FLORISTIC COMPOSITION AND PHYTOGEOGRAPHY CONTEXTUALIZATION OF THE NATURAL REGENERATION OF AN ALLUVIAL FOREST LOCATED IN THE "PLANALTO SUL CATARINENSE" REGION, SC, BRAZIL[1]

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ABSTRACT – This study aimed at inventorying the natural regeneration of tree species in an Alluvial Araucaria Forest in the "Planalto Sul Catarinense" region, SC, Brazil; evaluating the dissimilarity between its adult and regenerative components; and verifying the natural regeneration floristic sharing among its different fragments. The regenerative component has been sampled and identified within 48 plots and classified according to the following height classes: Class 1, plants with height varying from 15 cm up to 1 m; Class 2, plants with height varying from 1 and 3 m; and Class 3, plants with height higher than 3 m and DBH (diameter at breast height) smaller than 5 cm. The floristic composition of adult individuals in the area and of regenerative individuals from other fragments has been obtained from the database of the Laboratory of Dendrology of CAV/UDESC. The structure of the regeneration was evaluated by phytosociological descriptors. Dissimilarity between the adult and the regenerative components has been determined by Jaccard, Sorensen and Bray-Curtis distances. The regeneration floristic sharing analysis of different areas was conducted by a dendrogram. A total of 818 individuals belonging to 59 species have been sampled, being *Allophylus edulis* (A.St.-Hil. et al.) Hieron. ex Niederl. the species with the greatest relative importance. Elevated similarity between the regenerative and adult components have been observed (from 0.24 to 0.43), suggesting a low floristic-structural turnover between components. The area under study have shown a greater floristic connection (<40% of dissimilarity) with other spatially close fragments, indicating that altitude and temperature are important ecological factors for its phyto-geographic compartmentalization.

Keywords: Araucaria Forest; Forest Ecology; Atlantic Forest.

COMPOSIÇÃO FLORÍSTICA E INSERÇÃO FITOGEOGRÁFICA DA REGENERAÇÃO NATURAL DE UMA FLORESTA ALUVIAL NO PLANALTO SUL CATARINENSE

RESUMO – O objetivo do estudo foi inventariar a regeneração natural arbórea de um fragmento de Floresta Ombrófila Mista Aluvial no Planalto Sul Catarinense, avaliar a dissimilaridade entre o estrato regenerante e adulto do mesmo fragmento e verificar o compartilhamento florístico da regeneração natural entre fragmentos na região. Os regenerantes foram amostrados em 48 parcelas, sendo estes identificados e classificados de acordo com a altura em: Classe 1, plantas com altura entre 15 cm e 1 m; Classe 2, plantas com altura entre 1 e

3 m; e, Classe 3, plantas com altura maior que 3 m e DAP (diâmetro à altura do peito) menor que 5 cm. A composição dos indivíduos adultos da área e de regenerantes de outros fragmentos foi obtida do banco de dados do Laboratório de Dendrologia do CAV/UDESC. A estrutura do componente regenerativo foi avaliada por meio de descritores fitossociológicos. A dissimilaridade entre o componente regenerante e adulto foi determinada por meio das distâncias de Jaccard, Sorensen e Bray-Curtis. A análise do compartilhamento florístico da regeneração de diferentes áreas foi realizada por meio de um dendrograma. Foram amostrados 818 indivíduos pertencentes a 59 espécies, sendo ***Allophylus edulis*** *(A.St.-Hil. et al.) Hieron. ex Niederl. a espécie de maior importância relativa. A dissimilaridade entre os regenerantes e adultos foi baixa (0,24 a 0,43), sugerindo que existe baixa substituição florístico-estrutural entre os componentes. A área estudada apresentou maior vínculo florístico (<40% de dissimilaridade) com outros fragmentos espacialmente próximos, sugerindo que altitude e temperatura representam importantes fatores ecológicos na compartimentalização fitogeográfica deste componente.*

Palavras-chave: Floresta Ombrófila Mista; Ecologia Florestal; Mata Atlântica.

