pijl classification (VAN DER PIJL, 1982): autochory, anemochory and zoochory, and successional categories: pioneer *latosensu* and non-pioneer *latosensu* according to Whitmore (1989). In addition, we assessed the threatened status of species sampled, according to Livro Vermelho da Flora do Brasil (MARTINELLI; MORAES, 2013).

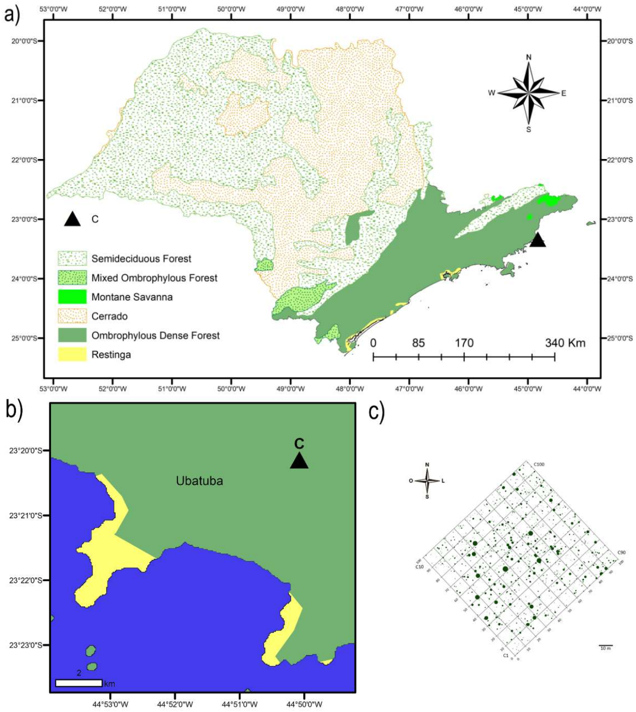

Figure 1. São Paulo vegetation map (a), plot location (b) and individual distributions (c) of tree communities surveyed in the Atlantic Rainforest of Serra do Mar State Park. Ubatuba, Brazil. C- Plot surveyed (tree community) in this work. ● – The circle size corresponds to the individual basal area.

Figura 1. Mapa da vegetação de São Paulo (a), localização do plot (b) e distribuição dos indivíduos (c) da comunidade arbórea analisada na Floresta Atlântica do Parque Estadual da Serra do Mar, Ubatuba, Brasil. Parcela C – Parcela levantada (comunidade arbórea) este trabalho. ● – O tamanho do círculo corresponde a área basal do indivíduo.

2.3. Data analysis

Phytosociological parameters such as relative density, frequency, and dominance, and the importance value index were calculated according to Mueller-Dombois; Ellenberg (1974). We estimated the Shannon diversity index (H´) and Pielou equability (J´), and we also conducted a rarefaction curve to assess the sample sufficiency by species accumulation (MORO; MARTINS, 2011). We also evaluated the structure parameters among ecological groups considering the species richness, abundance, dominance and mean values of height and diameter of each group. The analyses were performed using R software (R DEVELOPMENT CORE TEAM, 2017).

3. RESULTS

We surveyed 1,120 living individuals and 124 standing stems dead, which were excluded from the analyses of ecological groups. A total of 131 species were sampled in 40 families, with six individuals remaining indeterminate (Table 1). We found four sampled species in the list of threatened species of the Livro Vermelho da Flora do Brasil (MARTINELI; MORAES, 2013), two in the Vulnerable status, *Cupania furfuracea* Radkl. (Sapindaceae) and *Euterpe edulis* Mart. (Arecaceae), and two in the Endangered status, *Eugenia magnibracteolata* Mattos e D. Legrand (Myrtaceae) and *Virola bicuhyba* (Schott ex Spreng.) Warb.

(Myristicaceae). The Shannon diversity was 3.91 nats/ind and the Pielou equability was 0.81.

