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Tree and shrub flora in the surroundings of the Parque Nacional do Iguaçu, Paraná State, Brazil: contribution to ecological restoration

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ABSTRACT - (Tree and shrub flora in the surroundings of the Parque Nacional do Iguaçu, Paraná State, Brazil: contribution to ecological restoration). Aiming to expand the regional floristic knowledge and compile species information to subsidize restoration projects, we conducted a floristic survey in native forest fragments of an area located between the Parque Nacional do Iguaçu and the Área de Preservação Permanente do Lago de Itaipu, in western Paraná State. We found 204 species and 51 families, being the richest Fabaceae (29 spp.), Myrtaceae (18 spp.), Solanaceae (10 spp.), Euphorbiaceae, Meliaceae and Rutaceae (nine spp. each). The zoochoric syndrome was the most common (69% of the species), followed by anemochoric (17%) and autochoric (14%). The non-pioneer species were the most frequent (64%). In general terms, these results agree qualitatively with those observed in seasonal semideciduous forests. Based on phytosociological data from other studies, we indicated 34 locally abundant species that can be used in greater proportions in restoration projects. We recorded seven species threatened and 15 exotic, of which 12 have invasive potential and require actions for controlling.
Keywords: Atlantic forest, conservation, floristic, restoration, threatened species

RESUMO - (Flora arbórea e arbustiva no entorno do Parque Nacional do Iguaçu, PR, Brasil: contribuição para restauração ecológica). Conduzimos um estudo florístico em fragmentos de floresta nativa de uma área localizada entre o Parque Nacional do Iguaçu e a Área de Preservação Permanente do Lago de Itaipu, oeste do Estado do Paraná, objetivando ampliar o conhecimento florístico regional e compilar informações sobre as espécies para subsidiar projetos de restauração naquela área. Encontramos 204 espécies e 51 famílias, sendo as mais ricas Fabaceae (29 spp.), Myrtaceae (18 spp.), Solanaceae (10 spp.), Euphorbiaceae, Meliaceae e Rutaceae (nove spp. cada). A síndrome zoocórica foi a mais comum (69% das espécies), seguida pela anemocórica (17%) e autocórica (14%). As espécies não pioneiras foram as mais frequentes (64%). Qualitativamente, de modo geral, esses resultados coincidem com o observado em florestas estacionais semideciduais. Com base em dados fitossociológicos de outros estudos, indicamos 34 espécies localmente abundantes que podem ser usadas em maiores proporções em projetos de restauração. Registramos sete espécies ameaçadas de extinção e 15 exóticas, das quais 12 possuem potencial invasivo demandando ações de controle.
Palavras-chave: conservação, espécies ameaçadas, florística, Mata Atlântica, restauração

Introduction

The Iguaçu National Park (INP) is located in the Alto Paraná Atlantic Forest Ecoregion, the largest among the 15 ecoregions identified in the Atlantic Forest biome (Di Bitetti *et al.* 2003). It covered originally 471,204 km^2 extending from the western side of the Atlantic mountain range, in Brazil, to eastern Paraguay and northeastern Argentina. Its predominant vegetation type is the seasonal semideciduous forest (Di Bitetti *et al.* 2003). The vegetation cover in this Ecoregion was reduced to 7.8% of its original area, the greatest reduction being observed in Brazil where forest cover declined to only 2.7% of its original area; followed by Paraguay and Argentina, with 13.4% and 50% of remaining vegetation, respectively (Di Bitetti *et al.* 2003). According to these authors, Argentina preserves the largest continuous forest cover in the Alto Paraná Forest Ecoregion, comprising much of the Misiones Province. In the border region between

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Brazil and Argentina, the Iguaçu National Park stands out as the largest protected area covering a territory of 185,262 ha (Di Bitetti *et al.* 2003). The native forest cover in this region constitutes the largest continuous remnant of seasonal semideciduous forest in the context of the Atlantic forest biome (Galindo-Leal & Câmara 2005).

The functional connection between the INP and other protected areas in Argentina and Paraguay as well as in the Brazilian States of Paraná, Santa Catarina, Rio Grande do Sul, São Paulo and Mato Grosso do Sul represents a highly favorable condition for the conservation of the Atlantic Forest biodiversity (Di Bitetti *et al.* 2003, Galindo-Leal & Câmara 2005). To this end, some proposals have been discussed, such as the Biodiversity Corridor of the Paraná River (Limont *et al.* 2015) and the Biodiversity Conservation Landscape for the Alto Paraná Forest Ecoregion (Di Bitetti *et al.* 2003). These are considered long-term strategies for biodiversity conservation through the maintenance of the ecological process of the biota (Di Bitetti *et al.* 2003).

An important region for the implementation of those strategies is located between the INP and the southern limit of the permanent preservation area of the Itaipu Lake (PPAIL), in western Paraná State, where the connection between the northern and southern sectors of the Biodiversity Conservation Landscape for the Alto Paraná Forest Ecoregion could be established (Di Bitetti *et al.* 2003). The PPAIL consists of a 2,900 km long strip, with an average width of 217 m of reforestation or native forest remnants that runs along almost the entire length of the Itaipu Hydroelectric reservoir margins (Itaipu Binacional 2016a).

However, the connection between the INP and the PPAIL is hindered by the eminently agricultural land use in the region and by the busy BR 277 Highway, which separates apart these two protected areas. The map of the Biodiversity Conservation Landscape for the Alto Paraná Forest Ecoregion indicates the establishment of a biological corridor in this region (Di Bitetti *et al.* 2003). An example of a biological corridor already established there is the Santa Maria corridor consisting of remnants of native vegetation and a 60-m width reforestation strip in the Bonito River Basin (Itaipu Binacional 2016b). Notwithstanding, a wider biological corridor should yet be designed in the region in order to warrant an effective connection between the two sectors of the Biodiversity Conservation Landscape for the Alto Paraná Forest Ecoregion (Di Bitetti *et al.* 2003). Furthermore, the simple recovery of native forests in the river margins and other permanent preservation areas in small rural properties can greatly enhance the functional connectivity at the landscape scale in the region (Seganfredo 2015).

Either for the establishment of a biological corridor between the INP and the PPAIL, or for the recovery of permanent preservation areas in the region, there will be the necessity of forest restoration (*sensu* Aronson *et al.* 2011). Floristic knowledge about native vegetation remnants is critical to the choice of the most suitable species for restoration projects (*e.g.* Monge 2009); to avoid the use of exotic species, and enable high diversity forest restoration. The current floristic knowledge in the region covers the surroundings of the Santa Maria biological corridor, in the Santa Terezinha de Itaipu municipality (Gris 2012), at an average altitude of 270 m above sea level; and specific areas inside the INP, at altitudes ranging from 150 to 750 m above sea level (Souza 2015).

The present contribution aimed to extend the regional floristic knowledge in the region between the INP and the PPAIL to a 440 km^2 study area covering an altitudinal range expanding from 200 m to 600 m above sea level in the municipalities of Céu Azul, Matelândia, Medianeira and Serranópolis do Iguaçu. Beyond a floristic list, we aimed to provide useful information compiled from the literature for the application of the list in restoration projects in the study area, such as successional category, dispersal syndrome, conservation status and indication of locally abundant species.

