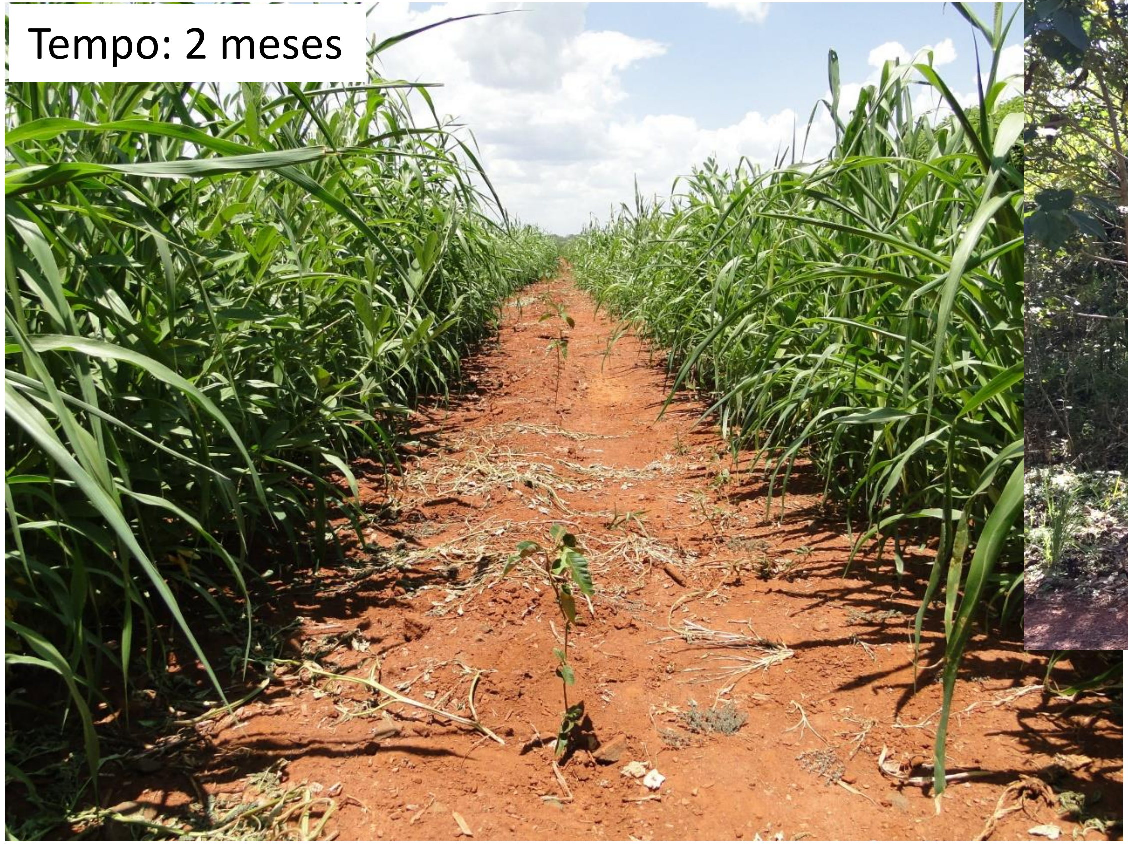
SOBRE2018
II Conferência Brasileira de Restauração Ecológica
X Simpósio Brasileiro sobre Tecnologia de Sementes Florestais
21 a 23 de novembro de 2018 • Belo Horizonte • MG

Efeitos de prioridade como ferramenta potencial de metodologias de restauração de ecossistemas brasileiros

Tempo: 2,5 anos



Tempo: 2 meses

Ricardo Ribeiro Rodrigues
LERF/LCB/ESALQ/USP
www.lerf.esalq.usp.br

Efeito de Prioridade (*priority effects*): organismos que
positiva ou negativamente o estabelecimento, cresci
estabelecem **depois**, influenciando assim o processo
comunidade natural (Fukami 2015; Temperton

Acta Botanica Brasilica 29(1): 73-81. 2015.
doi: 10.1590/0102-33062014abb3642

Species-specific associations between overstory and understory tree species in a semideciduous tropical forest

Flaviana Maluf Souza[1], Sergius Gandolfi[2] and Ricardo Ribeiro Rodrigues[2]

Table 1. Abundance of the overstory trees and the total density of understory individuals beneath their canopies (mean ± standard error) in a tropical semideciduous forest in Brazil. There were no significant differences in the density of understory individuals among overstory species (permutational ANOVA, $P < 0.05$).

Family	Overstory species	Code	Number of sampled individuals	Density of individuals underneath the canopy (individuals/m²)
Apocynaceae	*Aspidosperma polyneuron* Müll.Arg.	Aspo	50	0.155 ± 0.015
Rutaceae	*Balfourodendron riedelianum* (Engl.) Engl.	Bari	26	0.170 ± 0.019
Fabaceae	*Piptadenia gonoacantha* (Mart.) J.F.Macbr.	Pigo	14	0.151 ± 0.032
Anacardiaceae	*Astronium graveolens* Jacq.	Asgr	10	0.127 ± 0.023
Rutaceae	*Esenbeckia leiocarpa* Engl.	Esle	10	0.133 ± 0.014
Fabaceae	*Centrolobium tomentosum* Guillem. ex Benth.	Ceto	9	0.181 ± 0.021
Phyllanthaceae	*Savia dictyocarpa* Müll.Arg.	Sadi	8	0.173 ± 0.034
Fabaceae	*Senegalia polyphylla* (DC.) Britton & Rose	Sepo	6	0.149 ± 0.049
Malvaceae	*Ceiba speciosa* (A.St.-Hil.) Ravenna	Cesp	5	0.140 ± 0.029

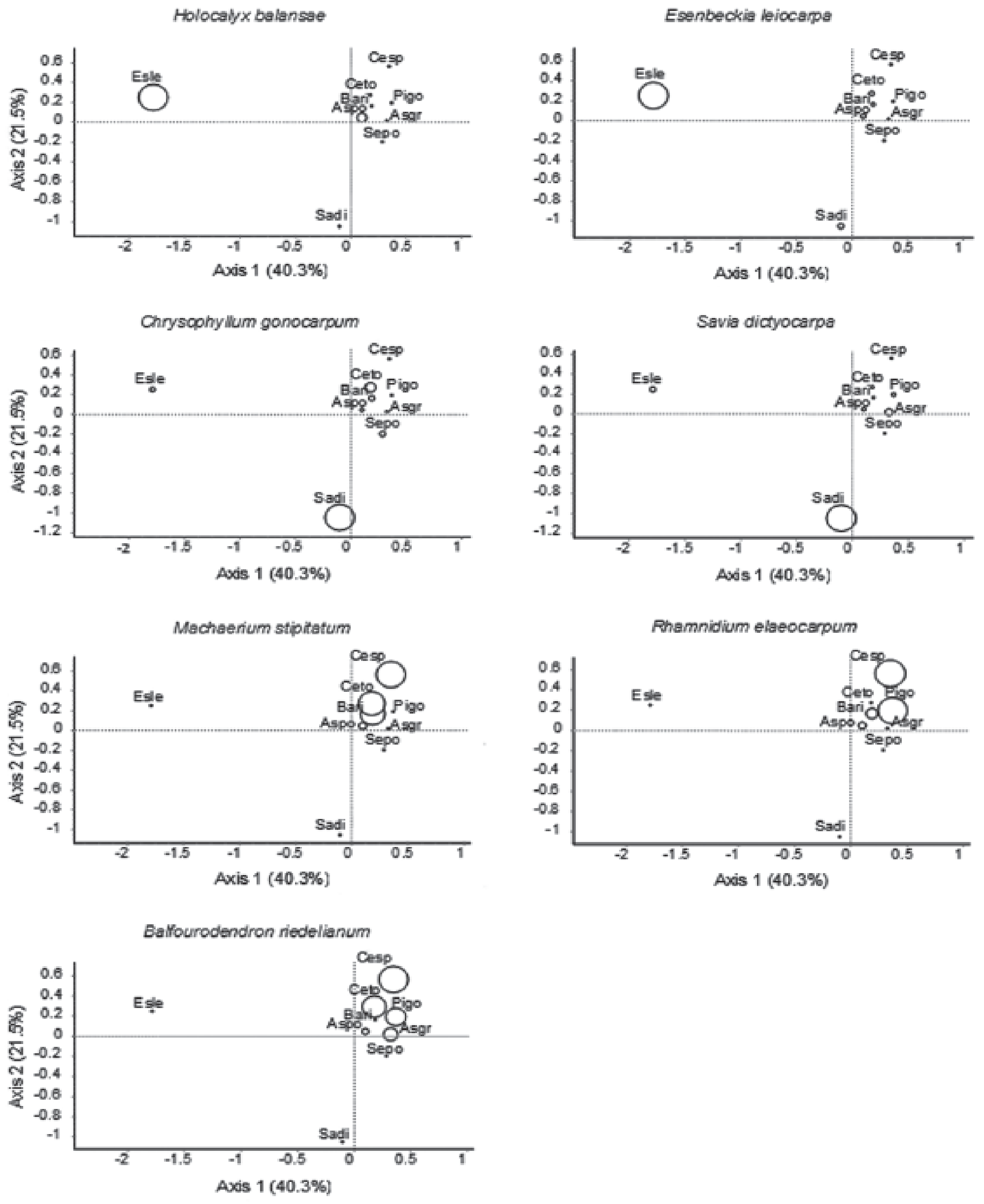
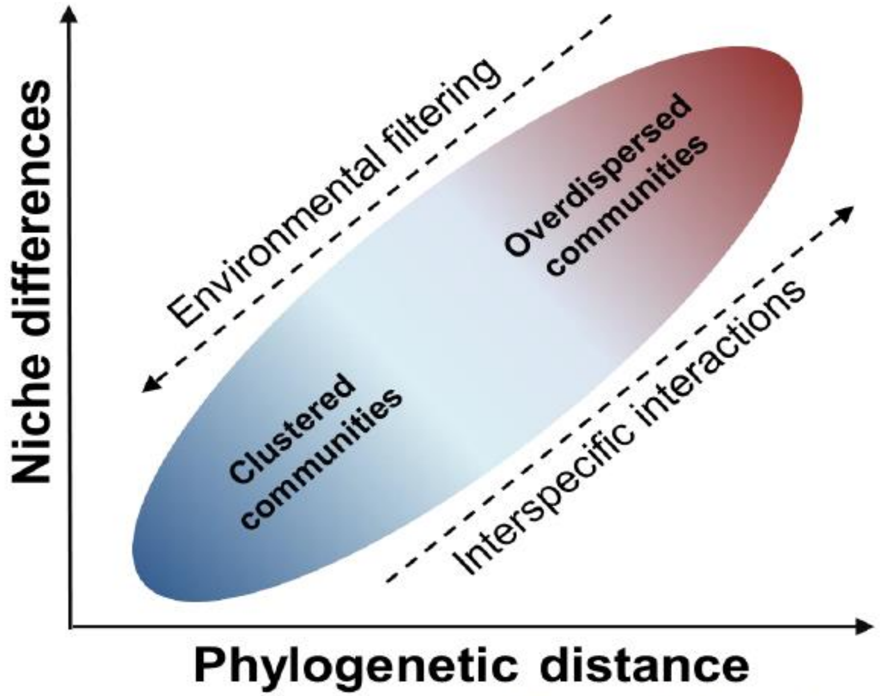