Table 1. Species list, structural parameters, dispersal syndromes and successional class of surveyed community in the Atlantic Rainforest of Serra do Mar State Park, São Paulo, Brazil, (Abd - Abundance; RelFr - Relative Frequency; RelDo- Relative Dominance. IV - Importance Value; Zoo - Zoochory; Ane - Anemochory; Aut - Autochory. NP – Non-Pioneer. P - Pioneer. NC – Not-Classified.
Tabela 1. Relação das espécies, descritores estruturais, síndromes de dispersão e classe sucessional, da comunidade levantada na Floresta Atlântica do Parque Estadual da Serra do Mar. (Abd. – Abundância; RelFr – Frequência relativa; RelDo – Dominância Relativa; IV – Valor de Importância; Zoo – Zoocórica; Ane – Anemocórica; Aut – Autocórica; NP – Não Pioneira; P – Pioneira; NC – Não Classificadas).

Family	Specie	Abd.	RelFR	RelDo	IV	Dispersion syndrome	Successional Class
Annonaceae	*Guatteria australis* A.St.-Hil.	4	0.45	0.21	0.33	Zoo	NP
	Annonaceae 1	3	0.35	0.25	0.29	NC	NC
Araliaceae	*Schefflera angustissima* Marchal (Frodim)	8	0.92	0.35	0.66	Zoo	P
	Schefflera calva (Cham.) Frodin e Fiaschi	1	0.12	0.06	0.09	Zoo	P
Arecaceae	*Astrocaryum aculeatissimum* (Schott) Burret	7	0.69	0.24	0.52	Zoo	NP
	Euterpe edulis Mart.	124	7.04	2.7	6.95	Zoo	NP
	Syagrus pseudococos (Raddi) Glassman	19	1.85	1.89	1.83	Zoo	NP
Bignoniaceae	*Jacaranda puberula* Cham.	2	0.23	0.14	0.18	Ane	P
Boraginaceae	*Cordia silvestris* Fresen.	1	0.12	0.14	0.11	Zoo	NP
	Cordia taguahyensis Vell.	10	0.92	0.68	0.83	Zoo	NP
Cardiopteridaceae	*Citronella paniculata* (Mart.) R.A. Howard	10	1.04	0.21	0.71	Zoo	P
Caricaceae	*Jacaratia heptaphylla* (Vell.) A. DC.	1	0.12	0.18	0.13	Zoo	NP
Celastraceae	*Salacia grandifolia* (Mart.) G. Don	3	0.35	0.04	0.22	Zoo	NP
Chrysobalanaceae	*Couepia venosa* Prance	9	0.92	2.24	1.33	Zoo	NP
	Hirtella hebeclada Moric. Ex DC.	1	0.12	0.04	0.08	Zoo	NP
Clusiaceae	*Garcinia gardneriana* (Planch. e Triana) Zappi	17	1.62	0.81	1.32	Zoo	NP
Cyatheaceae	*Alsophila sternbergii* (Sternb.) D.S. Conant	23	1.62	1.64	1.70	Ane	P
	Cyathea phalerata Mart.	5	0.46	0.24	0.38	Ane	P
Elaeocarpaceae	*Sloanea guianensis* (Aubl.) Benth.	11	1.27	0.91	1.06	Zoo	NP
Euphorbiaceae	*Alchornea glandulosa* Poepp.	6	0.58	0.54	0.55	Zoo	P
	Alchornea triplinervia (Spreng.) Mull. Arg.	1	0.12	0.11	0.11	Zoo	P
