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IMPACT OF *Bambusa tuldoides* MUNRO (POACEAE) ON FOREST REGENERATION

ABSTRACT: Bamboo grove may cause changes in the structure and floristic composition of natural regeneration. This study evaluated the impact caused by *Bambusa tuldoides* Munro at natural regeneration, in riparian forest in Rio Grande do Sul, south of Brazil. Two areas were evaluated: riparian forest without bamboos (SB) as the reference area, and riparian forest dominated by *Bambusa tuldoides* (CB). In 2014, ten plots (10x10 m) were installed in each area. All individuals belonging to classes I (30≤ H <130 cm) and II (CBH≤5 cm) were measured and identified. Floristic composition, phytosociological indexes, Shannon diversity index, Margalef richness, Simpson dominance, Sorensen similarity, and cluster analysis by Twinspan were evaluated. Richness and absolute density decreased in CB compared to SB. The areas presented low floristic similarity, and high dominance of one or more species in both classes. Myrtaceae was the predominant botanic family in SB, especially *Campomanesia xanthocarpa*. In CB most species were secondary, as *Myrsine umbellata*, *Cupania vernalis*, and *Ocotea puberula*. Due to the large differences between SB and CB, the groups formed were restricted mostly to the species of each area. Species such as *Myrsine umbellata* (class I and II) and *Strichnos brasiliensis* (class II) appear as indicators and former of groups in CB. We concluded that high density of *Bambusa tuldoides* affect the richness and diversity of regeneration natural, changing the establishment and perpetuation of the species. Secondary species show greater potential for adaptation to these environments and can act as key species in management and recovery actions.

IMPACTO DE *Bambusa tuldoides* MUNRO (POACEAE) NA REGENERAÇÃO FLORESTAL

RESUMO: Bambuzais podem acarretar alterações na estrutura e composição florística da regeneração natural. O presente trabalho avaliou o impacto causado por *Bambusa tuldoides* na regeneração natural de mata ciliar no Rio Grande do Sul, sul do Brasil. Foram avaliadas duas áreas: mata ciliar sem bambus (SB), como área de referência, e área de mata ciliar substituída por *Bambusa tuldoides* (CB). Em 2014, dez parcelas (10x10 m) foram instaladas em cada área. Todos os indivíduos pertencentes às classes I (30≤ H<130 cm) e II (CAP≤5 cm) foram identificados. Avaliaram-se composição florística, índices fitossociológicos, índice de diversidade de Shannon, diversidade de Margalef Dominância de Simpson, similaridade de Sorensen e análise de agrupamento por Twinspan. Riqueza e densidade absoluta foram menores em CB, comparativamente a SB. As áreas apresentaram baixa similaridade florística e alta dominância de uma ou mais espécies em ambas as classes. Myrtaceae foi a família predominante em SB, com destaque para *Campomanesia xanthocarpa*. Em CB, a maioria das espécies foram secundárias, como *Myrsine umbellata, Cupania vernalis* e *Ocotea puberula*. Devido às grandes diferenças entre SB e CB, os agrupamentos formados ficaram restritos, em sua maioria, às espécies de cada área. Espécies como *Myrsine umbellata* (classe I e II) e *Strichnos brasiliensis* (classe II) aparecem como indicadoras e formadoras de grupos em CB. Conclui-se que adensamentos de *Bambusa tuldoides* afetam a riqueza e diversidade da regeneração natural, alterando o estabelecimento e perpetuação das espécies. Espécies secundárias demonstram maior potencial de adaptação a estes ambientes, podendo atuar como espécies-chave em ações de manejo e recuperação.

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INTRODUCTION

Natural regeneration is related to several processes to maintenance of vegetal communities as nutrients availability, opening of forest clearings and competition (MARIMON et al., 2010; SANTOS et al., 2012). Studies about natural regeneration are important to comprehend the forest dynamics and structure, helping in management and monitoring of environmental changes (LARPKERN et al., 2011; LIMA et al., 2012; FUKUSHIMA et al., 2015).