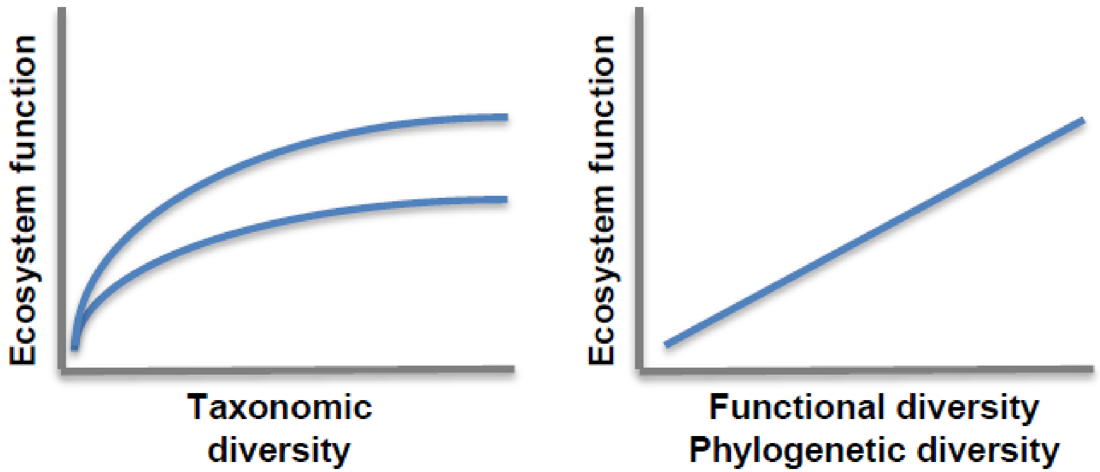
Figure 2. Density of the seven understory species that contributed most to the ordination that resulted from the Correspondence Analysis. The position of each circle corresponds to the scores of the overstory species, and the size of the circle is directly proportional to the density of understory individuals. The codes for the overstory species names are referenced in Table 1.

Ecologia funcional e filogenética

Markus Gastauer VALE



Gastauer et al. 2018. Journal of Cleaner Production. Doi: 10.1016/j.jclepro.2017.10.223



Adaptado de Cadotte et al. 2011. Journal of Applied Ecology. Doi: 10.1111/j.1365-2664.2011.02048.x

Maior diversidade funcional/filogenética para **maximizar** funcionamento ecossistêmico

Journal of Applied Ecology

Journal of Applied Ecology 2015, **52**, 805–809 doi: 10.1111/1365-2664.12413

PRACTITIONER'S PERSPECTIVE

Using plant functional traits to restore Hawaiian rainforest

Rebecca Ostertag[1]*, Laura Warman[2], Susan Cordell[2] and Peter M. Vitousek[3]

[1]*University of Hawaii at Hilo, Hilo, HI 96720, USA;* [2]*Institute of Pacific Islands Forestry, USDA Forest Service, Hilo, HI 96720, USA; and* [3]*Stanford University, Stanford, CA 94305, USA*

Table 1. List of functional traits measured in 25 Hawaiian lowland wet forest sites

Functional trait	Biological significance	Trait range	Source of data
Leaf : petiole ratio	Light acquisition and self-shading	2·81–200·00	Measured
Leaf thickness	Resource acquisition, longevity and resource use	0·17–1·40	Measured
Leaf mass per area (LMA)	Photosynthesis, resource availability and longevity	8·24–469·22	Measured
Foliar nitrogen (%)	Concentration of RuBisCO, photosynthesis and fast-to-slow strategies	0·55–2·25	Measured
Foliar carbon (%)	Leaf construction and resource use	32·62–49·63	Measured
Foliar carbon : nitrogen	Leaf longevity and fast-to-slow strategies	14·82–79·78	Measured
Foliar phosphorus (%)	Leaf quality	Trace–0·30	Measured
Stem specific gravity (g cm^{-3})	Diameter growth rate, mortality rate, hydraulic capacity and carbon storage	0·16–1·51	Measured
Water-use efficiency	Water-use efficiency, resource use and acquisition	42·26–154·16	Calculated
Max plant height (m)	Competitive vigour, plant fecundity and light acquisition	5–30	Bibliographic
Seed mass (g)	Dispersal, longevity and survival	<0·01–2·50	Bibliographic
Stature*	Dispersal, longevity and carbon storage	1–3	Observation
Canopy architecture†	Light interception and stability	1–3	Observation
Leaf area (cm^2)	Photosynthetic capacity and resource allocation	2·8–>1000	Measured
Water content (%)	Resource use and allocation, and fast-to-slow strategies	2·59–85·9	Measured