	Mabea piriri Aubl.	16	1.27	1.73	1.48	Aut	P
	Pausandra morisiana (Casar.) Radlk.	2	0.23	0.02	0.14	Zoo	NP
	Sapium glandulosum (L.) Morong	2	0.23	0.77	0.39	Zoo	P
	Tetrorchidium rubrivenium Poepp.	1	0.12	0.08	0.10	Aut	P
	Euphorbiaceae 1	4	0.46	0.21	0.34	NC	NC
Fabaceae	*Copaifera langsdorffii* Desf.	3	0.35	0.15	0.26	Zoo	NP
	Dahlstedtia pinnata (Benth.) Malme	3	0.23	0.03	0.18	Ane	P
	Inga striata Benth.	1	0.12	0.03	0.08	Zoo	P
	Inga sp.1	3	0.35	2.13	0.92	Zoo	P
	Inga sp.2	1	0.12	1.90	0.70	Zoo	P
	Lonchocarpus cultratus (Vell.) Az.Tozzi e H.C.Lima	1	0.12	0.01	0.07	Ane	P
	Swartzia oblata R.S. Cowan	6	0.58	2.25	1.12	Zoo	NP
	Swartzia simplex var. *grandiflora* (Raddi) R.S. Cowan	15	1.50	1.27	1.39	Zoo	NP
	Zollernia ilicifolia (Brongn.) Vogel	11	1.04	1.06	1.03	Zoo	NP
	Mimosoideae 1	1	0.12	0.31	0.17	NC	NC
	Fabaceae 1	3	0.35	1.37	0.66	NC	NC
	Fabaceae 2	1	0.12	0.40	0.20	NC	NC
Lauraceae	*Cryptocaria mandiocana* Meisr	4	0.46	1.23	0.68	Zoo	NP
	Cryptocaria saligna Mez	7	0.69	0.50	0.60	Zoo	NP
	Endlicheria paniculata (Spreng.) J.F. Macbr.	9	0.35	0.12	0.42	Zoo	NP
	Ocotea dispersa (Nees) Mez	9	1.04	0.62	0.82	Zoo	NP
	Ocotea divaricata (Nees) Mez	1	0.12	0.14	0.11	Zoo	NP
	Ocotea teleiandra (Meisn.) Mez	1	0.12	0.04	0.08	Zoo	NP
Lecythidaceae	*Cariniana estrelensis* (Raddi) Kuntze	2	0.23	0.04	0.15	Ane	NP
Malvaceae	*Eriotheca pentaphylla* (Vell.) A. Robyns	19	1.73	4.51	2.67	Ane	P
	Quararibea turbinata (Sw.) Poir.	6	0.69	0.10	0.44	Zoo	NP
Melastomataceae	*Miconia* sp.	2	0.23	0.08	0.16	NC	NC
Meliaceae	*Guarea macrophylla* Vahl	3	0.35	0.27	0.29	Zoo	P
	Trichilia silvatica C. DC.	4	0.46	0.76	0.53	Zoo	NP
	Meliaceae 1	1	0.12	0.02	0.08	NC	NC
Monimiaceae	*Mollinedia engleriana* Perkins	1	0.12	0.02	0.07	Zoo	NP
	Mollinedia lamprophylla Perkins	8	0.69	2.79	1.40	Zoo	NP
	Mollinedia schottiana (Spreng.) Perkins	93	6.93	2.41	5.88	Zoo	NP
	Mollinedia sp.	1	0.12	0.01	0.07	NC	NC
Moraceae	*Ficus luschnathiana* (Miq.) Miq.	1	0.12	0.72	0.31	Zoo	NP
	Ficus pulchella Schott	1	0.12	0.68	0.30	Zoo	NP
	Ficus sp.	1	0.12	0.01	0.07	NC	NC
	Sorocea hilarii Gaud.	4	0.35	0.05	0.25	Zoo	NP
Myristicaceae	*Virola bicuhyba* (Schott ex Spreng.) Warb.	16	1.73	8.79	3.98	Zoo	NP
Myrtaceae	*Calyptranthes lucida* Mart. ex DC.	2	0.23	0.13	0.18	Zoo	NP