Material and methods

Study area - The study area covers predominantly the municipality of Matelândia and, to a lesser extent, of Céu Azul, Medianeira and Serranópolis do Iguaçu, in Paraná State, Brazil. For methodological convenience, we defined the study area as the polygon circumscribed by the Highways BR 277 and PR 495 and by the northwestern border of the INP, covering an area of 440 km^2 (figure 1). The average annual temperature in the region is 21.6 ºC, with average annual rainfall of 1,803 mm. Climate is subtropical, Cfa according to Köppen classification system (EMBRAPA 2011). Vegetation in the native forest fragments is seasonal semideciduous forest (Di Bitetti *et al.* 2003) due to the predominance of phanerophytes, the subtropical

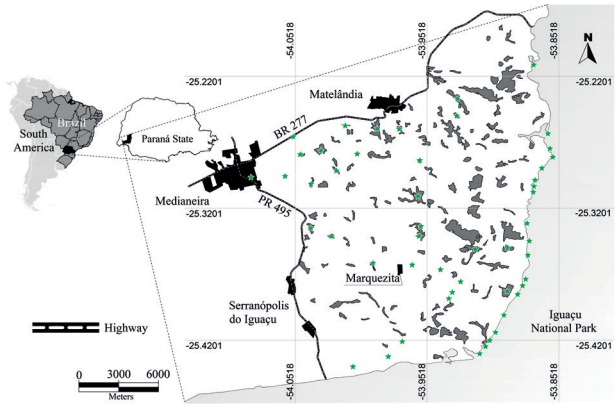

Figure 1. Study area, western Paraná State, Brazil. The area consists of a polygon delimitated by BR 277 and PR 495 highways, and by the northwestern limit of the Iguaçu National Park. The localities of botanical records are indicated by stars. Source: Fundação SOS Mata Atlântica and INPE (2016).

climate seasonality and the leaf shedding of part of the tree individuals (Instituto Brasileiro de Geografia e Estatística 2012). Seasonal semideciduous forests of localities inside the INP, near the study area and extending through a similar altitudinal range, were classified as typical and humid submontane forests by Souza (2015).

Floristic survey - We visited 16 native forest fragments located in the study area from October 2013 to December 2015 during field campaigns that had an average duration of 3 days and monthly periodicity. The number of visits to each fragment along the study period varied, being greater in larger and less disturbed ones. As our objective was to describe the floristic composition of the study area as a whole and not of each fragment individually, we did not compiled an individual floristic list of each fragment, so frequency of species across fragments in the area is not available. Fragments were chosen taking into account the sampling of the entire study area with a distribution of sampling effort as homogeneous as possible, and also considering the access authorization by landowners. We also sampled the northwestern edge of the Iguaçu National Park between the limits of the Park and the so called Old Guarapuava Road between Serranópolis do Iguaçu and Céu Azul municipalities, walking the length of this road in that stretch. The forest fragments studied have different disturbance histories and include secondary forests and primary forests with different levels of degradation (degraded primary forest *sensu* Aronson *et al.* 2011). The vegetation of the northwestern edge of the INP was considered as secondary forest. The method used for the floristic survey was based on the walking method (Filgueiras *et al.* 1994), considering only the tree and shrub components and using trails already existent in the forests. The botanical material was collected with the use of a telescopic pruner and all collections were geo-referenced using Global Positioning System (GPS). In addition to the forest fragments and the INP edge, we also collected botanical material along the rural roads in the study area.

We processed the botanical material according to the conventional techniques (Fidalgo & Bononi 1989). Both fertile and vegetative materials were identified by comparison with herbarium specimens deposited in the Forestry Institute of São Paulo State (Dom Bento José Pickel Herbarium - SPSF), and by consulting the specialized literature. The voucher herbarium sheets were deposited in the SPSF Herbarium, with duplicates deposited in the herbarium of the Federal Technological University of Paraná - *Campus* Medianeira (Figueira Herbarium - FIG). Only fertile materials were deposited in the SPSF herbarium, while 27 vegetative materials, corresponding to 27 species, were deposited in the FIG herbarium. These species were not found in reproductive phase during the study period, but we decided to incorporate the respective voucher to the FIG herbarium considering the absence of herbarium sheets of these species in this recently established collection (Cielo-Filho *et al.* 2016).

We sorted the species into families and genera according to the APG IV system (APG IV 2016). To check spelling, corrected and accepted names we consulted the List of Species of the Brazilian Flora (Brazilian Flora 2020 in construction 2016). For most species, plant habits classification was obtained in the List of Species of the Brazilian Flora, but we follow Souza *et al.* (2013) for palm and fern, although we counted these habits as tree in the results. Verification of endangered species was based on the Red List of Endangered Species of the International Union for Conservation of Nature (International Union for Conservation of Nature 2016) and the Official List of Endangered Species of the Brazilian Flora (Brasil 2014), which was based on the list presented by Martinelli & Moraes (2013). We did not use the Red List of Paraná State (Paraná 1995), since this list is out of date. With the aim of supporting future forest restoration projects and the establishment of a biological corridor in the study area, we compiled information concerning the successional category (*sensu* Swaine & Whitmore 1988) and dispersal

syndrome (*sensu* Pijl 1982) of the identified species from the literature (*e.g.* Lorenzi 1992, Gandolfi *et al.* 1995, Lorenzi 1998, Silva & Soares-Silva 2000, Carvalho 2003, Carpanezzi & Carpanezzi 2006, Carvalho 2006, Carvalho 2008, Lorenzi 2009, Carvalho 2010, Barbosa *et al.* 2015). We also indicated the native species found in the present contribution which were also registered, as locally abundant species, in phytosociological studies available for the INP and its surroundings (Gris 2012, Souza 2015). To do this, we considered species occupying the first ten positions in the importance value ranking of a typical submontane forest in the Santa Maria Natural Patrimony Private Reservoir (Gris 2012), and of typical and humid submontane forests in the interior of the INP (Souza 2015).

Results

We performed 940 botanical records of native species, 303 in primary forest and 520 in secondary forest, averaging 51 records per fragment. The remainder 117 records were done on the margins of rural roads. We identified 204 tree and shrub native species from 51 families and 134 genera (table 1). The arboreal habit was represented by 174 species, while the shrubby habit by 96 species. Sixty six species presented both habits. The richest families were Fabaceae (29 species), Myrtaceae (18), Solanaceae (10), Euphorbiaceae, Meliaceae and Rutaceae (nine species each). The richest genera were *Eugenia* (eight species), *Solanum* and *Zanthoxylum* (six species each), *Ocotea*, *Trichilia* and *Aegiphila* (four species each). The most common dispersal syndrome was zoochoric (141 species, 69%) followed by anemocoric (35 species, 17%) and autochoric (28 species, 14%) syndromes. Most (130) species (64%) belonged to the non-pioneer successional category and the 74 remainder (36%) was classified as pioneer. Of the 204 recorded species, seven are threatened due to habitat loss and overexploitation (table 2). Additionally to the native species, we found 15 exotic species, of which eight were recorded inside forest fragments and seven in more anthropogenic environments such as roadsides, gardens and pastures (table 3).