1. INTRODUCTION

Among the forest typologies occurring in the Atlantic Forest domain in the State of Santa Catarina, there is the Araucaria Forest, a typical phytoecological region of Southern Brazil. In this forest it can be found the gymnosperms *Araucaria angustifolia* (Bertol.) Kuntze (popularly known just as araucaria) and *Podocarpus lambertii* Klotzsch ex Endl. (popularly known as pinheiro-bravo), consorted with angiosperms of the following genera: *Drimys*, *Ocotea*, *Nectandra*, among others. IBGE (2012) identifies four Mixed Ombrophilous Forest (MOF) formations – alluvial, lower montane, montane and upper montane. The Alluvial Araucaria Forest differs from the other types since they occur on old terraces associated to the hydrographic network.

Alluvial Araucaria Forests are subject to floods, consequently, all species living in it are adapted to water condition, which acts as an environmental filter by influencing the forest's floristic and structure. According to Carvalho et al. (2009), the alluvial areas soil moisture influences plants differently according to their stage of development so that the moisture gradient can determine structural differences among the community strata. Lobo and Joly (2000) highlight some flooding effects observed in this kind of environment, such as the reduction of the amount of oxygen available to plant roots caused by soil saturation by water, an increase in soil acidification and an elevated concentration of soluble ions as iron and manganese. In order to establish themselves in these peculiar environments, species have developed physiological and morphological adaptive structures. However, such environments are usually impacted since they are strategic locations for human usage and occupation (SILVA et al., 2012a) making it necessary to take some actions for the forests' conservation and recovering.

Studying natural regeneration allows us to predict the future behavior and development of the forest by observing changes in the species patterns of richness and dominance as it provides the relation and quantity of species that constitute its regenerative component and area distribution (Norden et al., 2009). Studies on the tree species natural regeneration in Alluvial Araucaria Forests of the Santa Catarina plateau are so far non-existent, though. Few related studies have been carried out in other Brazilian states, such as the study of Barddal et al. (2004) in an Alluvial Araucaria Forest's understory located in Paraná, Brazil. Understanding the natural regeneration of a forest is very important for defining its conservation strategies. In addition, the phytogeographic contextualization of the studied fragment allows us to understand its similarity with surrounding areas and therefore to define its particularities in order to determine their importance for its conservation.

We have worked under the following hypotheses: i) the regenerative component of the studied fragment has a high participation of flood tolerant species common in alluvial areas; ii) the regenerative component has high similarity to the tree species adult component; iii) the participation of more tolerant species in the regenerative component contributes to the dissimilarity with other fragments of the region. By considering the proposed hypotheses, our goals have been defined as follows: to inventory the natural regeneration of tree species in a fragment of an Alluvial Araucaria Forest of the "Planalto Sul Catarinense" region, SC, Brazil; to evaluate the similarity between both the tree species' regenerative and adult strata of the fragment; and to

determine the similarity between its natural regeneration and that of other fragments in the region.

2. MATERIALS AND METHODS

The study was carried out in a fragment of an Alluvial Araucaria Forest located in the municipality of Lages, SC, Brazil. It lies on the Caveiras River bank at latitude 27°51'03"S and longitude 50°13'31"W therefore reaching an average altitude of 884 m. According to Köppen classification, its climate is classified as Cfb, humid subtropical mesothermic with cool summers and no dry season, but some severe frosts; its average temperature is 15.9ºC and its average annual precipitation is around 1,400 mm (Brasil, 1992). The geological substrate is composed of siltstones from the Rio do Rastro formation and sandstones from the Botucatu formation. Classifications held in the field have indicated the occurrence of Humic Cambisols in the most drained areas and Haplic Gleysols in the most humid ones.

All vegetation evaluations were carried out in 48 sample units of 10 × 20 m – previously installed for a former study on tree species adult component (Loebens, 2015) – in which subplots have been allocated for studying natural regeneration. Adult component plots have been allocated in a stratified way considering three sectors as strata (16 plots per sector): forest-river edge (near the river), fragment's interior and non-forest matrix-forest edge (far from the river). Tree species individuals with DBH less than 5.0 cm have been considered as part of the regenerating stratum. In order to survey such sectors, each plot has been divided into subplots with different areas varying according to the plant size class adapted from the methodology proposed by Volpato (1994): i) Class 1, plants of height from 15 cm to 1 m, evaluated in 5 m²; ii) Class 2, plants of height from 1 to 3 m, evaluated in 10 m²; iii) Class 3, plants higher than 3 m and with DBH (diameter at breast height) less than 5 cm, evaluated in 20 m². All individuals belonging to the tree species regenerating component have been tagged, classified by their respective class and therefore identified. Identifications have been carried out according to literature and experts; species have been classified in families according to the APG III system (2009).