Family	Specie	Abd.	RelFR	RelDo	IV	Dispersion syndrome	Successional Class
	Calyptranthes strigipes O. Berg	1	0.12	0.01	0.07	Zoo	NP
	Campomanesia guaviroba (DC)	1	0.12	0.10	0.10	Zoo	P
	Campomanesia xanthocarpa O.Berg	3	0.35	0.20	0.27	Zoo	NP
	Campomanesia sp.	1	0.12	0.17	0.12	Zoo	NP
	Eugenia brevistyla D.Legrand	5	0.58	0.51	0.51	Zoo	NP
	Eugenia cereja D. Legrand	21	1.96	0.68	1.50	Zoo	NP
	Eugenia excelsa Cambess.	2	0.23	0.03	0.15	Zoo	NP
	Eugenia fusca O. Berg	20	1.85	0.79	1.47	NC	NC
	Eugenia linguaeformis O. Berg	6	0.69	0.37	0.53	NC	NC
	Eugenia magnibracteolata Mattos e D. Legrand	6	0.69	1.20	0.81	Zoo	NP
	Eugenia melanogyna (D. Legrand) Sobral	1	0.12	0.01	0.07	Zoo	NP
	Eugenia monosperma Vell.	2	0.23	0.05	0.15	Zoo	NC
	Eugenia mosenii (Kausel) Sobral	2	0.23	0.03	0.15	Zoo	NP
	Eugenia multicostata D. Legrand	2	0.23	0.89	0.43	Zoo	NP
	Eugenia oblongata O. Berg	20	1.96	1.75	1.83	Zoo	NP
	Eugenia prasina O. Berg	15	1.62	0.41	1.14	Zoo	NP
	Eugenia subavenia O. Berg	3	0.35	0.05	0.22	Zoo	P
	Eugenia sp.1	3	0.35	0.44	0.35	NC	NC
	Eugenia sp.2	7	0.69	0.56	0.63	NC	NC
	Eugenia sp.3	3	0.12	0.28	0.22	NC	NC
	Marlierea obscura O. Berg	28	2.59	2.93	2.73	Zoo	NP
	Marlierea racemosa (Vell.) Kiaersk.	2	0.23	0.14	0.18	Zoo	NP
	Marlierea riedeliana (O.Berg) D. Legrand	2	0.23	0.09	0.17	Zoo	NC
	Marlierea silvatica (Gardner) Kiaersk.	1	0.12	0.37	0.19	Zoo	NP
	Marlierea sp.	2	0.23	0.02	0.14	NC	NC
	Myrcia insigniflora M.F.Santos	7	0.81	0.88	0.77	NC	NC
	Myrcia neoblanchetiana E.Lucas & Sobral	6	0.58	0.25	0.45	NC	NC
	Myrcia pubipetala Miq.	1	0.12	0.16	0.12	Zoo	NP
	Myrcia spectabilis DC.	12	1.15	0.24	0.82	Zoo	NP
	Myrcia strigipes Mart..	22	2.31	1.48	1.95	Zoo	NP
	Myrciaria floribunda (H. West ex Willd.) O. Berg	11	1.04	0.9	0.97	Zoo	NP
Nyctaginaceae	*Guapira opposita* (Vell.) Reitz	34	3.23	4.08	3.48	Zoo	NP
Ochnaceae	*Ouratea parviflora* Baill.	4	0.35	0.05	0.25	Zoo	NP
Peraceae	*Pera glabrata* (Schott) Poepp. ex Baill.	2	0.23	0.12	0.18	Zoo	P
Phyllantaceae	*Hyeronima alchorneoides* Allemão	8	0.81	3.03	1.52	Zoo	NP
Piperaceae	*Piper* cf. *cernunn* A.DC.	4	0.46	0.05	0.29	Zoo	P
Polygonaceae	*Ruprechtia laxiflora* Meisn.	1	0.12	0.69	0.30	Ane	NP
Primulaceae	*Stylogyne lhotzkyana* (A.DC.) Mez.	2	0.23	0.05	0.15	Zoo	NP
Proteaceae	*Roupala montana var. brasiliensis* (Klotzsch)	1	0.12	0.27	0.16	Ane	NP
Quiinaceae	*Quiina glaziovii* Engl.	3	0.35	0.23	0.28	Zoo	P
Rosaceae	*Prunus Myrtifolia* (L.) Urb.	4	0.46	0.6	0.47	Zoo	NP
Rubiaceae	*Bathysa australis* (A. St.-Hil.) Benth e Hook. f.	6	0.69	0.61	0.61	Aut	NP
	Bathysa mendoncaei K. Schum.	68	5.20	2.77	4.67	Aut	NP
	Coussarea accedens Mull. Arg.	34	3.23	1.15	2.47	Zoo	P
	Coussarea meridionalis (Vell.) Müll. Arg.	73	5.08	2.08	4.56	Zoo	NP
	Faramea picinguabae M. Gomes	7	0.81	0.07	0.50	NC	NC
	Ixora gardneriana Benth.	1	0.12	0.07	0.09	Zoo	NP
	Psycotria mapoureoides DC.	2	0.23	0.09	0.17	Zoo	NP
	Rudgea vellerea Müll. Arg.	3	0.35	0.12	0.24	Zoo	NP
	Rustia formosa (Cham. e Schltdl. ex DC.) Klotzsch	28	2.19	2.71	2.47	Aut	P
	Rubiaceae 1	1	0.12	0.06	0.09	NC	NC
	Rubiaceae 2	1	0.12	0.07	0.09	NC	NC
Salicaceae	*Casearia* sp.	1	0.12	0.02	0.07	NC	NC
Sapindaceae	*Cupania furfuracea* Radkl.	1	0.12	0.04	0.08	Zoo	NP
	Cupania oblongifolia Mart.	16	1.27	4.04	2.25	Zoo	NP
	Matayba sp.	1	0.12	0.02	0.07	NC	NC
	Sapindaceae 1	1	0.12	0.06	0.09	NC	NC
Sapotaceae	*Chrysophyllum* cf. *paranaense* T.D. Penn.	1	0.12	0.02	0.08	Zoo	NC
	Chrysophyllum flexuosum Mart.	30	3.12	1.41	2.40	Zoo	NP
	Chrysophyllum viride Mart. e Eichler	2	0.23	2.74	1.05	Zoo	NP
	Ecclinusa ramiflora Mart.	5	0.58	1.45	0.82	Zoo	NP
	Manilkara subsericea (Mart.) Dubard	2	0.23	0.32	0.24	Zoo	NP
	Pouteria venosa (Mart.) Baehni	4	0.46	0.25	0.36	Zoo	NP
Siparunaceae	*Siparuna guianensis* Aublet	2	0.23	0.01	0.14	Zoo	P
Urticaceae	*Cecropia glaziovi* Snethl.	4	0.35	0.48	0.39	Zoo	P
	Pourouma guianensis Aubl.	2	0.23	0.46	0.29	Zoo	P
Verbenaceae	*Citharexylum myrianthum* Cham.	1	0.12	0.12	0.11	Zoo	P
Indeterminate	Indeterminate 1	4	0.12	1.61	0.61	NC	NC
	Indeterminate 2	1	0.48	0.32	0.37	NC	NC
	Indeterminate 3	1	0.12	0.33	0.18	NC	NC

