CIÊNCIA e NATURA

UFSM

Ci. e Nat., Santa Maria v.42, e44, p. 1-26, 2020

DOI: 10.5902/2179460X39503

ISSN 2179-460X

Biologia-Ecologia Submissão 12/08/19 Aprovação 23/06/20 Publicação 01/07/20

# Arboreal diversity in dairy-producing properties in the Arroio da Seca micro-river basin, Rio Grande do Sul, Brazil

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**ABSTRACT**

The Deciduous Seasonal Forest (DSF) in Rio Grande do Sul (RS) is fragmented and partially protected by environmental legislation [Legal Reservation (LR) and Permanent Preservation Area (PPA)]. The aim of this study was to characterize diversity of the arboreal species situated in LR and PPA of 12 dairy-producing properties in the Arroio da Seca micro-river basin. A total of 398 plots with 100m² were used, and height, perimeter, and species were recorded. Phytosociological parameters were calculated using an electronic spreadsheet. Richness of 130 species was recorded as well as a Shannon-Wiener index of 3.79 (0.04). Ninety percent of the sampled area is in the early and intermediate stages of regeneration and most species with high importance value are typical of secondary vegetation. The PPA had higher estimated richness and diversity than the LR; however, there was higher infestation of exotic species in the PPA.

**Keywords**: Atlantic Forest; Phytosociology; Deciduous Seasonal Forest

**RESUMO**

A Floresta Estacional Decidual no Rio Grande do Sul encontra-se fragmentada e com proteção parcial pela legislação ambiental (Reserva Legal – RL – e Áreas de Preservação Permanente – APP –). Objetivou-se caracterizar a diversidade de espécies arbóreas situadas nas RL e APP de 12 propriedades rurais com produção leiteira na microbacia do Arroio da Seca. Utilizaram-se 398 parcelas de 100 m² (para cada fragmento, utilizaram-se parcelas suficientes para alcançar a curva do coletor), registrando-se altura, perímetro e espécie. Os parâmetros fitossociológicos foram calculados em planilha eletrônica. Foi registrada riqueza de 130 espécies e índice de Shannon-Wiener de 3,79 (0,04). 90% da área amostrada se encontra nos estágios inicial e médio de regeneração e a maioria das espécies com alto índice de valor de importância é típica de vegetação secundária. A APP se mostrou com maior riqueza estimada e diversidade do que RL, porém, na APP registrou-se maior infestação de exóticas.

**Keywords**: Fitossociologia; Floresta Estacional Decidual; Mata Atlântica

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## 1 INTRODUCTION

Covering the southern slope of Serra Geral, the High Uruguay River Valley and dispersed areas in the Ijuí, Ibicuí and Jacuí River basins (BRENA *et al*., 2001), the DSF is inserted in the Atlantic Forest Biome (BRASIL, 2006). It is a forest with over 50% of individuals belonging to the upper stratum, with no foliage during cold winter (IBGE, 2012).

Several floristic, phytosociological, and phenological studies have been conducted on the DSF of Serra Geral slope arboreal stratum, in RS, mainly in the surrounding areas of Santa Maria/RS (Ibicuí-Mirim, Jaguari, and Vacacaí River basins), Cachoeira do Sul/RS (Jacuí River basin) and municipalities in the region of the Valleys (Taquari-Antas and Pardo River basins). Literature on this floristic formation provides descriptions of its composition, phytosociology, timber production estimate and plant population dynamics and their relationships with biotic and abiotic factors (ZERWES *et al*., 2018). Among the studies that focused exclusively on floristic composition, only one study was detected, Rempel *et al*. (2018), who studied the riparian forest in rural properties of Vale do Taquari/RS. While Silva *et al*. (2019) analyzed the edge effect on the floristic composition of a forest fragment in Teutônia/RS. In relation to the spectra of different diaspore dispersal strategies, the studies by Melo *et al*. (2016) in a riparian forest and by Turchetto *et al*. (2017) on a forest fragment near agricultural activities, in Vera Cruz/RS and Nova Palma/RS, respectively, were done. Composition, structure and phytosociology of the arboreal stratum have been the focus of several studies, such as Teixeira *et al*. (2014) in Colinas/RS, Melo *et al*. (2016) in Vera Cruz/RS, Ariotti *et al*. (2016) in Sério/RS, Teixeira *et al*. (2017) in Muçum/RS, Roca Sales/RS, Colinas/RS, Lajeado/RS and Taquari/RS municipalities, and Lucheta *et al*. (2018) in Muçum/RS.

The Continuous Forest Inventory of RS used a quanti-qualitative analysis of the forest resources in plots distributed throughout the formation (BRENA *et al*., 2001). Markus *et al*. (2018) in Arroio do Meio/RS, Estrela/RS and Fazenda Vilanova/RS worked with forest fragments in dairy-producing rural properties and their relationship with sustainability in the activity. Fonseca *et al*. (2017) evaluated the changes undergone by floristic composition and phytosociological structure between two different strata in Cachoeirinha/RS, one in the reference riparian forest with arboreal/shrub species, and another in natural regeneration stratum. Scipioni *et al*. (2015) in Pantano Grande/RS evaluated the occurrence of plant groupings and their relationship with declivity, topography, and pedology. Budke *et al*. (2008) evaluated the influence of flood pulse disturbances on the vegetation of Cachoeira do Sul/RS, and compared parameters of the arboreal stratum with topography and pedology. Andrzejewski *et al*. (2019) performed analyzes to differentiate floristic groups in a forest fragment in Jaguari/RS, where a cluster analysis revealed differences between successional stages.

From the standpoint of conservation, it is worth noting that Law 12.651/2012 (BRASIL, 2012) establishes two important instruments for the maintenance of forest remnants, which are LR and PPA. Another, is the Law of the Atlantic Forest (BRASIL, 2006), which establishes rules for use and occupation of the biome's native areas according to its characteristics and when it should be protected. LR consists of assigning a percentage of rural property's area (20% in RS) to the sustainable use of natural resources and fostering of biodiversity conservation. On the other hand, PPA provides protection to the surrounding area of water resources, on foothills, or parts of it, with slope higher than 45° and hill tops (with minimum heights of 100 m); in summary, it aims at preserving water resources, geological and soil stability, as well as allowing for gene flux (BRASIL, 2012).

Although protective actions exist, the DSF is an endangered forest formation in RS, since there are only residual settlements that cover 4.16% of the state's surface (BRENA *et al*., 2001). Its fragmentation started with the colonization by European immigrants in the past in the Southern portion of Brazil, when they started to introduce agriculture activities (BARBIERI *et al*., 2014), being cattle breeding one of them, for milk production farms. Based on the current characterization of the vegetation and its organization in the property area, it is possible to identify where the improvements are necessary, allowing LRs to perform their ecological functions and natural regeneration (WOLLMANN; BASTOS, 2015; SANTANA *et al*., 2020) or restoring the native vegetation in PPAs (FABBRO-NETO *et al*., 2014). Therefore, phytosociology might be used to indicate vegetation degradation, like Spellmeier *et al*. (2019) study, who showed impacts on natural regeneration comparing fragments with and without the bovine's entrance.

The aim of the present study was to characterize species diversity in the arboreal stratum, with emphasis on species with greater phytosociological importance in forest fragments of submontane formation, situated in dairy-producing rural properties LRs and PPAs in the Arroio da Seca micro-river basin, RS, Brazil. The focus was diagnose the level of conservation in the environment comparing the data obtained with other studies, to check if the properties's LRs and PPAs are in accord, or not, with the standards provided for in legislation, and where required, what measures the property needs to adopt for environmental improvements.

