Floresta e Ambiente 2019; 26(1): e20150267
https://doi.org/10.1590/2179-8087.026715
ISSN 2179-8087 (online)

Original Article

Conservation of Nature

Forests of the Iguaçu National Park: Structure, Composition, and Richness

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Abstract

Considering the importance of the Iguaçu National Park for the conservation of the Atlantic Forest and the absence of scientific or technical studies characterizing the ecology of forest species after seven and a half decades of its existence, a phytosociological survey of the arboreal vegetation was conducted to identify the various existing species and their successional stages. A total of 54 families, 135 genera, and 218 species were found in this survey. *Euterpe edulis* Mart. was the most frequently occurring species, which together with *Aspidosperma polyneuron* Müll. Arg., characterize the seasonal forests in the central and south regions of the park. In the north region, located 700 m asl, *Araucaria angustifolia* (Bertol.) Kuntze and *Ilex paraguariensis* A. St.-Hil. were observed along with some seasonal species, characterizing a transitional environment between seasonal and ombrophillous forests. In general, forests in the park were classified in advanced stages of ecological succession.

Keywords: successional stages, ecotone, semi-deciduous forests.

1. INTRODUCTION

Aiming to avoid the complete deterioration of the Atlantic Forest Biome, laws have been enacted to ensure that degraded areas are recovered and the use of the remaining areas on farms is managed rationally. In addition, several protected units (UC) such as the Iguaçu National Park (INP) have been created.

Despite the effectiveness of surveillance and protection within the boundaries of the INP, numerous farms, residences, and sawmills had already been established there before the Park was created, mainly in its southwest region, where the vegetation was completely cleared for agriculture and livestock uses. In other areas, there was selective logging, leading to virtual disappearance of some of the prevailing species and reduction of the potential for natural regeneration in some places due to loss of the seed bank (Ferreira, 1999).

In this context, the Park's first management plan of this UC called for detailed studies of the floristic structure and phytosociological and ecological successional stages of the vegetation in different regions. According to Ziller (1998), these studies would establish the structural patterns of vegetation and species occurrences, which would direct the management and recovery in areas where natural succession had been compromised.

In characterizing the structure of a forest, the number of trees and species distribution are directly associated with the growth habits of the species and environmental conditions of the site (Lin et al., 2013). The assessment of parameters of horizontal and vertical structure must also be observed in characterizing the structure, as well as the percentages of importance and coverage (Mueller-Dambois & Ellenberg, 1974).

After characterization of a particular forest area is performed, Meira & Martins (2002) advised that the comparative floristic aspect should be emphasized, wherein different remnants could have their floral compositions confronted or related by similarity index (Ríos et al., 2010) or analysis grouping (Avila et al., 2011). Meira & Martins (2002) also mentioned that such methods enable observation of the floristic proximity between different forest formations, which is useful to the understanding of the Brazilian forest phytogeography.

The importance of the INP for the conservation of forest species in the Atlantic Forest and the absence of technical information after seven and a half decades of its existence substantiate this study, which was conducted in order to identify the forest species and succession stages of the different existing vegetation formations.

2. MATERIAL AND METHODS

Study area - The Iguaçu National Park (INP) is located in the western region of the state of Paraná and encompasses a total area of 185,262.50 hectares (ha). The geographic region occupied by the INP is characterized by Cfa climate (Alvares et al., 2013). The terrain is determined by the Iguaçu River watershed and lies between 100 and 750 m asl as from the river bank. Bhering (2007) published the latest soil classification conducted in Parana state; for the region of the INP, the following classes have been identified: Ortic Rendzic Chernosol, Haplic Gleysol, Eutrophic Litholic Neosol, Red Disferric Latosol, Eutrophic Red Latosol, and Red Eutroferric Nitosol, with predominance of Nitosol and Latosol.

Forests in the INP are composed of different vegetation formations. Alluvial, Submontane and Montane formations of Semi-deciduous Forest (FES) predominate in the south and central regions and, in the north region, an ecotone between FES and Ombrophillous Mixed Forest (FOM), as well as Alluvial FOM are observed (Souza et al., 2017).

Data and analysis - Seven groups of three plots were installed along the existing altitudinal gradient in the region from the Iguaçu River bank to the northernmost region of the Park. The plots were installed at intervals of 100 m asl in the West-East direction (Figure 1). In total, 21 permanent plots were installed, each sampling plot comprising an area of 2,000 m^2 (20 x 100 m) totaling 4.20 ha.

Plot groups consisted of three plots: group one consisted of plots 1, 2, and 3; group two was composed of plots 4, 5, and 6; and so on. Finally, group seven included plots 19, 20, and 21. At each elevation, plots were positioned at variable distances from each other and parallel to the river course. They were distributed along the drainage slopes from their base up to the plateau regions near the watershed boundaries.

All living trees with circumference ≥15.70 cm (DBH ≥5.00 cm) were included in the survey and their

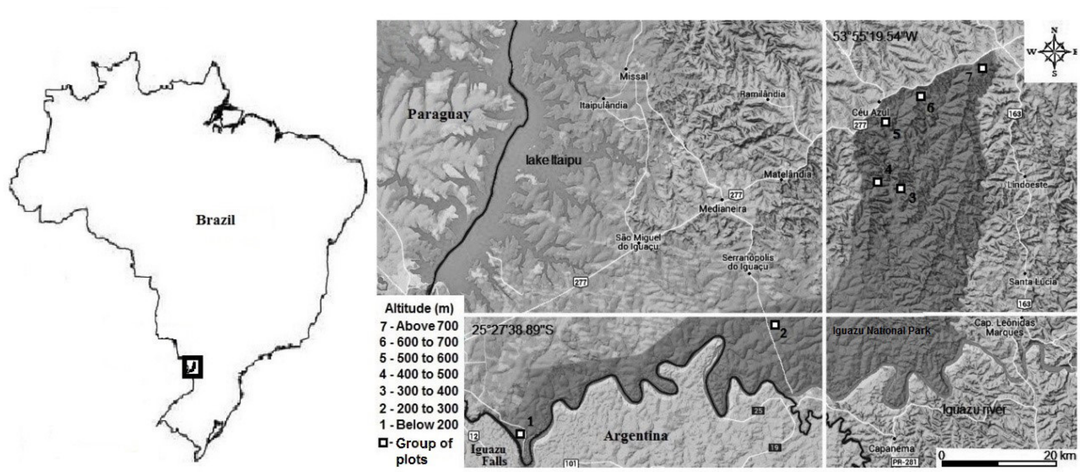

Figure 1. Localization of seven groups of plots installed in the Iguaçu National Park.

respective dendrologic materials were sent to the Botanical Museum of Curitiba for identification. The names were determined through a database search of the Missouri Botanical Garden (tropicos.org). Family classification followed the APG III (2009). Species were classified into Pioneer (PI), Light-Demanding Climax (CL), and Shade-Tolerant Climax (CS) according to adaptation from Oliveira-Filho et al. (1994) to the system proposed by Swaine & Whitmore (1988), and considering the bibliographies of Ziller (1998), Jarenkow & Waechter (2001), Silva et al. (2008), Gasper et al. (2013a), and Gasper et al. (2013b), as well as to field observations. The species were also classified by vegetation formation based on the analysis of the distribution records of species available at *Species*Link (splink.org.br).

