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A N I N T E R N A T I O N A L J O U R N A L

Natural Regeneration in a Quaternary Coastal Plain in Southern Brazilian Atlantic Rain Forest

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ABSTRACT

Composition, structure and dynamics of an eight year old secondary forest was studied at Reserva Volta Velha (26°04'S; 48°38'W), southern Brazil. A 0.72ha plot was divided into 36 subplots of 20X10m, where all trees/shrubs greater than 1m tall were identified, measured (height/diameter) and evaluated (successional status). The results were: (1) 95 species collected within 68 genera and 44 families; the most species rich families were Myrtaceae and Asteraceae with 8 species each; (2) the most important species (considering biomass and density) were Psidium cattleianum, Eupatorium casarettoi, Ocotea pulchella and Ternstroemia brasiliensis; (3) the most similar area was a fallow abandoned 35 years ago; (4) the higher species diversity were found in border subplots, indicating that most of the species do not tolerate extreme conditions in the center of the opening, and are colonizing the area through the borders.

Key words: Atlantic Rain Forest, floristics, structure, regeneration, dynamics

INTRODUCTION

After centuries of land cover change by man's activity on Earth, many researchers have turned their efforts towards a better understanding of the composition and function of natural ecosystems, and especially the processes related to regeneration of natural and degraded areas (Gomes-Pompa *et al*, 1991). Accordingly, it is common knowledge that through natural regeneration, many ecosystems can "recover". This recovery is dependent on some pos-disturbance environmental restraints, such as soil characteristics, *i.e.* density and chemistry, climate (temperature and humidity), light, proximity to sources of diaspores, and the existence of an active soil seed bank (Denslow, 1987; Garwood, 1989).

The Brazilian Atlantic Forest fits well into the context of anthropogenic land cover change. Originally, this phytogeographic unit extended from northeastern to southern Brazilian Coast. Due to climatic changes during the glacial and interglacial periods in the Quaternary (Por, 1992; Ab´Saber, 1979), this vegetation showed some discontinuity even before the arrival of the Europeans at the Brazilian Coast. Now, after almost 500 years from the first European colonization, this vegetation is only about 5% (20,000 km^2) of the original area (Por, 1992).

Most of the remnants of the Atlantic Rain Forest are in areas of difficult access, such as steep hills and mountainous areas. The lowlands, especially those in the southeastern and southern Brazil are vanishing due to real estate expansion and exploitation. The study of these communities in

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different successional states is crucial to our understanding of their natural regeneration, in order to accumulate enough knowledge to re-establish the degraded areas.

The goal of this study is to contribute to the understanding of the natural regeneration dynamics of the Atlantic Forest, through the comparative analysis of the floristic composition and structure of a fallow of approximately 8 years old in a private reserve in Itapoá, SC, Brazil.

Our major questions were 1. In which way this studied area differs from other adjacent areas in more advanced successional stages? 2. Floristically, which are the similarities comparing the studied area with other coastal lowland forest ecosystems? 3. Based on the species successional status and increasing of diversity, how is succession taking place?

METHODS

Study Area: The Reserva Volta Velha (26°04' S; 48°38' W; Figure 1) in the Itapoá county, State of Santa Catarina, Brazil, is a private reserve (RPPN), and is part of the area considered as the Atlantic Forest Biosphere Reserve.

Figure 1 – Location of the study area of a 8-year-old fallow in Tropical Rain Forest, Santa Catarina, Southern Brazil.

The regional climate is classified as AB'3ra', according to Thornthwaite´s classification; which means superhumid, mesothermic, with little or no hydrological deficit and annual potential summer evapotranspiration lower than 48% (Santa Catarina, 1986). The mean annual temperature in this zone is 21.4 °C. The hottest month is January, with a maximum temperature of 27° C and the coldest month is June with minimum temperature of 16 °C. Mean annual rainfall is 2170 mm, with no well-defined dry period. Maximum rainfall occurs between January and March. Therefore, although the reserve is geographically outside the tropics, this region can be climatically considered tropical (Klein, 1978; Negrelle, 1995).