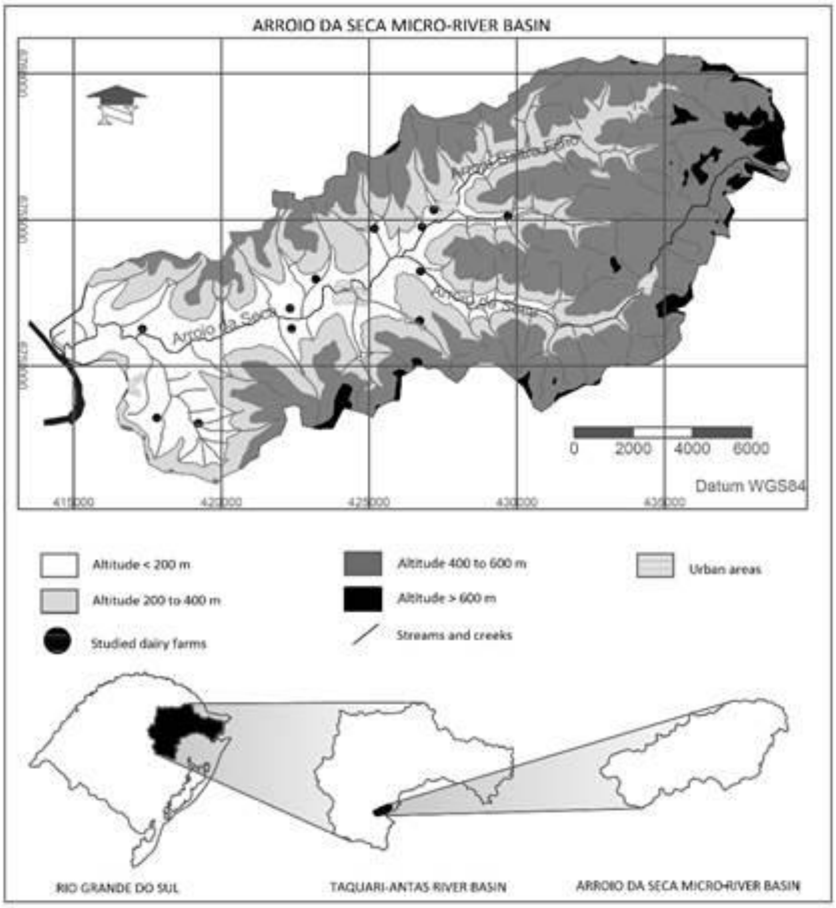
## 2 MATERIAL AND METHODS

The survey was conducted in 12 dairy-producing properties in the Arroio stream micro-basin, which belongs to the Taquari-Antas River basin (Figure 1). Arroio da Seca extends for approximately 37 km, and its source is in Carlos Barbosa/RS. It joins Taquari River in Colinas/RS, and the micro-river basin has 194 km² (MINISTÉRIO DO EXÉRCITO, 1980a; MINISTÉRIO DO EXÉRCITO, 1980b).

According to IBGE map (2012), the vegetation present is DSF, and there are two formations: submontane (up to 400 m of altitude) and montane (above 400 m). The basin is situated on the Serra Geral mountain slope, with basalts from the Serra Geral Formation and intertrap sandstone of the Botucatu Formation (CPRM; MME, 2006). Soils are classified according to the National Infrastructure of Spatial Data (INDE, 2016) as Associations of Typical and Chernosolic Eutroferric Red Nitosol, Latosolic Eutroferric Red Nitosol, and Typical Eutrophic Litolic Neosol. Climate in the region is Subtropical – *Cfa* (KOEPPEN, 1948), with mean temperature and annual rainfall of 18.5°C and 1600 to 1800mm, respectively (INMET, 2012).

In order to allow for the comparison among properties, only the submontane formation was sampled, as it covers the majority of the municipalities of Imigrante and Colinas/RS. The properties were selected according to the following criteria: with margins in Arroio da Seca (six on each side) and location along the submontane portion of the basin (three to the west, mid-west, mid-east, and east). For the floristic-phytosociological survey, sampling units (SUs) were performed in each one of the 54 forest fragments present in PPAs and LRs of the properties; SU consisted of 100 m² plots (10 m by 10 m) spread along transects which divided the fragment's larger sides in half. A spacing of 20 m was kept between plots. This was done until sampling sufficiency was reached based on the collector curve. If the accumulation curve for the stabilization of species was not obtained, an extra transect was performed 20 m away from the main transect. All arboreal individuals with perimeter in breast height (PBH) equal to or higher than 15 cm were measured, as suggested by Felfili *et al*. (2011), and height (obtained using a laser meter) and PCH were recorded.

Figure 1 - Map of the Arroio da Seca micro-river basin, with the location of the rural properties sampled (Coordinates UTM 22J). Source: data from the study and adapted from the Ministério do Exército (1980a, 1980b).



Species were identified according to Sobral *et al*. (2013), that it is a dichotomous key using vegetative structures for tree and arborescent species in the Rio Grande do Sul state. The species were reviewed by biologists with experience in identifying tree species in the Rio Grande do Sul, aiming to reduce the possibility of false positives. It should also be noted that an additional project is being carried out aiming to collect exsiccatae of all species in the reproductive stage, aiming to compose a future e-book on regional tree vegetation. It was also used the List of Species of the Brazilian Flora (REFLORA, 2016) to check scientific names and to define if they are native or exotic species, and families were classified according to the Angiosperm Phylogeny Group IV (2016). For invasive exotic plants, the List of Invasive Exotic Species from Rio Grande do Sul State was consulted (RIO GRANDE DO SUL, 2013). Fertile botanic material was incorporated to the HVAT Herbarium of Univates. Successional stage was defined based on the CONAMA Resolution (BRASIL, 1994).

The following data are shown: mean values, standard deviation (SD – shown between parentheses after the mean), abundance, dominance, and IVI, calculated with an electronic spreadsheet, following the formulas by Lima *et al*. (2012). The following were also calculated: richness, equability, and Shannon-Wiener diversity index (calculation basis in nats), which followed the formulas described in Lima *et al*. (2012). Rarefaction by sample (Mao tau) and a principal component analysis (PCA) relative to the abundance of each species in the plots performed (variance-covariance matrix and 95% confidence interval) was performed using the Past 2.17c software (HAMMER *et al*., 2001) to estimate total richness and to perform comparisons between PPA and LR. Normality was assessed by the D'Agostino-Pearson test, and after, the non-parametric Kruskal-Wallis statistical test was performed using the BioEstat 5.3 software (AYRES *et al*., 2007).

## 3 RESULTS AND DISCUSSION

A total of 8863 arboreal individuals were sampled in 398 SUs; 2828 in 145 SUs inside PPAs and 6035 in 253 SUs inside LRs. Table 1 shows a comparison between vegetation data obtained in the total survey, in PPA and in LR. Of the total individuals, 4.94% were dead trees standing. About the successional stage, it was observed that 90% of the SUs were indicating initial and intermediate stages of regeneration. This high percentage of fragments in regeneration also had impact on the density of individuals, which was high in the total survey and in the different environments (Table 1) compared to other studies on DSF of RS: Callegaro *et al*. (2014) with 1614 ind $ha^{-1}$ in Agudo/RS, Lucheta *et al*. (2014) with 2306 ind $ha^{-1}$ in Colinas/RS, and Teixeira *et al*. (2017) with 1483 ind $ha^{-1}$ in a riparian forest comprising Muçum/RS, Roca Sales/RS, Colinas/RS, Lajeado/RS and Taquari/RS municipalities. Rarefaction by sample indicated that the collector curve stabilizations were obtained in the total survey, PPA and LR (Fig. 2), and sampled richness was recorded within the confidence interval (95%) of maximum estimated richness, as shown in Table 1. In the total survey, 130 species were recorded (Table 2), classified in 105 genera and 46 families.

Table 1 – Comparison of vegetation data obtained in the total survey in samplings conducted in different environments in the study: Legal Reservation (LR) and Permanent Preservation Area (PPA). Key: σ – Standard deviation

| **Variable** | **Environment** | | **Total properties** |
|---|---|---|---|
| | **PPA** | **LR** | |
| Advanced or primary stage (%) | 15.9 | 11.5 | 10.0 |
| Initial regeneration stage (%) | 6.9 | 7.1 | 7.0 |
| Intermediate regeneration stage (%) | 77.2 | 81.4 | 83.0 |
| Absolute density of the community ($ind.ha^{-1}$) (σ) | 1,855.9 (29.7) | 2,266.4 (38.7) | 2,116.8 (33.1) |
| Relative density of exotic species (%) (σ) | 15.6 (1.6) | 12.2 (1.2) | 13.3 (1.2) |
| Shannon-Wiener Diversity (σ) | 3.81 (0.04) | 3.71 (0.04) | 3.79 (0.04) |
| Equability (σ) | 0.81 (0.01) | 0.79 (0.01) | 0.78 (0.01) |
| Sampled richness (number of species) (σ) | 112 (3.6) | 113 (4.3) | 130 (3.4) |
| Total estimated richness sampling (%) | 96.9 | 96.3 | 97.5 |
| Estimated richness for n = 145 (sampling units) (σ) | 112.0 (3.6) | 101.5 (4.2) | 107.7 (3.9) |
| Sampling units (10 by 10 m plots) with understory degraded by cattle | 22 | 29 | 51 |
| Total sampling units (10 by 10 m plots) | 145 | 253 | 398 |