Vegetation sampling was conducted to ensure the observation of environmental changes in the INP, stratified into two levels so that all plots were installed in different environments. Even with the adoption of this sampling criterion, in order to verify the efficiency of the survey in relation to its floristic scope, a species-area curve was constructed to enable observation of the relationship between the number of species and the cumulative sampling effort (Felfili et al., 2011).

Characterization of the horizontal structure was performed by plot, in which 10 diameter classes with amplitude of 10 cm from the minimum diameter considered were arbitrarily defined to avoid an excessive number of classes to be grouped as trees with diameter ≥95 cm. To characterize the vertical structure, heights from the ground to the morphological inversion point of trees were measured using a retractable graduated rod, and were then distributed into 11 height classes with amplitude of 2 m from the ground surface.

Plots were classified into three succession stages: initial, intermediate, and advanced, according to the following attributes: species richness (S); dominance (DOA) ($m^2.ha^{-1}$), density (DE) ($trees.ha^{-1}$), and cover value (CV) for the ecological groups; horizontal and vertical structure of vegetation. Decisions were also subsidized by contributions reported by Whitmore (1989), Schorn & Galvão (2009), Holz et al. (2009), and Gasper et al. (2013b). The CONAMA resolution no. 2 of 18 March 1994 (Brasil, 1994) was observed for the ecological succession analysis despite not having been applied as a criterion for decisions.

Cover value for each ecological group was calculated by the following equation: $CV = DR + DOA$, where: DR refers to the ratio between the density obtained for the ecological group and the total density observed in the plot; DOA refers to the ratio between the dominance of each ecological group and the total dominance observed in the plot.

Aiming at a good floristic characterization of the forest, the tree species observed by Ziller (1998) during a Rapid Ecological Assessment of the INP were added to the list. In this floristic survey, Ziller (1998) visited observation points distributed throughout the Park. Likewise, as before, all botanical material was sent to the Botanical Museum of Curitiba for identification.

3. RESULTS

Floristic cover - In 10 plots, it was possible to sample 151 species, or 90% of the total. The remaining 11 plots contributed little to the increase in the number of species sampled, with addition of only 16 species, indicating that a large number of species occurred in common between the plots. In 20 plots, 100% of the species had already been sampled.

Floristic composition - Sampling of the plots showed occurrence of 4,299 trees that, when added to the species found by Ziller (1998), represented 54 botanical families, 135 genera, and 218 species (Table 1). Two trees measured in the plots could only be identified at the family level, which were grouped and assigned to the family Myrtaceae. Another nine trees could not be identified due to absence of leaves caused by seasonality, and were assigned to the "Unknown"

Table 1. Floristic checklist of the tree species in the Iguaçu National Park with their classification in ecological groups (GE), vegetation formation, occurrence in plot groups, and registry by similarity to voucher specimens deposited in the Botanic Museum of Curitiba (MBM).

Family/*Species*	GE	Vegetation Formation		Occurrence in Plot Groups	Voucher in the MBM
ANACARDIACEAE					
Astronium graveolens Jacq.	CL	FES	FOM	3.5.7	7412
Lithraea brasiliensis March.	CL	-	FOM	-	-
Mangifera indica L.*	NC	-	-	-	-
Schinus therebinthifolia Raddi.	PI	FES	FOM	-	-
Toxicodendron striatum (Ruiz & Pav.) Kuntze*	NC	-	-	6	83904
ANNONACEAE					
Annona cacans Warm.	CS	FES	-	6	359684
Annona emarginata (Schltdl.) H. Rainer	CL	FES	FOM	1.2.3.4.5.7	136781
Rollinia salicifolia Schltdl.	CS	FES	FOM	-	-
APOCYNACEAE					
Aspidosperma australe Müll. Arg.	CS	FES	-	4	277233
Aspidosperma cylindrocarpon Müll. Arg.	CS	FES	-	-	-
Aspidosperma polyneuron Müll. Arg.	CS	FES	-	2.4.5.6.7	6773
Rauvolfia sellowii Müll. Arg.	CL	FES	-	4.5.6	69630
Tabernaemontana catharinensis A. DC.	PI	FES	-	1.5.7	36274
ASTERACEAE					
Piptocarpha angustifolia Dusén ex Malme	PI	FES	FOM	-	-
Vernonia discolor (Spreng.) Less.	PI	-	FOM	-	-
AQUIFOLIACEAE					
Ilex brevicuspis Reissek	CL	FES	FOM	3.5.7	16311
Ilex dumosa Reissek	CL	FES	FOM	2	27053
Ilex paraguariensis A. St.-Hil.	CS	FES	FOM	7	18976
Ilex theezans Mart. Ex Reissek	CS	-	FOM	-	-
ARALIACEAE					
Aralia warmingiana (Marchal) J. Wen	CS	FES	-	6	157192
Schefflera morototoni (Aubl.) Maguire. Steyerm. & Frodin	CL	FES	FOM	4.6	12268
ARAUCARIACEAE					
Araucaria angustifolia (Bertol.) Kuntze	CL	FES	FOM	7	22489
ARECACEAE					
Euterpe edulis Mart.	CS	FES	-	1.2.4.5.6	9399
Syagrus romanzoffiana (Cham.) Glassman	PI	FES	FOM	1.2.3.4.5.6.7	66225

*Exotic plants; PI - Pioneer; CL - Light-Demanding Climax; CS - Shade-Tolerant Climax; NC - Not classified; FES - Semi-deciduous Forest; FOM - Ombrophillous Mixed Forest. The species exclusively observed by Ziller (1998) do not provide information on occurrence in the plot groups and on the MBM registry.

Table 1. Continued...