The families with the highest species richness were Myrtaceae (32 species), Fabaceae (12), Rubiaceae (11), Euphorbiaceae (7), and Lauraceae (6) which together comprised 49.6% of the individuals surveyed. In the other hand, ten families just recorded one or two individuals. The highest values of importance (VI) were recorded for Myrtaceae (19.39%), Rubiaceae (15.9%), and Arecaceae (9.3%).

Among the species, *Euterpe edulis* (IV = 6.9%) was the most important, followed by *Mollinedia schottiana* (5.9%) and *Bathysa mendoncaei* (4.7%). The *Euterpe edulis* was the most abundant species with 124 individuals (11.1% of the total), followed by *Mollinedia schottiana* (8.3%) and *Coussarea meridionalis* (6.5%), which together comprised 290 individuals surveyed. While 43 species were represented by only one individual. Regarding the species accumulation curve, our study presented sampling sufficiency (Figure 2).

In the sampled plot, we found 23.01 m² of basal area occupied by living individuals and 2.23 m² occupied by stems deaths. The tree community presented 5.3% of the branched individuals, 7.9m of mean height (standard deviation = 3.5), with minimum and maximum values of 1.8 and 25m respectively, and 12.7cm of mean diameter (standard deviation = 9.9), with minimum and maximum values of 4.5 and 87.5cm, respectively.

