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PHYTOSSOCIOLOGICAL ASSESSMENT OF A NATURAL REGENERATION SITE IN THE SOUTHEAST ATLANTIC FOREST BIOME[1]

AVALIAÇÃO FITOSSOCIOLÓGICA DE UMA ÁREA DE REGENERAÇÃO NATURAL NO SUDESTE DO BIOMA MATA ATLÂNTICA[1]

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ABSTRACT – On **s**ome portions of the biodiversity Atlantic Forest bioversity hotspot, land abandonment has regenerated back to forest. However, the composition and structure of these areas are not well known. Thus, the aim of this study was to inventory a 45 years old natural regeneration forest site in a small farm (68 ha) in the Southeast portion of Atlantic Forest Biome in Brazil. In November 2019 all regenerating individuals (<15 cm of circumference at ground level and> 50 cm of height) and adults (>15 cm of circumference at breast height) were counted, identified, classified in ecological groups, dispersal and conservation status, and measured in 0.34 ha. We calculated Importance Value (VI) for all species. Of the 2720 individuals sampled, 435 were adults and 2285 regenerating individuals. Families with greatest species richness were Fabaceae, Myrtaceae and Euphorbiaceae. The majority of species and individuals were non-pioneer and zoochorous. Most of the regenerants belong to the specie *Guarea kunthiana* and were non-pioneer species, wich might indicate an advanced stage of forest succession. Additionally, high VI species were mostly non-pionners.

Keywords: Composition; Passive restoration; Phytosociology; Tropical forest.

RESUMO - Em algumas porções do hotspot de biodiversidade da Mata Atlântica, o abandono de terras tem se regenerado de volta à floresta. No entanto, a composição e estrutura dessas áreas não são bem conhecidas. Assim, o objetivo deste estudo foi inventariar um fragmento florestal de regeneração natural com 45 anos de idade em uma pequena propriedade (68 ha) na porção sudeste do bioma Mata Atlântica no Brasil. Em novembro de 2019 todos os indivíduos em regeneração (<15 cm de circunferência ao nível do solo e > 50 cm de altura) e adultos (>15 cm de circunferência ao nível do peito) foram contados, identificados, classificados nos grupos ecológicos, dispersão e status de conservação, e medidos em 0,34 ha. Calculamos o Valor de Importância (VI) para todas as espécies. Dos 2720 indivíduos amostrados, 435 eram adultos e 2.285, regenerantes. As famílias com maior riqueza de espécies foram Fabaceae, Myrtaceae e Euphorbiaceae. A maioria das espécies e indivíduos eram não pioneiros e zoocóricos. Grande parte dos regenerantes pertenceram à espécie *Guarea kunthiana* e eram espécies não pioneiras, o que pode indicar o estágio mais avançado de dinâmica florestal. As espécies de alto VI foram também em sua maioria não pioneiras.

Palavras-chave: Composição; Restauração passiva; Fitossociologia; Floresta tropical.

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1 INTRODUCTION

The Atlantic Forest Biome, a biodiversity hotspot (Myers et al., 2000), which in the past extended over a large part of Brazilian coast (Galindo-Leal and Câmara, 2003), has now only 12.4% of its native vegetation cover remaining in Brazil (SOS Mata Atlântica and Instituto Nacional de Pesquisas Espaciais - INPE, 2017) due to anthropic changes, such as agriculture and industrialization, that occurred mostly in the first half of the 19th century (Dean, 1996).

The majority of the forest remnants are inside private farms and ranches, while nature reserves protect only 9% of the native forest left (Ribeiro et al., 2009). Since 1962, forest regeneration has been occurring on portions of cattle ranches and farms due to demographic and market shifts (Rezende et al., 2015; Silva et al., 2017; Calaboni et al., 2018; Chazdon et al., 2020).

The assessment and monitoring of restored forests are essential (Brancalion et al., 2015) since they allow evaluation from a degraded area under restoration. Our research focuses on the Atlantic Rainforest in Paraíba do Sul River Valley, Southeast Brazil. The valley sits on the fringe between the two major metropolitan areas of Brazil (São Paulo and Rio de Janeiro). Although populous, the valley is currently characterized by a landscape mosaic of tropical forest remnants and pastures. Historically, Atlantic Forest in the valley gave place to sugar cane, coffee and more recently pasture (Dean, 1996).

Land abandonment has been occurring in the last years and the Atlantic rainforest biome in São Paulo state (Nalon et al., 2020) and much of the valley is experiencing forest cover increase (Silva et al., 2017). The region has become a focus and a study case for regeneration of the Atlantic Forest biome.