Family/*Species*	GE	Vegetation Formation		Occurrence in Plot Groups	Voucher in the MBM
ASPARAGACEAE					
Cordyline spectabilis Kunth & C.D. Bouché	CL	FES	FOM	2	266966
BIGNONIACEAE					
Handroanthus albus (Cham.) Mattos	CL	FES	FOM	5	66524
Handroanthus chrysotrichus (Mart. ex A. DC.) Mattos.	CL	FES	-	-	-
Handroanthus heptaphyllus (Vell.) Mattos	CL	FES	-	3.5.6	384364
Jacaranda micrantha Cham.	PI	FES	FOM	1.3.5.6.7	11273
Jacaranda puberula Cham.	PI	-	FOM	7	70749
BORAGINACEAE					
Cordia americana (L.) Gottschling & J. S. Mill.	CL	FES	-	1.2.3.4.5	336335
Cordia ecalyculata Vell.	CL	FES	-	1.2.4.5.6.7	236875
Cordia superba Cham.	CS	FES	-	6	128764
Cordia trichotoma (Vell.) Arráb. Ex Steud.	CL	FES	-	1.2.3.4.5.6.7	21646
CALOPHYLLACEAE					
Calophyllum brasiliense Cambess.	CS	FES	-	4	287625
CANELLACEAE					
Capsicodendron dinisii (Schwacke) Occhioni	CL	-	FOM	-	-
CANNABACEAE					
Celtis iguanaea (Jacq.) Sarg.	PI	FES	FOM	3	260947
Trema micrantha (L.) Blume	PI	FES	FOM	6	63979
CARDIOPTERIDACEAE					
Citronella gongonha (Mart.) R.A. Howard	CL	FES	-	2.4.5	136760
Citronella paniculata (Mart.) R.A. Howard	CL	FES	FOM	5	4465
CARICACEAE					
Jacaratia spinosa (Aubl.) A. DC.	CL	FES	-	1.2.4.5.6.7	149157
CELASTRACEAE					
Maytenus alaternoides Reissek	CS	FES	FOM	-	-
Maytenus aquifolium Mart.	CS	FES	FOM	2	72301
CLUSIACEAE					
Garcinia gardneriana (Planch. & Triana) Zappi	CS	FES	-	4	342548
ERYTHROXYLACEAE					
Erythroxylum deciduum A. St.-Hil.	CL	FES	FOM	7	15662
EUPHORBIACEAE					
Actinostemon concolor (Spreng.) Müll. Arg.	CS	FES	FOM	-	-
Alchornea glandulosa Poepp.	CL	FES	FOM	2.5.6.7	222764
Alchornea sidifolia Müll. Arg.	CS	FES	FOM	-	-
Alchornea triplinervia (Spreng.) Müll. Arg.	CL	FES	FOM	1.3.4.5.6.7	135940
Croton urucurana Baill.	PI	FES	-	-	-
Sapium glandulatum (Vell.) Pax	PI	FES	FOM	-	-
Sebastiania brasiliensis Spreng.	CS	FES	FOM	2.3.4.5.6.7	255056
Sebastiania commersoniana (Baill.) L. B. Sm. & Downs	CS	FES	FOM	2.3.6.7	1572
Sebastiania schottiana var. *angustifolia* (Müll. Arg.) Pax. & K. Hoffm	PI	FES	-	-	-
FABACEAE					
Acacia bimucronata DC.	PI	FES	-	1.4	3064
Albizia edwallii (Hoehne) Barneby & J.W. Grimes	PI	FES	FOM	1	9859

*Exotic plants; PI - Pioneer; CL - Light-Demanding Climax; CS - Shade-Tolerant Climax; NC - Not classified; FES - Semi-deciduous Forest; FOM - Ombrophillous Mixed Forest. The species exclusively observed by Ziller (1998) do not provide information on occurrence in the plot groups and on the MBM registry.

Table 1. Continued...

Family/*Species*	GE	Vegetation Formation		Occurrence in Plot Groups	Voucher in the MBM
Albizia niopoides (Spuce ex Benth.) Burkart	PI	FES	-	1.2.4	78526
Anadenanthera colubrina (Vell.) Brenan	CL	FES	-	2.4	201656
Apuleia leiocarpa (Vogel) J. F. Macbr.	CL	FES	-	1.4.5.6	14941
Bauhinia forficata Link	PI	FES	FOM	1.3.6	9120
Calliandra foliolosa Benth.	CS	FES	-	3.4.6	234521
Copaifera langsdorffii Desf.	CL	FES	-	-	-
Dalbergia brasiliensis Vogel.	CL	FES	FOM	-	-
Dalbergia frutescens (Vell.) Britton	CL	FES	FOM	2.3.4.5.7	243562
Dalbergia sp.	NC	-	-	-	-
Enterolobium contortisiliquum (Vell.) Morong	CL	FES	-	2.3	9857
Erythrina falcata Benth.	CL	FES	FOM	3.4.7	70136
Holocalyx balansae Micheli	CS	FES	-	1.2.3.4.5.6	12641
Inga marginata Willd.	CL	FES	FOM	1.4.5.6	234522
Inga striata Benth.	CL	FES	FOM	3.7	210008
Inga uruguensis Hook. & Arn.	PI	FES	-	-	-
Inga vera subsp. affinis (DC.) T.D. Penn.	CL	FES	FOM	2.3.7	9255
Inga virescens Benth.	PI	FES	FOM	-	-
Lonchocarpus campestris Mart. Ex Benth.	CL	FES	FOM	1.2.3.4.5.6.7	8475
Lonchocarpus cultratus (Vell.) A.M.G. Azevedo & H. C. Lima	CL	FES	FOM	3	11747
Lonchocarpus leucanthus Burkart	CL	FES	FOM	1.4	-
Lonchocarpus muehlbergianus Hassl.	CL	FES	FOM	1	248961
Lonchocarpus nitidus (Vogel) Benth.	CL	FES	FOM	1.3.4.5	40400
Machaerium paraguariense Hassl.	CL	FES	FOM	1.3.4.5	345372
Machaerium stipitatum (DC.) Vogel	CL	FES	FOM	1.2.3.4.5.6.7	63596
Myrocarpus frondosus Allemão	CL	FES	-	2.4.5.6.7	218359
Myroxylon peruiferum L. f.	CS	FES	-	2.3.5	1033
Parapiptadenia rigida (Benth.) Brenan	CL	FES	-	1.2.3.4.5.6.7	14927
Peltophorum dubium (Spreng.) Taub.	CL	FES	-	2.5.7	53529
Pterogyne nitens Tul.	CL	FES	-	-	-
Schizolobium parahyba (Vell.) S.F. Blake	PI	FES	-	6	348640
Senegalia polyphylla (DC.) Britton	PI	FES	-	5	9867
Senegalia recurva (Benth.) Seigler & Ebinger	PI	FES	FOM	5.7	7015
Senegalia velutina (DC.) Seigler & Ebinger	PI	FES	-	2	9883
LAMIACEAE					
Aegiphila mediterranea Vell.	PI	FES	FOM	1.2.4.5	15014
Aegiphila sellowiana Cham.	PI	FES	FOM	5	257076
Vitex megapotamica (Spreng.) Moldenke	CL	FES	FOM	3	67566
LAURACEAE					
Cinnamomum glaziovii (Mez) Kosterm.	CS	-	FOM	6	--
Cinnamomum sellowianum (Nees & Mart.) Koesterm.	CL	-	FOM	6.7	249663
Cryptocarya aschersoniana Mez	CS	FES	FOM	-	-
Endlicheria paniculata (Spreng.) J. F. Macbr.	CS	FES	-	-	234475
Nectandra grandiflora Nees & mart. ex Nees	CS	FES	FOM	-	-
Nectandra lanceolata Nees & Mart.	CS	FES	FOM	1.2.3.4.5.6.7	23258
Nectandra megapotamica (Spreng.) Mez.	CS	FES	FOM	1.2.3.4.5.6.7	234482
Nectandra sp.	NC	-	-	-	-