The specific study site is located at a hectare that was cut down for manihot plantation. After two years of cultivation and at least two fires, it was abandoned eight years before the beginning of this study. This site was surrounded by secondary forest (previously cultivated and abandoned 35 years ago) and also by forest with no historical or visual signs of perturbation – henceforth referred to as "intact forest". This site is dominated by plains with little altimetric variations – mean topographic levels at 0.033% - with sandy soils classified as Podzol, according to Dorneles (1996) and Lolis (1996).

Floristic survey: The floristic composition was studied by collecting all vascular plants found within the one hectare from Dec/95 to Dec/96. The material collected was identified following classical procedures. All flowering identified material was registered at the Herbarium of the Universidade Federal do Paraná (UPCB). Vegetative material was identified by comparison but not registered. Subspecies and/or varieties were not considered in the present paper.

Community Structure: Thirty-six contiguous plots (20 X 10m each) were used for this structural analysis, making up 0.72 ha. In this survey, all trees and shrubs equal to or greater than 1m tall were included, identified and collected when necessary. These individuals were marked with aluminum tags and numbered. The following measurements were taken: height – by using a rod and metric steel tapes; diameter at 15 cm from the soil – using a caliper or a diametric tape.

With the collected data, we analyzed the following parameters: density (D), frequency (F), dominance (DO) and importance value (IV) (Mueller-Dumbois & Ellemberg, 1974).

The diversity and floristic composition of the present study were analyzed comparatively with 3 other studies carried at the same Reserve but at stands of different successional stages; (1) Dorneles (1996), who studied the natural regeneration process by analyzing the structure and composition of the seedling/sapling stratum of a 35 years old fallow; (2) Lolis (1996), who studied the structure of the tree and shrub components of the same 35 years old fallow and (3) Negrelle (1995) who studied the floristic composition and the community structure in an intact-forested area. The Shannon index was used to calculate diversity and the Sørensen´s index to evaluate floristic similarity, following the procedure described in Magurran (1984).

Succession: All identified species were evaluated in order to be classified in a ecological group - successional status. The classification was based on the criteria presented in Denslow (1980) and also considers the presence and absence of each species in 4 different sites, representing different successional stages (present study; Lolis, 1996; Dorneles, 1996; Negrelle, 1995). Additional auto-ecology information from literature were also used to establish the following categories: (1) pioneers (big gap specialists)– which germinate, grow and reproduce only in clear areas; (2) anthropogenic pioneers – which can be found as seedlings and saplings in natural conditions under the canopy of intact forests, but are especially abundant and dominant in anthropogenic disturbed areas (Kageyama, pers.comm); (3) opportunists (small gap specialists) – which can germinate in the shade, but need a clearing to grow and reproduce and (4) shade tolerants – which germinate, grow and reproduce under the canopy. The density and diversity of different successional categories were used to evaluate how succession is taking place in the studied area.

RESULTS

Floristic and structure: ninety six species of vascular plants, included in 69 genera and 45 families were collected during the floristic survey in the studied area. Among these, eight were identified only at the genus level, 6 at the family level and one as a morphospecies. The most speciouse families were Myrtaceae (8 sp), Asteraceae (8 sp), Melastomataceae (7) and Rubiaceae (6). The most speciouse genera were *Ilex* (Aquifoliaceae); *Eupatorium* (Asteraceae); *Ocotea* (Lauraceae), *Miconia* (Melastomataceae); *Gomidesia* (Myrtaceae) and *Ossaea* (Melastomataceae) (Table 1).

Among the 55 species sampled at the structural census, *Psidium cattleianum*, *Eupatorium casarettoi*, *Ocotea pulchella*, *Ternstroemia brasiliensis*, and *Erythroxilon amplifolium* were those with higher structural importance values. These species dominate the landscape due to the combination of higher values of density and frequency (especially *E. cassaretoi* and O. *pulchella*) or basal area (especially *P. cattleianum*). (Table 2).

The Shannon´s Index (H’) was 1.75, a lower value than the ones found by Lolis (1996) and Negrelle (1995), H´= 2.87 and H´= 3.85, respectively (difference between Lolis (1996) and the present study was not significant [*t* test, $P<0.05$]). The greatest similarity was found for an adjacent fallow of 35 years old (Table 3).