Thus, the aim of this study was to inventory a 45 years old natural regeneration forest site in a small farm (68 ha) in the Southeast portion of Atlantic Forest Biome in Brazil. We expected a higher importance of non-pioneer species and of zoochorous species. Specially in older sites, vegetation dynamic processes, such as: (i) establishment of fleshy fruit species that are dispersed into the sites from surrounding vegetation by birds and mammals, verified by the number of zoochorous species; and as (ii) the successional shift from mostly pioneers to early and, then, late secondary species gradually plays out over time (Chazdon, 2008).

2 METHODS

2.1 Study site

This study was conducted in a forest fragment of 68 ha, inside a farm located between the coordinates 22° 54' 25.12" S and 45° 03' 81.09'' W, in Cruzeiro municipality, Southeast Atlantic Forest Biome, São Paulo state, Brazil (Figure 1). Relief is hilly with slope between 20% to 45% (Empresa Brasileira de Pesquisa Agropecuária - Embrapa, 1979), soil is red-yellow latosol (Brasil, 1960), climate is classified as dry-winter subtropical Cwa (Alvares, 2013), with an annual mean temperature of 20,5º C (2019-2020), an average annual precipitation of 1400 mm, and a dry season between April and September, data collected at the National Institute of Meteorology (INMET, Portuguese acronym), from Cachoeira Paulista (Instituto Nacional de Meteorologia - INMET, 2020).

The farm is in the Atlantic Forest Biome, transition between evergreen and semi-deciduous forest (Instituto Brasileiro de Geografia e Estatística - IBGE, 2012). The landscape where the farm is inserted is mostly forested with mature secondary forest, especially in the north (Figure 1) and it has many protected areas, as for example, the Environmental Protection Area Mantiqueira (APA, Portuguese acronym), Natural Monument Mantiqueira (Mona, Portuguese acronym) and others. The area was a low-intensity cattle pasture with *Melinis minutiflora* until 1975 (personal communication with the land owner), when it was fenced and a natural regeneration process started (Martins et al., 2002).

2.2 Data collection

In November 2019 we randomly installed 34 plots of 25 x 4 m (100 m², plots were distant 100 m from each other), according to the monitoring protocol of Coordenadoria de Biodiversidade e Recursos Naturais – CBRN, contained in CBRN Ordinance 01/2015 (São Paulo, 2015) and Resolution SMA nº 32/2014 (São Paulo, 2014). All regenerating individuals (<15 cm of circumference at ground level and > 50 cm of height, according to CBRN 01/2015) and adults (>15 cm of circumference at 1.3 m height) inside plots were counted, identified, and measured. Indicators of the monitoring protocol of CBRN 01/2015 (São Paulo, 2015) and of Resolution SMA 32/2014 for this site were quantified and are presented in Massi et al. (2021, early view). Plant material was identified

using botanical identification references (Martins et al., 2002; Lorenzi, 2016). For plant family classification, we used the Angiosperm Phylogeny Group IV (APG, 2016) and the Brazil Flora List (Flora do Brasil 2020 em Construção, 2020).