Dominance of invasive exotic species is one of the most evident impacts of anthropic changes in the distribution of vegetal communities. These species can interfere in ecological processes, such as seed rain, seed bank and species recruitment (TABARELLI; MANTOVANI, 2000; CAMPANELLO et al., 2007, ELIAS et al., 2015; LIMA et al., 2012). Bamboos are inhibitors of succession by model of Connell and Slatyer (1977).

Invasive species list from Rio Grande do Sul State (RS) presents bamboos species (SEMA, 2013). Nevertheless, there are other species, such as *Bambusa tuldoides* Munro that, even not presenting invasive characteristics (SHIRASUNA et al., 2013), change the dynamics of natural ecosystems. In the RS, this species was introduced for productive purposes resulting in great densities, mainly in the metropolitan region (DA COSTA et al., 2015).

Bambusa tuldoides is a species of medium-sized and pantropical distribution, forms clumps and is widely used in the production of cellulose and agglomerated panels (MORAIS et al., 2015; SPOLIDORO, 2008).

Current studies indicate that bamboos change forest structure, floristic composition and resilience of vegetal communities (ELIAS et al., 2015; FUKUSHIMA et al., 2015). Studies about natural regeneration in bamboo-dominated forest remnants allow show impacts in vegetal community and may to indicate restoration practices. These strategies are fundamental to ecosystems with low potential for natural regeneration, due to dispersal limitations (CHAZDON, 2012; HOLL; AIDE, 2011).

The present study aims to evaluate the impact of *Bambusa tuldoides* in natural regeneration. The hypothesis of the research is that a natural regeneration in bamboo grove is reduced and its floristic composition altered.

MATERIAL E METHODS

Area

The study was carried out in areas of the company CMPC Celulose Riograndense, municipality of Eldorado do Sul, in Rio Grande do Sul, the southernmost state in Brazil. Two areas of riparian forest were evaluated, one area of reference without the presence of bamboos (SB) and the other dominated by bamboo grove (CB):

a) Reference area without bamboo (SB). Ecological corridor with approximately 10 ha, located at the coordinates 30° 9'14.51"S e 51°34'24.27"O. It presents advanced successional stage, with canopy of 18 to 20 m. It has eventual cattle grazing in the understory.

b) Bamboo grove (CB). Riparian forest degradade by bamboo grove. This area presents 2 ha and is located at the following coordinates 30 ° 9'26.89 "S and 51 ° 35'31.78" W. The bamboos canopy presents in average 16 to 18 m, with an average density 1200 stems in each 10 m². This area presents solitary individuals of aldult trees.

The area of study is located in the Central Depression of Rio Grande do Sul and presents elements of Seasonal Forest, in area of contact between the Atlantic Forest and Pampa biomes. The soils are Haplic Cambisols of granite origin, with the presence of material of origin in the A and B horizons. The region presents humid Subtropical climate with dry summer (ST UMv) (ALVARES et al., 2013).

The bamboos were introduced in the region at the end of the 18th century for supply of raw material to Fábrica de Papel e Celulose Pedras Brancas (Paper and Pulp Mill Pedras Brancas), the first of this type in Rio Grande do Sul. The plantings extended until the 1960s, when the species was substituted by eucalyptus and black wattle. However, extensive areas dominated by the species remain until nowadays, taking the place of productive spaces and of permanent preservation areas (APPs).

Sampling

In 2014, ten sampling units of 10x10 m were systematically installed in the CB and SB areas. It was carried out the identification of all the individuals, present in the sample units of 10x10 m, belonging to two regeneration classes. In class I, individuals between 30 cm and 130 cm in height (30 ≤ H <130 cm) were sampled. For class II, individuals with circumference at the height of the breast (CBH) less than 5 cm (CBH≤5), regardless of height. Regenerating individuals of bamboo were not evaluated.

The identification of the species was performed directly in field and, when this was not possible, in the Herbarium of the Department of Forest Sciences (HDCF) of Universidade Federal de Santa Maria.

Data analysis

Density and absolute frequency for each sampled species were calculated, according to Mueller-Dombois and Ellenberg (1974). In determination of diversity, the

indexes of Shannon (H´) were used, submitted to the t test of Hutcheson (1970). Was calculated Margalef of richness (MAGURRAN, 1988) and Simpson dominance (BROWER; ZARR, 1984). For floristic similarity analysis throughout the environmental gradient it was used the Sorensen index (WOLDA, 1981).