P. cattleianum, *O. pulchella*, *T. brasiliensis*, *E. casarettoi* and *Andira anthelminthica* also occur in Restinga vegetation (Silva, 1990; Sugiyama and Mantovani, 1993); which are responsible – among other species – to the considerable similarity with this type of vegetation.

Other areas, such as an adjacent intact forest (Negrelle, 1995), a distant intact forest (Silva, 1985) and a very distant fallow (Torezan, 1995) had low similarity with the one we studied.

Succession: *P. cattleianum*, *O. pulchella* and *T. brasiliensis* - all among the 10 most important (IV) species - were included as anthropogenic pioneers. *E. casarettoi*, the second in IV, was included as a pioneer. The group with the most number of species was the opportunists (small gap specialists), with 20 species, followed by pioneers with 12. Seven were included as shade tolerants and 10 were not included in any category due to lack of information. The assignment of an ecological group for each species is available in Table 2.

From all the species sampled in this approach, 42% were only found in plots adjacent to the older fallow or the intact forest. The plots closer to the edge were the ones with the highest diversity (Kruskal-Wallis Test. $P<0.05$; Figure 2). Even though not all plots on the edge of the sampled area were close to the border of the forested region.

Table 1 – Vascular plants occurring at a 8 year old fallow at the Atlantic Rain Forest, in Southern Brazil; where H = herbaceous; T = trees; L = lianas; E = epiphytes; S = shrubs; UPCB = Universidade Federal do Paraná's Herbarium, Hab - habit.