Table 2 – Floristic and phytosociological data in the total survey. Key: IVI - Importance Value Index, DRe % - Relative density, Fre % - Relative frequency, Dore %. - Relative Dominance, Voucher – from HVAT Herbarium of Univates, exo – exotic species. Source: data from the study

| Family | Species | Common name | IVI | Dre | Fre | Dore | Voucher |
|---|---|---|---|---|---|---|---|
| Anacardiaceae | *Schinus terebinthifolia* Raddi | aroeira-vermelha | 3.94 | 4.33 | 3.3 | 4.19 | 3841 |
| Annonaceae | *Annona neosalicifolia* H.Rainer | Araticum | 0.71 | 0.66 | 0.85 | 0.61 | 3869 |
| | *Annona rugulosa* (Schltdl.) H.Rainer | Araticum | 0.11 | 0.09 | 0.2 | 0.03 | - |
| Apocynaceae | *Aspidosperma australe* Müll.Arg. | Guatambu | 0.74 | 0.7 | 0.7 | 0.81 | - |
| Araucariaceae | *Araucaria angustifolia* (Bertol.) Kuntze | pinheiro-brasileiro | 0.02 | 0.01 | 0.03 | 0.02 | - |
| Arecaceae | *Syagrus romanzoffiana* (Cham.) Glassman | Jerivá | 1.59 | 1.41 | 1.41 | 1.93 | - |
| Asteraceae | *Baccharis dracunculifolia* DC. | Vassoura | 0.2 | 0.31 | 0.23 | 0.05 | 3847 |
| | *Baccharis semiserrata* DC. | Vassoura | 0.21 | 0.25 | 0.31 | 0.08 | - |
| | *Piptocarpha sellowii* (Sch.Bip.) Baker | braço-forte | 0.04 | 0.04 | 0.08 | 0.01 | - |
| Bignoniaceae | *Jacaranda micrantha* Cham. | Caroba | 0.74 | 0.36 | 0.79 | 1.09 | - |
| | *Tecoma stans* (L.) Juss. ex Kunth *exo* | Carobinha | 1.8 | 1.89 | 2.09 | 1.43 | - |
| Boraginaceae | *Cordia americana* (L.) Gottschling & J.S.Mill. | Guajuvira | 2.95 | 1.88 | 2.14 | 4.85 | 3852 |
| | *Cordia trichotoma* (Vell.) Arráb. ex Steud. | Louro | 1.04 | 0.88 | 1.55 | 0.7 | - |
| Cannabaceae | *Celtis iguanaea* (Jacq.) Sarg. | esporão-de-galo | 0.25 | 0.26 | 0.39 | 0.08 | - |
| | *Trema micrantha* (L.) Blume | Grandiúva | 0.93 | 1 | 1.24 | 0.54 | 3867 |
| Cardiopteridaceae | *Citronella paniculata* (Mart.) R.A.Howard | Congonha | 0.02 | 0.01 | 0.03 | 0.01 | - |
| Caricaceae | *Vasconcellea quercifolia* A.St.-Hil. | mamoeiro-do-mato | 0.1 | 0.06 | 0.14 | 0.11 | - |
| Celastraceae | *Maytenus ilicifolia* Mart. ex Reissek | Cancorosa | 0.16 | 0.13 | 0.31 | 0.03 | - |
| Combretaceae | *Terminalia australis* Cambess. | sarandi-amarelo | 0.03 | 0.02 | 0.06 | 0 | - |
| Cunoniaceae | *Lamanonia ternata* Vell. | Guaraperê | 0.03 | 0.02 | 0.06 | 0.02 | - |
| Ebenaceae | *Diospyros inconstans* Jacq. | maria-preta | 0.11 | 0.08 | 0.14 | 0.12 | - |
| | *Diospyros kaki* L.f. *exo* | Caquí | 0.05 | 0.05 | 0.08 | 0.03 | - |
| Erythroxylaceae | *Erythroxylum argentinum* O.E.Schulz | Cocão | 2.21 | 2.92 | 2.2 | 1.52 | 3868 |

| Family | Species | Common name | IVI | Dre | Fre | Dore | Voucher |
|---|---|---|---|---|---|---|---|
| Escalloniaceae | *Escallonia bifida* Link & Otto | canudo-de-pito | 0.94 | 1.45 | 0.79 | 0.58 | 3837 |
| Euphorbiaceae | *Actinostemon concolor* (Spreng.) Müll.Arg. | laranjeira-do-mato | 1.04 | 1.58 | 1.16 | 0.39 | 3848 |
| | *Alchornea triplinervia* (Spreng.) Müll.Arg. | Tanheiro | 0.86 | 0.45 | 0.59 | 1.53 | - |
| | *Gymnanthes klotzschiana* Müll.Arg. | Branquilho | 1.1 | 1.33 | 0.9 | 1.07 | 3851 |
| | *Manihot grahamii* Hook. | mandiocão-brabo | 0.02 | 0.02 | 0.03 | 0.01 | - |
| | *Pachystroma longifolium* (Nees) I.M.Johnst. | mata-olho | 0.31 | 0.15 | 0.23 | 0.54 | - |
| | *Ricinus communis* L. *exo* | Mamona | 0.03 | 0.02 | 0.06 | 0 | - |
| | *Sapium glandulosum* (L.) Morong | Leiteiro | 0.43 | 0.33 | 0.62 | 0.33 | - |
| | *Sebastiania brasiliensis* Spreng. | Leiteirinho | 0.07 | 0.07 | 0.08 | 0.05 | - |
| | *Tetrorchidium rubrivenium* Poepp. | Canemuçu | 0.03 | 0.01 | 0.03 | 0.04 | - |
| Fabaceae | *Albizia edwallii* (Hoehne) Barneby & J.W.Grimes | angico-pururuca | 0.06 | 0.04 | 0.08 | 0.05 | - |
| | *Apuleia leiocarpa* (Vogel) J.F.Macbr. | Grápia | 0.15 | 0.09 | 0.17 | 0.18 | - |
| | *Bauhinia forficata* Link | pata-de-vaca | 2.95 | 3.73 | 3.78 | 1.36 | 3873 |
| | *Calliandra brevipes* Benth. | topete-de-cardeal | 0.01 | 0.01 | 0.03 | 0 | 3866 |
| | *Dalbergia frutescens* (Vell.) Britton | rabo-de-bugio | 0.31 | 0.33 | 0.51 | 0.09 | 3840<br>3861 |
| | *Enterolobium contortisiliquum* (Vell.) Morong | Timbaúva | 0.25 | 0.19 | 0.23 | 0.35 | 3836 |
| | *Erythrina falcata* Benth. | corticeira-da-serra | 0.35 | 0.09 | 0.14 | 0.83 | - |
| | *Inga marginata* Willd. | ingá-feijão | 0.92 | 1.15 | 1.1 | 0.51 | 3860 |
| | *Muellera campestris* (Mart. ex Benth.) M.J. Silva & A.M.G. Azevedo | rabo-de-bugio | 1.55 | 1.98 | 1.32 | 1.35 | - |
| | *Machaerium paraguariense* Hassl. | pau-de-malho | 2.23 | 2.31 | 2.62 | 1.75 | - |
| | *Machaerium stipitatum* Vogel | farinha-seca | 1.57 | 1.29 | 1.86 | 1.54 | - |
| | *Myrocarpus frondosus* Allemão | Cabreúva | 1.58 | 0.93 | 1.07 | 2.74 | - |
| | *Parapiptadenia rigida* (Benth.) Brenan | Angico | 2.04 | 1.92 | 2.85 | 1.35 | - |
| | *Schizolobium parahyba* (Vell.) Blake | Guapuruvú | 0.03 | 0.01 | 0.03 | 0.06 | - |