In order to verify if the sampling has reached sufficiency, a species accumulation curve has been elaborated by randomization (1.000 permutations). Phytosociological descriptors absolute and relative density and absolute and relative frequency have been calculated both by species and size class (Classes 1, 2 and 3). Accordingly, the Natural Regeneration by class (CNR) and Total Natural Regeneration (TNR) indexes have been calculated (Volpato, 1994).

By using both the data we have collected in the natural regeneration and the data of adults (tree species individuals with more than 5 cm of DBH) collected by Loebens (2015) in the same area, we have calculated the dissimilarity between the tree species regenerative and adult components. A presence-absence matrix of the sampled species of both components was used to calculate the Jaccard and Sorensen distances (floristic comparison). Another matrix with the number of individuals per species sampled in the components was used to calculate the Bray-Curtis distance (floristic-structural comparison). The species *Rudgea parquioides* (Cham.) Müll.Arg has been removed from the matrices because it did not reach diameters above 5 cm and therefore it cannot be classified as adult as far as this criterion is concerned.

We have compared the sampled regenerating component to the regenerating component of other studies (Figure 1; Table 1) held in the "Planalto Sul Catarinense" region, SC, Brazil, through a presence-absence matrix of the tree species regenerating component of seven sites, which data are available in the database of the Laboratory of Dendrology of the CAV/UDESC. The floristic dissimilarity was calculated by Sorensen's distance and a dendrogram was constructed by using the UPGMA algorithm. All dissimilarities analyzes have been carried out in the statistical language program R (R Development Core Team, 2014) through the Vegan package (Oksanen et al., 2014).

3. RESULTS

A total of 818 individuals (26,771 ind.ha^{-1}) belonging to 30 families, 42 genera and 59 species have been sampled in the regenerating stratum (Table 2). The most representative families were: Myrtaceae (17 species and eight genera), Lauraceae (four species distributed into two genera) and Salicaceae (four species belonging to three genera). It is worth mentioning the occurrence of an exotic species considered as an invader of natural areas, the *Ligustrum sinense* Lour. (present only in

Figure 1 – Localization and delimitation of the forest fragments where the surveys of natural regeneration have been carried out in the municipalities of Capão Alto, Lages and Urubici, "Planalto Sul Catarinense" region, SC, Brazil.
Figura 1– *Localização e delimitação dos fragmentos florestais onde foram realizados levantamentos da regeneração natural, nos municípios de Capão Alto, Lages e Urubici, Planalto Sul Catarinense.*

Table 1 – Regenerative component phytosociological surveys held in the "Planalto Sul Catarinense" region, SC, Brazil, and used for the floristic comparison with our study.
Tabela 1 – *Levantamentos fitossociológicos do componente regenerativo realizados na região do Planalto Sul Catarinense utilizados para a comparação florística com o presente estudo.*

Fragment/ Municipality	Geographical coordinates	Phyto-physiognomy	Alt.	Sampling method and inclusion level	N
Alluvial (our study)/Lages	27º50'48''S and 50º13'49''W	Alluvial MOF	884	Plots, tree species regenerating individuals from 15 cm in height to 5 cm of DBH	59
Urubici	28°04'24"S and 49°37'12"W	Upper montane MOF	1600	Plots, tree species regenerating individuals below 5 cm of DBH	29
Capão Alto	28°11'32"S and 50°44'40"W	Transition between MOF and DSF	700	Plots, tree species regenerating individuals from 20 cm in height to 5 cm of DBH	52
Pedras Brancas/ Lages	27°51'54"S and 50°11'11"W	Montane MOF	990	Plots, tree species regenerating individuals from 20 cm in height to 5 cm of DBH	83
Guará/Lages	27°51'51''S and 50°19'04''W	Montane MOF	980	Plots, tree species regenerating individuals from 15 cm in height to 5 cm of DBH	58
EPAGRI/ Lages	27º48'18''S and 50º19'59''W	Montane MOF	970	Plots, tree species regenerating individuals from 15 cm in height to 5 cm of DBH	61
PARNAMUL/ Lages	27º47'04''S and50º20'44''W	Montane MOF	950	Plots, tree species regenerating individuals from 15 cm in height to 5 cm of DBH	44

Alt.: average altitude (m); N: number of regenerating tree species; MOF: Mixed Ombrophilous Forest; DSF: Deciduous Seasonal Forest; DBH: diameter of breast height.

class 1). The species accumulation curve has tended to stabilize (Figure 2) and, by including the last five plots, which corresponds to a sampling intensity of approximately 10%, only a 1.6% increase in the number of species has been observed.