In table 1 we indicated 14 species reported as locally abundant in Typical Submontane Forest and 10 species reported as locally abundant in Humid Submontane Forest, according to phytosociological studies available for the INP and its surroundings (Gris 2012, Souza 2015). Of the mentioned locally abundant species, only four are pioneer ones: *Alchornea triplinervia*, *Dendropanax cuneatus*, *Sebastiania brasiliensis* and *Luehea divaricata*.

Discussion

An important aspect of the present floristic survey was the apparently low species richness, when compared to other studies conducted in Atlantic forests at lower latitudes. For instance, surveys of tree and shrub flora in the seasonal semideciduous forest, carried out in protected areas in the municipalities of Paranapanema and Itapeva, both in São Paulo State, registered 349 and 317 species, respectively (Cielo-Filho *et al.* 2009, Souza *et al.* 2012). However, as pointed out by these authors, the high richness in those areas may be related to the presence of Cerrado remnants in the region, which would expand the regional species pool, increasing the richness in remnants of seasonal semideciduous forest. Even without the influence of the Cerrado flora, the number of tree and shrub species (266) reported by Rossetto & Vieira (2013) for the seasonal semideciduous forest of the Mata dos Godoy State Park, northern Paraná State, was higher than that found in the present study.

It could be suggested that the flora in northern remnants of seasonal semideciduous forest of the Paraná State is richer than in the remnants located at higher latitudes of the State, due to more rigorous climatic conditions. For instance, the number of tree species (197) reported for the Mata dos Godoy State Park, where a comprehensive floristic study in a well conserved forest remnant was carried out (Rossetto & Vieira 2013), was greater than that found in our study (174), as well as in the studies of Souza (2015) and Gris (2012) which identified, respectively, 165 and 112 native tree species in the INP and forest fragments nearby. However, when considered together, the floristic data available for the study area and its surroundings - this study, Gris (2012) and Souza (2015) - summed up 228 native tree species, what suggests that the tree flora in northern remnants of seasonal semideciduous forest of the Paraná State is not richer than in southern ones.

Another aspect to be considered in these richness comparisons is the differences concerning methods and anthropogenic disturbance histories among study areas. For instance, the use of an inclusion criterion to sampling plant individuals - stem perimeter at breast height equal or more than 15 cm - by Gris (2012) and Souza (2015) may have limited the number of species

Table 1. Tree and shrub native flora in western Paraná State, Brazil. SD, dispersal syndrome: AUT: autochoric, ANE: anemochoric, ZOO: zoochoric; CS, successional category: P: pioneer, NP: non-pioneer; sh: shrub, tr: tree; FIG and SPSF, record number in the FIG and SPSF herbaria. C, complementary information: species reported as locally abundant in typical (a) and humid (b) forests in the Iguaçu National Park and surroundings (Gris 2012, Souza 2015), locally abundant pioneer species according to visual assessment (c) and tree species exclusive of the present study (e).

Family/Species	Vernacular name	Habit	SD	CS	FIG	SPSF	C
Pteridophyta							
Cyatheaceae							
Alsophila sternbergii (Sternb.) D.S. Conant	samambaiaçu	fern	ANE	NP	458	49546	e
Gimnospermae							
Araucariaceae							
Araucaria angustifolia (Bertol.) Kuntze	araucária	tr	ZOO	NP	235	48974	
Angiospermae							
Acanthaceae							
Aphelandra schottiana (Nees) Profice	anil-bravo	sh	AUT	NP	83	48228	
Ruellia angustiflora (Ness) Lindau *ex* Rambo	guiné	sh	AUT	NP	45	48227	
Ruellia cf. *brevifolia* (Pohl) C. Ezcurra	pingo-de-sangue	sh	AUT	NP	580	50142	
Anacardiaceae							
Astronium graveolens Jacq.	guaritá	tr	ANE	NP	536	50099	
Schinus terebinthifolius Raddi	aroeira-vermelha	sh, tr	ZOO	P	11	47917	
Annonaceae							
Annona emarginata (Schltdl.) H.Rainer	araticum-mirim	sh, tr	ZOO	P	259	49005	
Apocynaceae							
Aspidosperma australe Müll.Arg.	pequiá	tr	ANE	NP	257	49003	
Aspidosperma polyneuron Müll.Arg.	peroba-rosa	tr	ANE	NP	204	48865	a
Rauwolfia sellowii Müll.Arg.	casca-d'anta	tr	ZOO	NP	65	48211	
Tabernaemontana catharinensis A.DC.	jasmin	sh, tr	ZOO	P	243	48962	c
Tabernaemontana hystrix Steud.	leiteiro	tr	ZOO	P	256	49002	
Aquifoliaceae							
Ilex paraguariensis A.St.-Hil.	erva-mate	sh, tr	ZOO	NP	296	49174	
Araliaceae							
Aralia warmingiana (Marchal) J. Wen	carobão	tr	ZOO	P	585		
Dendropanax cuneatus (DC.) Decne. & Planch.	maria-mole	tr	ZOO	P	167	48628	a
Schefflera morototoni (Aubl.) Maguire *et al.*	mandioqueiro	tr	ZOO	P	598		
Arecaceae							
Euterpe edulis Mart.	palmito-juçara	palm	ZOO	NP	308	49189	a
Syagrus romanzoffiana (Cham.) Glassman	jeriva	palm	ZOO	NP	443	49528	a,b
Asteraceae							
Baccharis dracunculifolia DC.	vassourinha	sh	ANE	P	477	49559	
Dasyphyllum brasiliense (Spreng.) Cabrera	sucará	sh, tr	ANE	NP	586		e
Piptocarpha rotundifolia (Less.) Baker	candeia	tr	ANE	NP	606		e
Bignoniaceae							
Handroanthus albus (Cham.) Mattos	ipê-amarelo-da-serra	tr	ANE	NP	589		
Handroanthus heptaphyllus (Vell.) Mattos	ipê-roxo	tr	ANE	NP	199	48888	

continue

Table 1 (continuation)