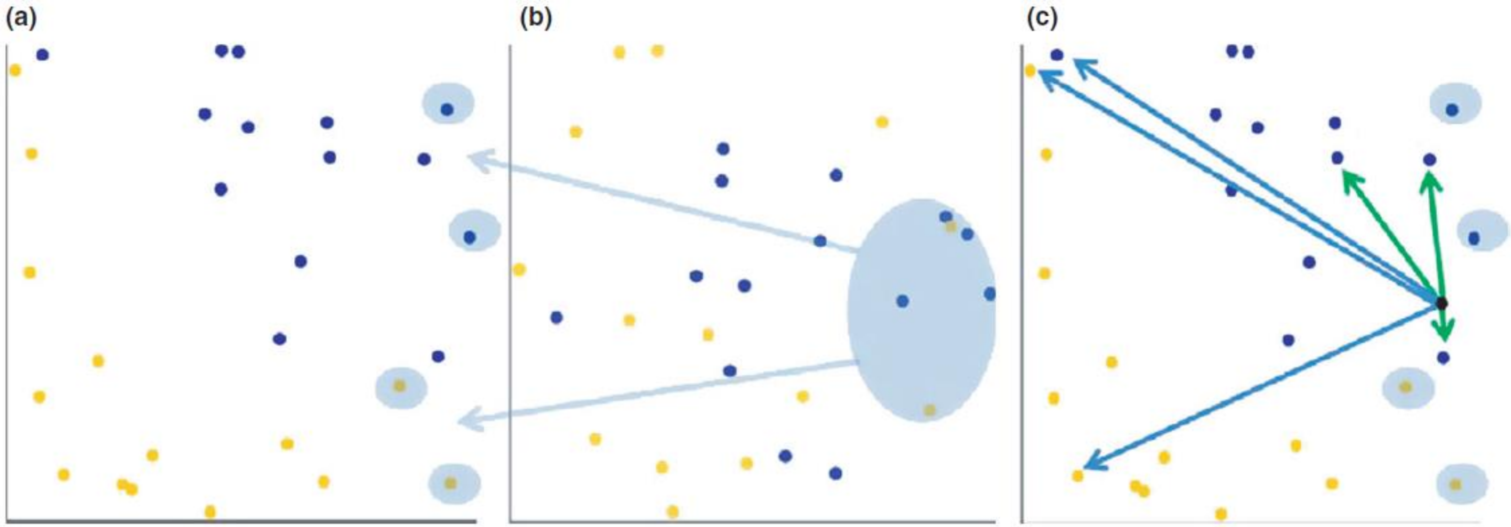
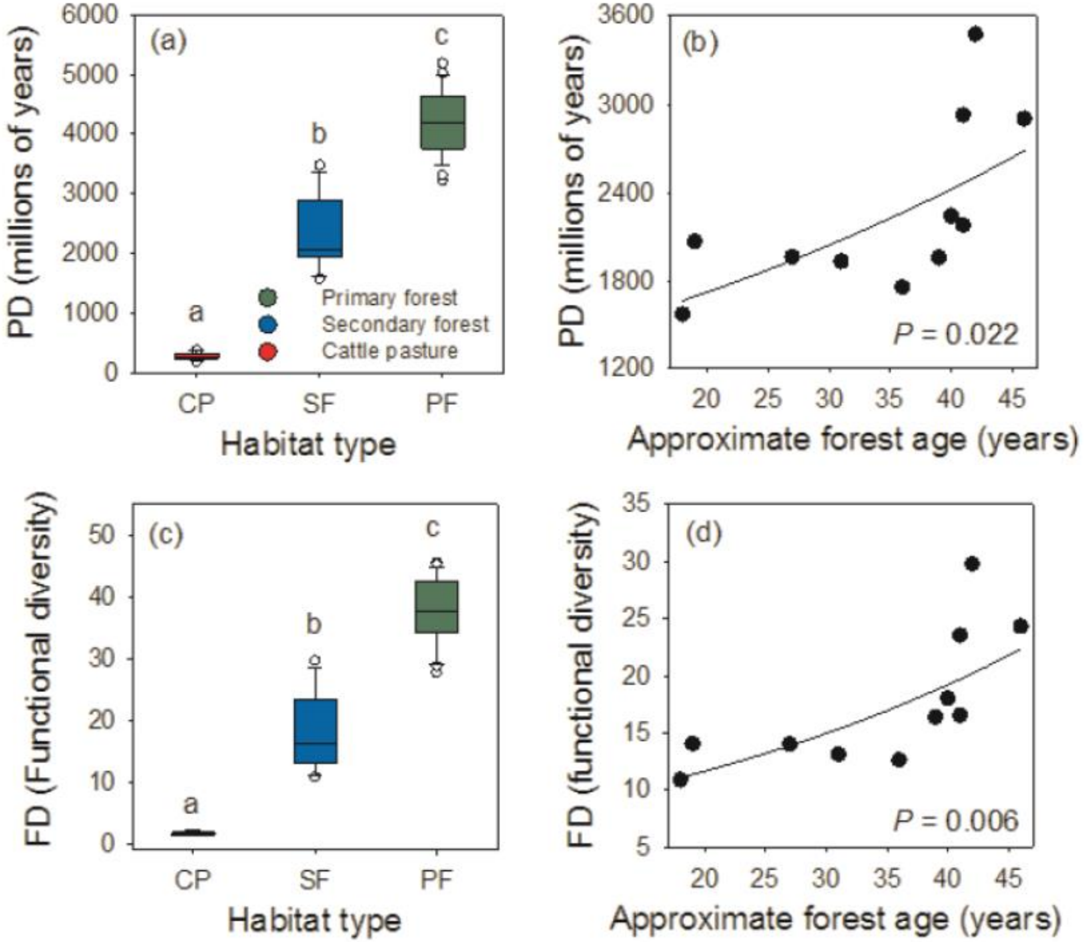
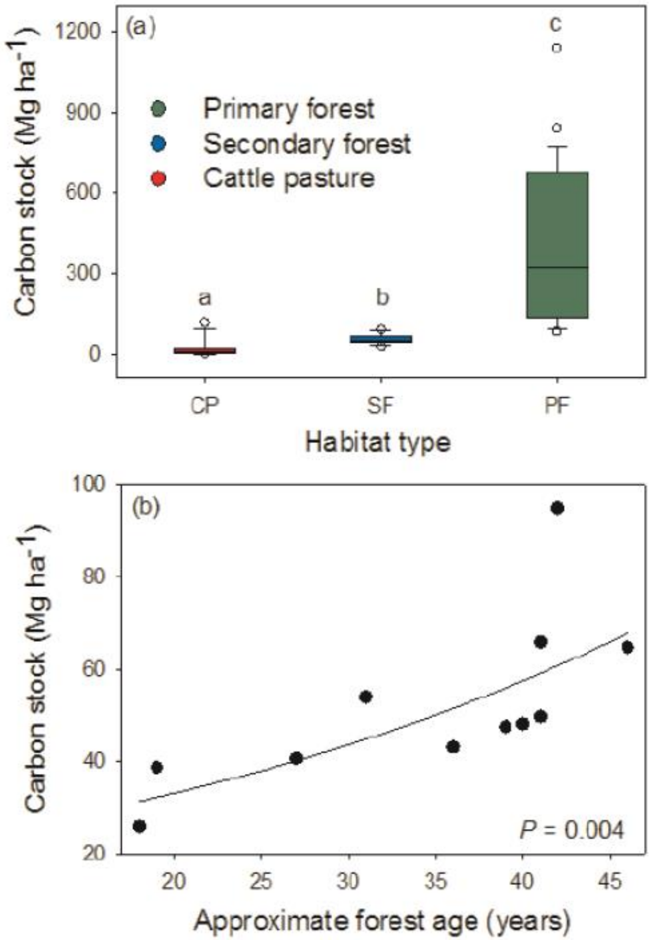


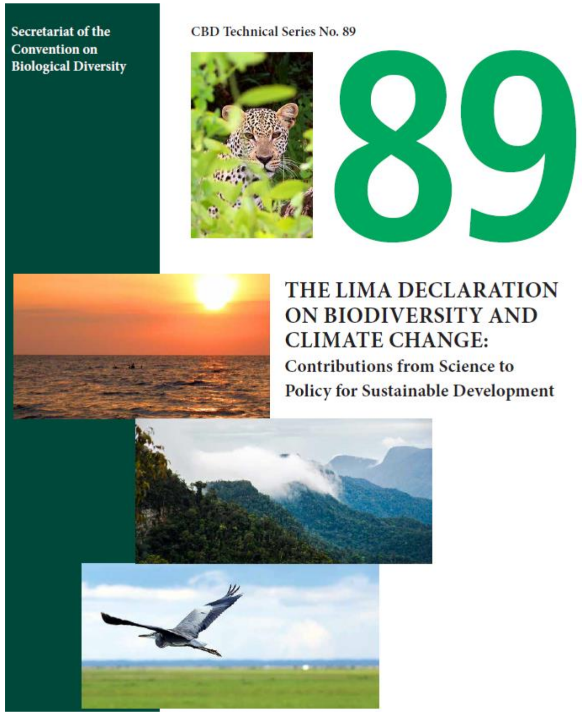
Fig. 1. Overview of the ordination process used to select species. (a) Principal component analysis (PCA) showing all species: natives in blue and non-natives in yellow. Species circled are the 'core species' identified in the second PCA as being 'high-carbon species'. (b) PCA highlighting carbon-related traits; the species circled are the ones selected for having the slowest carbon turnover, according to their position in the PCA. (c) On the main PCA, once a centroid has been found (centre point between the four core species), species are identified as having redundant (similar – geometrically closest on axis 1) or complementary (less similar – geometrically distant on axis 1) trait profiles.



(a)
PD (millions of years)
6000
5000
4000
3000
2000
1000
0
a
b
c
Primary forest
Secondary forest
Cattle pasture
CP
SF
PF
Habitat type
(b)
PD (millions of years)
3600
3000
2400
1800
1200
P = 0.022
20
25
30
35
40
45
Approximate forest age (years)
(c)
FD (Functional diversity)
50
40
30
20
10
0
a
b
c
CP
SF
PF
Habitat type
(d)
FD (functional diversity)
35
30
25
20
15
10
5
P = 0.006
20
25
30
35
40
45
Approximate forest age (years)



(a)
Carbon stock (Mg ha-1)
1200
900
600
300
0
Primary forest
Secondary forest
Cattle pasture
a
b
c
CP
SF
PF
Habitat type
(b)
Carbon stock (Mg ha-1)
100
80
60
40
20
P = 0.004
20
25
30
35
40
45
Approximate forest age (years)



INSTITUTO TECNOLÓGICO VALE

VALE

Seleção funcional de espécies

Espécies da lista vermelha:
Conservação de espécies e biodiversidade

Folhas grandes de crescimento rápido produzindo sombra abundante:
Evitar a proliferação de heliófitos (exóticos) e proporcionar condições para a germinação de outras espécies

Alta densidade de madeira, longa vida e alta biomassa de raízes:
Sequestro de carbono

Raízes profundos e casca grossa:
Resistência ao fogo e absorção de água e nutrientes

Alto valor madeireiro:
Produção de madeira comercial

Sistema radicular superficial extensivo, alto turnover foliar e fixação de N2:
Proteja o solo contra a erosão e melhore a fertilidade e estrutura do solo

Produção abundante de frutas carnudas e alta complexidade do dossel:
Conservação da biodiversidade e conectividade da paisagem, atraindo pássaros dispersores de sementes e outros animais

Gaustauner et al.

Adaptado de Thomas et al. 2017. https://hdl.handle.net/10568/90681

Applied Vegetation Science ▮▮ (2015)

Flower functional trait responses to restoration time

Letícia Couto Garcia, Marcus Vinicius Cianciaruso, Danilo Bandini Ribeiro, Flavio Antonio Maës dos Santos & Ricardo Ribeiro Rodrigues