*Exotic plants; PI - Pioneer; CL - Light-Demanding Climax; CS - Shade-Tolerant Climax; NC - Not classified; FES - Semi-deciduous Forest; FOM - Ombrophillous Mixed Forest. The species exclusively observed by Ziller (1998) do not provide information on occurrence in the plot groups and on the MBM registry.

Table 1. Continued...

Family/*Species*	GE	Vegetation Formation		Occurrence in Plot Groups	Voucher in the MBM
Ocotea acutifolia (Nees) Mez	CS	FES	FOM	-	-
Ocotea diospyrifolia (Meisn.) Mez.	CS	FES	FOM	1.2.3.4.5.6.7	111187
Ocotea indecora (Schott) Mez.	CS	FES	FOM	4.7	335848
Ocotea porosa (Nees & Mart.) Barroso	CS	-	FOM	-	-
Ocotea puberula (Rich.) Nees	CL	FES	FOM	1.2.5.7	201053
Ocotea pulchella Mart.	CS	FES	FOM	-	-
Ocotea silvestris Vattimo-Gil	CS	FES	FOM	2.4.5.6.7	159701
LECYTHIDACEAE					
Cariniana legalis (Mart.) Kuntze	CL	FES	-	-	-
LOGANIACEAE					
Strychnos brasiliensis (Spreng.) Mart.	CL	FES	FOM	2.3.4.5.7	67211
MALVACEAE					
Bastardiopsis densiflora (Hook. & Arn.) Hassl.	CL	FES	-	1.2.3.4.5	313106
Ceiba speciosa (A. St.-Hil.) Ravernna	CL	FES	-	1.4.5	359685
Guazuma ulmifolia Lam.	CL	FES	-	7	239761
Heliocarpus popayanensis Kunth	PI	FES	-	1	338069
Luehea divaricata Mart.	CL	FES	FOM	1.3.4.7	66585
MELASTOMATACEAE					
Miconia hymenonervia (Raddi) Cogn.	CS	FES	-	4.5.7	-
Miconia pusilliflora Beurl.	CS	FES	-	7	7859
MELIACEAE					
Cabralea canjerana (Vell.) Mart.	CL	FES	FOM	1.2.3.4.5.6.7	66335
Cedrela fissilis Vell.	CL	FES	FOM	1.2.3.4.5.6.7	54094
Guarea kunthiana A. Juss.	CS	FES	-	1.4.6	37543
Guarea macrophylla Vahl	CS	FES	FOM	4.6	348527
Trichilia casaretti C. DC.	CS	FES	-	4.5.6	283080
Trichilia catigua A. Juss.	CS	FES	-	1.2.3.4.6.7	8291
Trichilia claussenii C. DC.	CS	FES	FOM	2.4.5.6	37522
Trichilia elegans A. Juss.	CS	FES	FOM	1.2.3.4.5.6	103578
Trichilia pallens C. DC.	CS	FES	FOM	1.7	37524
MONIMIACEAE					
Hennecartia omphalandra J. Poiss.	CS	FES	FOM	1.2.3.5.7	104156
Mollinedia blumenaviana Perkins	CS	-	FOM	6	15039
Mollinedia clavigera Tul.	CS	-	FOM	6.7	147658
MORACEAE					
Ficus insipida Willd.	CL	FES	-	-	-
Ficus luschnathiana (Miq.) Miq.	CL	FES	FOM	2.4.6	251016
Ficus sp.	NC	-	-	-	-
Maclura tinctoria (L.) O. Don ex Steud	CL	FES	-	1.5.6	66415
Sorocea bonplandii (Baill.) W.C. Burger. et al.	CS	FES	FOM	1.2.4.5.67	43753
MYRTACEAE					
Calycorectes riedelianus O. Berg	CS	FES	-	-	-
Campomanesia guazumifolia (Cambess.) O. Berg	CS	FES	FOM	1	47731
Campomanesia xanthocarpa Mart. Ex O. Berg.	CS	FES	FOM	1.2.3.4.5.6.7	66536
Eucalyptus sp.*	NC	-	-	-	-
Eugenia burkartiana (D. Legrand) D. Legrand	CS	FES	FOM	1.2.4.6	6554

*Exotic plants; PI - Pioneer; CL - Light-Demanding Climax; CS - Shade-Tolerant Climax; NC - Not classified; FES - Semi-deciduous Forest; FOM - Ombrophillous Mixed Forest. The species exclusively observed by Ziller (1998) do not provide information on occurrence in the plot groups and on the MBM registry.

Table 1. Continued...