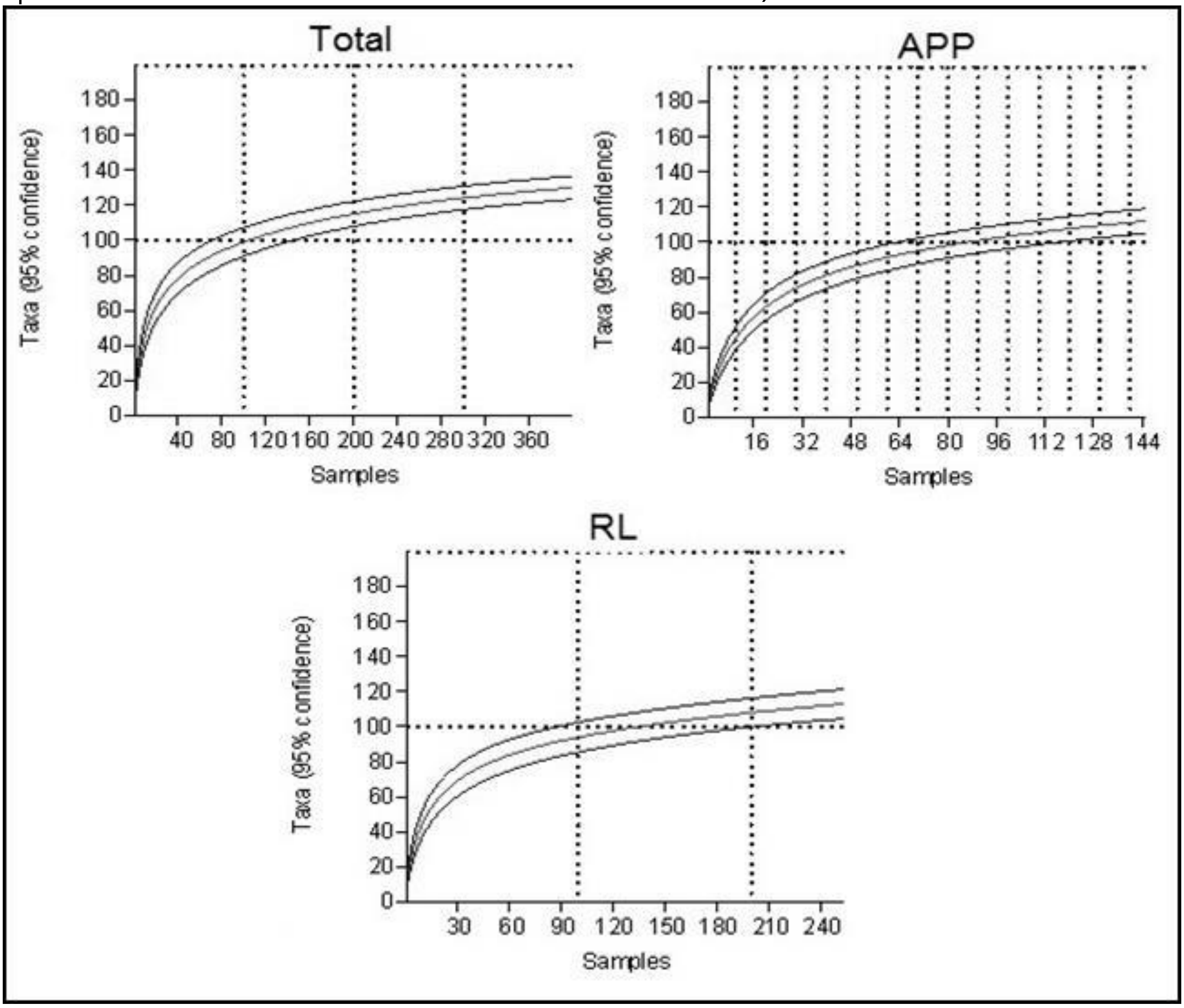
| Family | Species | Common name | IVI | Dre | Fre | Dore | Voucher |
|---|---|---|---|---|---|---|---|
| | *Senegalia bonariensis* (Gillies ex Hook. & Arn.) Seigler & Ebinger | unha-de-gato | 0.29 | 0.36 | 0.42 | 0.1 | - |
| | *Tipuana tipu* (Benth.) Kuntze *exo* | Tipuana | 0.3 | 0.07 | 0.17 | 0.67 | - |
| Lamiaceae | *Aegiphila brachiata* Vell. | Gaioleira | 0.03 | 0.04 | 0.06 | 0.01 | 3870 |
| | *Vitex megapotamica* (Spreng.) Moldenke | Tarumã | 0.06 | 0.04 | 0.08 | 0.07 | 3872 |
| Lauraceae | *Aiouea saligna* Meisn. | canela-amarela | 0.05 | 0.02 | 0.06 | 0.07 | - |
| | *Cinnamomum verum* J.Presl *exo* | caneleira-verdadeira | 0.06 | 0.06 | 0.08 | 0.03 | - |
| | *Endlicheria paniculata* (Spreng.) J.F.Macbr. | canela-amarela | 0.02 | 0.01 | 0.03 | 0.01 | - |
| | *Nectandra megapotamica* (Spreng.) Mez | canela-preta | 7.03 | 6.11 | 5.72 | 9.25 | 3835 |
| | *Nectandra oppositifolia* Nees | canela-ferrugem | 0.02 | 0.01 | 0.03 | 0.03 | - |
| | *Ocotea puberula* (Rich.) Nees | canela-guaicá | 3.44 | 2.16 | 2.99 | 5.16 | - |
| | *Persea americana* Mill. *exo* | Abacateiro | 0.97 | 0.76 | 0.79 | 1.37 | - |
| Loganiaceae | *Strychnos brasiliensis* Mart. | anzol-de-lontra | 0.15 | 0.17 | 0.23 | 0.07 | 3858 |
| Malvaceae | *Ceiba speciosa* (A.St.-Hil.) Ravenna | Paineira | 0.13 | 0.05 | 0.08 | 0.26 | 3854 |
| | *Dombeya wallichii* (Lindl.) Baill. *exo* | Astrapeia | 0.05 | 0.08 | 0.03 | 0.03 | - |
| | *Luehea divaricata* Mart. & Zucc. | açoita-cavalo | 2.07 | 1.85 | 1.89 | 2.47 | 3843 |
| Meliaceae | *Cabralea canjerana* (Vell.) Mart. | Canjerana | 1.01 | 0.75 | 1.27 | 1.02 | - |
| | *Cedrela fissilis* Vell. | Cedro | 0.32 | 0.18 | 0.39 | 0.38 | 3874 |
| | *Cedrela odorata* L. | Cedro | 0.01 | 0.01 | 0.03 | 0 | - |
| | *Guarea macrophylla* Vahl | baga-de-morcego | 0.06 | 0.06 | 0.11 | 0.01 | - |
| | *Trichilia clausseni* C.DC. | Catiguá | 2.23 | 2.49 | 2.28 | 1.91 | - |
| | *Trichilia elegans* A.Juss. | pau-ervilha | 1.34 | 1.99 | 1.66 | 0.35 | 3859 |
| Monimiaceae | *Mollinedia schottiana* (Spreng.) Perkins | cafezinho-do-mato | 0.05 | 0.04 | 0.08 | 0.02 | 3855 |
| Moraceae | *Ficus cestrifolia* Schott ex Spreng. | figueira-branca | 0.44 | 0.07 | 0.14 | 1.12 | - |
| | *Ficus luschnathiana* (Miq.) Miq. | Figueira | 0.52 | 0.37 | 0.45 | 0.73 | - |
| | *Maclura tinctoria* (L.) D.Don ex Steud. | Tajuva | 0.44 | 0.27 | 0.62 | 0.44 | - |
| | *Morus nigra* L. *exo* | amoreira-preta | 1.45 | 1.65 | 1.63 | 1.06 | 3850 |
| | *Sorocea bonplandii* (Baill.) W.C.Burger *et al.* | Cincho | 0.36 | 0.44 | 0.54 | 0.09 | - |

| Family | Species | Common name | IVI | Dre | Fre | Dore | Voucher |
|---|---|---|---|---|---|---|---|
| Myrtaceae | *Blepharocalyx salicifolius* (Kunth) O.Berg | Murta | 0.03 | 0.04 | 0.06 | 0 | - |
| | *Calyptranthes concinna* DC. | Guamirim | 0.1 | 0.09 | 0.14 | 0.05 | - |
| | *Calyptranthes brasiliensis* Spreng. | Guamirim | 0.03 | 0.01 | 0.03 | 0.04 | - |
| | *Calyptranthes tricona* D.Legrand | Guaburiti | 0.07 | 0.06 | 0.06 | 0.09 | - |
| | *Campomanesia xanthocarpa* (Mart.) O.Berg | Guabiroba | 0.38 | 0.28 | 0.62 | 0.24 | - |
| | *Eucalyptus* sp. *exo* | Eucalipto | 1.66 | 0.76 | 0.48 | 3.74 | - |
| | *Eucalyptus* sp.2 *exo* | Eucalipto | 0.02 | 0.01 | 0.03 | 0.02 | - |
| | *Eugenia involucrata* DC. | Cerejeira | 0.2 | 0.15 | 0.37 | 0.08 | - |
| | *Eugenia pyriformis* Cambess. | Uvaia | 0.03 | 0.02 | 0.06 | 0 | - |
| | *Eugenia rostrifolia* D.Legrand | Batinga | 0.38 | 0.36 | 0.45 | 0.34 | - |
| | *Eugenia uniflora* L. | Pitangueira | 1.23 | 1.46 | 1.47 | 0.75 | 3863 |
| | *Eugenia uruguayensis* Cambess. | Guamirim | 0.06 | 0.08 | 0.08 | 0.01 | - |
| | *Myrcia multiflora* (Lam.) DC. | Guamirim | 0.03 | 0.04 | 0.06 | 0.01 | - |
| | *Myrcianthes gigantea* (D.Legrand) D.Legrand | araçá-do-mato | 0.08 | 0.11 | 0.08 | 0.05 | - |
| | *Myrcianthes pungens* (O.Berg) D.Legrand | Guabiju | 0.63 | 0.47 | 0.54 | 0.89 | 3853 |
| | *Psidium guajava* L. *exo* | Goiabeira | 0.6 | 0.63 | 0.93 | 0.24 | 3842 |
| Nyctaginaceae | *Bougainvillea glabra* Choisy | Primavera | 0.02 | 0.02 | 0.03 | 0.01 | - |
| | *Pisonia ambigua* Heimerl | maria-mole | 0.05 | 0.04 | 0.08 | 0.04 | - |
| Oleaceae | *Ligustrum lucidum* W.T.Aiton *exo* | Ligustro | 0.82 | 0.61 | 0.59 | 1.26 | - |
| Paulowniaceae | *Paulownia tomentosa* (Thunb.) Steud. *exo* | kiri-japonês | 0.1 | 0.04 | 0.06 | 0.21 | - |
| Phytolaccaceae | *Phytolacca dioica* L. | Umbu | 1.11 | 0.26 | 0.51 | 2.56 | - |
| | *Seguieria aculeata* Jacq. | limoeiro-do-mato | 0.04 | 0.04 | 0.06 | 0.01 | - |
| Pinaceae | *Pinus elliottii* L. *exo* | pinheiro-americano | 0.02 | 0.01 | 0.03 | 0.01 | - |
| Piperaceae | *Piper aduncum* L. | Pariparoba | 0.01 | 0.01 | 0.03 | 0 | - |
| | *Piper amalago* L. | Pariparoba | 0.15 | 0.13 | 0.31 | 0.02 | 3845 |
| Platanaceae | *Platanus acerifolia* (Aiton) Willd. *exo* | Plátano | 0.19 | 0.02 | 0.03 | 0.51 | - |
| Primulaceae | *Myrsine coriacea* (Sw.) R.Br. ex Roem. & Schult. | Capororoca | 0.18 | 0.17 | 0.2 | 0.17 | - |
| | *Myrsine umbellata* Mart. | Capororoca | 1.35 | 1.69 | 1.63 | 0.74 | 3864 |
| Proteaceae | *Roupala montana* Aubl. | Carvalho | 0.02 | 0.01 | 0.03 | 0.01 | - |