For verification of group formation and indication of species for each cluster and sector, the method Twinspan was used (HILL, 1979), through matrix containing presence and absence data. The analysis was performed in PC-ORD program for Windows version 4.14 (McCUNE; MEFFORD, 1999).

RESULTS

The area with bamboos (CB) presented reduced number of individuals and species, comparatively with the area without bamboos (SB) (Table 1). The CB area did not present more than 10% of the total of sampled individuals, as well as it did not reach more than 50% of the richness verified in SB, for both classes of sampling.

TABLE 1 Structure of natural regeneration between areas with and without bamboos (CB and SB).

Variables	CLASS I		CLASS II	
	SB	CB	SB	CB
Total of individuals	1,408	85	638	26
Botanical families	25	15	26	11
Species	62	27	59	12
DA (ind·ha^{-1})	14,080	850	6,380	260

Where: SB = without bamboos; CB = with bamboo; class I = (30≤ H<130 cm); class II= (CBH≤5); DA = absolut density.

In SB/Class I, *Campomanesia xanthocarpa* presented the greatest number of individuals per ha (DA: 3230 ind·ha^{-1}, FA: 100), followed by *Myrcya glabra* (DA: 1730, FA: 80), *Sorocea bonplandii* (DA: 1050, FA: 100) and *Myrsine umbellata* (DA: 980, FA: 100) (Tab. 2).

In CB/ Class I, the species of greater importance was *Cupania vernalis* (DA: 140 ind·ha^{-1}, FA: 30) *Ocotea puberula* (DA: 130 ind·ha^{-1}, FA: 60) and *Myrsine umbellata* (DA: 120 ind·ha^{-1}, FA: 70) (Table 2).

For both areas, in class I, the Myrtaceae Family was the most representative, with 13 species in SB and six in CB.

In SB, in class II, Myrtaceae, again, was the most representative family (17 species). Species with the greatest distribution and density are Campomanesia xanthocarpa (DA: 2900 ind·ha^{-1}, FA: 100), Myrcia glabra (DA: 410 ind·ha^{-1}, FA: 80), m n (DA: 180 ind·ha^{-1}, FA: 70) and Trichilia elegans (DA: 160 ind·ha^{-1}, FA: 60) (Table 2).

In CB, the Sapindaceae family was the only one that presented two species and *Myrsine umbellata* was the most representative (DA: 60 ind·ha^{-1} and FA: 40). We observe in this class, low richness, small quantity of individuals, with densities and frequencies well below the ones found in SB (Table 2).

Species dominance *sensu* Simpson exists in both areas (Table 3). For SB/Class I, species as *Campomanesia xanthocarpa*, *Myrcia glabra*, *Sorocea bonplandii* and *Myrsine umbellata* presented together 47% of the total of individuals. In CB/Class I, *Cupania vernalis*, *Myrsine umbellata* and *Ocotea puberula* represented 45% of the sampled individuals. For the class II, *Campomanesia xanthocarpa*, represented 45% of the sampled individuals in SB and *Myrsine umbellata*, 23% in CB.

Based on the Margalef index, SB appears with greater diversity than CB in class I and II. Yet, when we analyze the diversity of Shannon we do not verify significant difference between areas (Table 3).

In relation to the floristic similarity we observe that for both areas, the similarity is low (0.36 in class I and 0.20 in class II) (Table 3).

In the formation of floristic groups, the class I (Figure 1) formed the group I (G1) in the first division, with self-value of 0.3248 and included only the parcels of SB area. Indicator species of this group was *Trichilia elegans* and *Myrcia* sp.

The second division presented self-value of 0.2261, and it did not represent ecological meaning, due to the homogeneity of data. The third division presented self-value of 0.6533, including only the parcels of CB area, and originating the second group (G2). The indicator was *Myrsine umbellata*, species that presented the greatest frequency in CB, presented in approximately 70% of the sampled area.