FAMILY	Voucher no. at UPCB	Habit
AMARYLLIDACEAE		
Hippeastrum sp	**	H
ANNONACEAE	**	
Guatteria australis A.St.Hil.	21350	T
Xylopia cf brasiliensis Spr.	21354	T
AQUIFOLIACEAE		
Ilex pseudobuxus Reiss.	21377	T
Ilex integerrima Reiss.	21382	T
Ilex theezans Mart.	21374	T
Ilex sp	**	T
APOCYNACEAE		
Temnadenia stellaris (Lindl.) Miers.	28883	L
ARACEAE		
Philodendron sp.	**	E
ARECACEAE		
Attalea dubia (Mart.) Burret	**	T
Geonoma schottiana Mart.	20914	S
Syagrus romanzoffiana (Cham.) Glassm.	**	T
ASTERACEAE		
Baccharis cassinefolia L.	**	S
Elephantopus mollis Kunth	28890	H
Eupatorium casarettoi Steyerm.	28891	S
Eupatorium inulaefolium HBK	**	S
Eupatorium laevigatum Lam.	**	H
Pterocaulon lorentzii Malme	**	H
Mikania trinervis Hooker et Arnott	28892	H
Vernonia beyrichii Less.	28893	L
BIGNONIACEAE		
Bignoniaceae sp	**	L
Jacaranda cf puberula Cham.	**	T/S
Tabebuia chrysotricha (Mart. ex DC.)	**	T
BLECHNACEAE		
Blechnum serrulatum L. C. Rich	28876	H
BROMELIACEAE		
Bilbergia sp	**	E
CELASTRACEAE		
Maytenus robusta Reiss.	21794	T
CLETHRACEAE		
Clethra scabra Loisel	21198	T
CLUSIACEAE		
Clusia parviflora Humb. & Bonpl. Ex Willd.	23434	T
COMMELINACEAE		
Dichorisandra thyrsiflora Mik.	21212	H
CYPERACEAE		
Scleria secans (L.) Urb.	28896	H
DENNSTAEDIACEAE		
Pteridium aquilinum Kuhn	**	H
DILLENIACEAE		
Davilla rugosa Poir.	21193	L
DIOSCOREACEAE		
Dioscorea laxiflora Mart. ex Griseb.	**	L
Dioscorea sp	**	L
DRYOPTERIDACEAE		
Rumohra adiantiformis (Forst.) Ching	28877	H
FABACEAE		
Andira anthelminthica (Vog.) Benth	28902	T
Desmodium adscendens (Sw.) DC.	23920	H
Desmodium incanum DC.	23917	H
Fabaceae sp	**	----
ERYTROXYLACEAE		
Erytroxylum amplifolium (Mart.) Schulz	21416	T/S
EUPHORBIACEAE		
Alchornea triplinervia Müll.Arg.	21408	T
Pera glabrata (Schott) Poepp. ex Baill.	21410	T
IRIDACEAE		
Neomarica candida (Hassl.) Sprague	21626	H
LAURACEAE		
Aniba firmula (Ness) Mez.	20919	T
Ocotea pulchella Mart.	20902	T/S
Ocotea catharinensis Mez	23486	T
Ocotea sp	**	T
MALPIGHIACEAE		
Byrsonima lingustrifolia Juss.	28913	T
MELASTOMATACEAE		
Miconia cinerascens Miq.	21390	T
Miconia rigidiuscula Cogn.	28920	T
Miconia sellowiana Naudin	21392	T
Ossaea amygdaloides Triana	**	S
Ossaea brachystachya Triana	**	S
Ossaea confertiflora (DC.) Triana	21395	S
Tibouchina clavata Wurdack	21399	S
MELIACEAE		
Cabralea canjerana (Vell.) Mart.	20922	T
MORACEAE		
Ficus organensis Miq.	**	T
MYRSINACEAE		
Myrsine coriacea (Sw.) R. Br. ex Roem. & *Schult.*	28945	T
Myrsine venosa DC.	21216	T
MYRTACEAE		
Eugenia umbelliflora O.Berg.	**	T
Gomidesia affinis (Camb.) Legrand	28950	T
Gomidesia fenzliana O.Berg.	28951	T/S
Gomidesia palustris (DC.) Legrand	21469	T
Myrcia multiflora (Lam.) DC.	23912	T
Myrtaceae 1	**	----
Myrtaceae 2	**	T/S
Psidium cattleianum Sab	21461	T/S
NYCTAGINACEAE		
Guapira asperula (Standley) Lundell	23446	T
Guapira opposita (Vell.) Reitz	23449	T
ORCHIDACEAE		
Cleistes paranaensis Schltr.	28956	H
Cyrtopodium paranaensis Schltr.	**	H
Liparis nervosa (Thunb.) Lindl.	28958	H
Paradisanthus mosenii Rchb. f.	**	H
Phymatidium myrtophillum Rodr.	22848	E
POACEAE		
Poaceae sp1	**	H
Poaceae sp2	**	H
Poaceae sp3	**	H
POLYPODIACEAE		
Microgramma vaccinifolia Copel.	25852	E
Polypodium latipes Langsd. & L.Fisch.	25864	H
ROSACEAE		
Prunus sellowii Koehne	21500	T/S
RUBIACEAE		
Amaioua guianensis Aubl.	22881	S
Diodia setigera DC.	**	H
Lipostoma cf capitatum (Graham) D. Don	**	H
Psychotria barbiflora DC.	22484	S
Rudgea villiflora K. Schum. ex Standl.	28965	S
Rubiaceae 1	**	S
RUTACEAE		
Zanthoxylum rhoifolium Lam.	**	T
SAPINDACEAE		
Matayba guianensis Aubl.	21494	T
SCHIZAEACEAE		
Schizaea pennula Sw.	28878	H
SMILACACEAE		
Smilax campestris Griseb.	23457	L
Smilax sp	**	L
SOLANACEAE		
Solanum pseudoquina A.St.Hil.	**	T
SYMPLOCACEAE		
Symplocos phaeocladus (Mart.) A. DC.	23011	T
Symplocos sp.	28971	T
THEACEAE		
Ternstroemia brasiliensis Camb.	20880	T/S
Gordonia fruticosa (Schrad.) H. Keng	**	T
TRIGONACEAE		
Trigonia rotundifolia Nees	28973	L

---- habit not assigned due to inconclusive data;
** vegetative material – which was not accepted at UPCB.

Table 2 – Species sampled in the structural analysis of an 8 year old fallow in the Lowland Atlantic Rain Forest, Itapoá, SC, Brazil; where AD – absolute density (individuals.ha^{-1}); RD – relative density (%); AF – absolute frenquency (%); RF – relative frequency (%); ADO – absolute dominance (m^{2}ha^{-1}); RDO – relative dominance (%); IV – importance value; Ecol. group – ecological group; P – pioneer (large gap specialists); AP – anthropogenic pioneer; O – opportunist (small gap specialist); T – shade tolerant; * - values smaller than 0.001; ** - values smaller than 0.01. Some species were not included in any ecological group due to lack of – or inconclusive – data.