For the ecological groups of dispersal syndrome, zoochory was predominant, involving 87% of the species and 76.3% of the classified individuals, while anemochory and autochory were restricted to few species (Table 2). The anemochory group presented the higher mean value of basal area and, on the other hand, the smaller abundance among the groups considered for dispersal syndromes.

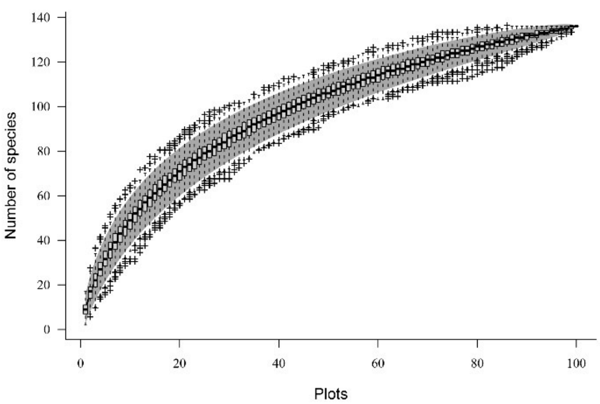

Figure 2. Species accumulated curve generated to tree community surveyed in the Atlantic Rainforest of Serra do Mar State Park, Ubatuba, Brazil.
Figura 2. Curva de acumulação gerada para a comunidade arbórea levantada na Floresta Pluvial Atlântica do Parque Estadual da Serra do Mar, Ubatuba, Brasil.

For the ecological groups of successional classes, the group of non-pioneers concerned 71.6% of species and 74.5% of individuals classified in the community sampled. However, we found the higher mean values of basal area and height for the pioneer's group (Table 2). Regarding height, some individuals of pioneer species stood out in the community with a maximum height greater than 23 meters, such *as Eryotheca penthaphylla* and *Mabea piriri,* raising the mean value of this attribute in the pioneer group.

Table 2. Structural parameters and diversity descriptors for different ecological groups in a tree community of in Atlantic Rainforest of Serra do Mar State Park, São Paulo, Brazil. Abd. - Abundance; N. spp. - Number of species; N. fam. - Number of families; Ab. Freq. - Absolutefrequency; Ab. Do. - AbsoluteDominance.
Tabela 2. Parâmetro estruturais e descritores de diversidade para os diferentes grupos ecológicos de uma comunidade arbórea da Floresta Atlântica Estadual da Serra do Mar, São Paulo, Brasil. Abd. – Abundância; N. spp. – Número de espécies; N. fam.- Número de famílias; Ab. Freq. – Frequência absoluta; Ab.Do. – Dominância Absoluta.

Ecological group	Abd.	N. spp.	N. fam.	Ab. Freq. (%)	Ab. Do. (m²)	Mean values of height (m)	Mean values of basal area (m²)
Anemochory	57	9	7	32	1.7	7.78	0.30
Autochory	119	5	2	64	1.8	7.81	0.15
Zoochory	859	93	32	99	17.4	7.88	0.20
Pioneer	190	29	16	75	4.5	8.12	0.24
Non-Pioneer	840	75	28	99	16.3	7.86	0.19
Community	1.120	131	40	100	27.5	7.92	0.20

4. DISCUSSION

The richest families of tree species in this survey were similar to several other studies carried out in the Atlantic Rainforest (CARVALHO et al., 2006; JOLY et al., 2012; KURTZ; ARAÚJO, 2000; MEDEIROS; AIDAR 2011; MARCHIORI et al., 2016; PADGURSCHI et al., 2011), and the species richness (131) was close to that registered in other surveys of the same vegetation type (ASSIS et al., 2011; PRATA et al., 2011). We found most individuals collected belonging to few species, which provided a great contribution to the richness observed. These results support the idea of the richness based mainly on species that occur with one or a few individuals in tropical forests (HUSTON, 1973; RABOSKY; HURLBERT, 2015). Regarding the species, we emphasize that *Euterpe edulis, Mollinedia schottiana* and *Coussarea meridionalis* were the highest abundant species of this survey, likewise found in other studies in Lowland Atlantic Rainforest (CAMPOS et al., 2011; PRATA et al., 2011; SANCHEZ et al., 2013).