For the class II (Figure 2) the first division of self-value 0.5230 originated two groups. The first group gathered species belonging to the SB and CB areas. As preferable ones of this group there is species of the greatest occurrence in SB, such as Myrtaceae and *Trichilia elegans* in CB. In second division with self-value 0.5240, it was formed G2, with *Strychnos brasiliensis* as indicator species and also as preferable one. In G3, it was clustered only parcels and species of SB, with *Campomanesia xanthocarpa* as indicator and, as preferable ones, a great number of species of Myrtaceae.

DISCUSSION

The elevated importance of Myrtaceae, verified in both areas in class I, is characteristic of forest formations in Rio Grande do Sul, mainly in Seasonal Forest,

TABLE 2 Species of class I (30≤H<130 cm) and class II (CBH≤5) with greater representation in the areas.

CLASS I		SB		CB	
SPECIES*	FAMILY	DA	FA	DA	FA
Campomanesia xanthocarpa (Mart.) O.Berg	Myrtaceae	3,230	100	40	20
Cupania vernalis Cambess.	Sapindaceae	-	-	140	30
Eugenia uruguayensis Cambess.	Myrtaceae	-	-	40	30
Maytenus dasyclada Mart.	Celastraceae	-	-	30	10
Maytenus sp.	Celastraceae	-	-	50	50
Myrcia glabra (O.Berg) D. Legrand	Myrtaceae	1730	80	-	-
Myrcia sp.	Myrtaceae	710	100	-	-
Myrsine loefgrenii (Mez) Imkhan.	Myrtaceae	440	90	-	-
Myrsine umbellata Mart.	Primulaceae	980	100	120	70
Nectandra megapotamica (Spreng.) Mez	Lauraceae	350	90	-	-
Ocotea puberula (Rich.) Nees	Lauraceae	-	-	130	60
Psychotria carthagenensis Jacq.	Rubiaceae	-	-	50	30
Psychotria sp.	Rubiaceae	750	90	-	-
Sorocea bonplandii (Baill.) W.C. Burger, Lanjouw & Boer	Moraceae	1,050	100	-	
Strychnos brasiliensis Mart.	Loganiaceae	-	-	-	-
Trichilia clausseni C.DC.	Meliaceae	750	70	-	-
Trichilia elegans A. Juss.	Meliaceae	470	10	30	30
Zanthoxylum rhoifolium Lam.	Rutaceae	-	-	20	20
Total of plants**		14,080		850	
CLASS II		SB		CB	
SPECIES*	FAMILY	DA	FA	DA	FA
Campomanesia xanthocarpa (Mart.) O.Berg	Myrtaceae	2,900	100	30	30
Chrysophyllum marginatum (Hook. & Arn.) Radlk.	Sapotaceae	-	-	30	30
Citrus sp.	Rutaceae	-	-	30	30
Cupania vernalis Cambess.	Sapindaceae	-	-	30	20
Eugenia uruguayensis Cambess.	Myrtaceae	250	30	-	-
Faramea montevidensis (Cham. & Schltdl.) DC.	Rubiaceae	180	40	-	-
Matayba elaeagnoides Radlk.	Sapindaceae	-	-	10	10
Maytenus sp.	Celastraceae	-	-	10	10
Myrcia glabra (O.Berg) D. Legrand	Myrtaceae	410	80	-	-
Myrcia multiflora (Lam.) DC.	Myrtaceae	190	30	-	-
Myrcia pubipetala D.Legrand	Myrtaceae	120	40	-	-
Myrsine umbellata Mart.	Primulaceae	120	70	60	40
Ocotea puberula (Rich.) Nees	Lauraceae	-	-	20	10
Sebastiania sp.	Euphorbiaceae	160	50	-	-
Sorocea bonplandii (Baill.) W.C. Burger, Lanjouw & Boer	Moraceae	180	70	-	-
Strychnos brasiliensis (Spreng.) Mart.	Loganiaceae	-	-	30	20
Trichilia elegans A. Juss.	Meliaceae	160	60	30	30
Total of plants**		6,380	-	260	-

*Ten most representative species in the set of areas of CB and SB; Absolute density (DA: ind.ha), Absolute frequency (FA: %). ** Density of all plants sampled in the study area.