Family/Species	Vernacular name	Habit	SD	CS	FIG	SPSF	C
Handroanthus ochraceus (Cham.) Mattos	ipê-amarelo	tr	ANE	NP	237	48993	
Jacaranda micrantha Cham.	caroba-miúda	tr	ANE	P	207	48860	
Boraginaceae							
Cordia americana (L.) Gottschling & J.S. Mill.	guaiuvira	tr	ANE	NP	317	49198	b
Cordia ecalyculata Vell.	louro-mole	tr	ZOO	NP	51	48129	
Cordia trichotoma (Vell.) Arrab. *ex* Steud.	louro-pardo	tr	ANE	NP	91	48324	
Heliotropium transalpinum Vell.	pau-de-sapo	sh	ZOO	P	250	48996	
Cannabaceae							
Celtis ehrenbergiana (Klotzsch) Liebm.	esporão-de-galo	sh, tr	ZOO	NP	513	50081	e
Celtis iguanaea (Jacq.) Sarg.	gumbixava	sh, tr	ZOO	NP	106	48320	
Celtis spinosa Spreng.	grão-de-galo	sh	ZOO	P	261	49007	
Trema micrantha (L.) Blume	candiúba	sh, tr	ZOO	P	348	49273	c
Cardiopteridaceae							
Citronella paniculata (Mart.) R.A. Howard	falsa-congonheira	tr	ZOO	NP	617		
Caricaceae							
Jacaratia spinosa (Aubl.) A. DC.	jaracatiá	tr	ZOO	NP	281	49159	
Celastraceae							
Maytenus aquifolia Mart.	falsa-espinheira-santa	sh, tr	ZOO	NP	607		
Clusiaceae							
Garcinia gardneriana (Planch. & Triana) Zappi	bacupari	sh, tr	ZOO	NP	269	49016	
Ebenaceae							
Diospyros inconstans Jacq.	marmelinho	sh, tr	ZOO	NP	603		e
Erythroxylaceae							
Erythroxylum argentinum O.E. Schulz	cocão	sh, tr	ZOO	NP	386	49300	e
Erythroxylum cuneifolium (Mart.) O.E. Schulz	fruta-de-pomba	sh	ZOO	NP	486	49639	
Erythroxylum deciduum A.St.-Hil.	marmelinho	sh, tr	ZOO	NP	377	49284	
Euphorbiaceae							
Acalypha amblyodonta (Müll.Arg.) Müll. Arg.	tapa-buraco	sh	AUT	P	508	49786	
Alchornea glandulosa Poepp. & Endl.	tanheiro, tapiá	sh, tr	ZOO	P	124	48633	
Alchornea triplinervia (Spreng.) Müll.Arg.	pau-jangada	sh, tr	ZOO	P	23	47898	a
Bernardia pulchella (Baill.) Müll.Arg.	canela-de-virá	sh	AUT	P	395	49304	
Croton triqueter Lam.	velane	sh	AUT	P	506	49787	
Croton urucurana Baill.	sangra-d'água	tr	AUT	P	385	49257	e
Gymnanthes klotzschiana Müll.Arg.	branquilho	sh, tr	AUT	NP	404	49334	
Sapium glandulosum (L.) Morong	pau-de-leite	sh, tr	ZOO	P	602		e
Sebastiania brasiliensis Spreng.	branquilho	sh, tr	AUT	P	4	47908	b
Fabaceae							
Albizia cf. *edwallii* (Hoehne) Barneby & J.W. Grimes	gurujuba	sh	AUT	NP	396	49301	
Albizia niopoides (Benth.) Burkart	farinha-seca	tr	AUT	P	599		
Anadenanthera colubrina (Vell.) Brenan	angico-branco	sh, tr	AUT	NP	406	49337	
Apuleia leiocarpa (Vogel.) J.F. Macbr.	garapa	tr	ANE	NP	376	49248	

continue

Table 1 (continuation)

Family/Species	Vernacular name	Habit	SD	CS	FIG	SPSF	C
Bauhinia longifolia (Bong.) Steud.	pata-de-vaca	sh, tr	AUT	P	35	48229	e
Bauhinia forficata Link	unha-de-vaca	tr	AUT	P	399	49292	
Calliandra foliolosa Benth.	cabelo-de-anjo	sh, tr	AUT	NP	253	48999	
Dalbergia frutescens (Vell.) Britton	rabo-de-bugio	sh	ANE	NP	14	47894	
Enterolobium contortisiliquum (Vell.) Morong	tamboril	tr	ZOO	P	173	48894	
Erythrina falcata Benth.	corticeira-da-serra	tr	AUT	NP	231	48977	
Holocalyx balansae Micheli	alecrim	tr	ZOO	NP	135	48648	
Inga marginata Willd.	ingá-feijão	tr	ZOO	NP	3	47906	
Inga vera Willd.	ingá-banana	tr	ZOO	P	39	48232	
Lonchocarpus cultratus (Vell.) A.M.G. Azevedo & H.C. Lima	embira-de-sapo	tr	ANE	P	20	47896	
Machaerium hirtum (Vell.) Stelfelld	jacarandá-de-espinho	tr	ANE	NP	478	49565	e
Machaerium paraguariense Hassl.	sapuvão	tr	ANE	NP	41	48231	
Machaerium stipitatum Vogel	sapuva	tr	ANE	NP	90	48341	a,b
Mimosa bimucronata (DC.) Kuntze	maricá	sh, tr	AUT	P	490	49770	
Muellera campestris (Mart. *ex* Benth.) M.J. Silva & A.M.G.Azevedo	embirinha	tr	ANE	NP	390	49302	
Myrocarpus frondosus Allemão	cabreúva-amarela	tr	ANE	NP	294	49172	
Parapiptadenia rigida (Benth.) Brenan	angico-da-mata	tr	AUT	NP	113	48677	
Peltophorum dubium (Spreng.) Taub.	canafístula	tr	ANE	P	12	47916	c
Pterocarpus rohrii Vahl	pau-sangue	tr	ANE	NP	601		e
Pterogyne nitens Tul.	amendoim	tr	ANE	NP	597		
Senegalia polyphylla (DC.) Britton & Rose	monjoleiro	sh, tr	AUT	P	81	48225	
Senegalia tenuifolia (L.) Britton & Rose	serra-goela	sh	AUT	P	448	49536	
Senna alata (L.) Roxb.	mata-pasto	sh, tr	AUT	P	600		e
Senna macranthera (DC. *ex* Collad.) H.S. Irwin & Barneby	manduirana	sh, tr	AUT	P	182	48884	e
Senna pendula (Humb.& Bonpl.*ex* Willd.) H.S.Irwin & Barneby	canudo-de-pito	sh, tr	AUT	P	183	48872	e
Lamiaceae							
Aegiphila brachiata Vell.	tamanqueiro	sh, tr	ZOO	P	378	49293	e
Aegiphila integrifolia (Jacq.) Moldenke	caiuia, gaioleira	sh, tr	ZOO	P	382	49290	
Aegiphila mediterranea Vell.	pau-de-tamanco	tr	ZOO	P	71	48221	
Aegiphila novofriburgensis Moldenke	tamanqueiro	sh	ZOO	P	34	48226	
Vitex megapotamica (Spreng.) Moldenke	tarumã	sh, tr	ZOO	NP	389	49282	
Lauraceae							
Nectandra lanceolata Nees	canela amarela	tr	ZOO	NP	7	47904	
Nectandra megapotamica (Spreng.) Mez	canelinha	tr	ZOO	NP	29	48137	a,b
Ocotea diospyrifolia (Meisn.) Mez	canela-louro	tr	ZOO	NP	306	49185	a,b
Ocotea puberula (Rich.) Nees	canela-guaicá	tr	ZOO	NP	116	48676	
Ocotea pulchella (Nees & Mart.) Mez	canela-lajeana	tr	ZOO	NP	596		e
Ocotea silvestris Vattimo-Gil	canela-do-campo	tr	ZOO	NP	60	48135	

continue

Table 1 (continuation)