	SPECIES	AD	RD	AF	RF	ADO	DOR	IV	Ecol.
1	*Psidium cattleianum*	1895.7	29.46	100.00	9.01	8.131	64.37	102.80	AP
2	*Eupatorium casarettoi*	2362.8	36.71	100.00	9.01	0.975	7.72	53.44	P
3	*Ocotea pulchella*	1250.0	19.42	92.00	8.29	2.177	17.23	44.94	AP
4	*Ternstroemia brasiliensis*	194.29	3.02	89.00	8.02	0.736	5.83	16.87	AP
5	*Erythroxylum amplifolium*	125.71	1.95	67.00	6.04	0.080	0.63	8.62	AP
6	*Myrsine coriacea*	104.29	1.62	69.00	6.22	0.021	0.17	8.01	AP
7	*Guatteria australis*	75.71	1.18	53.00	4.77	0.070	0.55	6.50	O
8	*Andira anthelminthica*	27.14	0.42	33.00	2.97	0.172	1.36	4.75	O
9	*Guapira opposita*	40.00	0.62	44.00	3.96	0.006	0.05	4.63	O
10	*Eupatorium laevigatum*	31.43	0.49	39.00	3.51	0.002	0.01	4.01	P
11	*Syagrus romanzoffiana*	34.29	0.53	28.00	2.52	0.005	0.04	3.09	P
12	*Gomidesia fenzliana*	21.43	0.33	28.00	2.52	0.008	0.22	3.07	P
13	*Guapira asperula*	22.86	0.36	25.00	2.25	0.005	0.04	2.65	O
14	*Clusia parviflora*	14.29	0.22	25.00	2.25	0.001	0.01	2.48	T
15	*Ilex pseudobuxus*	18.57	0.29	22.00	1.98	0.024	0.19	2.46	O
16	*Gordonia fruticosa*	15.71	0.24	19.00	1.71	0.028	0.22	2.17	P
17	*Baccharis cassinefolia*	22.86	0.36	19.00	1.71	0.003	0.02	2.09	O
18	*Ilex integerrima*	11.43	0.18	17.00	1.53	0.004	0.03	1.74	-----
19	*Ilex sp*	11.43	0.18	17.00	1.53	0.002	0.02	1.73	-----
20	*Alchornea triplinervia*	11.43	0.18	14.00	1.26	0.015	0.12	1.56	O
21	*Myrsine venosa*	12.86	0.20	14.00	1.26	0.004	0.04	1.50	T
22	*Ossaea amygdaloides*	11.43	0.18	14.00	1.26	0.001	0.01	1.45	P
23	*Solanum pseudoquina*	7.14	0.11	14.00	1.26	0.004	0.03	1.40	AP
24	*Ilex theezans*	7.14	0.11	14.00	1.26	0.003	0.03	1.40	O
25	*Miconia sellowiana*	8.57	0.13	11.00	0.99	0.007	0.06	1.18	O
26	*Pera glabrata*	8.57	0.13	11.00	0.99	0.006	0.05	1.17	O
27	*Matayba guianensis*	5.71	0.09	11.00	0.99	0.001	0.01	1.09	O
28	*Amaioua guianensis*	10.00	0.16	8.00	0.72	0.005	0.04	0.92	O
29	*Symplocos phaeoclados*	4.29	0.07	8.00	0.72	0.006	0.05	0.84	-----
30	*Symplocos sp*	1.43	0.02	3.00	0.27	0.003	0.42	0.71	-----
31	*Psychotria barbiflora*	10.00	0.16	6.00	0.54	*	**	0.70	T
32	*Ossaea confertifolia*	4.29	0.07	6.00	0.54	0.001	**	0.61	O
33	*Maytenus robusta*	2.86	0.04	6.00	0.54	0.003	0.03	0.61	O
34	*Rudgea villiflora*	2.86	0.04	6.00	0.54	*	**	0.58	O
35	*Ossaea brachystachia*	2.86	0.04	6.00	0.54	*	**	0.58	P
36	*Myrtacea sp*	2.86	0.04	6.00	0.54	*	**	0.58	-----
37	*Undetermined sp1*	2.86	0.04	6.00	0.54	*	**	0.58	-----
38	*Miconia rigidiuscula*	2.86	0.04	6.00	0.54	*	**	0.58	T
39	*Eupatorium inulaefolium*	2.86	0.04	6.00	0.54	*	**	0.58	P
40	*Byrsonima ligustrifolia*	1.43	0.02	3.00	0.27	0.022	0.17	0.46	O
41	*Eugenia umbelliflora*	1.43	0.02	3.00	0.27	0.015	0.12	0.41	P
42	*Tibouchina clavata*	7.14	0.11	3.00	0.27	0.001	0.01	0.39	P
43	*Geonoma schottiana*	4.29	0.07	3.00	0.27	0.004	0.03	0.37	T
44	*Vernonia beyrichii*	2.86	0.04	3.00	0.27	*	**	0.31	P
45	*Ocotea catharinensis*	1.43	0.02	3.00	0.27	0.002	0.01	0.30	-----
46	*Gomidesia palustris*	1.43	0.02	3.00	0.27	0.002	0.01	0.30	P
47	*Ficus organensis*	1.43	0.02	3.00	0.27	0.001	0.01	0.30	O
48	*Aniba firmula*	1.43	0.02	3.00	0.27	0.001	0.01	0.30	T
49	*Tabebuia chrysotricha*	1.43	0.02	3.00	0.27	*	**	0.29	-----
50	*Rubiaceae sp*	1.43	0.02	3.00	0.27	*	**	0.29	-----
51	*Prunus sellowii*	1.43	0.02	3.00	0.27	*	**	0.29	O
52	*Ocotea sp*	1.43	0.02	3.00	0.27	*	**	0.29	-----
53	*Myrcia multiflora*	1.43	0.02	3.00	0.27	*	**	0.29	T
54	*Miconia cinerascens*	1.43	0.02	3.00	0.27	*	**	0.29	O
55	*Clethra scabra*	1.43	0.02	3.00	0.27	*	**	0.29	O
	TOTAL	6435	100	1110	100	12.632	100	300	-----