| Family | Species | Common name | IVI | Dre | Fre | Dore | Voucher |
|---|---|---|---|---|---|---|---|
| Rhamnaceae | *Hovenia dulcis* Thunb. *exo* | uva-do-japão | 5.27 | 5.45 | 3.41 | 6.94 | 3856 |
| Rosaceae | *Eriobotrya japonica* (Thunb.) Lindl. *exo* | ameixa-amarela | 0.7 | 0.78 | 0.99 | 0.34 | 3846 |
| | *Prunus myrtifolia* (L.) Urb. | pessegueiro-do-mato | 0.47 | 0.31 | 0.48 | 0.63 | - |
| | *Pyrus communis* L. *exo* | Pêra | 0.08 | 0.05 | 0.08 | 0.11 | - |
| Rubiaceae | *Chomelia obtusa* Cham. & Schltdl. | Viuvinha | 0.11 | 0.12 | 0.17 | 0.04 | 3871 |
| | *Randia ferox* (Cham. & Schltdl.) DC. | limoeiro-do-mato | 0.07 | 0.08 | 0.06 | 0.07 | - |
| Rutaceae | *Citrus × limon* (L.) Osbeck *exo* | Limoeiro | 0.03 | 0.02 | 0.06 | 0.01 | - |
| | *Citrus reticulata* Blanco *exo* | Bergamoteira | 0.29 | 0.24 | 0.45 | 0.19 | - |
| | *Citrus x aurantium* L. *exo* | laranjeira-azeda | 0.39 | 0.38 | 0.56 | 0.22 | - |
| | *Zanthoxylum caribaeum* Lam. | mamica-de-cadela | 0.06 | 0.04 | 0.08 | 0.06 | 3862 |
| | *Zanthoxylum rhoifolium* Lam. | mamica-de-cadela | 0.53 | 0.59 | 0.73 | 0.27 | - |
| Salicaceae | *Banara tomentosa* Clos | farinha-seca | 0.01 | 0.01 | 0.03 | 0 | - |
| | *Casearia decandra* Jacq. | Guaçatunga | 0.06 | 0.05 | 0.11 | 0.02 | - |
| | *Casearia sylvestris* Sw. | chá-de-bugre | 2.07 | 2.3 | 2.85 | 1.07 | - |
| Sapindaceae | *Allophylus edulis* ((A.St.-Hil. *et al*.) Hieron. ex Niederl.. | chal-chal | 8.28 | 9.84 | 7.19 | 7.82 | - |
| | *Cupania vernalis* Cambess. | camboatá-vermelho | 7.83 | 10.54 | 6.79 | 6.15 | 3849 |
| | *Matayba elaeagnoides* Radlk. | camboatá-branco | 0.58 | 0.57 | 0.85 | 0.33 | - |
| Sapotaceae | *Chrysophyllum gonocarpum* (Mart. & Eichler ex Miq.) Engl. | aguaí-da-serra | 0.32 | 0.31 | 0.51 | 0.14 | - |
| | *Chrysophyllum marginatum* (Hook. &Arn.) Radlk. | aguaí-vermelho | 0.63 | 0.49 | 0.79 | 0.61 | 3857 |
| Simaroubaceae | *Picrasma crenata* (Vell.) Engl. | pau-amargo | 0.01 | 0.01 | 0.03 | 0 | - |
| Solanaceae | *Brugmansia suaveolens* (Willd.) Sweet *exo* | saia-branca | 0.15 | 0.18 | 0.23 | 0.06 | - |
| | *Brunfelsia australis* Benth. | Manacá | 0.03 | 0.04 | 0.06 | 0.01 | - |
| | *Cestrum intermedium* Sendtn. | Coerana | 0.5 | 0.42 | 0.82 | 0.26 | 3839 |
| | *Solanum mauritianum* Scop. | Fumeiro | 0.39 | 0.5 | 0.51 | 0.18 | 3844 |
| | *Solanum sanctae-catharinae* Dunal | joá-manso | 0.12 | 0.09 | 0.23 | 0.04 | 3865 |

| Family | Species | Common name | IVI | Dre | Fre | Dore | Voucher |
|---|---|---|---|---|---|---|---|
| Urticaceae | *Boehmeria caudata* Sw. | urtiga-mansa | 0.84 | 1.04 | 1.24 | 0.23 | 3853 |
| | *Urera baccifera* (L.) Gaudich. ex Wedd. | urtigão-bravo | 0.87 | 0.95 | 1.27 | 0.38 | - |

Figure 2 - Collector curves calculated using Past 2.17c for the different environments sampled, obtained using the rarefaction by sample method (Mao tau) (Legend: central curve – collector curve; curves perpendicular to the collector curve (above and below) – confidence interval of 95%; samples – sampling units; rate (95% confidence) – species richness estimated with 95% confidence interval)




In the portions with Neosol of the properties studied, forest fragments were observed generally at sites which were not attractive for cattle breeding, due to declivity and rocky outcrops. On the other hand, in the portions with Nitosol, fragments tended to occur in marginal dykes of water resources, where conversion to agriculture is not feasible. The environmental conscience by human understands nature like something that provide free natural resources, and not like an ecological service provider who maintains the ecosystems stability (FREITAS; ORTIGARA, 2017) leading to occur a preservation not by environmental motivation. In the present study, only one property had legal reserve registration, a situation that might be reversed with the current legal requirements, such as CAR – Rural Environmental Registration (BRASIL, 2012).

In the sampled environments, PPA and LR, 112 and 113 species were recorded, respectively. Comparatively, according to rarefaction per sample for n = 145 (Table 1), PPA had higher richness than LR. The higher richness in PPA might be related to the higher percentage of SUs sampled in advanced stage secondary vegetation or primary vegetation within this environment, compared to LR. According to the definition by CONAMA (BRASIL, 1994), primary stage represents the maximum local diversity and advanced secondary stage represents an environment in which regeneration has already attained high diversity.

Richness per hectare (32.7 species per hectare – sp ha$^{-1}$) was considered low compared to other studies carried out in submontane DSF of RS with the same methodology and inclusion criteria. In Agudo/RS, 57.6 sp ha$^{-1}$ (CALLEGARO *et al*., 2014 – 132 SU's), 58 sp ha$^{-1}$ in Vera Cruz/RS (MELO *et al*., 2016 – 135 SU's) and 61 sp ha$^{-1}$ in Nova Palma/RS (TURCHETTO *et al*., 2017 – 18 SU's). On the other hand, compared to rarefaction per sample, the estimated richness in the present study for 18 SUs it would be 58.9 (4.3), for 132 SUs it would be 105.5 (4.0), and, for 135 SUs, 106.0 (3.9); in other words, the local richness that occurred in the present study is comparatively higher than those in the studies mentioned above. The following species had higher IVI in the total survey, respectively: *Allophylus edulis* (A.St.-Hil. *et al*.) Hieron. ex Niederl., *Cupania vernalis* Cambess. and *Nectandra megapotamica* (Spreng.) Mez. The three species with the highest IVI in the different environments were also the same (Table 3), which reflects how representative these three native species are of the study area.