TABLE 3 Floristic diversity and similarity of Class I (30≤H<130 cm) and II (CBH≤5 cm) in SB and CB.

	CLASS I		CLASS II	
	SB	CB	SB	CB
Simpson	0,9084	0,9143	0,7811	0,8787
Shannon	3,013 a*	2,811 a	2,625 a	2,284 a
Margalef	8,552	5,627	8,981	3,376
Sorensen	0,36		0,20	

* Values followed by the same letter in the line, by class interval, did not differ significantly by the Hutcheson test at the 0.05% error probability level. Abbreviations: without bamboo (SB), with bamboo (CB).

highlighting the riverside formations (MILANESI; LEITE, 2014; VENZKE, 2012).

The expressive difference in the structure and richness of vegetation between SB and CB can be related to the competition by resources (space, water and nutrients) (SILVÉRIO et al., 2010), reduction of incident luminosity GRISCOM; ASHTON, 2002), among other alterations.

Silvério et al. (2010) studying the impact of cluster of *Actinocladum verticillatum* bamboo over the woody vegetation of two physiognomies of Cerrado, also noted that the number of individuals, species, genera, families and densities were higher in areas without bamboos.

There are evidences that the bamboos inhibit the recruitment in all the classes of size, resulting of the low rate of incident luminosity, hydric stress, competition for humidity of soil and physical damages, caused by the excessive accumulation of litter in young plants (GRISCOM; ASHTON, 2002).

The low richness of species in CB indicates the difficult in formation of superior strata, affecting the local ecological succession, what hinders the reconstitution of the Permanent Preservation Area. The recruitment of individuals for superior classes is impaired, once that the presence of bamboos decreases the growth rate
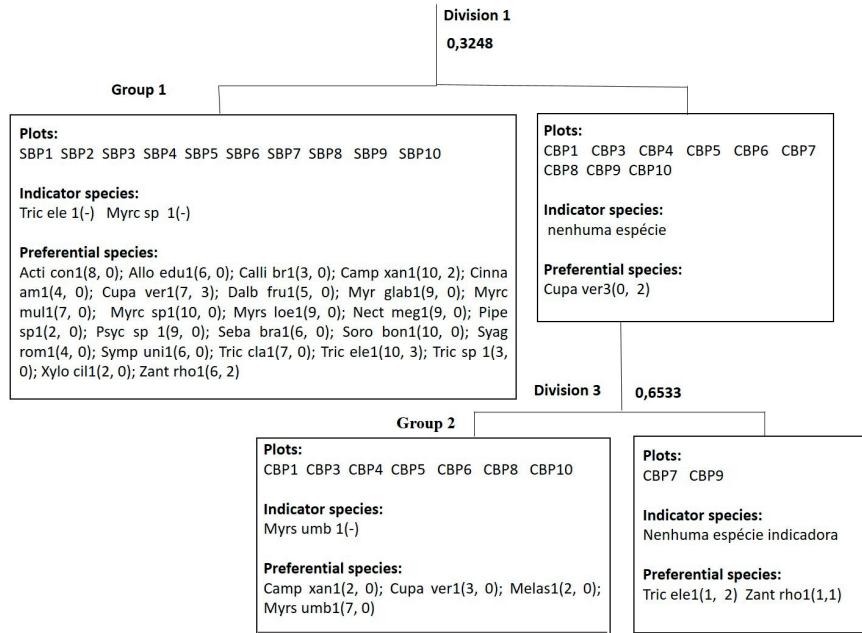
Division 1
0,3248

Group 1

Plots:
SBP1 SBP2 SBP3 SBP4 SBP5 SBP6 SBP7 SBP8 SBP9 SBP10

Indicator species:
Tric ele 1(-) Myrc sp 1(-)

Preferential species:
Acti con1(8, 0); Allo edu1(6, 0); Calli br1(3, 0); Camp xan1(10, 2); Cinna am1(4, 0); Cupa ver1(7, 3); Dalb fru1(5, 0); Myr glab1(9, 0); Myrc mul1(7, 0); Myrc sp1(10, 0); Myrs loe1(9, 0); Nect meg1(9, 0); Pipe sp1(2, 0); Psyc sp 1(9, 0); Seba bra1(6, 0); Soro bon1(10, 0); Syag rom1(4, 0); Symp uni1(6, 0); Tric cla1(7, 0); Tric ele1(10, 3); Tric sp 1(3, 0); Xylo cil1(2, 0); Zant rho1(6, 2)