The *Allophylus edulis* (A.St.-Hil. Et al.) Hieron. Ex Niederl. species has shown the highest TNR in the area under study (10.26%), followed by *Blepharocalyx salicifolius* (Kunth) O.Berg (7.50%) and *Eugenia uniflora* L. (6.36%). *Allophylus edulis* has also been

Table 2 – Species and their respective natural regeneration Indexes (NRIs, %) in the tree species regenerative component of an Alluvial Araucaria Forest fragment in the municipality of Lages, SC, Brazil.
Tabela 2 – *Espécies com seus respectivos Índices de Regeneração Natural (IRN's, em %) no estrato regenerante arbóreo de um fragmento de Floresta Ombrófila Mista Aluvial em Lages, SC.*

Families	Species	NRIs			
		C1	C2	C3	Total
Anacardiaceae	*Lithrea brasiliensis* Marchand	0	0	0.12	0.12
	Schinus terebinthifolius Raddi	0.18	0	0	0.18
Annonaceae	*Annona rugulosa* (Schltdl.) H. Rainer	2.18	1.14	0.12	3.44
Aquifoliaceae	*Ilex theezans* Mart. ex Reissek	0.36	0	0.12	0.49
Araucariaceae	*Araucaria angustifolia* (Bertol.) Kuntze	0.44	0	0.37	0.81
Asteraceae	*Dasyphyllum brasiliense*(Spreng.) Cabrera	0.54	0	0	0.54
	Dasyphyllum spinensis (Less.) Cabrera	0.18	0.14	0.12	0.45
Berberidaceae	*Berberis laurina* Billb.	0.57	0	0	0.57
Bignoniaceae	*Jacaranda puberula* Cham.	0.54	0	0	0.54
Cannabaceae	*Celtis iguanaea* (Jacq.) Sarg.	0.36	0	0	0.36
Cardiopteridaceae	*Citronella paniculata* (Mart.) R.A.Howard	0	0.14	0	0.14
Celastraceae	*Maytenus dasyclada* Mart.	0.62	0	0	0.62
Erythroxylaceae	*Erythroxylum deciduum* A.St.-Hil.	0	0.14	0	0.14
Euphorbiaceae	*Gymnanthes klotzschiana* Müll.Arg.	3.78	1.75	0.78	6.31
	Sebastiania brasiliensis Spreng.	0.18	0.47	0.14	0.79
Fabaceae	*Dalbergia frutescens* (Vell.) Britton	4.17	0.57	0.12	4.87
Lauraceae	*Nectandra lanceolata* Nees	0.44	0.14	0	0.58
	Nectandra megapotamica (Spreng.) Mez	3.65	1.36	0.27	5.28
	Ocotea puberula (Rich.) Nees	0.52	0	0.12	0.64
	Ocotea pulchella (Nees & Mart.) Mez	1.53	0.61	0.37	2.51
Loganiaceae	*Strychnos brasiliensis* Mart.	1.06	1.07	0.12	2.26
Melastomataceae	*Miconia cinerascens* Miq.	0.54	0.14	0	0.69
Myrtaceae	*Blepharocalyx salicifolius* (Kunth) O.Berg	6.66	0.71	0.12	7.50
	Calyptranthes concinna DC.	3.78	1.8	0.76	6.34
	Campomanesia rhombea O.Berg	0.26	0	0	0.26
	Campomanesia xanthocarpa (Mart.) O.Berg	2.2	0.47	0.37	3.04
	Eugenia pluriflora DC.	1.32	0.57	0.37	2.26
	Eugenia pyriformis Cambess.	0.62	0	0	0.62
	Eugenia uniflora L.	3.86	1.23	1.27	6.36
	Eugenia uruguayensis Cambess.	0.18	0	0	0.18
	Myrceugenia myrcioides (Cambess.) O.Berg	0.26	0	0.27	0.52
	Myrcia guianensis (Aubl.) DC.	0.44	0	0	0.44
	Myrcia hartwegiana (O.Berg) Kiaersk.	0.54	0.47	0.12	1.13
	Myrcia laruotteana Cambess.	0.36	0.71	0.41	1.48
	Myrcia oblongata DC.	0.18	0.18	0	0.36
	Myrcia palustris DC.	0.36	0	0	0.36
	Myrcia splendens (Sw.) DC.	0	0	0.12	0.12
	Myrciaria delicatula (DC.) O.Berg	2.2	1.19	0.82	4.21
	Myrrhinium atropurpureum Schott	0.36	0	0.12	0.49
Oleaceae	*Ligustrum sinense* Lour.	0.36	0	0	0.36
Podocarpaceae	*Podocarpus lambertii* Klotzsch ex Endl.	0.36	0.36	0	0.73
Primulaceae	*Myrsine coriacea* (Sw.) R.Br. ex Roem. & Schult.	0.18	0	0	0.18
	Myrsine parvula (Mez) Otegui	0.6	0.14	0	0.74
	Myrsine umbellata Mart.	0.18	0	0	0.18
Proteaceae	*Roupala montana* Aubl.	0.44	0.14	0	0.58
Rhamnaceae	*Scutia buxifolia* Reissek	0.36	0.18	0.12	0.67
Rosaceae	*Prunus myrtifolia* (L.) Urb.	0.44	0.32	0.25	1.01
Rubiaceae	*Rudgea parquioides* (Cham.) Müll.Arg.	2.77	2.25	0	5.03
Rutaceae	*Zanthoxylum kleinii* (R.S.Cowan) P.G. Waterman	0.18	0.28	0.12	0.59