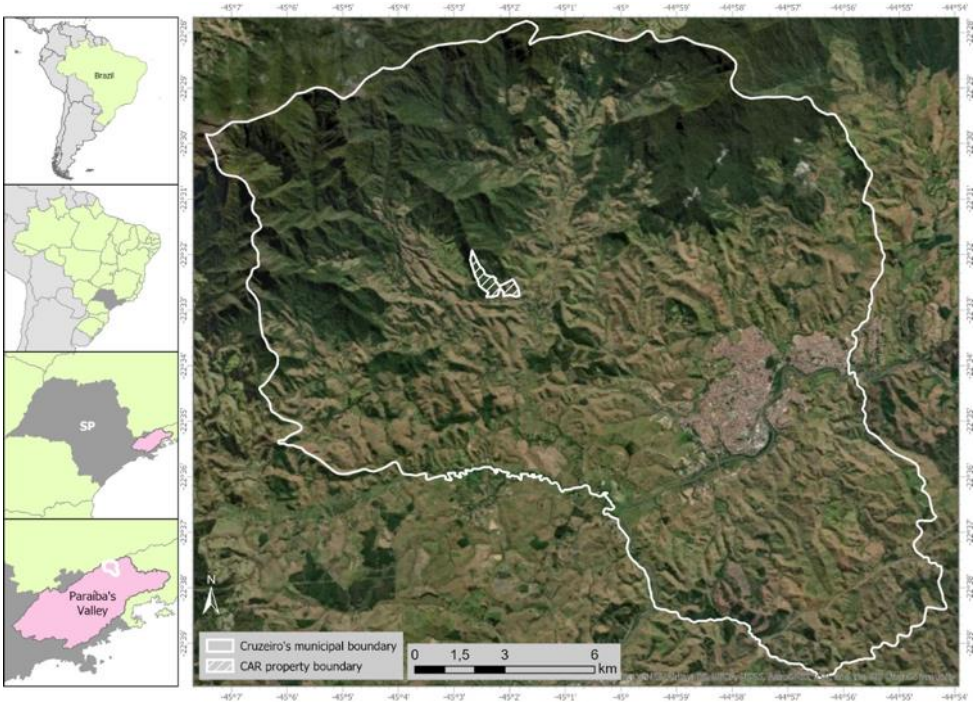

Figure 1. Satellite image of the study site, inside Cruzeiro municipality, São Paulo state, Brazil. Rural Environmental Registration (CAR, Portuguese acronym) defines self-declaratory land boundaries.

Figura 1. Imagem de satélite da área de estudo, no município de Cruzeiro, Estado de São Paulo, Brasil. O Cadastro Ambiental Rural (CAR) define limites de terras autodeclaradas.

We measured diameter at breast height (DBH) of adults. We calculated absolute and relative density, frequency and dominance and with that, Importance Value (IV) for all species with adult individuals. Species were classified according to the successional group into pioneers and non pioneers, to dispersal syndrome into anemochory, autochory and zoochory, using São Paulo (2008) and Instituto de Pesquisas Ecológicas - IPE (2018) and according to conservation status into not evaluated, least concern, near threatened and vulnerable, according to the list of species of Brazil threatened plant species list available on the Flora do Brasil website (Flora do Brasil 2020 em Construção, 2020). In addition, Sorensen similarity index between adults and regenerants was calculated (Begon et al., 2006).

3 RESULTS AND DISCUSSION

Of the 2720 individuals sampled, 435 were adults and 2285 regenerating individuals, belonging to 29 families and 95 species, of which 12 morphospecies were not identified (13% of the total richness: Table 1), because individuals had only a few or damaged leaves that made the identification impossible.

Families with greatest species richness were Fabaceae (16), Myrtaceae (seven), Euphorbiaceae (five) and Arecaceae, Bignoniaceae, Lauraceae and Malvaceae (four species each). Families with greatest individual abundance were Meliaceae (750), Fabaceae (446) and Myrtaceae (221), which together represented 52.1% of all sampled individuals. Also, 30.7% of regenerating individuals (702) were Meliaceae. The Sorensen index between adults and regenerants was 0.65, which indicates a high similarity between adults and regenerants. Despite that, 31 species were found only as regenerants, such as *Myrsine coriacea* (Sw.) R.Br. ex Roem. & Schult., the most abundant with 19 individuals and 17 species only as adults such as *Platypodium elegans* Vogel, the most abundant with eight individuals.

Table 1. Family, species, total number of individuals (N), adults (A) and regenerants (R), successional category (SC) in NP: non-pioneers, P: pioneers. Dispersal syndrome (DS) in Ane: anemochory, Aut: autochory and Zoo: zoochory. Conservation status (CS) in NE: not evaluated, LC: least concern, NT: near threatened, VU: vulnerable observed in a 45 years old regeneration site in the Southeast Atlantic Forest Biome (Cruzeiro municipality, SP, Brazil).

Tabela 1. Família, espécies, número total de indivíduos (N), adultos (A) e regenerantes (R), categoria sucessional (SC) em NP: não pioneiras, P: pioneiras. Síndrome de dispersão (DS) em Ane: anemocoria, Aut: autocoria e Zoo: zoocoria. Status de conservação(CS) em NE: não avaliada, LC: menos preocupante, NT: quase ameaçada, VU: vulnerável, observado em uma área de regeneração de 45 anos no sudeste do Bioma Mata Atlântica (Município de Cruzeiro, SP, Brasil).