Plots:
CBP1 CBP3 CBP4 CBP5 CBP6 CBP7 CBP8 CBP9 CBP10

Indicator species:
 nenhuma espécie

Preferential species:
Cupa ver3(0, 2)

Division 3 **0,6533**

Group 2

Plots:
CBP1 CBP3 CBP4 CBP5 CBP6 CBP8 CBP10

Indicator species:
Myrs umb 1(-)

Preferential species:
Camp xan1(2, 0); Cupa ver1(3, 0); Melas1(2, 0); Myrs umb1(7, 0)

Plots:
CBP7 CBP9

Indicator species:
Nenhuma espécie indicadora

Preferential species:
Tric ele1(1, 2) Zant rho1(1,1)

FIGURE I Groupings of forest regeneration present in class I (30≤ H <130 cm) in areas SB and CB. Abreviations: *Trichilia elegans* (Tric ele); *Myrcia* sp. (Myrc sp); *Actinostemon concolor* (Acti conc); *Allophylus edulis* (Allo edu); *Calliandra brevipes* (Calli br); *Campomanesia xanthocarpa* (camp xan); *Cinnamomum amoenum* (Cinnaam); *Cupania vernalis* (Cupa ver); *Dalbergia frutescens* (Dalb fru); *Myrcia glabra* (Myr gla); *Myrcia multiflora* (Myrc mul); *Myrsine loefgrenii* (Myrs loe); *Myrsine umbellata* (Myrs umb); *Nectandra megapotamica* (Nect meg); *Pipper* sp. (Pipe sp.); *Psychotria* sp. (Psyc sp); *Gymnantes klotzchiana* (Seba bra); *Sorocea bonplandii* (Soro bom); *Syagrus romanzoffiana* (Syag rom); *Symplocos uniflora* (Symp uni); *Trichilia clausseni* (Tric cla); *Trichilia* sp. (Tric sp); *Xylosma ciliatifolia* (Xylo cil); *Zanthoxylum rhoifolium* (Zant rho); *Melastomataceae* (Melas);
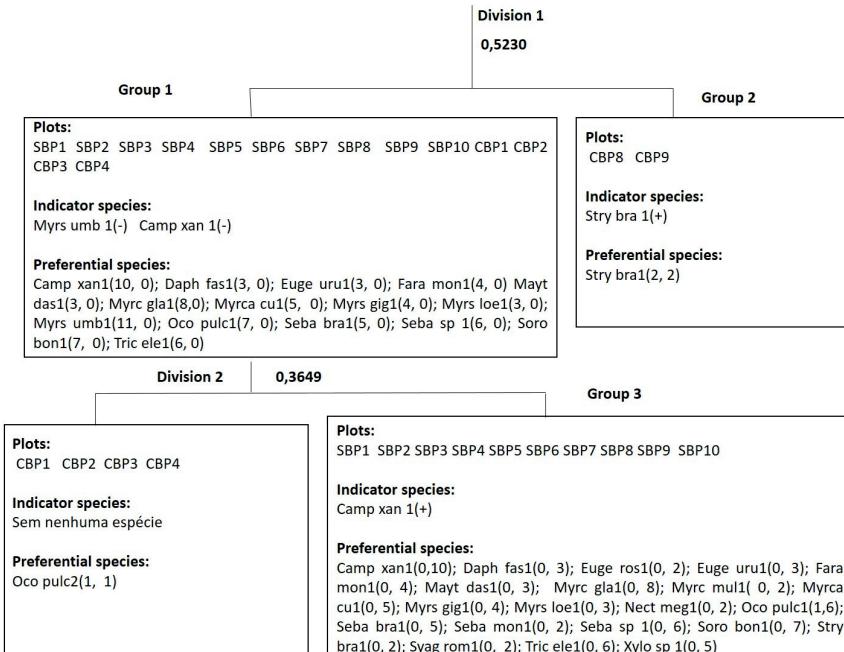
Division 1
0,5230