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	Zanthoxylum rhoifolium Lam.	0.36	0.14	0.12	0.63
Salicaceae	*Banara tomentosa* Clos	1.71	0.75	0.51	2.97
	Casearia decandra Jacq.	2.28	1.15	0.69	4.13
	Xylosma ciliatifolia (Clos) Eichler	0.18	0	0	0.18
	Xylosma tweediana (Clos) Eichler	0.18	0	0.14	0.32
Sapindaceae	*Allophylus edulis* (A.St.-Hil. et al.) Hieron. ex Niederl.	8.76	1.01	0.49	10.26
	Matayba elaeagnoides Radlk.	2.67	0	0.25	2.92
Solanaceae	*Solanum sanctae-catharinae* Dunal	0	0.14	0	0.14
Symplocaceae	*Symplocos uniflora* (Pohl) Benth.	0.18	0	0	0.18
Winteraceae	*Drimys brasiliensis* Miers	0.18	0	0	0.18
Total	59 espécies	67.79	21.86	10.21	

C1: Class1NRIs; C2: Class 2 NRIs; C3: Class 3 NRIs; Total: total NRIs.

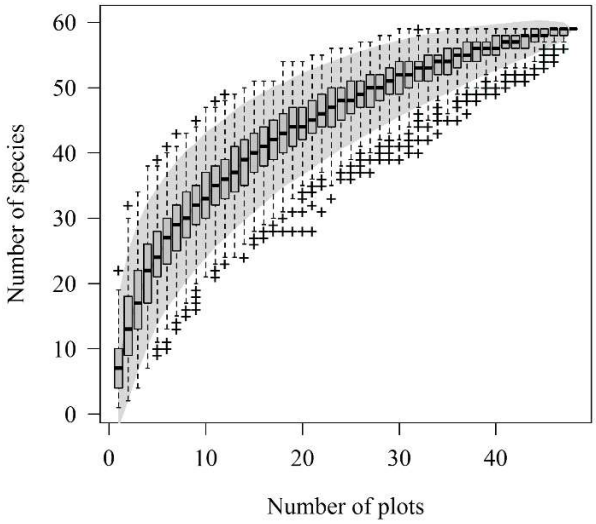

Figure 2 – Species accumulation curve for the regenerative component in an Alluvial Araucaria Forest in the municipality of Lages, SC, Brazil.
Figura 2 – *Curva de acumulação de espécies do estrato regenerante de uma Floresta Ombrófila Mista Aluvial em Lages, SC.*