Family	Species	N	A	R	SC	DS	CS
Anonaceae	*Guatteria australis* A.St.-Hil.	24	1	23	NP	Zoo	LC
Apocynaceae	*Aspidosperma discolor* var. *parvifolium* Müll.Arg.	15	1	14	NP	Ane	NE
	Aspidosperma polyneuron Müll.Arg.	1	0	1	NP	Ane	NT
	Tabernaemontana hystrix Steud.	17	5	12	P	Zoo	NE
Arecaceae	*Astrocaryum aculeatissimum* (Schott) Burret	5	0	5	NP	Zoo	LC
	Bactris setosa Mart.	1	0	1	NP	Zoo	NE
	Euterpe edulis Mart.	171	15	156	NP	Zoo	VU
	Syagrus romanzoffiana (Cham.) Glassman	35	5	30	NP	Zoo	LC
Asteraceae	*Piptocarpha macropoda* (DC.) Baker	2	0	2	P	Ane	NE
Bignoniaceae	*Handroanthus chrysotrichus* (Mart. ex DC.) Mattos	2	0	2	NP	Ane	NE
	Jacaranda macrantha Cham.	2	0	2	P	Ane	LC
	Sparattosperma leucanthum (Vell.) K.Schum.	50	11	39	P	Ane	NE
	Zeyheria tuberculosa (Vell.) Bureau ex Verl.	4	2	2	NP	Ane	VU
Boraginaceae	*Cordia trichotoma* (Vell.) Arráb. ex Steud	3	1	2	NP	Ane	NE
Cannabaceae	*Trema micrantha* (L.) Blume	5	4	1	P	Zoo	NE
Cyatheaceae	*Alsophila setosa* Kaulf.	5	0	5	NP	Ane	NE
Erythroxylaceae	*Erythroxylum citrifolium* A.St.-Hil.	4	0	4	NP	Zoo	NE
Euphorbiaceae	*Alchornea glandulosa* Poepp. & Endl.	8	1	7	P	Zoo	NE
	Croton floribundus Spreng.	19	2	17	P	Aut	NE
	Croton urucurana Baill.	1	1	0	P	Aut	NE
	Gymnanthes klotzschiana Müll.Arg.	3	1	2	P	Aut	NE
	Sapium glandulosum (L.) Morong	69	3	66	P	Zoo	NE
Fabaceae	*Anadenanthera peregrina* (L.) Speg.	5	4	1	NP	Aut	NE
	Bauhinia forficata Link	4	1	3	P	Aut	NE
	Centrolobium tomentosum Guillem. ex Benth.	1	0	1	NP	Ane	LC
	Dalbergia nigra (Vell.) Allemão ex Benth.	53	20	33	NP	Ane	VU
	Erythrina verna Vell.	3	2	1	NP	Aut	NE
	Fabaceae sp. 1	2	0	2	-	-	-
	Inga sessilis (Vell.) Mart.	26	3	23	P	Zoo	NE
	Inga striata Benth.	20	1	19	P	Zoo	NE
	Leucochloron incuriale (Vell.) Barneby & J.W.Grimes	2	2	0	P	Aut	NE
	Lonchocarpus sp.	1	0	1	-	-	-
	Machaerium hirtum (Vell.) Stellfeld	28	6	22	NP	Ane	NE
	Machaerium nyctitans (Vell.) Stellfeld	57	27	30	NP	Ane	LC
	Machaerium stipitatum (DC.) Vogel	23	10	13	NP	Ane	NE
	Piptadenia gonoacantha (Mart.) J.F.Macbr.	212	35	177	P	Aut	LC
	Platypodium elegans Vogel	8	8	0	NP	Ane	NE
	Senna macranthera (DC. Ex Collad.) H.S.Irwin & Barneby	1	1	0	P	Aut	NE
Lamiaceae	*Aegiphila integrifolia* (Jacq.) Moldenke	1	1	0	P	Zoo	NE
	Vitex polygama Cham.	4	3	1	NP	Zoo	NE
Lauraceae	*Endlicheria paniculata (Spreng.) J.F.Macbr.*	1	1	0	NP	Zoo	NE
	Nectandra oppositifolia Nees & Mart.	120	10	110	P	Zoo	NE
	Ocotea corymbosa (Meisn.) Mez	3	0	3	NP	Zoo	NE
	Ocotea volutina (Nees) Rohwer	2	2	0	NP	Zoo	NE