Family/Species	Vernacular name	Habit	SD	CS	FIG	SPSF	C
Laxmanniaceae							
Cordyline spectabilis Kunth & Bouché	guaraiva	tr	ZOO	P	616		
Loganiaceae							
Strychnos brasiliensis Mart.	salta-martim	sh	ZOO	NP	408	49327	
Malvaceae							
Bastardiopsis densiflora (Hook. & Arn.) Hassl.	jangada-brava	tr	ANE	P	153	48629	c
Ceiba speciosa (A.St.-Hil.) Ravenna	paineira	tr	ANE	NP	105	48335	
Guazuma ulmifolia Lam.	mutamba-preta	tr	ZOO	P	109	48654	
Heliocarpus popayanensis Kunth	jangada-brava	tr	ANE	P	175	48891	c
Luehea divaricata Mart. & Zucc.	açoita-cavalo	tr	ANE	P	57	48113	b
Pavonia sepium A.St.-Hil.	carrapicho	sh, tr	AUT	NP	504	49782	e
Sida cf. *planicaulis* Cav.	guanxuma	sh	AUT	P	566	50128	
Melastomataceae							
Miconia cinerascens Miq.	jacatirão	sh, tr	ZOO	P	507	49784	e
Miconia discolor DC.	apaga-brasa	tr	ZOO	NP	380	49305	e
Miconia pusilliflora (DC.) Naudin	pixirica	sh, tr	ZOO	P	89	48322	
Meliaceae							
Cabralea canjerana (Vell.) Mart.	canjerana	tr	ZOO	NP	150	48673	a
Cedrela fissilis Vell.	cedro	tr	ANE	NP	40	48128	a
Guarea guidonia (L.) Sleumer	marinheiro	sh, tr	ZOO	NP	588		
Guarea kunthiana A. Juss.	canjambo	tr	ZOO	NP	5	47914	a
Guarea macrophylla Vahl	baga-de-morcego	tr	ZOO	NP	101	48326	
Trichilia catigua A. Juss.	catiguá	tr	ZOO	NP	273	49020	
Trichilia clausseni C. DC.	quebra-machado	tr	ZOO	NP	224	48992	
Trichilia elegans A. Juss.	catiguazinho	sh, tr	ZOO	NP	169	48632	
Trichilia pallida Sw.	baga-de-morcego	tr	ZOO	NP	202	48873	
Monimiaceae							
Hennecartia omphalandra J. Poiss.	canema	tr	ZOO	NP	614		
Moraceae							
Ficus guaranitica Chodat	figueira-branca	tr	ZOO	NP	26	47900	e
Ficus insipida Willd.	figueira-mata-pau	tr	ZOO	P	1	47919	
Ficus luschnathiana (Miq.) Miq.	figueira	tr	ZOO	NP	367	48960	
Maclura tinctoria (L.) D.Don *ex* Steud.	taiuva	tr	ZOO	NP	18	47913	
Sorocea bonplandii (Baill.) W.C. Burger *et al.*	cincho	sh, tr	ZOO	NP	227	48978	a
Myrtaceae							
Calyptranthes concinna DC.	guamirim-facho	tr	ZOO	NP	466	49550	
Campomanesia guaviroba (DC.) Kiaersk.	gabiroba	tr	ZOO	NP	277	49154	e
Campomanesia guazumifolia (Cambess.) O. Berg	sete-capotes	tr	ZOO	NP	371	49211	
Campomanesia xanthocarpa (Mart.) O. Berg	gabiroba	tr	ZOO	NP	333	49266	
Eugenia burkartiana (D. Legrand) D. Legrand	guamirim	tr	ZOO	NP	286	49164	
Eugenia florida DC.	guamirim	tr	ZOO	NP	613		

continue

Table 1 (continuation)

Family/Species	Vernacular name	Habit	SD	CS	FIG	SPSF	C
Eugenia hiemalis Cambess.	guamirim-miúdo	sh, tr	ZOO	P	123	48656	
Eugenia involucrata DC.	cereja-do-rio-grande	tr	ZOO	NP	297	49175	
Eugenia pyriformis Cambess.	uvaia	sh, tr	ZOO	P	46	48133	c
Eugenia ramboi D. Legrand	batinga-branca	tr	ZOO	NP	587		
Eugenia subterminalis DC.	cambuí-pitanga	tr	ZOO	NP	61	48132	
Eugenia uniflora L.	pitangueira	sh, tr	ZOO	NP	334	49260	e
Myrceugenia euosma (O. Berg) D. Legrand	cambuizinho	tr	ZOO	P	591		e
Myrcia pulchra (O. Berg) Kiaersk.	guamirim	tr	ZOO	NP	592		e
Myrcia splendens (Sw.) DC.	jambinho, guamirim	tr	ZOO	NP	593		e
Myrcianthes pungens (O. Berg) D. Legrand	guabiju	tr	ZOO	NP	16	47901	e
Myrciaria tenella (DC.) O. Berg	cambuí	tr	ZOO	NP	594		e
Plinia rivularis (Cambess.) Rotman	guapuriti, piúna	tr	ZOO	NP	206	48869	
Nyctaginaceae							
Guapira hirsuta (Choisy) Lundell	maria-mole	sh, tr	ANE	NP	447	49531	e
Guapira opposita (Vell.) Reitz	flor-de-pérola	sh, tr	ZOO	NP	67	48213	e
Neea pendulina Heimerl	maria-mole	sh, tr	ZOO	P	595		
Pisonia ambigua Heimerl	maria-faceira	tr	ZOO	NP	78	48222	
Phyllanthaceae							
Margaritaria nobilis L.f.	sobragirana	sh, tr	ZOO	NP	50	48131	e
Phytolaccaceae							
Phytolacca dioica L.	cebolão	tr	ZOO	P	230	48959	
Piperaceae							
Piper aduncum L.	pimenta longa	sh, tr	ZOO	P	107	48328	c,e
Piper amalago L.	jaborandi	sh	ZOO	NP	108	48329	
Polygonaceae							
Ruprechtia laxiflora Meisn.	marmeleiro-do-mato	tr	ANE	NP	295	49173	
Primulaceae							
Geissanthus ambiguus (Mart.) G. Agostini	pau-de-charco	sh	ZOO	NP	610		
Myrsine coriacea (Sw.) R.Br. *ex* Roem. & Schult.	capororoca	sh, tr	ZOO	P	302	49180	c
Myrsine loefgrenii (Mez) Imkhan.	pororoca	tr	ZOO	NP	270	49017	e
Myrsine umbellata Mart.	copororoca	tr	ZOO	NP	44	48127	
Proteaceae							
Roupala montana var. brasiliensis (Klotzsch) K.S.Edwards	carvalho-brasileiro	sh, tr	ANE	NP	266	49012	
Rosaceae							
Prunus myrtifolia (L.) Urb.	pessegueiro-bravo	tr	ZOO	NP	2	47905	
Rubus erythroclados Mart. *ex* Hook. f.	amora-branca	sh	ZOO	P	473	49566	
Rubiaceae							
Coussarea contracta (Walp.) Müll.Arg.	pasto-de-anta	sh, tr	ZOO	NP	260	49006	e
Ixora venulosa Benth.	ixora-do-mato	sh, tr	ZOO	NP	590		
Palicourea marcgravii A.St.-Hill	erva-do-rato	sh	ZOO	NP	364	49184	
Psychotria carthagenensis Jacq.	erva-de-gralha	sh, tr	ZOO	NP	239	48968	

continue

Table 1 (continuation)