identified as the species with the highest NRC in Class 1 (8.76%), however, it has shown reduced values in the other classes (1.01% and 0.49% in classes 2 and 3, respectively). *Rudgea parquioides* has reached the eighth place in TNR and had the highest NRC in Class 2 (2.25%), but showed no individuals in Class 3. *Eugenia uniflora* has shown the highest NRC in Class 3 (1.27%) as well as high values of NRC in the other classes (3.86% and 1.23% in classes 1 and 2, respectively). In general, Class 1 has shown the highest NRC values (67.79%), followed by Classes 2 (21.86%) and 3 (10.21%).

By comparing the regenerating stratum with the adult stratum, dissimilarity values of 0.38, 0.24 and 0.43 have been found for the distances of Jaccard, Sorensen and Bray-Curtis, respectively. Among the adult and regenerating strata a total of 47 common species, 19 exclusive species in the adult stratum and 10 exclusive species in the regenerating stratum have been observed.

The dissimilarity dendrogram (Figure 3), which has shown a cophenetic correlation with $p < 0.001$, has indicated that the studied area (Alluvial) had a greater floristic relation (< 40% dissimilarity) with the

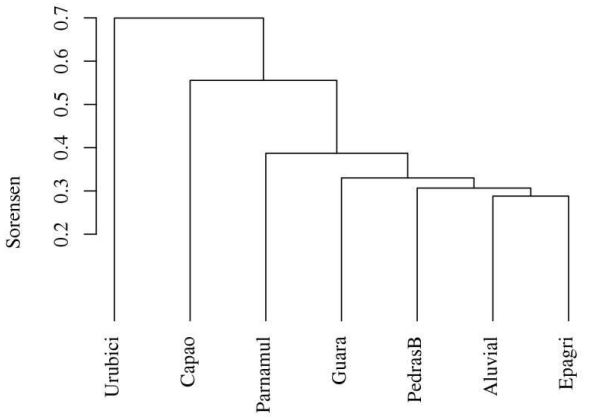

Figure 3 – Dendrogram build from the sampled species presence-absence in seven areas in the "Planalto Sul Catarinense" region, SC, Brazil.
Figura 3 – *Dendrograma construído a partir da presença e ausência das espécies amostradas em sete áreas no Planalto Sul Catarinense.*

regenerative component of other spatially close areas located in the municipality of Lages (EPAGRI, Pedras Brancas, Guará and PARNAMUL) (Figure 1). The highest distinction has been observed with fragments located in the municipalities of Urubici (dissimilarity of 70%) and Capão Alto (dissimilarity of 55%). They are both located in distinct and geographically more distant phyto-physiognomies: the Urubici fragment is located in an upper montane Araucaria Forest and Capão Alto's fragment is located in a transition area between a Deciduous Seasonal Forest and an Araucaria Forest.

4. DISCUSSION

The most representative families Myrtaceae, Lauraceae and Salicaceae have also stood out in some Araucaria Forest sub-formations both in the regenerative component (Caldato et al., 1996; Barddal et al., 2004; Narvaes et al., 2005; Cordeiro and Rodrigues, 2007; Souza et al., 2012) and the adult component (Higuchi et al., 2012a,b; Silva et al., 2012b). These results indicate the families' high capacity of occupying the different strata of the vertical profile of such phyto-physiognomy.

The species richness we have verified liken that of other studies on natural regeneration in Araucaria Forests fragments (Caldato et al., 1996). The presence of the exotic species *Ligustrum sinense* in the fragment is probably related to its wide use in urban arborization in addition to offer a quite attractive fruit for the birdlife and be well-adapted to the region.

Sampling has adequated to the area floristic characterization. According to Kersten and Galvão (2011), sampling sufficiency is reached when the species/area curve tends to stability and the addition of new plots does not significantly alter the number of survey species. Authors consider the sampling to be satisfactory when a 10% increase in the sampling area adds less than 5% in new species, which has been the case in our study.