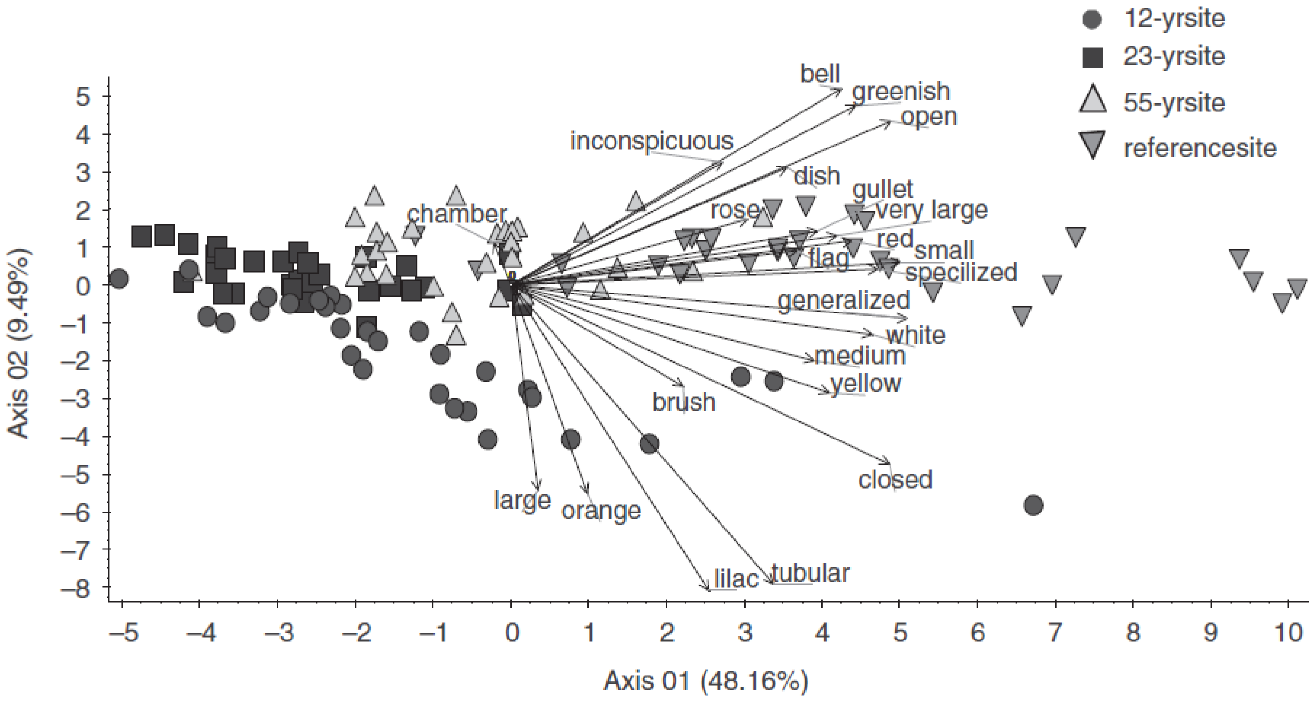


Fig. 3. Principal components analysis with biplot of total plant community species abundance and flower traits for three sites undergoing restoration and one reference forest. Circles, squares, triangles and inverted triangles represent plots (i.e. data as the number of species with each flower trait per plot) of 12, 23, 55 yr and reference sites, respectively.

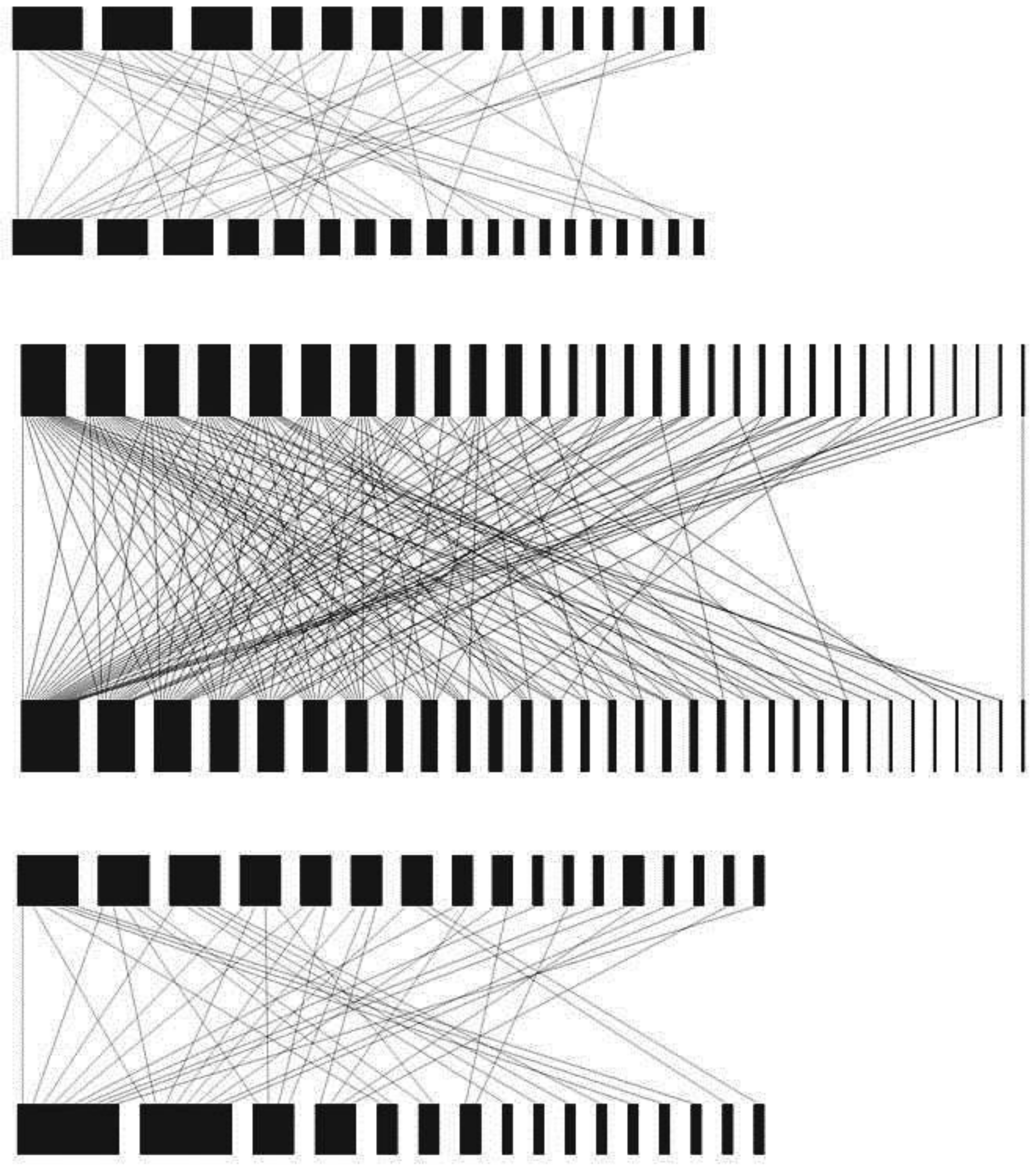


Figure 1. Bird-seed dispersal networks in three restored sites in São Paulo state, Brazil. The lower boxes represent seed species, the upper boxes bird species, box size is proportional to abundance and the links represent the interactions. A) 15 year-old restored plot, B) 25 year-old restored plot, C) 57 year-old plot.

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RESEARCH ARTICLE

Applied Vegetation Science IAVS

Are the assemblages of tree pollination modes being recovered by tropical forest restoration?

Paula María Montoya-Pfeiffer[1] | Ricardo Ribeiro Rodrigues[2] | Jean Paul Metzger[3] | Claudia Inês da Silva[1] | Oswaldo Santos Baquero[4] | Isabel Alves dos Santos[1]

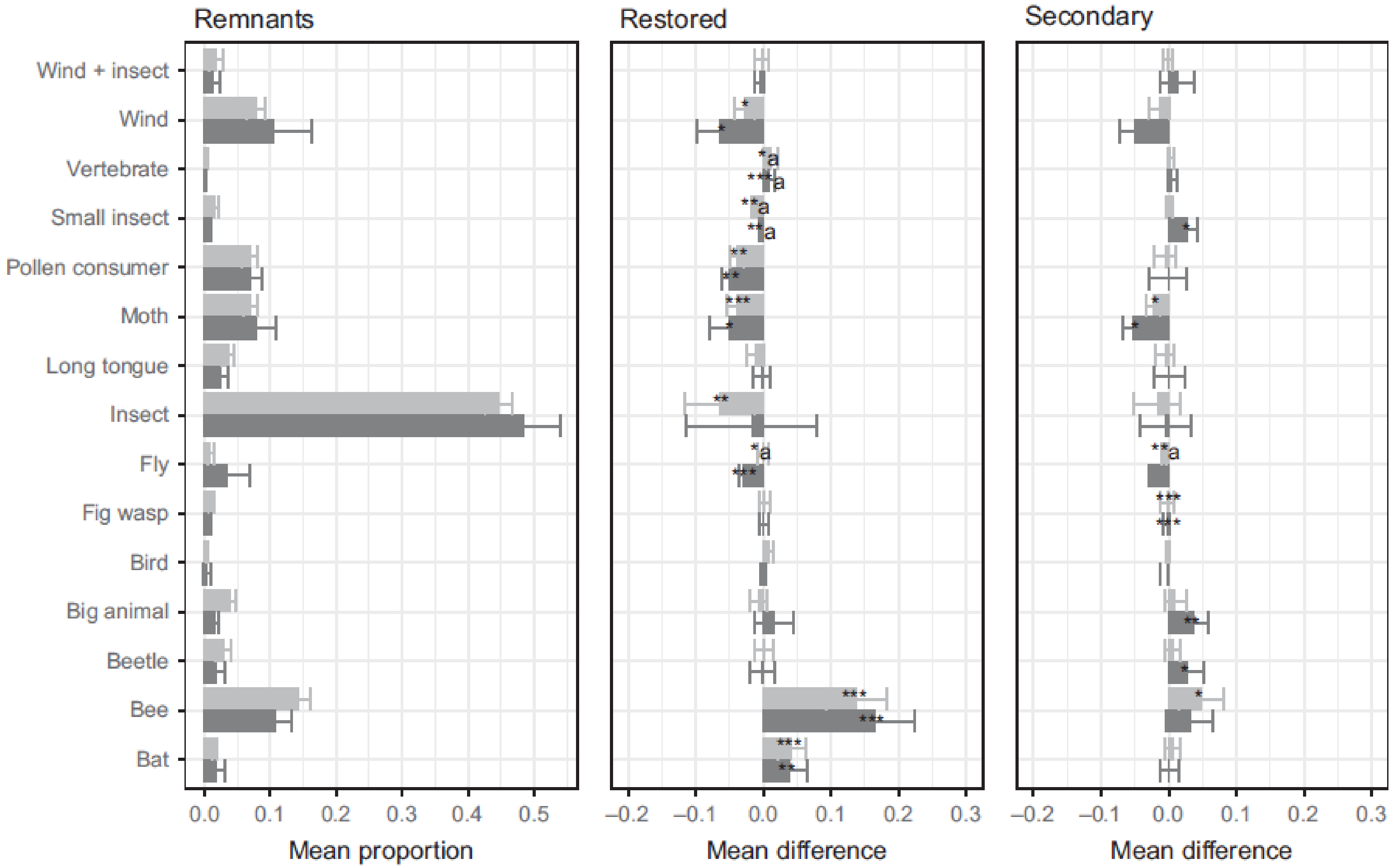

FIGURE 3 Mean values and CIs (95%) of species (light-grey) and abundance (dark-grey) proportions of pollination modes at remnants (primary forest) and the differences found among restored (tree plantings) and secondary (naturally regenerated) tropical semi-deciduous forests. The figure shows greater changes among restored forests than secondary forests, compared with primary forests. Asterisks (*) denote significant differences in GLM: *0.05, **0.01, ***0.001. "a" indicates changes in the presence–absence of pollination modes using zero-inflated binomial models