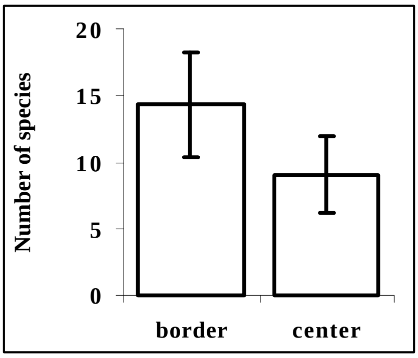

Figure 2 – Mean number of species in border and center plots (mean ± one SD) in an 8-year-old fallow in the Lowland Atlantic Rain Forest. Itapoá. SC. Brazil.

Some of the species that occurred preferentially closer to the border were *Miconia sellowia, Clethra scabra*, and *Pera glabrata*. which all were observed occurring in small gaps inside the forest too (personal observation).

DISCUSSION

As reported to other initial successional stages, resulting from anthropogenic perturbation (*i.e.* Gomez-Pompa *et al.*, 1991; Maser, 1994; Rosenzweig, 1995), the studied area showed a low diversity. The high diversity of Myrtaceae, Asteraceae, Melastomataceae and Rubiaceae was also expected since these are well-represented families in tropical and subtropical South America (Barroso, 1984, 1986; Cronquist, 1988). On the other hand, the low diversity of Orchidaceae, reported as a very speciouse family of the Atlantic Rain Forest, could be due to the small number of trees with girth big enough to allow the profusion of epiphytes.

Based on geographical distribution data, one could predict the occurrence of those very speciouse genuses found in the studied area. *Ilex* (Aquifoliaceae) is a genus that has its center of distribution in mid-southern South America (Edwin and Reitz, 1967). *Eupatorium* (Asteraceae) and *Ocotea* (Lauraceae) have beenn reported as pantropical with highest diversity in South America (Cabrera and Klein, 1989; Vattimo, 1956) as well *Miconia* (Melastomataceae) and *Gomidesia* (Myrtaceae), both neotropical (Wurdack, 1962; Legrand and Klein, 1967). *Ossaea* (Melastomataceae) is the only one cited as a genus with higher diversity in Asia (Wurdack, 1962).