Despite the similarity of the floristic profile to other non-alluvial areas of the Araucaria Forest, structural variations with differences among species of greater community representativeness are observed in the presence of families and species of wide distribution, such as *Araucaria angustifolia* and *Drimys brasiliensis* Miers. Such pattern suggests the importance of alluvial influence as a relevant ecological factor for species selection and establishment. The high TNR species we have found are probably somehow tolerant to water stress. Indeed, Silva et al. (2007) have found the highest TNR three species as common to flooded forests so that *Allophylus edulis* and *Eugenia uniflora* are considered as alluvial preferential while *Blepharocalyx salicifolius* is considered as nonpreferential by occurring both in alluvial and swamp flooded forests.

Standing out in Class 1 and showing a reduced NRC in the other classes, *Allophylus edulis* pattern indicates that despite forming a bank of young individuals of high relative importance it may be subject to ecological factors controlling its density. Standing out in Class 2 and being absent from Class 3, *Rudgea parquioides* may have a reduced growth capacity in the area. Although being a small tree species it can reach up to approximately 4 m in height. Cardoso et al. (2010) have observed a maximum height of 3.70 m for this species in Paraná, Brazil, which indicates that it could reach the Class 3 (> 3 m) in our study. Standing out in Class 3 and showing a good participation in the other classes, *Eugenia uniflora* has a good establishment capacity in the area being therefore able to resist abiotic and biotic stress well (e.g. competition and herbivory).

The decreasing distribution in the number of individuals in size classes represents a classic pattern for uneven aged natural forests, in which there are more individuals of smaller sizes (regenerating individuals of Class 1) due to factors that limit its development and survival, such as herbivory and competition, therefore enabling only a smaller ratio to reach higher size classes.

In general, dissimilarity measures between the regenerating and adult components have shown a high similarity between components (dissimilarity of < 50%) therefore suggesting low floristic (Jaccard and Sorensen) or floristic-structural turnover (Bray-Curtis) so as to indicate just a few future changes in the forest in the absence of large-scale disturbances. However, more structural rather than floristic differences are observed (greater dissimilarity by the Bray-Curtis index) thus reflecting population differences in the distribution of individuals among the adult and regenerative components. On one hand, a species with many regenerative components may be underrepresented among adults, such as *Dalbergia frutescens* (Vell.) Britton, which has shown 40 regenerating but only five adult individuals. On the other hand, a species of few regenerative individuals might show a high

representativeness among adults, such as *Gymnanthes klotzschiana* Müll.Arg., which has shown 59 regenerating and 388 adult individuals. Such structural variations among populations may represent either ecological differences between them or distinct phases in the fragment's colonization and establishment process. By studying Amazon flooded areas, Assis and Wittman (2011) have observed a low similarity between the canopy and the understory species, which has been considered by the authors as a consequence of the influence of the flood regime on the species local establishment capacity.

Despite the alluvial factor, the dendrogram analysis has indicated a high floristic similarity of the studied area with surrounding areas and more dissimilarity with the municipalities of Urubici and Capão Alto. Due to its high altitude around 1600 m and constant cloudiness Urubici is particularly featured by a high relative humidity as well as high organic matter content in soils and low temperatures with frequent frost, which causes a peculiar floristic composition with distinctive species (Marcon et al., 2014). In turn, Capão Alto is located at an altitude of approximately 600 m on the banks of a Pelotas River tributary therefore receiving a strong influence of the deciduous component and featuring as an ecological tension area. By considering the geographic scale used in our study it is observed that the regenerative component follows the same phytogeographic pattern of the adult component (Higuchi et al., 2012a), in which aspects related to altitude and temperature are determinant in species distribution. It is thus inferred that on regional scale the climate, which is mainly represented by temperature as observed by Higuchi et al. (2012a), determines a species pool. At the local scale this set of species gets influenced by environmental filters, such as the flooding of soils in alluvial areas, which acts on the species relative importance as we have observed since there was a higher TNR of tolerant species.

5. CONCLUSION

Natural regeneration has shown a floristic pattern featured by the high importance of species tolerant to flooding. The studied forest is expected to present low floristic turnover in short time because of the high floristic and floristic-structural similarity between its adults and regenerating individuals. The greater floristic connection observed with geographically close areas at an altitudinal range of approximately 1,000 suggests that both altitude and temperature are important ecological factors for the phytogeographic compartmentalization of such component, therefore defining the regional pool of species potentially capable of establishing in alluvial areas.

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