Family/Species	Vernacular name	Habit	SD	CS	FIG	SPSF	C
Psychotria leiocarpa Cham. & Schltdl.	grandiúva-de-anta	sh	ZOO	NP	405	49332	
Randia armata (Sw.) DC.	laranja-de-macaco	sh, tr	ZOO	NP	418	49352	e
Rutaceae							
Balfourodendron riedelianum (Engl.) Engl.	pau-marfim	tr	ANE	NP	32	48118	a,b
Helietta apiculata Benth.	canela-de-veado	tr	ANE	NP	431	49349	
Pilocarpus pennatifolius Lem.	jaborandi	tr	AUT	NP	103	48333	
Zanthoxylum caribaeum Lam.	arruda-brava	tr	ZOO	NP	216	48958	
Zanthoxylum fagara (L.) Sarg.	tembetari, mamica	sh, tr	ZOO	NP	163	48627	e
Zanthoxylum monogynum A.St.-Hil.	Juvá	tr	ZOO	NP	618		e
Zanthoxylum petiolare A.St.-Hil. & Tul.	mamica-de-porca	tr	ZOO	NP	441	49533	
Zanthoxylum rhoifolium Lam.	mamica-de-cadela	tr	ZOO	NP	357	49251	
Zanthoxylum riedelianum Engl.	mamica-de-porca	tr	ZOO	NP	247	48957	e
Salicaceae							
Banara tomentosa Clos	cambroé	sh, tr	ZOO	NP	329	49524	
Casearia decandra Jacq.	cafezeiro-do-mato	sh, tr	ZOO	NP	328	49155	
Casearia gossypiosperma Briq.	espeteiro	tr	ZOO	P	190	48880	
Casearia sylvestris Sw.	carvalinho	sh, tr	ZOO	P	203	48867	c
Prockia crucis P. Browne *ex* L.	cuiteleiro	sh, tr	ZOO	NP	303	49181	
Xylosma ciliatifolia (Clos) Eichler	espinho-de-agulha	sh, tr	ZOO	NP	565	50127	
Sapindaceae							
Allophylus edulis (A.St.-Hil. *et al.*) Hieron. *ex* Niederl.	chal-chal, vacum	sh, tr	ZOO	P	242	48965	c
Cupania vernalis Cambess.	camboatã-vermelho	tr	ZOO	NP	154	48626	
Diatenopteryx sorbifolia Radlk.	maria-preta	tr	ANE	P	264	49010	c
Matayba elaeagnoides Radlk.	camboatã-branco	sh, tr	ZOO	NP	331	49263	
Sapotaceae							
Chrysophyllum gonocarpum (Mart. & Eichler *ex* Miq.) Engl.	caxeta-amarela	tr	ZOO	NP	15	47912	a,b
Chrysophyllum marginatum (Hook. & Arn.) Radlk.	aguaí	tr	ZOO	NP	58	48108	
Simaroubaceae							
Picrasma crenata (Vell.) Engl.	pau-amargo	tr	ZOO	NP	358	49000	
Solanaceae							
Acnistus arborescens (L.) Schltdl.	marianeira	sh	ZOO	P	361	49250	
Aureliana wettsteiniana (Witasek) Hunz. & Barboza	fumeirinho	tr	ZOO	P	387	49298	e
Cestrum intermedium Sendtn.	coreana	sh, tr	ZOO	P	238	48961	
Cestrum strigilatum Ruiz & Pav.	coerana	sh, tr	ZOO	P	104	48325	
Solanum asperolanatum Ruiz & Pav.	jurubeba	sh	ZOO	P	453	49542	
Solanum caavurana Vell.	caavurana	sh	ZOO	P	345	49269	c
Solanum mauritianum Scop.	fona-de-porco	sh, tr	ZOO	NP	350	49280	
Solanum pseudoquina A. St.-Hil.	tabaqueira	tr	ZOO	P	433	49428	
Solanum sanctae-catharinae Dunal	joá-manso	tr	ZOO	P	485	49638	

continue

Table 1 (continuation)

Family/Species	Vernacular name	Habit	SD	CS	FIG	SPSF	C
Solanum variabile Mart.	jurubeba	sh, tr	ZOO	NP	369	49208	e
Styracaceae							
Styrax leprosus Hook. & Arn.	carne-de-vaca	tr	ZOO	P	346	49432	c
Symplocaceae							
Symplocos celastrinea Mart.	mate-falso	sh, tr	ZOO	NP	492	49767	e
Symplocos estrellensis Casar.	canela-conserva	sh, tr	ZOO	NP	474	49557	e
Urticaceae							
Boehmeria caudata Sw.	urtiga-mansa	sh	ZOO	NP	241	48987	
Cecropia pachystachya Trécul	embaúba	tr	ZOO	P	25	47899	c
Urera baccifera (L.) Gaudich. *ex* Wedd.	urtiga	sh, tr	ZOO	NP	319	49200	b
Verbenaceae							
Aloysia gratissima (Gillies & Hook.) Tronc.	cidrilha	sh	ZOO	P	502	49789	
Aloysia virgata (Ruiz & Pav.) Juss.	cambará-de-lixa	sh, tr	ZOO	P	99	48332	c
Citharexylum solanaceum Cham.	pau-viola	tr	ZOO	P	355	49281	e
Lantana camara L.	camará	sh, tr	ZOO	P	85	48115	e
Lantana trifolia L.	lantana	sh	ZOO	NP	461	49549	
Stachytarpheta cayennensis (Rich.) Vahl	rincão	sh	ZOO	P	366	49151	
Violaceae							
Pombalia bigibbosa (A.St.-Hil.) Paula-Souza	ganha-saia	sh	AUT	P	82	48114	c
Pombalia communis (A.St.-Hil.) Paula-Souza	apanha-saia	sh	AUT	NP	438	49430	

recorded in those studies. This kind of methodological limitation may also have restricted the tree species richness found in other studies, such as in the Rio das Cobras Farm, southwestern Paraná State - 128 species (Viani *et al*. 2011); in protected areas of the Argentine Province of Misiones: Iguazú National Park and its surroundings - 72 species (Chediack 2008) and Osununú Private Reserve - 96 species (Velazco *et al*. 2015); in protected areas of the Paraguayan side of the area of influence of the Itaipu Lake - 127 species (Monge 2009); and in the São Francisco State Park, northern Paraná State, where 113 tree species were recorded, although in this case the relatively low richness seems to be also related to the intensive practice of selective logging before the protected area had been established (Tomé *et al*. 1999, Zama *et al*. 2012).