Biological Conservation 142 (2009) 1242–1251

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journal homepage: www.elsevier.com/locate/biocon

On the restoration of high diversity forests: 30 years of experience in the Brazilian Atlantic Forest

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A R T I C L E I N F O

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Available online 20 January 2009

Keywords:
Biodiversity conservation
Brazil
Public policies
Restoration practices

A B S T R A C T

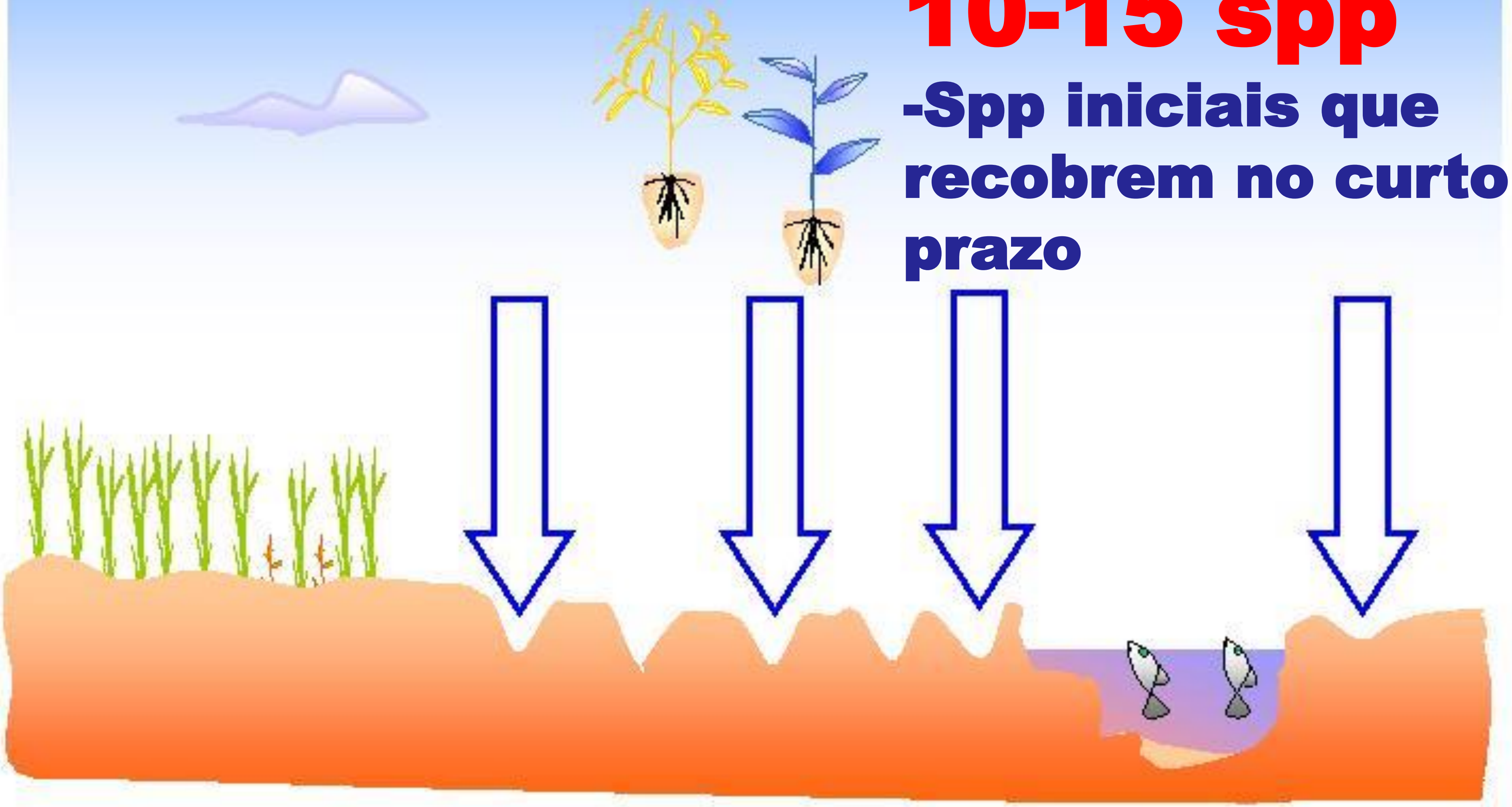
We present a review of more than 30 years of ecological restoration in the Brazilian part of the Atlantic Forest. Based on what has been done in this biome, we try to summarize the main findings and challenges for restoration in this highly threatened forest biome. We found that many past experiences did not result in self-perpetuating forests, for different reasons. Currently, most projects aim to construct self-sustaining communities and no longer see restoration as a deterministic process. We also found that the reconstruction of permanent forest with high diversity is feasible but it depends on the strategies applied and on the surrounding landscape. Although many new techniques have been created (e.g. seed rain management or promotion of natural regeneration), the most used one in the Atlantic Forest is still the planting of many native species from different functional groups. Native species are largely used and perform well even in highly disturbed environments. Today, many projects are trying to produce thousands of hectares of permanent forests and many technical advances are about to be incorporated. But restoration also faces some main challenges to become an effective and widespread means of conserving the Atlantic Forest which are, namely, reducing costs, planning restoration actions at landscape-level, and conforming to socio-political issues. The socio-political tools to overcome such barriers in practice have yet to be developed.

ESPECIES DE RECOBRIMENTO

Plantio de linhas de mudas de árvores que apresentam RÁPIDO CRESCIMENTO E GRANDE COBERTURA.

10-15 spp

-Spp iniciais que recobrem no curto prazo



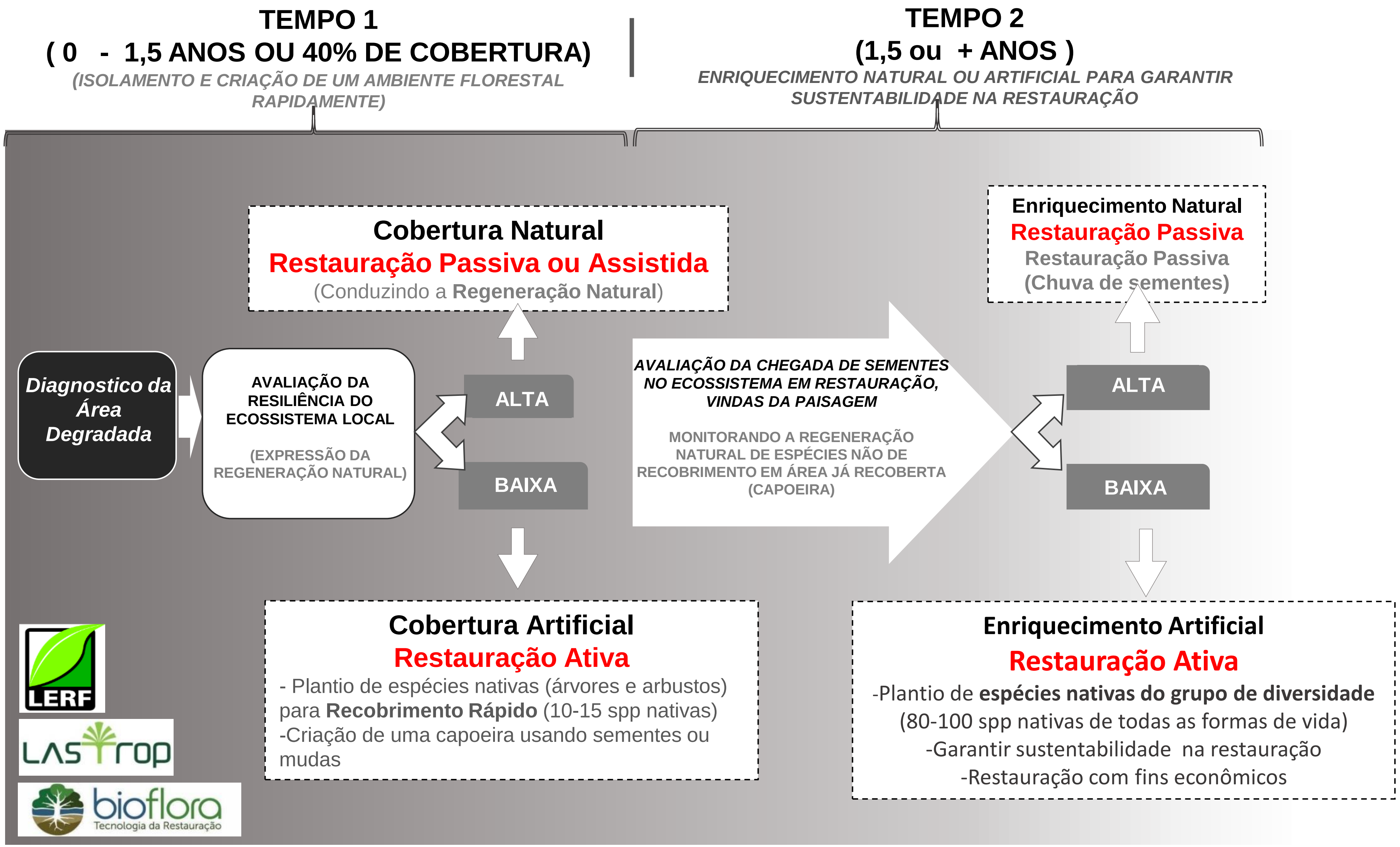

ESPÉCIES DE DIVERSIDADE
Plantio de linhas de mudas de árvores que apresentam
CRESCIMENTO MAIS LENTO E PEQUENA COBERTURA
Paisagens muito fragmentadas
60-80 spp
-Varios grupos funcionais, incluindo a pioneiras que não recobrem no curto prazo
-Diversas formas de vida