Family/*Species*	GE	Vegetation Formation		Occurrence in Plot Groups	Voucher in the MBM
Eugenia clorophylla O. Berg	CS	FES	FOM	4.7	-
Eugenia hiemalis Cambess.	CS	FES	FOM	2	391511
Eugenia involucrata DC.	CL	FES	FOM	2.3	170424
Eugenia pyriformis Cambess.	CL	FES	FOM	1.2.3.4.7	66537
Eugenia ramboi D. Legrand	CS	FES	FOM	4.7	10842
Eugenia subterminalis DC.	CL	FES	-	2.5	-
Myrcia laruotteana Cambess.	CS	FES	FOM	2.5	238806
Myrcia rostrata DC.	CS	FES	FOM	-	-
Myrciaria floribunda (H. West ex Willd.) O. Berg	CL	FES	FOM	7	66217
Myrtaceae	NC	-	-	5	-
Pimenta pseudocaryophyllus (Gomes) L. R. Landrum	CL	-	FOM	-	-
Plinia rivularis (Cambess.) Rotman	CS	FES	-	1.2.3.4.6	132200
Psidium cattleyanum Sabine	CL	-	FOM	-	-
NYCTAGINACEAE					
Neea schwackeana Heimerl	CL	FES	-	2	250272
Pisonia ambigua Heimerl	CL	FES	-	1.6	71877
OPILIACEAE					
Agonandra engleri Hoehne	CL	FES	-	7	235155
PINACEAE					
Pinus sp.*	NC	-	-	-	-
PHYTOLACCACEAE					
Gallesia integrifolia (Spreng.) Harms	CL	FES	-	-	-
Seguieria guaranitica Speg.	CL	FES	-	1.2.3.4.5.6	52723
PIPERACEAE					
Piper amalago L.	CL	FES	-	1.4	191797
PODOCARPACEAE					
Podocarpus lambertii Klotzsch ex Endl.	CS	FES	FOM	-	-
POLYGONACEAE					
Ruprechtia laxiflora Meisn.	CS	FES	-	1.3.4.5	9262
PRIMULACEAE					
Myrsine coriacea (Sw.) R. Br. Ex Roem. & Schult.	PI	FES	FOM	2.4	186138
Myrsine umbellata Mart.	PI	FES	FOM	1.2.3.4.5.7	186139
PROTEACEAE					
Grevillea robusta A. Cunn. Ex R. Br.*	NC	-	-	-	-
Roupala asplenioides Sleumer	CL	FES	-	5	10288
Roupala brasiliensis Klotzsch	CL	FES	FOM	7	29157
RHAMNACEAE					
Colubrina glandulosa Perkins	CL	FES	-	-	-
Hovenia dulcis Thunb.*	NC	-	-	6.7	26374
ROSACEAE					
Prunus myrtifolia (L.) Urb.	CL	FES	FOM	2.3.4.5.6.7	295
Prunus sellowii Koehne	CL	FES	FOM	-	-
RUBIACEAE					
Alseis floribunda Schott	CS	FES	-	2	129304
Faramea cyanea Müll. Arg.	CL	FES	-	-	-
Ixora velutina Wall.	CS	FES	-	2.4.5.6	-

*Exotic plants; PI - Pioneer; CL - Light-Demanding Climax; CS - Shade-Tolerant Climax; NC - Not classified; FES - Semi-deciduous Forest; FOM - Ombrophillous Mixed Forest. The species exclusively observed by Ziller (1998) do not provide information on occurrence in the plot groups and on the MBM registry.

Table 1. Continued...

Family/*Species*	GE	Vegetation Formation		Occurrence in Plot Groups	Voucher in the MBM
Psychotria carthagenensis Jacq.	CS	FES	FOM	2.4.6.7	238789
Rudgea jasminoides (Cham.) Müll. Arg.	CS	FES	FOM	2.7	384884
Simira sampaioana (Standl.) Steyerm.	CL	FES	-	1	12578
RUTACEAE					
Balfourodendron riedelianum (Engl.) Engl.	CS	FES	-	1.2.3.4.5.6	48772
Citrus limon(L.) Osbeck*	NC	-	-	7	35846
Citrus sinensis (L.) Osbek*	NC	-	-	1.2.7	255839
Helietta apiculata Benth.	PI	FES	-	2.3	8482
Pilocarpus pennatifolius Lem.	CS	FES	FOM	1.3.4	103178
Zanthoxylum kleinii (R. S. Cowan) P. G. Waterman	PI	FES	FOM	-	-
Zanthoxylum naranjillo Griseb.	PI	FES	-	1.2.3.5	195738
Zanthoxylum petiolare A. St.-Hil. & Tul.	PI	FES	-	2.3.5	11779
Zanthoxylum rhoifolium Lam.	PI	FES	FOM	2.3.4.5	17977
SALICACEAE					
Banara tomentosa Clos	CS	FES	FOM	2.3.6.7	38001
Casearia decandra Jacq.	CS	FES	FOM	1.2.3.4.5.7	67198
Casearia lasiophylla Eichler	CL	FES	FOM	7	348529
Casearia obliqua Spreng.	CS	FES	FOM	1.2.7	5067
Casearia sylvestris Sw.	CL	FES	FOM	1.2.4.6.7	10832
Prockia crucis P. Browne ex L.	CL	FES	FOM	3.4.5.6.7	135207
Xylosma ciliatifolia (Clos) Eichler	CL	FES	FOM	7	4286
SAPINDACEAE					
Allophylus edulis (A. St.-Hil.. et al.) Hieron. Ex Niederl.	CL	FES	FOM	1.2.3.4.5.6.7	348531
Allophylus guaraniticus Radlk.	CL	FES	FOM	-	-
Cupania vernalis Cambess.	CL	FES	FOM	3.5.6.7	345421
Diatenopteryx sorbifolia Radlk.	CL	FES	-	1.2.3.4.5.6.7	111280
Matayba elaeagnoides Radlk.	CL	FES	FOM	3.5.7	80089
SAPOTACEAE					
Chrysophyllum gonocarpum (Mart. & Eichler ex Miq.) Engl.	CS	FES	-	1.2.3.4.5.6.7	174840
Chrysophyllum marginatum (Hook. & Arn.) Radlk.	CL	FES	FOM	1.2.3.4.5.6.7	239238
SIMAROUBACEAE					
Picrasma crenata Engl. In Engl. & Prantl	CS	FES	FOM	2.3	130135
SOLANACEAE					
Cestrum intermedium Sendtn.	CL	FES	FOM	1.5.6	15466
Cestrum strigilatum Ruiz & Pav.	PI	FES	-	5	3095
Solanum argenteum Dunal	PI	FES	-	5	4246
Solanum campaniforme Roem. & Schult.	PI	FES	-	5	345427
Solanum granuloso-leprosum Dunal	PI	FES	FOM	3.5	56670
Solanum guaraniticum A. St.-Hil.	PI	FES	FOM	7	67654
Solanum mauritianum Scop.	PI	FES	FOM	3	345423
Solanum pseudoquina A. St.-Hil.	PI	FES	FOM	3.5	8942
Solanum sanctaecatharinae Dunal	PI	FES	FOM	2.3.5.7	-
STYRACACEAE					
Styrax acuminatus Pohl	CL	-	FOM	7	4375
Styrax leprosus Hook. & Arn.	CL	-	FOM	3.6.7	191584

*Exotic plants; PI - Pioneer; CL - Light-Demanding Climax; CS - Shade-Tolerant Climax; NC - Not classified; FES - Semi-deciduous Forest; FOM - Ombrophillous Mixed Forest. The species exclusively observed by Ziller (1998) do not provide information on occurrence in the plot groups and on the MBM registry.

Table 1. Continued...