Table 3 – Floristic and phytosociological data of the 15 species with the highest Importance Value Index in the different environments studied – PPA and LR. Key: IVI – importance value index (%), Dre – relative density (%); Fre – Relative frequency (%); Dore – relative dominance (%); n – abundance in individuals; exo – Exotic species. Source: data from the study.

| Specie | PPA | | | | | LR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | IVI | Dre | Fre | Dore | n | IVI | Dre | Fre | Dore | n |
| *Nectandra megapotamica* | 8.22 | 7.13 | 6.29 | 11.22 | 192 | 6.43 | 5.63 | 5.42 | 8.25 | 323 |
| *Allophylus edulis* | 7.24 | 9.14 | 6.87 | 5.69 | 246 | 8.82 | 10.17 | 7.38 | 8.9 | 583 |
| *Cupania vernalis* | 6.92 | 9.18 | 6.54 | 5.05 | 247 | 8.27 | 11.18 | 6.91 | 6.72 | 641 |
| *Hovenia dulcis* | 6.52 | 6.5 | 3.56 | 9.49 | 175 | 4.64 | 4.95 | 3.33 | 5.63 | 284 |
| *Eucalyptus sp. exo* | 3.87 | 1.93 | 0.83 | 8.86 | 52 | 0.55 | 0.21 | 0.3 | 1.13 | 12 |
| *Ocotea puberula* | 3.52 | 2.45 | 2.9 | 5.22 | 66 | 3.4 | 2.02 | 3.03 | 5.14 | 116 |
| *Bauhinia forficata* | 2.96 | 3.57 | 3.73 | 1.58 | 96 | 2.93 | 3.8 | 3.75 | 1.24 | 218 |
| *Erythroxylum argentinum* | 2.68 | 3.6 | 2.15 | 2.3 | 97 | 1.98 | 2.6 | 2.22 | 1.12 | 149 |
| *Gymnanthes klotzschiana* | 2.65 | 3.05 | 2.07 | 2.83 | 82 | 0.33 | 0.52 | 0.3 | 0.17 | 30 |
| *Trichilia clausseni* | 2.63 | 3.08 | 2.57 | 2.23 | 83 | 2.05 | 2.21 | 2.18 | 1.75 | 127 |
| *Cordia americana* | 2.04 | 1.37 | 1.57 | 3.17 | 37 | 3.42 | 2.11 | 2.43 | 5.71 | 121 |
| *Schinus terebinthifolia* | 1.92 | 2.01 | 1.9 | 1.85 | 54 | 4.94 | 5.42 | 4.01 | 5.38 | 311 |
| *Parapiptadenia rígida* | 1.84 | 1.52 | 2.81 | 1.17 | 41 | 2.14 | 2.11 | 2.86 | 1.44 | 121 |
| *Machaerium paraguariense* | 1.46 | 1.45 | 1.99 | 0.94 | 39 | 2.61 | 2.72 | 2.94 | 2.17 | 156 |
| *Tecoma stans exo* | 1.14 | 1.37 | 1.24 | 0.81 | 37 | 2.14 | 2.13 | 2.56 | 1.74 | 122 |

In the PCA, *A. edulis*, *C. vernalis*, *N. megapotamica* and *H. dulcis* also varied from the others (α = 0,05), there is also differentiation of *Erythroxylum argentinum* O.E.Schulz and *Schinus terebinthifolia* Raddi. The PCA of the total survey (Figure 3) indicates that 24.2% of the variance followed axis 1, which is associated with the density ranking; axis 2, with 8.0% of the variance, is associated with differences in species distribution in the plots; in addition to these, there are another 13 axes above the Jolliffe cutoff point (1.69% of the variance). Inside PPAs (Figure 4), axes 1 (22.2% of variance) and 2 (10.3% of variance) are related to the distribution of species in the plots; with another 24 axes above the Jolliffe cutoff point (0.66% of the variance). Inside LRs (Figure 5), axis 1 (24.9% of variance) is associated with the density ranking and axis 2 (7.8% of variance) with the distribution of species in the plots; in addition, there are another 14 axes above Jolliffe's cutoff point (1.57% of the variance).

Figure 3 – Principal component analysis (PCA) of the abundances of each species in the sampling units of the total survey, elaborated in Past 2.17c. (Legend: Component 1 - PCA axis with the highest percentage of variance; Component 2 - PCA axis with the second highest percentage of variance; Ellipse - 95% confidence interval)

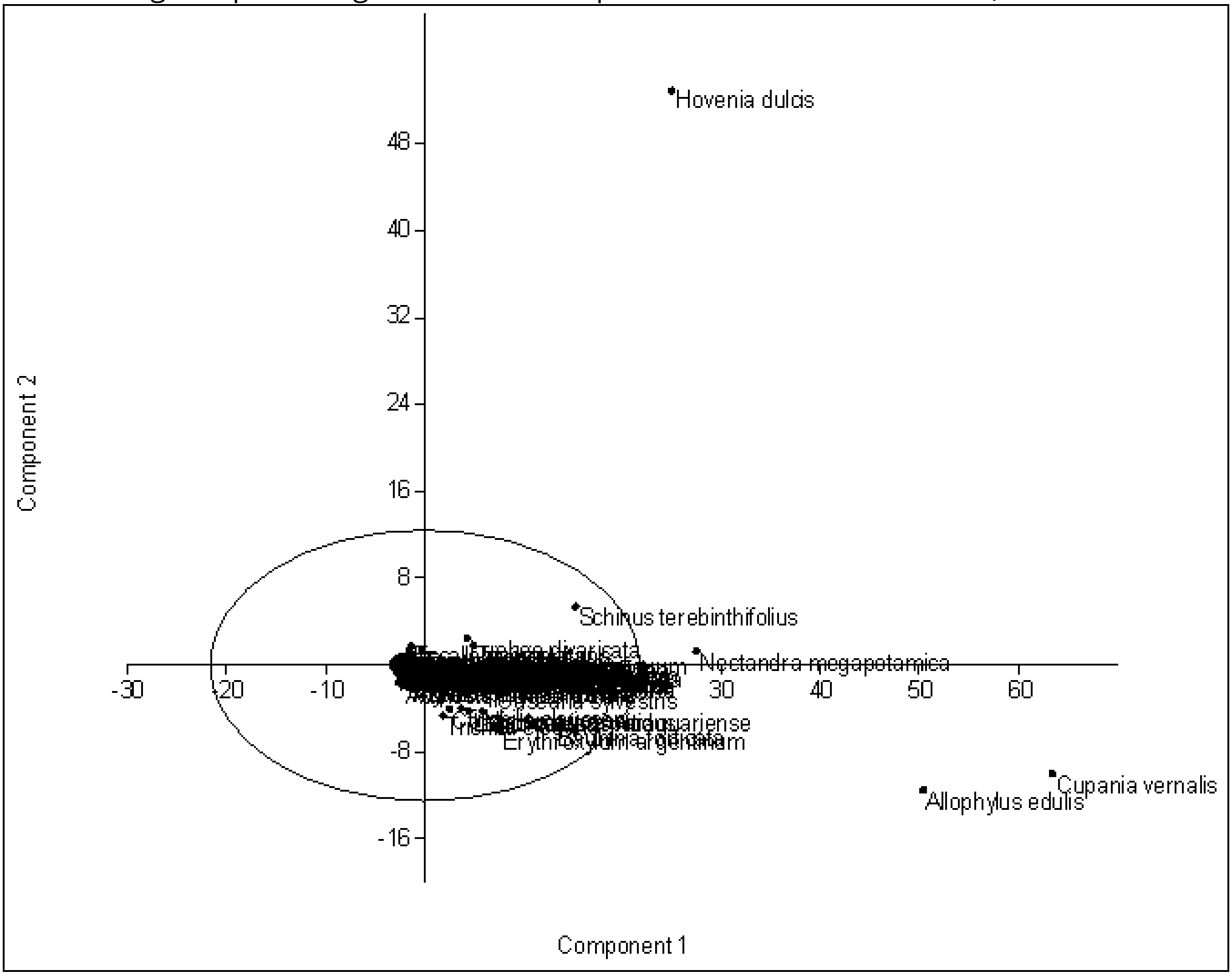


Figure 4 - Principal component analysis (PCA) of the abundances of each species in the sample units in permanent preservation areas (PPAs), elaborated in Past 2.17c. (Legend: Component 1 - PCA axis with the highest percentage of variance; Component 2 - PCA axis with the second highest percentage of variance; Ellipse - 95% confidence interval)