SPP de Recobrimento
SPP de Diversidade
SPP de Recobrimento
6 meses


Foto 04/2004 - 3 anos

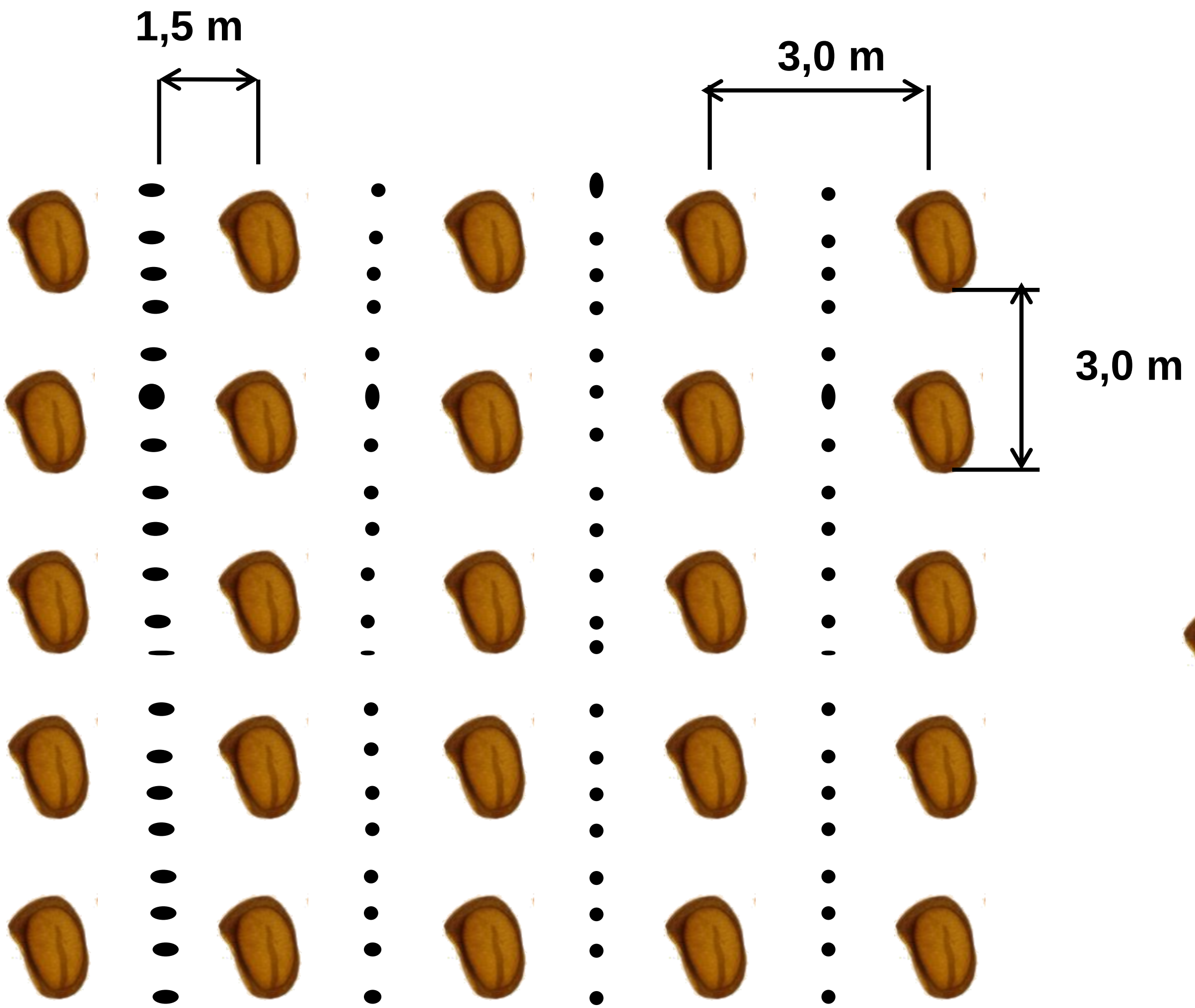
Metodologia de Restauração Florestal

BIOTROPICA
THE JOURNAL OF THE ASSOCIATION FOR TROPICAL BIOLOGY AND CONSERVATION
BIOTROPICA 48(6): 856–867 2016
10.1111/btp.12383



MÓDULO DE IMPLANTAÇÃO DO GRUPO RECOBRIMENTO E ADUBO VERDE

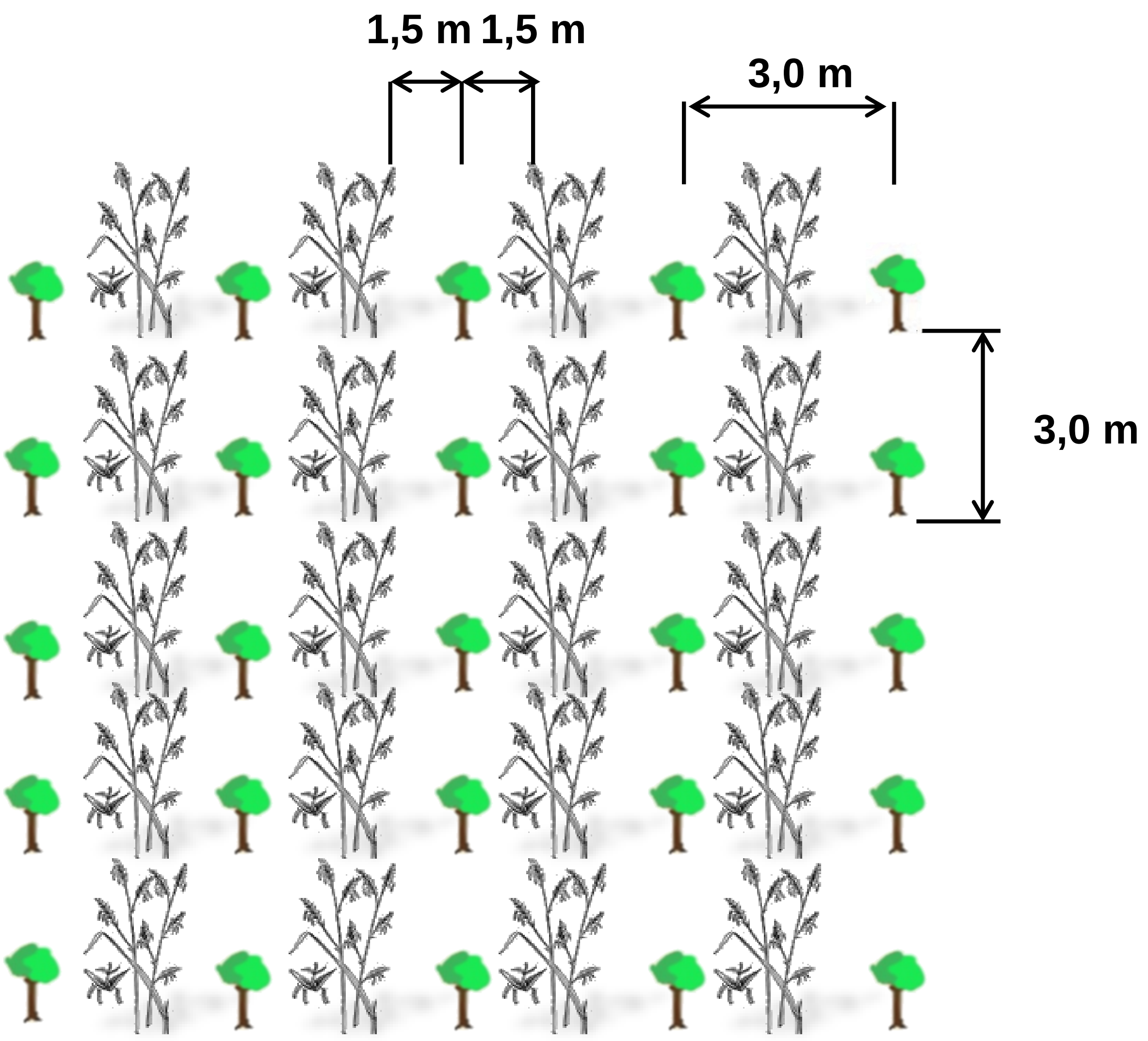
Tempo = 0 (implantação através da semeadura do grupo de Recobrimento e Adubo Verde)



	Nº de indivíduos.ha^{-1}
Semeadura do Grupo Recobrimento	1.111
Semeadura do Adubo Verde	
Total	1.111