The considerable similarity among the studied site and Restinga Vegetation could be the result of similarities in climate, soil and the regional geological and species' evolutionary history (Pianka, 1994; Brown, 1995; Gentry, 1982; Futuyma, 1992) which created a gradual transition from Restinga to Atlantic Rain Forest. Apparently, this similarity might be due to (1) both kinds of vegetation grow on Podzol and quartz-sands soils and (2) theoretically, over hundreds or thousands of years, Restinga Vegetation could have become Lowland Atlantic Rain Forest through the action of the biota on the evolution of soils. So, these two kinds of vegetation are somewhat related on a greater spatio-time scale.

It is important, when discussing similarity, to bear in mind that even though the successional process is known, stochastic factors have strong effects on an establishing community's composition (Mabberley, 1992), in a way that it makes each community unique for each area. This was clear when we found that the closest area to the present study – an adjacent 35-year-old fallow - was only 43.7% similar. It was interesting to notice an increase in the similarity with this 35-year-old fallow as we calculated it for greater minimum DBH. With higher minimum girth, the probability of including just the oldest individuals was greater – they were the first to establish when the area had just been abandoned. Therefore, the increase in the similarity with the increase of minimum girth showed that the first species to colonize the area studied by Lolis (1996) were similar to the ones colonizing the area of the present study; which showed some trend in predictability of the species colonizing the area after abandonment.

The impact of clear cutting and fire activities certainly have a strong influence in this young community's structure, *i.e.*, *P. cattleianum, T. brasiliensis* and *E. amplifolium* have most of their individuals with more than oone stem (35 stems in some *P. cattleianum*). Probably the successive clear cuts associated with the ability of resprouting from roots and/or stems might have been the cause of the increase in density of these species.

The species with the highest density, *Eupatorium casarettoi*, is a shrub typical of dunes close to the beach and of open Restinga Vegetation (Cabrera and Klein, 1989). This was probably because of the proximity of the Reserve to the beach – 5 km. Since its dispersal is anemochorous and there are long open areas due to real estate expansion, this species appears further into the plain.

Table 3 – Sørensen´s similarity indices (IS_S) obtained comparing floristic data from the present study site and from other different Atlantic Forest and Restinga sites.

STUDY SITE	CRITERIA	AUTHOR	IS_S
LARF, Itapoá, SC; 35 year old fallow	DBH≥ 10cm	Lolis (1996)	43.67
LARF, Itapoá, SC; 35 year old fallow	DBH< 5cm	Lolis (1996)	43.66
LARF, Itapoá, SC; 35 year old fallow	DBH≥ 8cm	Lolis (1996)	42.1
LARF, Itapoá, SC; 35 year old fallow	DBH≥ 5cm	Lolis (1996)	40.33
Restinga Forest, Ilha do Mel, Paranaguá-PR	DBH≥ 5cm	Silva (1990)	34.86
Restinga Forest, Ilha do Cardoso, SP	DBH≥ 1.6cm	Sugiyama (1993)	29.6
SMARF, Guaraqueçaba, PR	PBH≥ 10cm	Athayde (Com.Pes.)	28.28
LARF, Itapoá SC, intact forest	DBH< 5cm	Negrelle (1995)	27.58
SMARF, 13 year old fallow, Morretes, PR	DBH≥ 6.4cm	Guapyassu (1994)	17.02
Restinga Forest, Emboaba, Osório, RS	DBH≥ 5cm	Dillenburg (1986)	15.15
LARF, Morretes, PR	PBH≥ 20cm	Silva (1985)	13.59
Caxetais, coastal forested marshes	DBH≥ 10cm	Ziller (1992)	11.96
SMARF, 15 year old fallow, Vale do Ribeira, SP	Height> 1m	Torezan (1995)	9.41

LARF – Lowland Atlantic Rain Forest SMARF- Submontane Atlantic Forest; DBH – diameter at breast height; PBH – perimeter at breast height.

The categorization of species in ecological groups, although a very good tool, it is only didactic, since in nature there is a *continuum* of degree of dependence on gaps for regeneration. Besides, many times it is applicable only for the region where the research is developed, because environmental pressures upon gene regulation and expression mechanisms may alter the structure and physiologic behavior of the individuals from a population in a small period of time (Cronquist, 1988; Futuyma, 1992; Wolf, 1995). Therefore, the results revealed here might not be in perfect agreement with the categorization of the same species elsewhere.