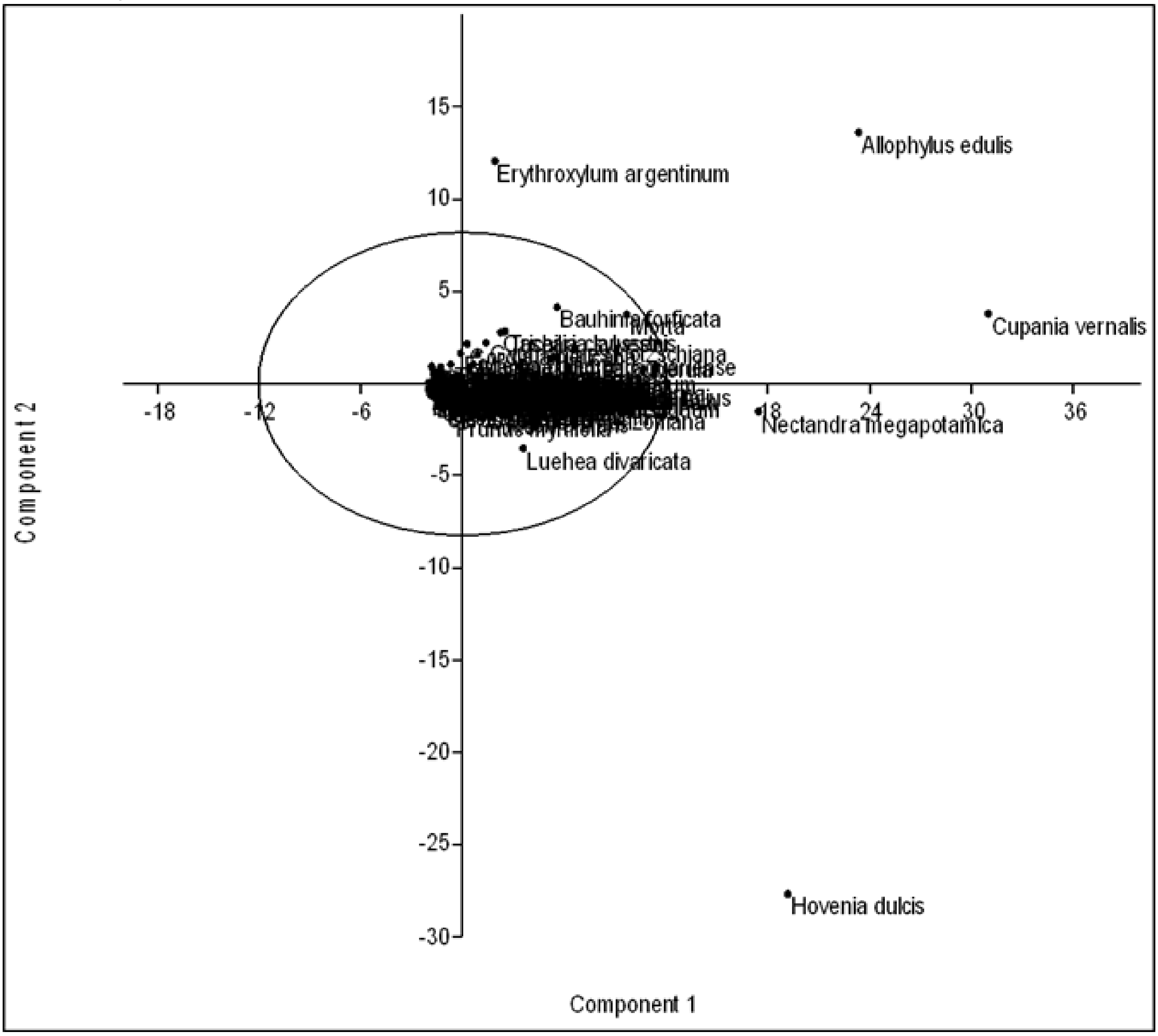
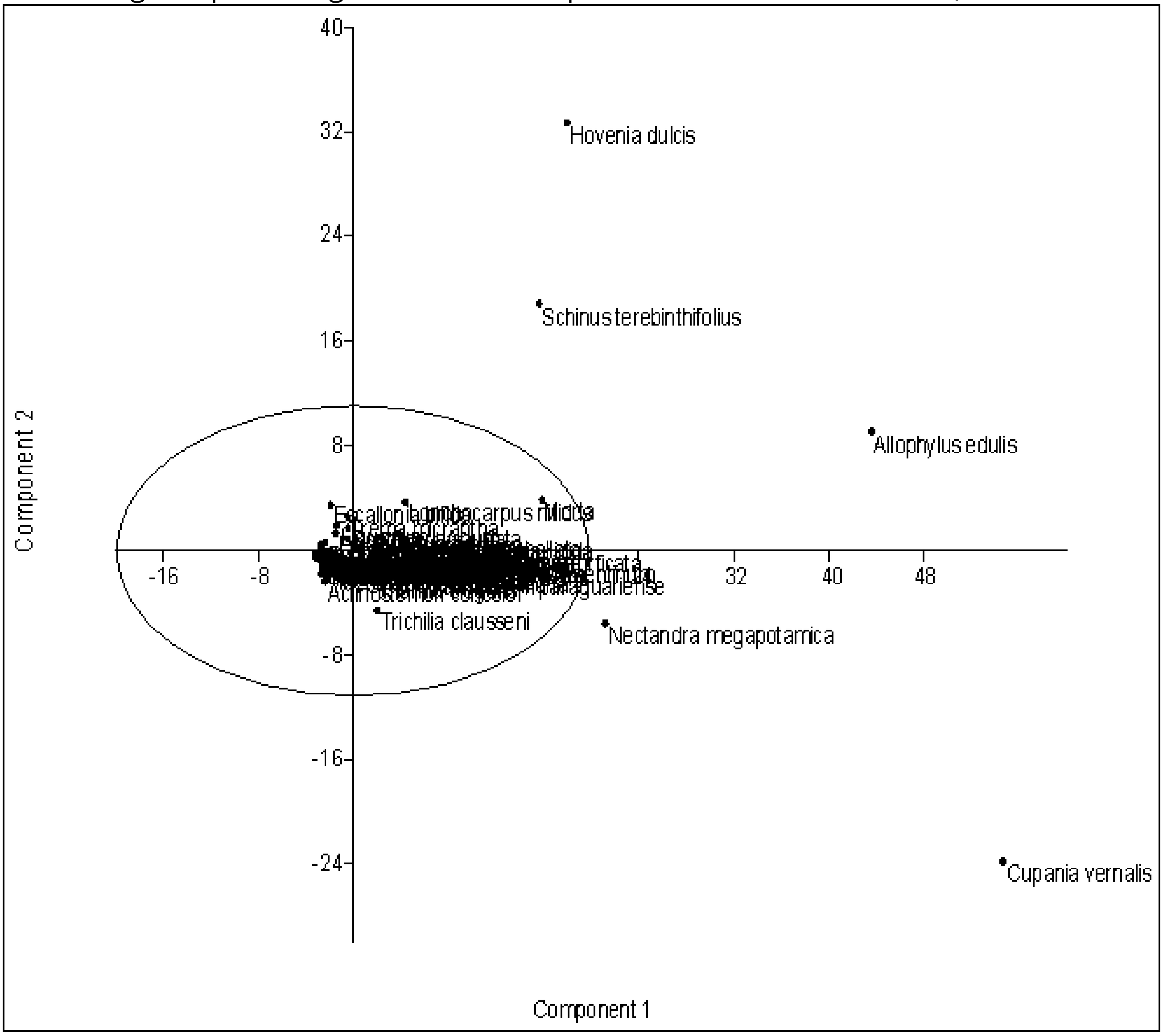


Figure 5 - Principal component analysis (PCA) of the abundances of each species in the sampling units of legal reserve (LRs), elaborated in Past 2.17c. (Legend: Component 1 - PCA axis with the highest percentage of variance; Component 2 - PCA axis with the second highest percentage of variance; Ellipse - 95% confidence interval)




Backes and Irgang (2009) reported that *N. megapotamica* has ecological importance as a fruit tree for birds. Brena *et al*. (2001). *C. vernalis* is widely distributed in RS, it provides fruits for birds and its flowers are melliferous (BACKES; IRGANG, 2009). It is considered typical of arboreal components in pioneer formations of the region of Low Jacuí River (near Porto Alegre) and of the canopy of Mixed Ombrophilous Forest (MOF) which occurs in Serra Geral in RS (BRENA *et al*., 2001). *A. edulis* is typical of shrub and tree agglomerations of pioneer formations (BRENA *et al*., 2001). It has ecological importance as a fruit tree for birds and primates, as well as for its melliferous flowers.