It is worth to note that 43 native tree species recorded in the present floristic survey (table 1) were not registered by Gris (2012) and Souza (2015) in the INP and its surroundings. This may be a consequence of sampling effect, but also of floristic particularities of the study area in relation to its surroundings. Of that 43 species, 70% are non-pioneer, 72% have zoochoric dispersal syndrome, while the other two dispersal syndromes comprised each, 14% of the remainder species. Comparing these data with the corresponding percentages observed for the whole set of species in this study, there is no evidence of bias concerning successional category or dispersal syndromes for the set of species exclusive of the present research. However, in relation to the distribution of exclusive species among families, there was a highlight for Myrtaceae, with seven of the 18 species found being exclusive. This may be a consequence of the relatively complex taxonomy of this family. Another highlight may be perceived for the distribution of species between habits: 56% of the exclusive species present both arboreal and shrubby habit, while the corresponding value for the whole set of species in this study is of 32%. We suggest that because we did not use an inclusion criterion to sampling plant individuals as the other studies referred above - stem perimeter at breast height equal or more than 15 cm - we attained a better representation of the flora composed by species presenting simultaneously the arboreal and shrubby habits. Furthermore, the overrepresentation of the shrubby-arboreal habit among the exclusive species may be a consequence of the intensive sampling of edge habitats in the present study, as indicated by the

Table 2. Threatened species recorded in the study area, in western Paraná State, Brazil, according to the lists of the International Union for Conservation of Nature (IUCN) and the Brazilian Ministry of the Environment (MMA). CR, Critically Endangered; EN, Endangered; VU, Vulnerable. The information concerning the type of threat was obtained from Martinelli & Moraes (2013) and from IUCN (2016).

Family/Species	IUCN	MMA	Type of threat
Apocynaceae			
Aspidosperma polyneuron	EN		Timber exploitation.
Araucariaceae			
Araucaria angustifolia	CR	EN	Habitat loss, timber exploitation.
Arecaceae			
Euterpe edulis		VU	Habitat loss, exploitation of the palm heart.
Fabaceae			
Apuleia leiocarpa		VU	Timber exploitation.
Meliaceae			
Cedrela fissilis	EN	VU	Habitat loss, timber exploitation.
Myrtaceae			
Myrcianthes pungens	EN		Habitat loss.
Rutaceae			
Baufourodendron riedelianum	EN		Habitat loss, timber exploitation.

Table 3. Exotic species recorded in the study area, western Paraná State, Brazil. F, species recorded inside forest fragments; A, species recorded in anthropogenic environments such as roadsides, gardens and pastures.

Family/Species	F	A
Anacardiaceae		
Mangifera indica L.	X	
Asteraceae		
Gymnanthemum amygdalinum (Delile) Sch.Bip. *ex* Walp.		X
Bignoniaceae		
Handroanthus impetiginosus (Mart. *ex* DC.) Mattos		X
Tabebuia roseoalba (Ridl.) Sandwith		X
Tecoma stans (L.) Juss. *ex* Kunth		X
Bixaceae		
Bixa orellana L.		X
Fabaceae		
Leucaena leucocephala (Lam.) de Wit	X	
Lauraceae		
Persea americana Mill.	X	
Magnoliaceae		
Michelia champaca L.	X	
Meliaceae		
Melia azedarach L.	X	
Myrtaceae		
Psidium guajava L.		X
Syzygium jambos (L.) Alston		X

continue

Table 3 (continuation)

Family/Species	F	A
Rhamnaceae		
Hovenia dulcis Thunb.	X	
Rosaceae		
Eriobotrya japonica (Thunb.) Lindl.	X	
Rutaceae		
Citrus limon (L.) Osbeck	X	

greater percentage of shrub-tree-pioneer species in the set exclusive species (9/43 = 21%) than in the whole set of species (29/204 = 14%). Among the exclusive species, there was one threatened, *Myrcianthes pungens*, found in both primary and secondary forest fragments in the study area, what stress the importance of these remnants to biodiversity conservation.

On the other hand, 54 native tree species were registered by Gris (2012) and Souza (2015), but not by the present study. The data set resulting from the results of those authors complies study sites at altitudes ranging from 150 to 750 m above sea level, while the present study area covers an altitudinal range expanding from 200 m to 600 m above sea level, and 68% of our botanical records were done in study sites located at altitudes between 300 m and 500 m. The weak representation of the regional altitudinal extremes in our data set may help to explain the absence in our species list of the 54 species exclusive of the lists reported by Gris (2012) and Souza (2015). Another possible explanation comes from the landscape context: our study sites are situated in a highly fragmented landscape in which some species may have been lost because of edge effect, dispersal barriers and other process associated with forest fragmentation leading to local species extinction (Primack & Rodrigues 2001).

The distribution of species richness among families in the study area was similar to that found in other seasonal semideciduous forest studies in the Brazilian States of São Paulo (Cielo-Filho *et al.* 2009, Souza *et al.* 2012) and Paraná (Viani *et al.* 2011, Gris 2012, Zama *et al.* 2012, Rossetto & Vieira 2013); in the Province of Misiones, Argentina (Chediack 2008, Velazco *et al*. 2015); and in the Departments of Canindeyú and Alto Paraná, Paraguay (Monge 2009). However, an interesting feature of the study area was the relatively low representativeness of Lauraceae and the relatively high richness of Solanaceae. This could suggest a particularity of the flora of seasonal semideciduous forest remnants located in higher latitudes of the Paraná State, but, instead, seems to be a consequence of forest fragmentation or sampling effect, as discussed above. For instance, we recorded only six species of Lauraceae, but this number increases to 10 considering the results of floristic surveys nearby (Gris 2012, Souza 2015), equaling the number found in the Mata dos Godoy State Park in northern Paraná (Rossetto & Vieira 2013). In relation to Solanaceae, the number of tree and shrub species found in the Mata dos Godoy State Park, 19, was even higher than that found in the study area and its surroundings, 15 (this study, Gris 2012, Souza 2015). The presence of Fabaceae and Myrtaceae in the first two richness ranking positions is a characteristic shared by other studies of the tree and shrub flora in seasonal semideciduous forests of Argentina, Brazil and Paraguay (Cielo-Filho *et al.* 2009, Monge 2009, Souza *et al.* 2012, Rossetto & Vieira 2013, Velazco *et al*. 2015).

Despite the above considerations about an apparent lack of particularities in the flora of the study area concerning species richness and families representativeness, a botanist familiarized with the flora of seasonal semideciduous forest remnants located at lower latitudes that came to visit forest remnants in the study area and its surroundings, will still encounter some peculiarities of the tree and shrub flora of these higher latitudes remnants concerning species composition. For instance, she/he will miss some notorious species like, among others: *Croton floribundus* Spreng, *Copaifera langsdorffii* Desf., *Esenbeckia febrifuga* (A.St.-Hil.) A.Juss. *ex* Mart., *Gallesia integrifolia* (Spreng.) Harms, *Machaerium nyctitans* (Vell.) Benth., *Piptadenia gonoacantha* (Mart.) J.F.Macbr., *Zeyheria tuberculosa* (Vell.) Bureau *ex* Verl., *Geonoma schottiana* Mart. (and Arecaceae in general), *Moquiniastrum polymorphum* (Less.) G. Sancho (and Asteraceae in general), *Miconia theizans* (Bonpl.) Cogn. (and Melastomataceae in general).