Group 1

Plots:
SBP1 SBP2 SBP3 SBP4 SBP5 SBP6 SBP7 SBP8 SBP9 SBP10 CBP1 CBP2 CBP3 CBP4

Indicator species:
Myrs umb 1(-) Camp xan 1(-)

Preferential species:
Camp xan1(10, 0); Daph fas1(3, 0); Euge uru1(3, 0); Fara mon1(4, 0) Mayt das1(3, 0); Myrc gla1(8,0); Myrca cu1(5, 0); Myrs gig1(4, 0); Myrs loe1(3, 0); Myrs umb1(11, 0); Oco pulc1(7, 0); Seba bra1(5, 0); Seba sp 1(6, 0); Soro bon1(7, 0); Tric ele1(6, 0)

Group 2

Plots:
 CBP8 CBP9

Indicator species:
Stry bra 1(+)

Preferential species:
Stry bra1(2, 2)

Division 2   **0,3649**

Plots:
 CBP1 CBP2 CBP3 CBP4

Indicator species:
Sem nenhuma espécie

Preferential species:
Oco pulc2(1, 1)

Group 3

Plots:
SBP1 SBP2 SBP3 SBP4 SBP5 SBP6 SBP7 SBP8 SBP9 SBP10

Indicator species:
Camp xan 1(+)

Preferential species:
Camp xan1(0,10); Daph fas1(0, 3); Euge ros1(0, 2); Euge uru1(0, 3); Fara mon1(0, 4); Mayt das1(0, 3); Myrc gla1(0, 8); Myrc mul1(0, 2); Myrca cu1(0, 5); Myrs gig1(0, 4); Myrs loe1(0, 3); Nect meg1(0, 2); Oco pulc1(1,6); Seba bra1(0, 5); Seba mon1(0, 2); Seba sp 1(0, 6); Soro bon1(0, 7); Stry bra1(0, 2); Syag rom1(0, 2); Tric ele1(0, 6); Xylo sp 1(0, 5)

FIGURE 2 Groupings of forest regeneration present in class II (CBH≤5) in the areas SB and CB. Abreviations: *Campomanesia xanthocarpa* (Camp xan); *Daphnopsis fasciculata* (Daph faz); *Eugenia uruguayensis* (Euge uru); *Eugenia rostrifolia* (Euge ros); *Faramea montevidensis* (Fara mon); *Maytenus dasyclada* (Mayt das); *Myrcia glabra* (Myc gla); *Myrcia multiflora* (Myrc mul); *Myrciaria cuspidata* (Myrca cu); *Myrsine grandiflora* (Myrs gig); *Myrsine loefgrenii* (Myrs loe); *Myrsine umbellata* (Myrs umb); *Ocotea pulchela* (Oco pulc); *Gymnantes klotzchiana* (Seba bra); *Sebastiania* sp. (Seba sp); *Sorocea bonplandii* (Soro bom); *Trichilia elegans* (Tric ele); *Strychnos brasiliensis* (Stry bra); *Nectandra megapotamica* (Nect meg); *Syagrus romanzoffiana* (Syag rom); *Xylosma ciliatifolia* (Xylo sp).

and survival, causing stagnation in forest succession (GRISCOM; ASHTON, 2002; ELIAS et al., 2015).

Bamboo species may occupy the canopy of forest areas and hinder or hinder the development of native forest regeneration, causing a change in the structure and diversity of plant communities (CAMPANELLO et al., 2007, SANTOS et al., 2012, SANTOS et al., 2015, ELIAS et al., 2015) resulting in loss of biodiversity in tropical ecosystems (SILVÉRIO et al., 2009). Outside its natural habitat, the bamboos do not have natural predators, neither individuals that compete in equality for the capture of food and sun light, which can result in environmental imbalance in the place where this species was introduced (DA SILVA et al., 2011).

In relation to the ecological indexes, the dominance of *Campomanesia xanthocarpa* and *Myrsine umbellata* in SB and CB areas. The relevance of *Myrsine umbellata* in the inhospitable CB environment characterizes it as strongly tolerant and therefore valuable for use in ecological restoration in environments with inhibitory vegetation (CONNEL; SLATYER, 1977).