In the study area, Myrtaceae and Fabaceae were the richest families, comprising a third of the total of identified species and presenting a proportional individuals distribution among its species. On the other hand, we found the ten most abundant species comprising around about 50% of individuals.

Overall, we have found a similar species composition to other studies carried out on preserved areas of this phytogeographic domain, and the sampling of large populations of threatened species, such as Euterpe edulis and *Virola bicuhyba* mainly, highlights the importance of new floristic and phytosociological surveys to understanding the conservation and species distribution of tree communities with high diversity.

Our results indicate the most important families and species that are constant in preserved communities in the areas of the southeast Atlantic Rainforest (ASSIS et al. 2011; CARVALHO et al. 2007), and the tree diversity were similar of the majority surveys carried out in preserved communities of the Atlantic Rainforest (JOLY et al., 2012; KURTZ; ARAÚJO, 2000; SANCHEZ et al., 2013). Regarding the community structure, although the proportion of the number and basal area occupied by standing dead stems were higher in comparison with other communities surveyed in the same study area, we found consistent phytosociological parameters with these others tree communities (see JOLY et al. 2012).

Among the dispersal syndromes, we found that the distribution of individuals and species were classified following the distribution patterns of the Tropical Rainforest, in which the zoochoric species composed more than 70% of the species (CARVALHO, 2010; KINOSHITA et al., 2006; PENHALBER; MANTOVANI, 1997; PIVELLO et al., 2006). This result supports the idea that tropical forest tree diversity is mainly based on the group of zoochoric species, and its predominance would be related to the advanced preservation state and age of the community (LIEBSCH et al., 2008).

The species distribution among dispersal syndromes presents a variation trend in relation to the intensity of the dry season and the pluviometric regimes, in which the number of zoochoric species increases, in tree communities, from dry to humid regions (GENTRY, 1983). In addition, the number of zoochoric species is usually higher in preserved tropical forests, compared to communities located in disturbed areas or in initial stages of succession (BROWN; LUGO, 1990; CARVALHO 2010; NASCIMENTO et al., 2014).

We found a predominance of non-pioneer species among the succession classes, but the pioneer species presented a great contribution in the diversity of the tree community, involving about 30% of the species classified. The group of pioneers is a fundamental component in the tree community dynamic, and the richness of this group may be related to the presence of canopy gaps, allowing the establishment and maintenance of these populations, which are an essential part of forest dynamics (DENSLOW, 1980; TABARELLI et al., 2012).

Also, we found a preeminently mean value of height and basal area of pioneer species in the sampled community, but they occurred with a smaller abundance. This ecological group, whose main characteristic is its rapid growth in diameter and height, contributes to the structure maintenance of arboreal communities in the tropical rainforest (WHITMORE, 1989).

In general, mature forests tend to present a variation in their structure and species richness, which differ according to the successional stage of the community (HUBBEL et al., 1999; LIEBERMAN et al., 1990). However, higher values for basal area and species richness have been related to tree communities in preserved areas (BORÉM; OLIVEIRA-FILHO, 2002; JOLY et al., 2012; KURTZ; ARAÚJO, 2000). Thus, the results of structure, tree diversity and mainly the species distribution among ecological groups suggest an advanced successional stage of the studied tree community. Finally, our study brings an important dataset and results about very threatened vegetation, corroborating the importance of tree communities' surveys to improve the understanding of conservation and species composition in areas with high diversity.

5. CONCLUSIONS

In a nutshell, we found a similar floristic and structural composition of the other communities surveyed in preserved areas of the same physiognomy, and the species contribution of different ecological groups in the structure of the studied community was congruent with other surveys in Tropical Rainforests.

In the tree community surveyed, Myrtaceae and Fabaceae were the richest families, and *Euterpe edulis* was the most abundant species.

We found a great population of some threatened species, and we corroborated the dominance of zoochoric and non-pioneer species in the preserved communities along a continuum of Atlantic Rainforest.

The study design was corrected to describe the floristic composition, phytosociological structure and ecological groups of a tree community in a poorly known physiognomy of the Atlantic Rainforest.

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