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Family	Species	N	A	R	SC	DS	CS
Lecythidaceae	*Cariniana estrellensis* (Raddi) Kuntze	1	0	1	NP	Ane	NE
	Lecythis pisonis Cambess.	1	0	1	P	Zoo	NE
Malvaceae	*Apeiba tibourbou* Aubl.	5	2	3	NP	Aut	NE
	Ceiba speciosa (A.St.-Hil.) Ravenna	1	1	0	NP	Ane	NE
	Luehea grandiflora Mart.	120	55	65	NP	Ane	NE
	Pseudobombax grandiflorum (Cav.) A.Robyns	3	2	1	NP	Ane	LC
Melastomataceae	*Miconia cinnamomifolia* (DC.) Naudin	6	3	3	NP	Zoo	NE
	Miconia sellowiana Naudin	27	1	26	P	Zoo	NE
	Pleroma granulosum (Desr.) D. Don	11	10	1	P	Aut	NE
Meliaceae	*Cabralea canjerana* (Vell.) Mart.	4	1	3	NP	Zoo	NE
	Cedrela fissilis Vell.	7	3	4	NP	Ane	VU
	Guarea kunthiana A.Juss.	739	44	695	NP	Zoo	NE
Moraceae	*Ficus adhatodifolia* Schott in Spreng.	4	1	3	NP	Zoo	NE
	Maclura tinctoria (L.) D.Don ex Steud.	5	3	2	NP	Zoo	NE
Myrtaceae	*Eugenia* sp.	1	0	1	-	-	-
	Myrcia splendens (Sw.) DC.	196	20	176	NP	Zoo	NE
	Pimenta pseudocaryophyllus (Gomes) Landrum	13	2	11	NP	Zoo	NE
	Plinia cauliflora (Mart.) Kausel	1	0	1	NP	Zoo	NE
	Psidium guajava L.	3	1	2	P	Zoo	NE
	Psidium guineense Sw.	3	0	3	NP	Zoo	NE
	Syzygium jambos (L.) Alston	4	0	4	NP	Zoo	NE
Primulaceae	*Myrsine coriacea* (Sw.) R.Br. ex Roem. & Schult.	19	0	19	P	Zoo	NE
Rubiaceae	*Bathysa stipulata* (Vell.) C.Presl	2	0	2	NP	Aut	NE
	Coffea sp.	1	0	1	-	-	-
	Randia armata (Sw.) DC.	2	1	1	NP	Zoo	NE
Rutaceae	*Zanthoxylum rhoifolium* Lam.	6	5	1	NP	Zoo	NE
Salicaceae	*Casearia decandra* Jacq.	5	2	3	NP	Zoo	NE
	Casearia sylvestris Sw.	105	41	64	P	Zoo	NE
Sapindaceae	*Allophylus edulis* (A.St.-Hil. et al.) Hieron. ex Niederl.	2	0	2	P	Zoo	NE
	Cupania racemosa (Vell.) Radlk.	26	1	25	NP	Zoo	NE
	Cupania vernalis Cambess.	137	4	133	NP	Zoo	NE
Siparunaceae	*Siparuna brasiliensis* (Spreng.) A.DC.	2	0	2	NP	Zoo	LC
	Siparuna guianensis Aubl.	207	27	180	NP	Zoo	NE
Solanaceae	*Solanum pseudoquina* A.St.-Hil.	4	0	4	P	Zoo	LC
Urticaceae	*Cecropia glaziovii* Snethl.	2	1	1	P	Zoo	NE
	Cecropia pachystachya Trécul	3	3	0	P	Zoo	NE
Verbenaceae	*Aloysia virgata* (Ruiz & Pav.) Juss.	1	0	1	P	Zoo	NE
	Citharexylum myrianthum Cham.	4	4	0	P	Zoo	NE
Vochysiaceae	*Vochysia tucanorum* Mart.	2	1	1	NP	Ane	NE
Unknown 1	Unknown1	1	0	1	-	-	-
Unknown 2	Unknown2	1	0	1	-	-	-
Unknown 3	Unknown3	1	0	1	-	-	-
Unknown 4	Unknown4	1	0	1	-	-	-
Unknown 5	Unknown5	1	0	1	-	-	-
Unknown 6	Unknown6	1	1	0	-	-	-
Unknown 7	Unknown7	1	0	1	-	-	-
Unknown 8	Unknown8	1	1	0	-	-	-
Unknown 9	Unknown9	1	1	0	-	-	-
Unknown 10	Unknown10	1	1	0	-	-	-
Unknown 11	Unknown11	1	1	0	-	-	-
Unknown 12	Unknown12	1	1	0	-	-	-

Fabaceae and Myrtaceae were the most abundant (regarding individual abundance and species richness) families in the studied site, corroborating other studies in evergreen (Lima and Guedes-Bruni, 1997; Marques et al., 2015) and deciduous tropical forests (Oliveira-Filho et al., 1993; Sartori et al., 2015). In the studied farm, seventeen years back, Martins et al. (2002) found the same dominance of families. For regenerants, Meliaceae (*Guarea kunthiana*: late secondary) had also a high number of individuals.