Margalef index, which has as basis the numerical distribution of different species, shows greater diversity of SB in class I and II. In relation to diversity, Margalef index, which has as basis the numerical distribution of different species, we observed greater diversity of WB in class I and II. Kanieski et al. (2012) obtained index of 3.81 for the forest regeneration and considered the area with low specific richness.

The diversity of Shannon probably was not significant due the expressive number of rare species in WB. The low similarity in areas of the same forest typology and spatially near with each other can be explained by the presence of bamboos, once that these ones change the establishment and development of a great number of native species (LIMA et al., 2007) generating competition for resources, continuous shading and allelophatic effects (GRISCOM; ASHTON, 2002).

Studies about the influence of bamboo in forest succession in China (TAYLOR; ZISHENG, 1988) and in Japan (TANAKA, 1988) attributed the low density of trees, seedlings and young plants to the reduced levels of occurring light in the low story of bamboo. The light is not the only factor of restriction of forest succession in these environments, factors as density of clumps, competition for nutrients and allelopathy can exert negative effect in floristic composition, micro-climate and structure of litter (GRISCOM; ASHTON, 2006).

In relation to the floristic groups, the indicator species of G1, *Trichilia elegans* and *Myrcia* sp., observed in great density and frequency throughout the whole WB sector belongs to abundant genera in low story of seasonal forest (VENZKE, 2012; BÜNDCHEN et al., 2015).

Trichilia elegans exerts influence in forest succession, and it is found with elevated density and frequency in the regeneration of seasonal forests (STAGGEMEIER; GALETTI, 2007). The preferable ones of G1 are abundant in low story of late forests (TABARELLI; MANTOVANI, 2000; KOCH et al., 2010).

In G2, *Myrsine umbellata*, the indicator species can be related to their ecological characteristics, which defines who understory species of great ecological plasticity (SANTOS et al., 2012), therefore adapted to the shaded environments. Densification of bamboos affects the development of pioneers and initial secondary species, as far as it causes the decreasing of light rate and closing of canopy in tropical forest (TABARELLI; MANTOVANI, 2000; CAMPANELLO et al., 2007).

In Montane Atlantic forest in southeast of Brazil, the more tolerant species to densification of bamboo belong to Ocotea and Myrsine, due to its characteristics of ecological adaptability (TABARELLI; MANTOVANI, 2000). Among the preferable species we highlight *Cupania vernalis*, occurring both within the forest, at a more advanced stage of forest succession (ÁVILA et al., 2011).

In class II, *Myrsine umbellata* presented significant occurrence in both areas, while *Campomanesia xanthocarpa* was the most representative species in SB, both indicators of G1. As preferable ones of this group there is species of greater occurrence in SB, such as Myrtaceae and *Trichilia elegans* in CB.

In G2, *Strychnos brasiliensis*, indicator and preferable species appears as the only species occurring in the parcels eight and nine of CB. Campanello et al. (2007) also found *Strychnos brasiliensis* in the regeneration of semi-seasonal forest dominated by bamboos and lianas, and it is one of the most representatives in this environment.

Species that is resistant to the shading environment such as *Myrsine umbellata* and *Strychnos brasiliensis,* can be important in the process of management and recovery of areas dominated by bamboo. Bitariho and McNeilage (2007) highlight that secondary forest species contributed to the decrease of forest cover of bamboos in Bambuno, southwest of Uganda.

In G3, we highlight the importance of *Campomanesia xanthocarpa* in the formation of groups, which can be related to its good adaptation in environments with periodic flooding, typical of riparian forest (CARVALHO; NAKAGAWA, 2000). Besides that, the production of fruit in great quantity and very appreciated by the wild fauna (CARVALHO; NAKAGAWA, 2000) contributes to the species to have great dispersion in the area.

CONCLUSION

Bambusa tuldoides impacted the forest regeneration. Establishment and recruitment of native species were reduced.

The richness and diversity of natural regeneration were affected by the presence of bamboos.

Secondary species demonstrates greater potential of adaptation in environments dominated by bamboo grove, and it can act as key-species in future actions of management and recovery.

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