GRUPO RECOBRIMENTO E ADUBO VERDE

Tempo = 0 a 12 meses após implantação



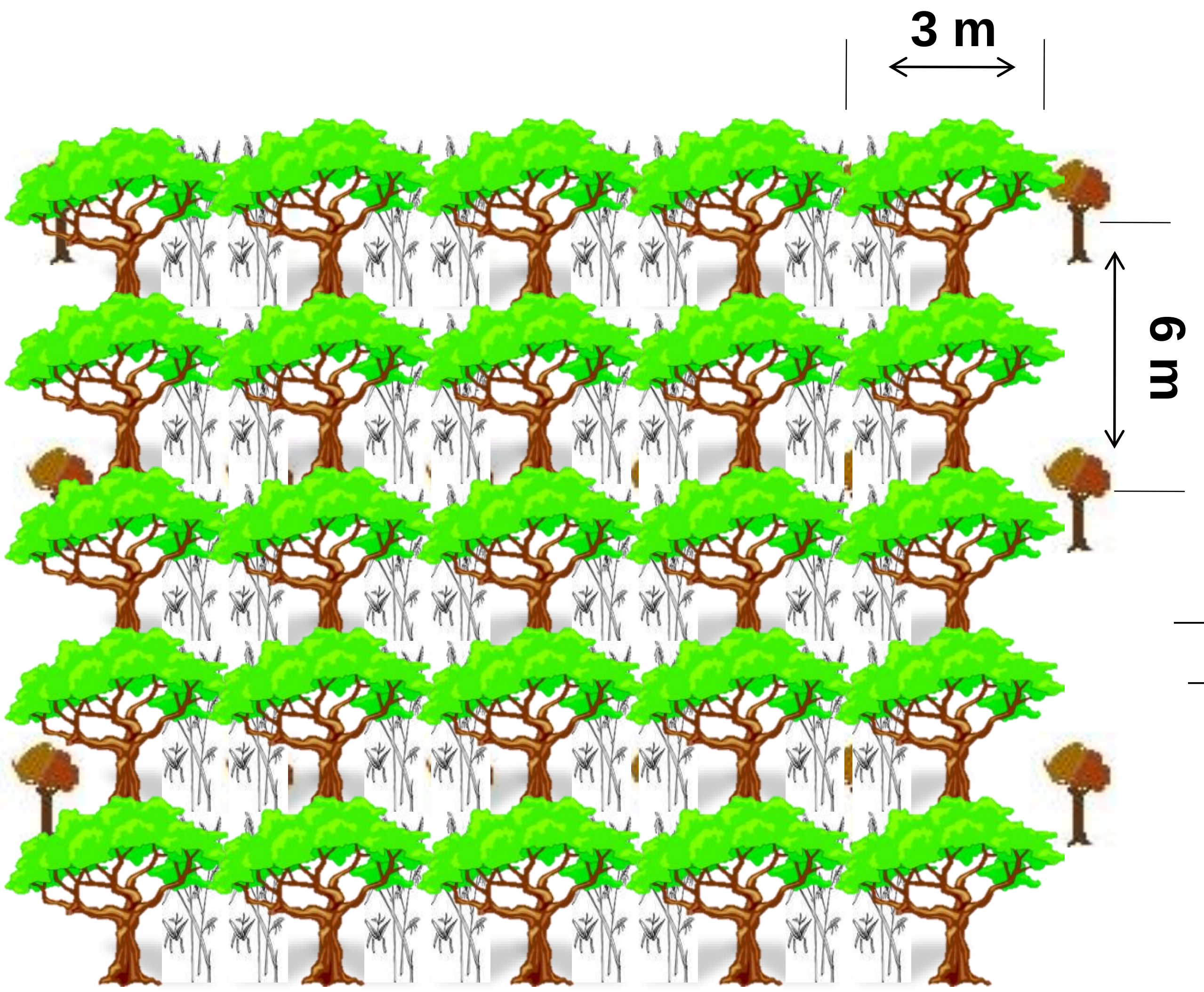
Nº de indivíduos.ha^{-1}

Grupo Recobrimento

Adubo Verde

Senescência das espécies de Adubo Verde e crescimento do Grupo de Recobrimento

Tempo = 12 a 18 meses após implantação



Enriquecimento com Grupo de Diversidade (2-2,5 anos), usando "mudas" de mais de 80 spp de diferentes formas de vida

Nº de indivíduos.ha^{-1}

Grupo Recobrimento

Adubo Verde

Enriquecimento– 555 ind/ha

Alta Floresta MT
0 ano

Baixo Potencial de Regeneração Natural
Restauração Ativa

Juara MT- 1 mês

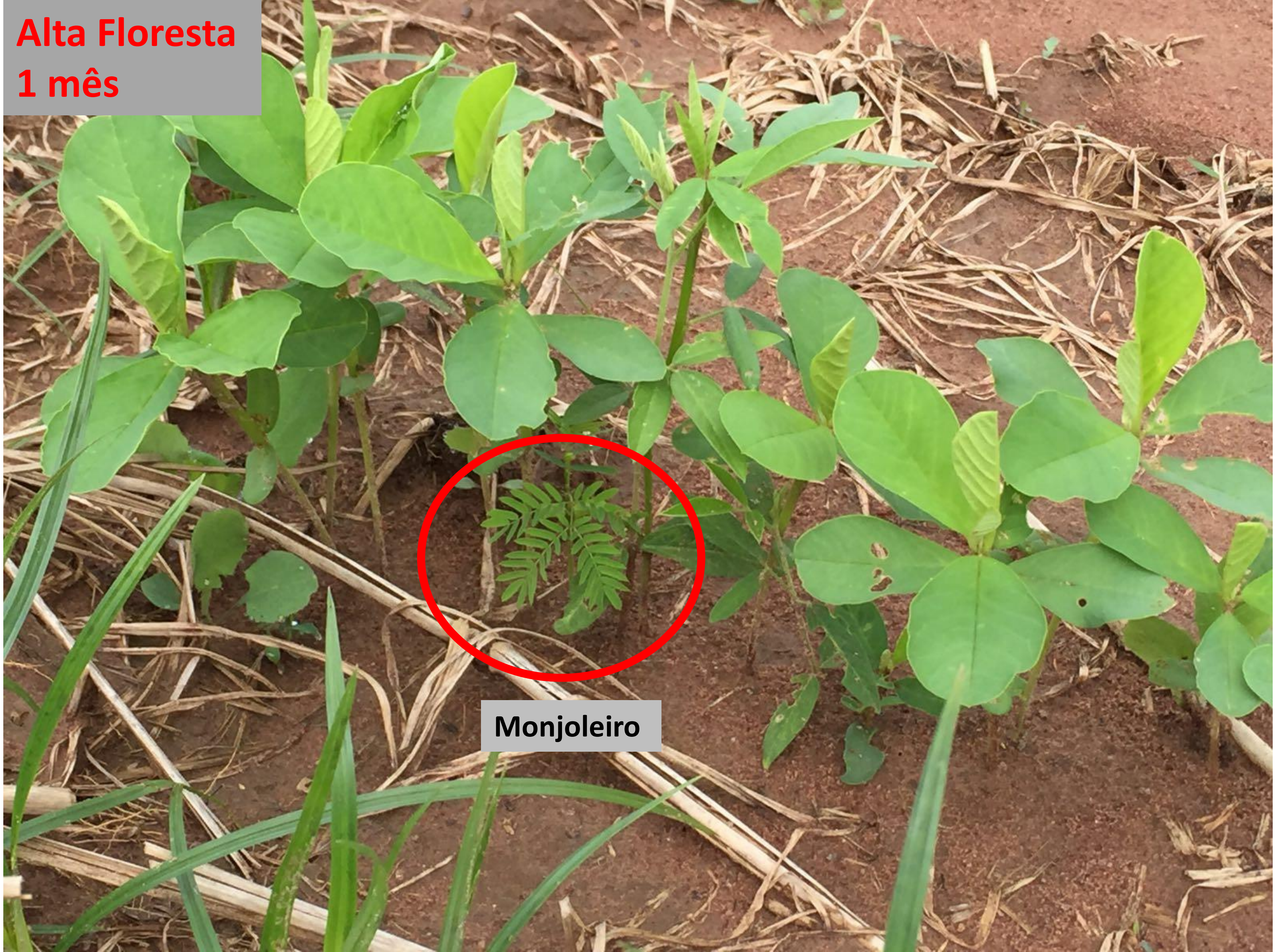
Baixo Potencial de Regeneração Natural
Restauração Ativa

Alta Floresta
2 mês

Baixo Potencial de Regeneração Natural
Restauração Ativa

Alta Floresta 2 mês

Baixo Potencial de Regeneração Natural
Restauração Ativa


Alta Floresta
1 mês
Monjoleiro

Alta Floresta MT
6 mês

Baixo Potencial de Regeneração Natural
Restauração Ativa


Alta Floresta MT
2 anos

Alta Floresta
3 anos

ARARAS/SP Dez.– 2013
2 meses

Baixo Potencial de Regeneração Natural
Restauração Ativa

ARARAS/SP Dez.– 2013
4 meses

Baixo Potencial de Regeneração Natural
Restauração Ativa

ARARAS/SP Junho– 2014
8 meses

Baixo Potencial de Regeneração Natural
Restauração Ativa

ITU/SP JULHO – 2015
1 ano e 10 meses

Baixo Potencial de Regeneração Natural
Restauração Ativa

Ambiente onde é feito Enriquecimento com Grupo de Diversidade

ARARAS/SP março 2016
2 anos e 5 meses

Baixo Potencial de Regeneração Natural
Restauração Ativa

	Nº plots	
	2013	2014
PCH Palmeira; Nucleação julho 2011; 18,70 ha	27	27
PCH Palmeiras; Badran Março 2010; 12,59 ha	20	20
PCH Palmeiras; Irene e Helia; Junho 2010; 16,05 ha	20	20
PCH Palmeiras; Plantio junho 2011; 6,4 ha	11	11
PCH Palmeiras; Plantio outubro 2010; Área úmida; 14,27 ha	18	18
PCH Palmeiras; Plantio outubro 2010; Pastagem; 10,30 ha	14	14
PCH Palmeiras; Plantio outubro 2010; solo seco; ME; 30,79 ha	36	36
PCH Palmeiras; Plantio outubro 2010; Wilson Cana; 17,96 ha	22	22
PCH Retiro; Projeto 1; 30,22 ha	47	34
PCH Retiro; Projeto 2; 6,37 ha	9	9
PCH Retiro; Projeto 3; 28 ha	32	32
PCH Retiro; Projeto 4; 12,76 ha	20	20
PCH Retiro; Projeto 5; 1,20 ha	6	67
PCH Retiro; Projeto 6; 50 ha	0	54