Family/*Species*	GE	Vegetation Formation		Occurrence in Plot Groups	Voucher in the MBM
SYMPLOCACEAE					
Symplocos pentandra Occhioni	CL	FES	-	7	23478
Symplocos uniflora (Pohl) Benth.	CL	-	FOM	-	-
UNKNOWN	NC	-	-	2.5.6.7	-
URTICACEAE					
Cecropia pachystachya Trécul	PI	FES	-	1.2.4.5.6	238741
Urera baccifera (L.) Gaudich.	PI	FES	FOM	1.2.3.4.5.6	191567
VERBENACEAE					
Aloysia virgata (Ruiz & Pav.) Juss.	CL	FES	-	1	261
Duranta vestita Cham.	PI	-	FOM	-	-
WINTERACEAE					
Drimys brasiliensis Miers	CS	-	FOM	-	-

*Exotic plants; PI - Pioneer; CL - Light-Demanding Climax; CS - Shade-Tolerant Climax; NC - Not classified; FES - Semi-deciduous Forest; FOM - Ombrophillous Mixed Forest. The species exclusively observed by Ziller (1998) do not provide information on occurrence in the plot groups and on the MBM registry.

group. For the same reason, six species could only be identified by Ziller (1998) at the genus level.

The most representative families in number of species were Fabaceae (34), Myrtaceae (18), and Lauraceae (16), followed by Euphorbiaceae, Meliaceae, Rutaceae, and Solanaceae with nine species each. The most frequent genera were *Eugenia*, *Ocotea*, and *Solanum* (seven), *Nectandra* (six), *Inga*, *Lonchocarpus*, and *Trichilia* (five), *Casearia*, *Cordia*, *Ilex,* and *Zanthoxylum* (four).

Considering only the sampling in the plots, the 10 species with the highest absolute density accounted for 44.96% of the total relative density: *E. edulis* (735), *Sorocea bonplandii* (241), *Machaerium stipitatum* (143), *Nectandra megapotamica* (137), *Sebastiania brasiliensis*, *Cabralea canjerana* and *Ocotea diospyrifolia* (134), *Balfourodendron riedelianum* (122), *Chrysophyllum gonocarpum* (104), and *Syagrus romanzoffiana* (92). The 10 species most commonly found in the plots and their respective frequencies (%) were *O. diospyrifolia* (100), *N. megapotamica* (95.24), *C. gonocarpum* (95.24), *S. romanzoffiana*, *Campomanesia xanthocarpa* and *Chrysophyllum marginatum* (90.48), *S. bonplandii*, *M. stipitatum* and *C. canjerana* (85.71), and *B. riedelianum* (80.95).

Among the 218 species listed, 13 were not classified into ecological groups and vegetation formation because they were not identified at the species level or were exotic. Among the 205 remaining species, 78 (38.05%) were classified as presenting FES characteristics, 17 (8.29%) as FOM, and 110 (53.66%) are of occurrence in both formations. Regarding successional stage, 70 species (34.15%) were classified as Shade-Tolerant Climax, 92 (44.88%) as Light-Demanding Climax, and 43 (20.98%) as Pioneer.

Successional stage - In general, high values of richness and dominance were recorded in the plots and, in some cases, an expressive range of diameters and predominance of climax species were observed (Table 2). These results indicate that the forest remains well preserved.

In plot 6, low values of dominance and density were recorded (22.02 $m^2.ha^{-1}$ and 675 $trees.ha^{-1}$), attributed to the high occurrence of *Chusquea* Kunth. (Criciúma) and *Cyathea* sp. (Xaxim-bravo), as well as to the presence of canopy gaps opened by the falling of large trees.

The highest dominance and density values were observed in plot 12, associated with the presence of *Aspidosperma polyneuron* - the largest diameter class, Light-Demanding Climax species (*Apuleia leiocarpa*, *Cabralea canjerana, Diatenopteryx sorbifolia*, and *Ficus luschnathiana*) - 70, 80 and 90 diameter classes, and the high density of *E. edulis* and *S. bonplandii* - the first diameter class. Such a physiognomy is typical of seasonal forests with low levels of human disturbance.

Table 2. Relative frequency (%) by diameter class, cover value for the ecological groups, and successional stage (SS) of plots installed in the Iguaçu National Park.

P	S'	DOA	N	Diameter Class (cm)										Cover Value			SS
				10	20	30	40	50	60	70	80	90	>95	PI	CL	CS	
1	47	25.23	805	64.60	18.01	10.56	4.35	1.86	-	-	-	0.62	-	10.12	89.95	94.77	INT
2	45	33.10	805	64.60	12.42	8.70	5.59	4.35	3.73	0.62	-	-	-	5.59	102.04	85.52	ADV
3	39	33.16	1,100	73.64	11.36	7.73	3.18	2.73	0.91	-	-	-	0.45	14.36	57.69	125.83	ADV
4	61	29.18	1,260	72.62	15.08	6.35	4.37	0.79	0.79	-	-	-	-	10.81	74.60	114.09	ADV
5	44	29.90	720	59.72	19.44	9.03	7.64	1.39	0.69	0.69	0.69	-	0.69	9.40	97.74	92.00	ADV
6	47	22.02	675	64.44	17.04	8.89	6.67	1.48	0.74	0.74	-	-	-	19.37	81.90	97.87	INT
7	36	42.70	1,035	65.22	21.26	4.35	1.93	3.38	1.45	1.45	-	0.48	0.48	16.47	100.45	83.09	ADV
8	45	37.04	785	58.60	21.66	8.28	5.10	2.55	1.91	0.64	0.64	-	0.64	34.57	76.81	88.63	INT
9	42	27.13	795	67.92	17.61	3.77	4.40	2.52	3.14	0.63	-	-	-	25.08	106.32	68.60	INT
10	49	38.03	855	76.02	9.36	5.85	3.51	0.58	2.34	1.17	-	-	1.17	18.64	82.35	99.01	ADV
11	43	33.14	1,510	84.77	7.62	3.64	0.99	2.32	0.33	-	-	-	0.33	5.23	50.57	144.20	ADV
12	48	54.13	1,575	84.13	6.98	3.49	1.90	0.63	0.95	0.63	0.32	0.32	0.63	5.01	41.78	153.21	ADV
13	59	29.09	960	77.08	9.90	3.13	5.21	2.60	0.52	1.04	0.52	-	-	32.17	79.38	82.13	INT
14	49	23.65	730	74.66	9.59	8.22	1.37	3.42	2.05	0.68	-	-	-	41.79	90.24	67.21	INT
15	48	38.73	755	70.20	9.93	10.60	2.65	-	3.97	0.66	0.66	-	1.32	11.62	77.26	110.02	ADV
16	53	32.50	1,185	75.53	11.81	4.64	5.06	0.84	0.84	0.84	-	0.42	-	5.84	54.01	139.67	ADV
17	45	39.13	1,110	75.68	8.11	7.21	1.80	4.05	2.25	-	-	0.45	0.45	5.58	71.83	122.58	ADV
18	46	44.69	1,345	76.58	10.04	5.95	2.60	1.86	1.49	0.37	-	0.37	0.74	0.00	51.08	147.40	ADV
19	52	37.13	1,500	72.33	16.00	6.33	2.33	1.67	1.00	-	-	0.33	-	11.38	138.18	49.12	INT
20	45	24.84	785	68.15	14.01	5.73	8.28	3.82	-	-	-	-	-	9.69	121.49	68.06	INT
21	47	23.71	1,205	71.37	19.92	6.22	1.24	1.24	-	-	-	-	-	21.05	100.39	78.08	INT
Average				72.67	13.24	6.26	3.49	2.02	1.28	0.44	0.12	0.16	0.33	14.94	83.15	100.53	ADV