The spatial distribution within the clearing may be due to the existence of less extreme conditions closer to the border when compared with its center – which receives more light – has higher soil surface temperature and lower relative humidity (Popma *et al.*, 1988; Matlack, 1994; Denslow, 1987). Therefore, spatial heterogeneity leads to differential colonization of species in different parts of a clearing in the forest (Turner *et al.*, 1998). In fact, some authors have found preferential establishment of some species. *i.e.*, *Miconia argentea* in small gaps, in the border of big gaps, or in center of big gaps only after these have been colonized by pioneers, where/when ambient conditions are less extreme (Brandani *et al.*, 1988; Brokaw, 1987; Denslow, 1987). We must also consider the fact that many species do not have very efficient dispersal mechanisms. So the distance from the source of diaspores will affect the amount (Yao *et al.*, 1999) and the diversity of the seed rain falling at the clearing – the closer to the border, the greater and richer the seed rain will be (Garwood, 1989).

From the results obtained in this study, we can hypothesize that succession in these anthropogenic clearings takes place in the following pattern: (1) pioneer and anthropogenic pioneer species first colonize the area abandoned; (2) after this first ‘step’, the environmental conditions begin to change and then small gap specialists and tolerant species start to colonize the area too – mainly on the borders of the opening. In such pattern, we could expect a gradual increase in species diversity over time.

It is clear that the geological formation of these Quaternary plains is the main cause of this vegetation’s low plant diversity and of its similarity with Restinga Vegetation.

In regard to the previsibility of the species composition in fallows through time, we observed that in large anthropogenic perturbations, like in the present area, it was more likely to find certain species more frequently than others, where there was no soil variation. In small natural gaps this was not the case because these areas are rapidly colonized and stochastic factors seem to play a major role in its composition, reducing its previsibility (Foster and Tilman, 2000). We also found that in these anthropogenic clearings, species other than the usual pioneers dominated the colonization process, since the environmental pressures in these areas were also different.

Attention must be drawn to the fact that most part of this type of coastal ecosystems are being turned into pastures, *Pinus* plantations and real estate. We do not know the functions of these ecosystems on regional climate, hydrology and nutrient cycling. Therefore, we need better understanding of the composition and functioning of regenerating plant communities.

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RESUMO

A maior parte das áreas florestais no domínio da Floresta Atlântica se encontra degradada devido a diferentes pressões antrópicas. No intuito de ampliar os conhecimentos sobre relictos de florestas nativas intactas, e também de áreas abandonadas para se obter dados sobre os processos naturais de regeneração, foi realizado um estudo da composição florística, estrutura e dinâmica de uma comunidade vegetal em estágio seral inicial de 8 anos. em Floresta Ombrófila Densa das Terras Baixas, na Reserva Volta Velha, Itapoa-SC, Brasil. Foram utilizados os métodos usuais de coleta, herborização e identificação das espécies encontradas, e a análise estrutural foi feita utilizando-se 36 parcelas retangulares de 20 X 10m, sendo incluídas todas as plantas arbustivo/arbóreas com no mínimo 1 metro de altura. Os resultados obtidos foram os seguintes: 1- Foram encontradas 96 espécies, dentro de 68 gêneros e 44 famílias; as famílias com maior número de espécies foram Myrtaceae e Asteraceae com 8 espécies cada, e o gênero mais representado foi Ilex, com 4 espécies; 2- As espécies mais importantes (parâmetros fitossociológicos) no local foram *Psidium cattleianum*, *Eupatorium casarettoi*, *Ocotea pulchella* e *Ternstroemia brasiliensis*; 4- A área mais similar à do presente estudo foi uma área vizinha abandonada há 35 anos; áreas de restinga também demostraram ser relativamente semelhantes; 5- O grupo ecológico com maior número de espécies foi o de oportunistas (especialistas de pequenas clareiras), e houve um maior número de espécies nas parcelas de borda, mostrando que a maior parte das espécies não toleram as condições extremas do centro da clareira. e sua colonização se dá via bordas.

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