It must be stressed that some species found by Gris (2012) in plantings done in the Permanent Preservation Area of Itaipu Lake and in the reforestation strip of the Santa Maria biological corridor may not be native of the region. We highlight the following exotic or probably exotic species registered in Gris (2012), but not in the present contribution nor in Souza (2015): *Annona neosericea* H. Rainer, *Handroanthus impetiginosus* Mattos, *Croton floribundus*, *Manihot grahamii* Hook., *Anadenanthera peregrina* (L.) Speg., *Calliandra brevipes* Benth., *Cassia leptophylla* Vogel, *Copaifera langsdorffii*, *Machaerium nyctitans*, *Piptadenia gonoacantha*, *Poincianella pluviosa* (DC.) L.P. Queiroz. and *Eugenia gracillima* Kiaersk.. Together with the species explicitly stated as exotic of the Brazilian territory in Gris (2012), these species should be avoided in future restoration projects in the region.

Corroborating the ranking of representativeness of dispersal syndromes observed in other studies carried out in seasonal semideciduous forest (Silva & Soares-Silva 2000, Santos & Kinoshita 2003, Kinoshita *et al.* 2006, Zama *et al.* 2012) and agreeing with the general pattern observed in tropical forests (Howe & Smallwood 1982), the most frequent dispersal syndrome was the zoochory (69%), followed by anemochory (17%) and autochory (14%). The percentage of zoochoric species that we found in this study was higher than that found in other studies in well preserved seasonal semideciduous forests (Silva & Soares-Silva 2000, Santos & Kinoshita 2003, Kinoshita *et al.* 2006), what shows a good overall representativeness of zoochoric species in our floristic sampling. The same can be inferred for the representativeness of non-pioneer species, 64%, a percentage higher than that found in the Mata dos Godoy State Park, where 55.8% of the species found may be considered as non-pioneers, taking the late secondary and climax categories adopted by Silva & Soares-Silva (2000) together. The Mata dos Godoy State Park shelters a well preserved seasonal semideciduous forest remnant in advanced successional stage (Silva & Soares-Silva 2000, Rossetto & Vieira 2013). Given the importance of a good representativeness of non-pioneer and zoochoric species in restoration projects, our study presents a promising species list to support initiatives of this nature in the area studied. In line with this assertion is the inclusion of the shrubby habit in the present floristic survey, since the use of non-tree species in restoration projects have been recently encouraged (Durigan *et al.* 2010, Barbosa *et al.* 2015).

The endangered species recorded in this study denote the overall conservation status of the Atlantic forest, especially with regard to the drastic reduction in vegetation cover (Ribeiro *et al.* 2009) resulting in significant habitat loss. Another aspect that stands out is the overexploitation of natural resources (timber and palm heart in the case of *Euterpe edulis*). The most critically threatened species we found in the study area was *Araucaria angustifolia*, considered "critically endangered" and "endangered", respectively, in the IUCN and MMA consulted lists. It should be noted that this species is rare in the study area, occurring mostly in anthropogenic sectors situated on the edge of the INP, in the strip sampled at the margins of the old Guarapuava road. This could suggest that those specimens were planted there by the first settlers who arrived in the area in the 1950s and 1960s. On the other hand, the presence of adult reproductive individuals of *Araucaria angustifolia* at the beginning of the colonization period was confirmed by ancient settlers in neighborhood of the Marquezita town, but not for other localities in the study area (N.L. Viapiana, personal communication), indicating that the species is native, but was not widespread in that area. In the highest elevations of the INP, above the altitudinal range of our study area, Souza (2015) identified a transitional zone between seasonal semideciduous forest and ombrophilous mixed forest, where *Araucaria angustifolia* is one of the most abundant species. Additionally, Ombrophilous Mixed Forests are also encountered not so far away from our study area (less than 150 km), for instance, in the Argentine Province of Misiones (*e.g.* in the Cruce Caballero Provincial Park (Rios 2006)), and in vast tracts of the Southwest region of Paraná State (Castella & Britez 2004). Notwithstanding, as this species is locally rare and not widespread in our study area, we did not recommend its extensive use in restoration projects in this area. On the other hand, we encouraged the widespread use in such projects of all the other endangered species registered in the present study.

The locally abundant species indicated in table 1 are, in general, more prone to become well established in restoration areas and, so, their use in higher proportions can favor the rapid forest recover. In using the indication of locally abundant species in table 1 to design restoration projects, one should consider if the species were reported as locally abundant in typical or humid submontane forest, and apply this last species category in the restoration of sites located in river margins and depressions of the terrain, where

soils are more humid, while the first species category must be reserved to the restoration of sites with drier soil conditions. Some of the locally abundant species can be applied in both situations (table 1). Another consideration refers to the successional category of the locally abundant species indicated, the majority of which, non-pioneer. As restoration plantings, in general, apply a greater proportion of pioneer than non-pioneer species, it would be interesting the indication of additional locally abundant pioneer species, besides the four already mentioned. To do this, we listed the following pioneer species considered as locally abundant through visual assessment by the authors (table 1): *Tabernaemontana catharinensis*, *Trema micrantha*, *Peltophorum dubium*, *Bastardiopsis densiflora*, *Heliocarpus popayanensis*, *Eugenia pyriformis*, *Piper aduncum*, *Myrsine coriacea*, *Casearia sylvestris*, *Allophylus edulis*, *Diatenopteryx sorbifolia*, *Solanum caavurana*, *Styrax leprosus*, *Cecropia pachystachya*, *Aloysia virgata* and *Pombalia bigibbosa*. Naturally, all species listed in table 1 should be considered in restoration plantings in the study area, the ones not cited as locally abundant should be considered for the achievement of high diversity plantings.

Among the exotic species found in the study area, with the exception of *Michelia champaca*, *Gymnanthemum amygdalinum* and *Syzygium jambos*, all others have confirmed invasive potential, especially *Tecoma stans*, *Leucaena leucocephala* and *Hovenia dulcis* (Zenni & Ziller 2011). Such species constitute serious threats to biodiversity conservation in the region and should be targeted by control actions aimed at the eradication of their populations in natural environments. Additionally, actions aiming to prevent anthropogenic disturbances in the forest remnants should be implemented in order to allows secondary forests in the study area to reach more advanced successional stages, since the susceptibility to invasion by exotic species may be greater in forests of earlier successional stages, as suggested for the invasion by *Hovenia dulcis* in forests of the upper Uruguay region (Lazzarin *et al*. 2015).

In conclusion, we reported the floristic composition of an area situated in a strategic region for the conservation of the seasonal semideciduous forest in the context of the Atlantic forest biome. In general, regarding species richness, we did not detect any particularity of the flora of the study area and its surroundings in relation to the flora of seasonal semideciduous forest remnants located at lower latitudes. The same can be said regarding species distribution among families, and frequency distribution of dispersal syndromes and ecological groups, for the flora of the study area. However, some peculiarities emerged due to the lack in the study area of certain tree species commonly found in those remnants. We provided information on dispersal syndromes and successional categories for 204 tree and shrub species and indicated 34 locally abundant and seven threatened ones, in order to aid in the design of restoration projects in the study area. We also identified 15 exotic tree species in the area, of which, 12 have invasive potential, requiring eradication programs.

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