Plantio em 2011
Tempo 1 = 2013
Tempo 2 = 2014

Farah et al. in preparation

	Número de indivíduos			
Espécie	**Tempo 1**	**Tempo 2**	**Diferença (%)**	**Grupo**
Aspidosperma polyneuron	3	2	-33,3	D
Balfourodendron riedelianum	4	1	-75	D
Cariniana estrellensis	2	2	0	D
Cedrela fissilis	8	13	+162,5	D
Copaifera langsdorffii	3	0	-100	D
Eugenia myrcianthes	3	0	-100	D
Eugenia uniflora	17	0	-100	D
Ficus adhatodifolia	8	0	-100	D
Handroanthus heptaphyllus	2	2	0	D
Hymenaea courbaril	5	4	-20	D
Maclura tinctoria	6	15	+250	D
Myracrodruon urundeuva	34	42	+123,5	D
Myroxylon peruiferum	4	15	+375	D
Nectandra megapotamica	3	6	+200	D
Parapiptadenia rigida	7	35	+500	D
Peltophorum dubium	94	114	+121,3	D
Platypodium elegans	14	0	-100	D
Poecilanthe parviflora	10	0	-100	D
Tabernaemontana hystrix	14	15	+107,1	D
Trema micrantha	17	10	-41,2	D
Bauhinia forficata	33	24	-27,3	R
Croton floribundus	16	16	0	R
Croton urucurana	83	62	-25,3	R
Guazuma ulmifolia	67	88	+131,3	R
Heliocarpus popayanensis	84	46	-45,2	R
Inga vera	108	88	-18,5	R
Senna pendula	13	3	-76,9	R
Solanum granulosoleprosum	68	36	-47,1	R

Bacterial Diversity in Tree Canopies of the Atlantic Forest

M. R. Lambais,[1]* D. E. Crowley,[3]* J. C. Cury,[1] R. C. Büll,[1] R. R. Rodrigues[2]

The leaf surface, also known as the phyllosphere, is one of the most common habitats for terrestrial microorganisms (*1*), but almost nothing is known about the diversity of microorganisms that inhabit this environment (*2*). Here, we report a survey of bacterial diversity in the leaf canopy of a tropical Atlantic forest. The Atlantic Forest of Brazil is a biodiversity hotspot that has been reduced to less than 8% of its original size over the past 4 centuries and is considered to be the oldest forest on the planet, containing about 20,000 vascular plant species, of which about one-half are endemic (*3*, *4*). Initially we compared the bacterial communities on the leaf surfaces of nine tree species (table S1) by using a molecular method that generates a DNA fingerprint of the predominant bacteria from their 16S ribosomal RNA (rRNA) gene sequences (*5*) (fig. S1). Our results showed that bacterial communities from the same tree species varied but could be consistently grouped by discriminant analyses (table S2). These data are consistent with previous research showing that different plants select for distinct microbial communities (*6*).

To identify the bacteria in the phyllospheres of *Trichilia catigua*, *T. clausenii*, and *Campomanesia xanthocarpa*, we analyzed 418 partial DNA sequences encoding 16S rRNA genes (*5*). Comparison of homologous and heterologous coverage curves indicated that all three phyllosphere communities were significantly different in their bacterial species compositions (fig. S2). For all clone libraries, the sample size was sufficient to recover the most abundant deep phylogenetic groups. At evolutionary distances (*D*) higher than 0.20 (the cutoff value for group sequences at the phylum level), the homologous coverages were greater than 96% (fig. S2). At a *D* of 0.03, corresponding to bacterial species, coverages varied from 67 to 81% (fig S2). Species richness was estimated by using Chao1 nonparametric estimator (table S3). Each phyllosphere community harbored from at least 95 to 671 bacterial species (Fig. 1 and table S3), of which only 0.5% were common to all of the trees studied. Almost all of the bacteria (97%) were from undescribed species, suggesting they may be unique to the phyllosphere habitat (table S4).

Although this initial survey was limited in scope, extrapolation of our results for the 20,000 vascular plant species in the Atlantic Forest would yield about 2 to 13 million new bacterial species. The absolute diversity of bacteria in nature is unknown, but by comparison the Earth's oceans have been estimated to contain up to 2 million species, whereas a ton of soil may have 4 million species (*7*). The estimates for phyllosphere diversity could be decreased considerably should future surveys reveal higher amounts of overlap in bacterial community composition between tree species. On the other hand, the bacterial species richness for the individual trees surveyed represent minimum estimates of that which may occur on individual trees. Variations in community structures within tree species may possibly correspond to different leaf ages, location in the canopy, light incidence, and microclimate conditions that influence the leaf environment (*8*). The current study provides a glimpse into the microbial diversity in tree canopies of tropical forests, and there are many questions that arise from this research. Do the same tree species in completely different locations or continents harbor similar communities? To what degree do various environmental factors affect the composition and structure of phyllosphere communities? What is the diversity of fungi and archaea on the plant leaf surfaces, and what role does phyllosphere microbial community play in protection against herbivory or infection by pathogens? As we begin to survey the bacterial species through systematic surveys of different plants, there will be exciting opportunities for studies of the metabolic capabilities and the ecological functions of phyllosphere microorganisms in terrestrial ecosystems.

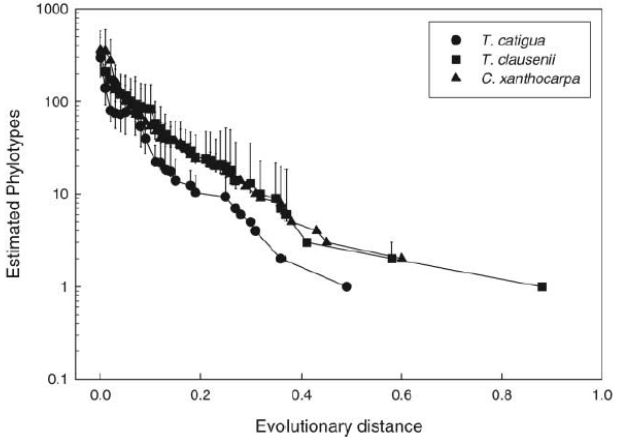


Fig. 1. Estimated number of phylotypes at different evolutionary distances, using Chao1 nonparametric estimator, on the leaf surface of different tree species. Bars represent 95% confidence intervals.

References and Notes

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Supporting Online Material

www.sciencemag.org/cgi/content/full/312/5782/1917/DC1
Materials and Methods
Figs. S1 and S2
Tables S1 to S4
Data and Analyses

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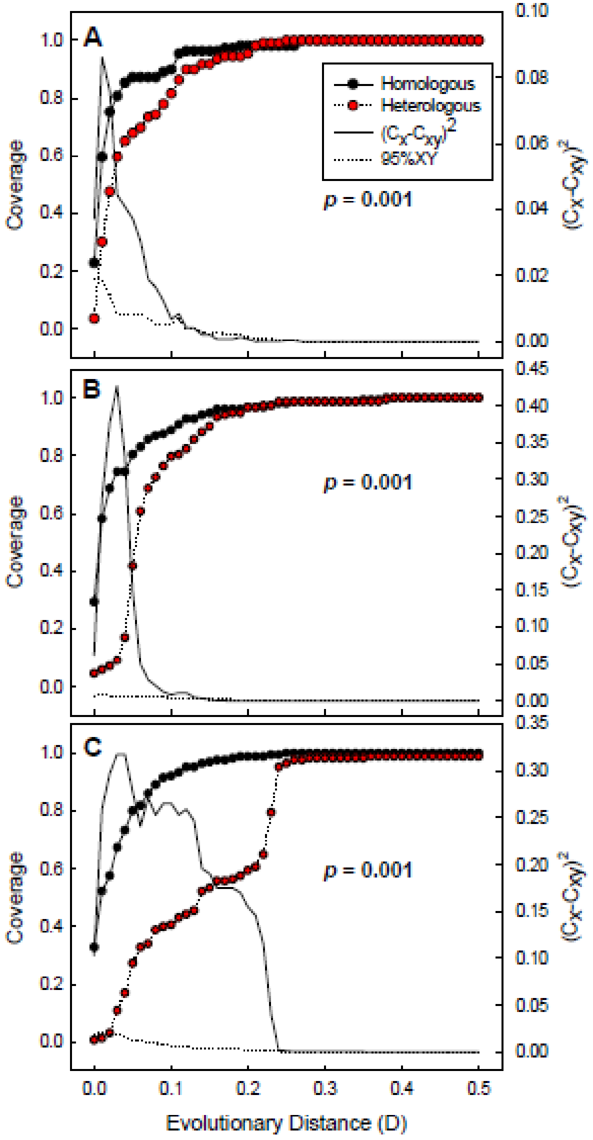

Fig. S2. LIBSHUFF analysis of the bacterial communities of in the phyllosphere of *T. catigua*, *T. clausenii* and *C. xanthocarpa*. **A**, *T. catigua* (homologous) x *T. clausenii*; **B**, *T. clausenii* (homologous) x *C. xanthocarpa*; **C**, *C. xanthocarpa* (homologous) x. *T. catigua* Communities are significantly different at $P = 0.001$. The distribution of $(C_x-C_{xy})^2$ as a function of D indicates that the bacterial communities of the phyllosphere of *T. catigua* and *T. clausenii*, *T. clausenii* and *C. xanthocarpa* and *C. xanthocarpa* and *T. catigua* differ mostly at D < 0.12, D < 0.15 and D < 0.36, respectively.

Obrigado!!!!!

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