P - Plot; S' - Species richness; DOA - Dominance per hectare ($m^2.ha^{-1}$); N - Density per hectare ($trees.ha^{-1}$); Ecological group: PI - Pioneer, CL - Light-Demanding Climax, CS - Shade-Tolerant Climax; INT - Intermediate succession stage; ADV - Advanced succession stage.

The smaller diameter range observed in some plots suggested intermediate stages of succession. Hydromorphism was observed in the soil of plot 4, which limited the occurrence of large trees and justified its advanced successional classification. In plot 2, despite the limited range of diameter class (70 cm), the dominance value of 30 $m^2.ha^{-1}$ indicated vegetation in good conservation condition. In plots 8 and 9, located on the bottom of a drainage slope, presence of *Guadua chacoensis* (Taquaruçu) contributed to the low density values and their classification in intermediate stages.

Preserved forests present points of morphological inversion distributed in different strata, reaching expressive heights. This characteristic could be observed in all plots and, despite the positive asymmetry and negative kurtosis, the distribution curves extended to heights >13 m, as shown in Table 3. The highest relative frequencies were found below nine meters, justified by the high density in the initial diameter classes and recurrence of Shade-Tolerant Climax species.

Low frequency in the highest classes characterizes the emerging stratum above the relatively open canopy, typical of seasonal forests in southern Brazil (Leite & Klein, 1990). The most prevalent species in these classes were *A. polyneuron*, *A. leiocarpa, B. riedelianum, Ceiba speciosa, Cordia trichotoma*, *Jacaratia spinosa*, *M. stipitatum, Myrocarpus frondosus*, and *P. rigida*.

Presence of *Araucaria angustifolia* above 19 m was observed in plots 19, 20, and 21. This species is associated with *P. rigida, Casearia decandra*, and *Nectandra lanceolata* between 11 and 17 m, and the high density of *C. canjerana, C. xanthocarpa*, and *Ilex paraguariensis* in the understory, between 3 and 7 m, characterized the vertical structure of this transitional vegetation between FOM and FES. Specimens of emergent species in FES were identified within these plots in the classes of 7, 9, and 11 m, including *A. polyneuron, C. trichotoma*, and *M. frondosus.*

Table 3. Relative frequency (%) by height class to the morphological inversion point for the 21 plots installed in the Iguaçu National Park.

Plot	N	Center of height class from ground to the morphological inversion point (m)											Asymmetry	Kurtosis
		1	3	5	7	9	11	13	15	17	19	21		
1	805	4.35	36.02	31.06	16.77	3.73	4.97	0.62	1.86	-	0.62	-	1.45	0.79
2	805	5.59	36.02	28.57	13.66	8.70	2.48	1.86	2.48	0.62	-	-	1.42	0.68
3	1,100	4.09	27.27	24.09	16.36	10.00	8.64	5.00	2.27	1.36	0.91	-	1.09	-0.07
4	1,260	5.95	28.97	34.13	17.06	5.16	5.16	1.59	1.19	0.79	-	-	1.23	0.00
5	720	5.56	22.92	22.92	17.36	13.19	9.03	6.25	0.69	-	1.39	0.69	0.41	-1.39
6	675	4.44	28.89	29.63	18.52	10.37	2.96	1.48	0.74	1.48	1.48	-	1.18	-0.06
7	1,035	2.42	23.19	29.95	22.71	14.98	3.38	1.93	-	0.97	0.48	-	0.96	-0.57
8	785	6.37	19.11	24.20	19.75	10.19	10.83	6.37	2.55	0.64	-	-	0.66	-0.95
9	795	2.52	25.79	25.79	18.87	15.72	6.92	3.77	0.63	-	-	-	0.87	-0.84
10	855	4.09	24.56	31.58	19.30	10.53	4.68	2.92	0.58	1.17	0.58	-	0.97	-0.81
11	1,510	2.65	16.56	34.11	22.85	12.91	8.61	1.66	0.66	-	-	-	1.07	0.06
12	1,575	1.27	14.29	24.76	21.59	13.97	12.06	4.44	3.17	2.86	0.63	0.95	0.81	-0.37
13	960	4.69	23.44	34.90	19.27	11.98	3.65	1.56	-	-	0.52	-	1.31	0.62
14	730	4.79	27.40	32.19	20.55	8.90	2.05	1.37	1.37	0.68	-	0.68	1.25	0.00
15	755	1.32	20.53	18.54	23.84	19.87	9.27	3.31	2.65	0.66	-	-	0.51	-1.79
16	1,185	2.11	20.68	24.47	16.03	11.39	8.44	10.97	2.53	1.27	1.69	0.42	0.72	-0.91
17	1,110	1.80	18.47	28.83	13.06	15.32	7.66	10.36	3.15	1.35	-	-	1.15	1.37
18	1,345	1.12	15.61	30.11	14.50	10.04	15.99	7.43	4.09	0.74	-	0.37	1.13	1.24
19	1,500	3.00	15.33	26.00	25.67	15.67	9.00	2.67	1.00	1.00	0.67	-	1.00	-0.37
20	785	3.82	27.39	21.02	24.20	14.01	5.10	4.46	-	-	-	-	0.89	-0.93
21	1,205	4.15	19.92	33.61	24.48	13.69	2.90	0.83	0.41	-	-	-	1.17	0.01

N - Density per hectare (trees.ha^{-1}).

4. DISCUSSION

Floristic composition – Out of the 218 tree species listed, 51 were exclusive of the survey by Ziller (1998), 86 were exclusive of this survey, and 81 were common to both surveys. Ramos et al. (2008) identified 238 species in a FES remnant in Sao Paulo state and Silva & Soares-Silva (2000) identified 206 species in a FES in northern Parana state; Gasper et al. (2013b), identified 233 species between trees and shrubs in a Deciduous Forest in Santa Catarina state. Other researchers reported lower species richness in surveys conducted in smaller FES fragments in southern Brazil: Jarenkow & Waechter (2001), Giehl & Jarenkow (2008), Scipioni et al. (2011), Ríos et al. (2010), and Bianchini et al. (2003) identified 55, 82, 72, 64 and 116 species, respectively.