We found 95 species in 0.34 ha of a 45 years old secondary forest, Martins et al. (2002) found 66 species in 0.6 ha, of the same farm, but 26 years old. Well-preserved lowland rainforests had 100 species per hectare in the Atlantic Forest Biome of Pernambuco (Lima et al., 2019) and 185 species in the municipality of Ubatuba, São Paulo, close to the study site (Souza et al., 2018). Secondary neotropical forests take a median time of five decades to recover the species richness of old-growth forests with 80% recovery after 20 years (Rozendaal et al., 2019). Despite that, total richness of regenerants of 79 species indicate that, based on reference values of the Resolution SMA nº 32/2014, which recommends 30 species in 20 years, the study site can be considered recomposed.

Non-pioneer species was the richest ecological group (62%), followed by pioneers (38%). Among adult trees and regenerants, non-pioneer species dominated (60% and 78%, respectively; Figure 2A). Among individuals, adults and regenerants were mostly non pioneers (67 and 74%, respectively: Figure 2B). In 2002, Martins and collaborators have found the same results, i.e., prevalence of non-pioneer species and individuals in the same studied farm. Zoochorous species and individuals predominated among adults (57 and 51%, respectively) and regenerants (59 and 80%, respectively: Figures 2C and D). Finally, five species found in the study site were considered vulnerable or near threatened (Table 1), which highlights the importance of natural regeneration and ecosystem restoration to plant species conservation.

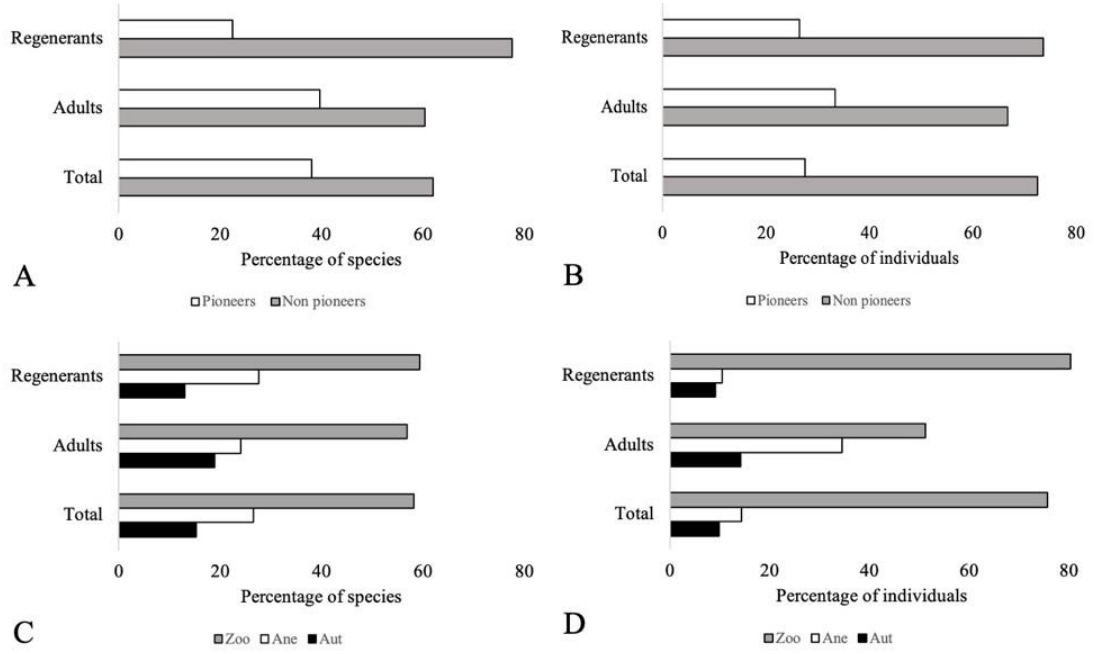

Figure 2. Percentage of species (A) and individuals (B) regenerants, adults and total found as pioneer and non-pioneers and of species (C) and individuals (D) regenerants, adults and total found as Zoo (zoochorous), Ane (anemochorous) and Aut (autochorous) in a 45 years old regeneration site in the Southeast Atlantic Forest Biome (Cruzeiro municipality, SP, Brazil).

Figura 2. Porcentagem de espécies (A) e indivíduos (B) regenerantes, adultos e total encontrados como pioneiros e não pioneiros e de espécies (C) e indivíduos (D) regenerantes, adultos e total encontrados como Zoo (zoocórica), Ane (anemocórica) e Aut (autocórica) em um sítio de regeneração com 45 anos no Sudeste do bioma Mata Atlântica (município de Cruzeiro, SP, Brasil).