Several studies show that *C. vernalis* and *A. edulis* are relevant in DSF of the Serra Geral mountain slope in RS. In the total survey conducted by Teixeira *et al*. (2017) in Muçum/RS, Roca Sales/RS, Colinas/RS, Lajeado/RS and Taquari/RS municipalities, *N. megapotamica*, *C. vernalis* and *A. edulis* had good IVI values. The last specie was registered in all six fragments of the study. The findings by Brena *et al*. (2001) in the Forest Inventory of RS showed that both species are representative either as adult trees or in the natural regeneration of intermediate and advanced stages of DSF; in the initial secondary stage, *C. vernalis* was also among the most representative species. Callegaro *et al*. (2014) found that *N. megapotamica*, *C. vernalis*, and *A. edulis* were among the most important species in the Parque Estadual Quarta Colônia (Quarta Colônia State Park) in Agudo/RS. Budke *et al*. (2008) found that *C. vernalis* had the highest IVI in alluvial DSF, occasionally flooded in Cachoeira do Sul/RS; however, the higher the flood frequency on site, the lower the abundance of *C. vernalis* and *A. edulis*. In a study conducted by Teixeira *et al*. (2014) in Colinas/RS, only *N. megapotamica* was among the species with the highest IVI. Markus *et al*. (2018) found that *C. vernalis* and *A. edulis* were among the species with the highest IVI in two of the three properties evaluated (*C. vernalis* in Arroio do Meio/RS and *A. edulis* in Estrela/RS and Fazenda Vilanova/RS).

A quantity of 22 from total species recorded in the study was exotic, accounting for 13.3% (1.2) of total abundance. *Hovenia dulcis* Thunb. stood out regarding abundance of invasive exotic species in the present study as it showed the fourth highest IVI, both in total survey and in PPA; on the other hand, it had the fifth highest IVI in LR. The success of *H. dulcis* was observed in Naujorks *et al*. (2015) study, which registered it as one of the three species with higher indices in the study area. This capacity derives from its pseudofruits, that are consumed by animals that disseminate the seeds through feces (MAIEVES *et al*., 2014), its great adaptation ability and its production of allelopathic substances (WANDSCHEER *et al*., 2011). Because of this, *H. dulcis* was considered a Category One invasive exotic species in RS, where new crops or the commercialization of its seedlings is prohibited (RIO GRANDE DO SUL, 2013). It is possible to remove *H. dulcis*, even from PPAs, provided there is a specific reference term for the licensing of such activity issued by the State Department of Environment (DEPARTAMENTO DE BIODIVERSIDADE, 2015). Aside from *H. dulcis*, the occurrence of other Category One invasive species was observed: *Cinnamomum verum* J.Presl, *Ligustrum lucidum* W.T.Aiton and *Tecoma stans* (L.) Juss. ex Kunth. About the following description, Category 2 for invasive species (species that might be used under controlled conditions), were observed: *Eriobotrya japonica* (Thunb.) Lindl., *Morus nigra* L., *Pinus elliottii* L., *Psidium guajava* L. and *Tipuana tipu* (Benth.) Kuntze.

The abundance of exotic species obtained in this study has raised concern in other studies, such as Rempel *et al*. (2018), who found that *H. dulcis* infested fragments of riparian forest in Vale do Taquari/RS, information which corroborates the present study, where the highest abundance of exotic species occurred in the PPA rather than in LR. This infestation by alien species becomes malefic because of the competition with native species, resulting in local ecosystem modification, compromising its functionality, in addition these species have the capacity to dominate local vegetation, impacting negatively the biodiversity (VAN-WILGEN; RICHARDSON, 2014; COURCHAMP *et al*., 2017). Therefore, its control is of the utmost importance for the sustainability of rural properties.

Along with *A. edulis*, *C. vernalis*, *N. megapotamica* and *H. dulcis*, another species who have higher IVI values were representative for the environments in the present study. In PPA, the following species also had the highest IVI: *Eucalyptus* sp., *Ocotea puberula* (Rich.) Nees, *Bauhinia forficata* Link, E. *argentinum, Gymnanthes klotzschiana* Müll.Arg. and *Trichilia claussenii* C.DC. In RL, S. *terebinthifolia, Cordia americana* (L.) Gottschling & J.S.Mill., O. *puberula, B. forficata, Machaerium paraguariense* Hassl., *T. stans* and *Parapiptadenia rigida* (Benth.) Brenan.

*B. forficata* (secondary vegetation, pollinated by bats), *C. americana* (comprises the canopy of the climax stage and is also a pioneer, its dense treetop is an ideal nesting site for several birds), *G. klotzschiana* (high IVI in riparian forests, both as adult and in initial secondary vegetation), *M. paraguariense* (common pioneer in the initial secondary stage), *O. puberula* (occurs in the canopy of the climax stage, and is also a pioneer and a fruit tree for birds), *P. rigida* (occurs as emerging tree over the canopy, as well as in secondary formation; as pioneer, it is pollinated by small bees) and *T. clausseni* (a fruit tree for birds and frequent in the understory of primary forests or advanced secondary forests) (BRENA *et al*., 2001; BACKES; IRGANG, 2009) are typical of DSF.

*S. terebinthifolia* is an aggressive pioneer, mellipherous, and a fruit tree for birds and ants (BACKES; IRGANG, 2009). It is typical of isolated stands in the middle of the Central Depression and on the upper montane grasslands (Campos de Cima da Serra) in RS, as well as in the understory of riparian forests of the MOF (BRENA *et al*., 2001). Its occurrence has been mentioned in several studies conducted in the DSF of Serra Geral mountain slope. As it is an aggressive pioneer, its high IVI corroborated the situation of predominance of middle secondary stage in LR areas of the present study.

*E. argentinum* is also considered a pioneer (which might explain its high IVI in this survey), widely distributed along the state, and it is mellifluous and a fruit tree for birds (BACKES; IRGANG, 2009). Its occurrence was only mentioned, having no relevant IVI in the forests studied of the DSF of the Serra Geral mountain slope, similar to the findings by Markus *et al*. (2018). *Eucalyptus* sp. is an exotic specie introduced in RS for logging purposes (BRENA *et al*., 2001), and it was found cultivated in the PPAs of the present study. T. stans lays in the same category as *H. dulcis*, of invasive exotic species (RIO GRANDE DO SUL, 2013).

Considering the Shannon-Wiener (H') diversity and equability (J) values obtained in the total survey, both the H' index and J in PPA were higher than in LR. However, there were no significant differences between the environments using the Kruskal-Wallis test (p = 0.0997). Among studies in preserved DSF areas in the Serra Geral mountain slope, it is worth mentioning H' and J values of 3.58 and 0.83 in Agudo/RS (CALLEGARO *et al*., 2014), 3.39 and 0.82 in Lajeado/RS (LUCHETA *et al*., 2015), 3.78 and 0.80 in Muçum/RS, Roca Sales/RS, Colinas/RS, Lajeado/RS and Taquari/RS municipalities (TEIXEIRA *et al*., 2017), 2.44 and 0,74 in Agudo/RS (FELKER *et al*, 2018) and 2.83 and 0.77 in Muçum/RS (LUCHETA *et al*., 2018). Nevertheless, despite the high species diversity, signs of degradation from anthropic influence are indicated by the infestation of exotic species, by the fact the most fragments are secondary in initial and intermediate stages of regeneration, by the intense fragmentation of remnants, and also by the entrance of cattle in these remnants.

## 4 CONCLUSIONS

The arboreal stratum surveyed in forest fragments of submontane formation, situated in the LR and PPA areas of dairy-producing rural properties in the Arroio da Seca micro-river basin, Rio Grande do Sul, Brazil, was characterized by having a richness of 130 species and a satisfactory Shannon-Wiener Diversity Index. However, vegetation had intermediate equability. In addition, it was inferred that 90% of the sampled areas were in the initial and intermediate stages of regeneration.

Most species with higher IVI were typical of secondary DSF vegetation, or were pioneers common to other phytoecological regions and exotic species. PPA had higher estimated richness than LR, possibly due to a higher proportion of SUs inside advanced stage secondary forests or in primary forests. However, their Shannon diversity index did not differ.

As a sustainability measure, the landowners should seek to regularize LRs in compliance with CAR, promote suppression, and take advantage of raw materials from exotic species in the forests, with emphasis on *H. dulcis* and *T. stans*. Observe the adequate environmental licensing aiming at eradicating these invasive species is fundamental, which would allow for the studied forest fragments to continue their process of ecological succession, attempting at a more rational and sustainable use of the soil which has also been occupied by cattle breeding activities.

## ACKNOWLEDGMENTS

The authors are grateful to the other members of the Research Group for helping in the first contact with some of the rural properties, to the anonymous revisers of the journal for their important contributions, to CAPES for the first author’s fee scholarship, and to the wife and grandfather of the first author for working in the field survey.

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