In this research, the botanical families Fabaceae and Myrtaceae were the most representative in number of species, corroborating the studies by Oliveira-Filho & Fontes (2000) in an FES in southeastern Brazil and Jarenkow & Waechter (2001) in the central region of Rio Grande do Sul state. These families have also presented higher richness in surveys conducted in northern Parana state (Silva & Soares-Silva, 2000), northwestern Santa Catarina state (Scipioni et al., 2011), Rio Grande do Sul state (Giehl & Jarenkow, 2008), and in northeastern Argentina (Ríos et al., 2010).

Other families common to the INP also reported by Jarenkow & Waechter (2001), Silva & Soares-Silva (2000), and Ríos et al. (2010) include Lauraceae and Meliaceae, observed among the five richest families. In contrast, Oliveira-Filho & Fontes (2000) observed high species richness only for Lauraceae. Scipioni et al. (2011) and Giehl & Jarenkow (2008) reported richness only for Meliaceae, associated with early succession in the former study and with alluvial forest in the latter.

Meira & Martins (2002) performed a comparative analysis of similarity between fragments of montane FES in Minas Gerais state (between 650 and 800 m asl) and semideciduous forests in Sao Paulo and northern Parana states. Based on the results, the authors hypothesized that the floristic similarity between montane and submontane FES increases proportionally to latitude.

Comparison between the species that occurred in plots located in the submontane FES of the INP (between 100 and 600 m asl) identified 27 species in common with the study by Meira & Martins (2002), apparently confirming their hypothesis. Some species even presented high density and dominance values, namely, *C. gonocarpum*, *M. stipitatum*, and *S. bonplandii*.

Also in support of the hypothesis of the aforementioned authors, high amplitude of dispersion along the altitudinal gradient was found for 52 seasonal species in the INP. These species are altitude indicators in the state of Sao Paulo, as described by Meira et al. (1989). Results of this analysis revealed 13 species occurring in the INP, 11 of which found in submontane FES: *Alchornea triplinervia, Luehea divaricata, C. canjerana, Cedrela fissilis, C. decandra, Casearia obliqua, Allophylus edulis, C. speciosa, Handroanthus albus, Myrsine umbellata*, and *Pisonia ambigua*. *Cupania vernalis* occurred only in montane regions 600 m asl, whereas *Roupala brasiliensis* was restricted to an ecotone between FES and FOM, 700 m asl.

Also corroborating this result, floristic similarity was observed between the montane FES (600-700 m asl) and the submontane Decidual Forests at higher latitudes below 550 m asl, as described by Jarenkow & Waechter (2001) and Scipioni et al. (2011). Those studies found a total of 55 and 79 species, respectively, of which 30 (54.54%) and 42 (53.16%) were common to those of the present study.

Successional stage - Budowski (1965) reported that in dense undisturbed forests or in forests in more advanced successional stages, the recruitment of Pioneer species is subject to emergence of canopy gaps, which may explain the low cover value for this ecological group in the INP. Holz et al. (2009) reported that the native forests of northeastern Argentina were mostly composed of Light-Demanding Climax and Shade-Tolerant Climax species, whereas Pioneer species accounted for 25%.

Shade-Tolerant Climax species are also widely recurrent and represented in greater abundance by *E. edulis*, *S. bonplandii*, *Sebastiania brasiliensis*, *N. megapotamica*, *O. diospyrifolia*, *B. riedelianum*, and *C. gonocarpum*, also in agreement with the results found by Holz et al. (2009). In the INP, this ecological group amounted to 100.53% of the total cover value for vegetation and, together with the Light-Demanding Climax species, to 183.68%.

Ziller (1998) described the central region of the Park as showing fewer traces of anthropogenic activities, illustrated by the lush vegetation and high floristic diversity. Furthermore, in addition to *A. polyneuron*, other species characteristic of vegetation in advanced-stage seasonal forests were recurrent in this region, including *A. leiocarpa*, *M. frondosus*, *B. riedelianum*, *Jacaratia spinosa*, *Lonchocarpus muehlbergianus,* and *Holocalyx balansae*. Also noteworthy is the wide range of diameters observed in the plots established in that region (plots 7 to 18).

However, some of the plots located on the slopes of the river valley of the central region showed a narrower range of diameters and recurrence of Pioneer species at intermediate stages of ecological succession. This finding may be associated with the rugged terrain and increased water availability (Muchailh et al., 2010). Another related factor may be the increased light incidence in the understory of the plots located on the drainage slopes oriented to the East, resulting in an edge effect (Schorn & Galvão 2009).

The narrower range of diameters and the high concentration of trees with morphological inversion point <7 m indicate intermediate successional stages for two plots in the southern and southwestern parts of the INP (plots 1 and 6). Ziller (1998) pointed out that, unlike the logging that occurred in other regions, the anthropogenic activities in this region included clearing of vegetation for agricultural use, which slowed the restoration process to its original state.

Further North in the Park, in the transition zone between Semideciduous and Ombrophillous Forests, ecological succession proceeds at an intermediate stage, indicated by reduction in dominance, lower range of diameters, and lower morphological inversion point. This result can be explained by the high level of anthropogenic disturbance because of the forest proximity to the municipality of Santa Tereza do Oeste (Ziller, 1998). Despite the intensified logging activities occurred in this area, the vegetation was not completely removed, and thus maintained its potential for recovery. Evidence of this potential is observed in the presence of species of high commercial value typical of Ombrophillous Forests.

5. CONCLUSIONS

In general, forests in advanced successional stage were observed throughout the Iguaçu National Park (INP). The central region presents few characteristics indicative of anthropogenic activities and portrays, more accurately, the original seasonal forests that occurred in the Parana River basin. The forests of the South and far North areas of the INP still present signs of anthropogenic activities, where some species show low recurrence and depend on a long period of in disturbance and isolation to return to its original state.

Evidence of the effect of altitude and latitude on the distribution of species of seasonal forests was observed to compare the results of this survey with those of studies conducted in the Southeast and extreme South regions of Brazil.

ACKNOWLEDGEMENTS

The authors are grateful to Chico Mendes Institute for Biodiversity Conservation (ICMBio) for the authorization and availability of the physical structure to conduct this study, Coordination for the Improvement of Higher Education Personnel (CAPES) for the financial support in the form of a scholarship, and to National Council for Scientific and Technological Development (CNPQ) for the financial assistance to conduct the fieldwork.

SUBMISSION STATUS

Received: 15 dec., 2015
Accepted: 25 may, 2018

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FINANCIAL SUPPORT

This study was funded by National Council for Scientific and Technological Development (CNPq), grant no. 484747/2011-8.

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