Vegetation dynamic processes in tropical forests include colonization by pioneer trees as one of the first phases of succession; then, low light availability in the understory favors establishment of shade-tolerant tree and of palm species that are dispersed into the site from surrounding vegetation by birds and mammals, attested by the high number of zoochorous species and by some regenerant species not found among adults; by 10–20 years after land abandonment, the stage is set for a shift in the abundance and composition of tree species, i.e. from mostly pioneers to early and, then, late secondary species, that gradually plays out over decades (Chazdon, 2008), which is the exact moment that this study took place (45 years after land abandonment). The high number of non-pioneer regenerants was attributed to the great emergence of *Guarea kunthiana*, that might be part of the initiating process to the "old-growth stage" of forest dynamics in the site.

Species with higher VI were *Dalbergia nigra*, *Casearia sylvestris*, *Guarea kunthiana*, *Luehea grandiflora*, *Machaerium nyctitans*, *Myrcia splendens*, *Piptadenia gonoacantha* and *Siparuna guianensis*. In general, these species had all high relative density, frequency and dominance. Exceptions were the very dense *Guarea kunthiana* (10.11%) and *Piptadenia gonoacantha* with high dominance (16.44%: Table 2).

Table 2. Family, species, relative density (RD), relative frequency (RF), relative dominance (RDo) and Importance value index (VI) observed in a 45 years old regeneration site in the Southeast Atlantic Forest Biome (Cruzeiro municipality, SP, Brazil).

Tabela 2. Família, espécie, densidade relativa (RD), frequência relativa (RF), dominância relativa (RDo) e índice de valor de importância (VI) observados em um sítio de regeneração com 45 anos de idade no sudeste do bioma Mata Atlântica (Município de Cruzeiro, SP, Brasil).

Family	Species	RD	RF	RDo	VI
Anonaceae	*Guatteria australis* A.St.-Hil.	0.23	0.41	0.06	0.71
Apocynaceae	*Aspidosperma discolor* var. *parvifolium* Müll.Arg.	0.23	0.41	0.17	0.81
	Tabernaemontana hystrix Steud.	1.15	0.83	1.31	3.28
Arecaceae	*Euterpe edulis* Mart.	3.45	2.89	2.24	8.58
	Syagrus romanzoffiana (Cham.) Glassman	1.15	1.24	2.44	4.82
Bignoniaceae	*Sparattosperma leucanthum* (Vell.) K.Schum.	2.53	2.48	3.62	8.63
	Zeyheria tuberculosa (Vell.) Bureau ex Verl.	0.46	0.83	0.11	1.40
Boraginaceae	*Cordia trichotoma* (Vell.) Arráb. ex Steud	0.23	1.24	0.19	1.66
Cannabaceae	*Trema micrantha* (L.) Blume	0.92	1.24	0.19	2.35
Euphorbiaceae	*Alchornea glandulosa* Poepp. & Endl.	0.23	0.41	0.13	0.77
	Croton floribundus Spreng.	0.46	0.83	0.42	1.71
	Croton urucarana Baill.	0.23	0.41	0.96	1.60
	Sapium glandulatum (Vell.) Pax	0.69	1.65	0.33	2.67
	Sebastiania commersoniana (Baill.) L. B. Sm.& Downs	0.23	0.41	0.10	0.74
Fabaceae	*Anadenanthera peregrina* (L.) Speg.	0.92	0.41	1.85	3.19
	Bauhinia forficata Link	0.23	6.61	0.35	7.19
	Dalbergia nigra (Vell.) Allemão ex Benth.	4.60	3.31	4.13	12.04
	Erythrina verna Vell.	0.46	0.83	0.29	1.58
	Inga sessilis (Vell.) Mart.	0.69	1.24	0.73	2.66
	Inga striata Benth.	0.23	0.41	1.39	2.03
	Leucochloron incuriale (Vell.) Barneby & J.W.Grimes	0.46	0.83	0.44	1.72
	Machaerium hirtum (Vell.) Stellfeld	1.38	3.31	1.41	6.10
	Machaerium nyctitans (Vell.) Benth.	6.21	6.20	5.81	18.21
	Machaerium stipitatum (DC.) Vogel	2.30	3.31	1.70	7.30
	Piptadenia gonoacantha (Mart.) J.F.Macbr.	8.05	1.65	16.44	26.14
	Platypodium elegans Vogel	1.84	3.31	3.27	8.41
	Senna macranthera (DC. Ex Collad.) H.S.Irwin & Barneby	0.23	1.24	0.03	1.50
Lamiaceae	*Aegiphila integrifolia* (Jacq.) Moldenke	0.23	0.41	0.09	0.73
	Vitex polygama Cham.	0.69	0.83	0.27	1.79
Lauraceae	*Endlicheria paniculata* (Spreng.) J.F.Macbr.	0.23	0.41	0.30	0.94

to be continued
continua

continuation Table 1
continuação Tabela 1

Family	Species	RD	RF	RDo	VI
	Nectandra oppositifolia Nees	2.30	2.89	4.81	10.00
	Ocotea volutina (Nees) Rohwer	0.46	0.41	0.75	1.63
Malvaceae	*Apeiba tibourbou* Aubl.	0.46	0.41	1.06	1.94
	Ceiba speciosa (A.St.-Hil.) Ravenna	0.23	0.83	0.06	1.12
	Luehea grandiflora Mart. & Zucc.	12.64	8.26	13.97	34.88
	Pseudobombax grandiflorum (Cav.) A.Robyns	0.46	0.41	0.12	0.99
Melastomataceae	*Miconia cinnamomifolia* (DC.) Naudin	0.69	1.24	0.50	2.43
	Miconia sellowiana Naudin	0.23	0.41	0.06	0.71
	Pleroma granulosum (Desr.) D. Don	2.30	0.41	3.00	5.72
Meliaceae	*Cabralea canjerana* (Vell.) Mart.	0.23	0.41	1.34	1.98
	Cedrela fissilis Vell.	0.69	1.24	0.27	2.20
	Guarea kunthiana A.Juss.	10.11	0.41	5.61	16.14
Moraceae	*Ficus adhatodifolia* Schott in Spreng.	0.23	0.41	0.34	0.98
	Maclura tinctoria (L.) D.Don ex Steud.	0.69	1.24	0.60	2.52
Myrtaceae	*Myrcia splendens* (Sw.) DC.	4.60	5.37	2.43	12.40
	Pimenta pseudocaryophyllus (Gomes) Landrum	0.46	0.41	0.09	0.96
	Psidium guajava L.	0.23	0.41	0.12	0.76
Rubiaceae	*Randia armata* (Sw.) DC.	0.23	1.24	0.04	1.51
Rutaceae	*Zanthoxylum rhoifolium* Lam.	1.15	0.83	1.47	3.45
Salicaceae	*Casearia decandra* Jacq.	0.46	0.83	0.10	1.39
	Casearia sylvestris Sw.	9.43	7.02	5.53	21.98
Sapindaceae	*Cupania racemosa* (Vell.) Radlk.	0.23	0.41	0.56	1.21
	Cupania vernalis Cambess.	0.92	4.96	0.59	6.47
Siparunaceae	*Siparuna guianensis* Aubl.	6.21	4.96	1.32	12.48
Urticaceae	*Cecropia glaziovii* Snethl.	0.69	0.41	0.09	1.19
	Cecropia pachystachya Trécul	0.23	1.24	1.12	2.59
	Cytharexyllum myrianthum Chamiáo	0.92	0.41	0.97	2.30
Vochysiaceae	*Vochysia tucanorum* Mart.	0.23	0.41	0.02	0.67
Unknown 6	Unknown 6	0.23	0.41	0.16	0.80
Unknown 8	Unknown 8	0.23	0.41	0.84	1.48
Unknown 9	Unknown 9	0.23	0.41	0.20	0.84
Unknown 10	Unknown 10	0.23	0.41	0.18	0.83
Unknown 11	Unknown 11	0.23	0.41	0.56	1.21
Unknown 12	Unknown 12	0.23	0.41	0.34	0.98

The phytosociological variables used in ecological studies demonstrated that high VI species were mostly non-pioneers, in 2002 high VI species were pioneers in the same farm studied by Martins et al. (2002). Adults and regenerants were similar in species composition (using Sorensen index), indicating that the 45 years old forest site might be in a self-sustainable stage, when native trees have self-sustaining populations. Despite that, 31 species were found only as regenerants, evidencing that new species are still arriving in the community, and 17 species only as adults, the majority being pioneers that may not be recruiting seedlings until a clearing is opened.

4 CONCLUSIONS

Our results showed that after 45 years, an old pasture in the Atlantic Forest Biome regenerated into a forest with predominance of non-pioneers and of zoochorous species and that this richness, despite low when compared to other protected forest remnants, could attest restoration of the site. As noted by other authors, pasture management conditions and the presence of nearby forests collectively determine the composition, richness and density of native regeneration sites. The results obtained corroborate other studies and show that an abandoned pasture in a forest landscape that had returned to native vegetation could explain part of the increase in forest cover observed in the last decades in Vale do Paraíba and also in Southeast Atlantic Forest of Brazil.

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