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ARTICLE

Floristic and characterization of grassland vegetation at a granitic hill in Southern Brazil

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ABSTRACT: (Floristic and characterization of grasslands vegetation of a granite hill in Southern Brazil). A floristic and vegetation study was carried out in the grassland formations at *Morro São Pedro*, Porto Alegre municipality, Rio Grande do Sul State, a granitic elevation area, so far poorly surveyed, that cradles important natural vegetation remnants of the region. After the study, which lasted from April 2005 to March 2009, we found 497 angiosperm species, distributed in four main grassland formation types: dry grassland, rocky grassland, humid grassland and wetlands. Among the species list three species are noteworthy: *Alstroemeria albescens*, a new species for the science, *Lepuropethalon spathulatum*, a new record for Southern Brazil, and *Thrasyopsis juergensii*, a new record for the Pampa biome. Based on our results and on support from other papers we concluded that ca. 65% of the grassland species present in the granitic hills of the region belong to seven main botanical families (Asteraceae, Poaceae, Fabaceae, Cyperaceae, Rubiaceae, Verbenaceae and Apiaceae). The species belonging to these families are also determining in the vegetation phytophysiognomical and structural composition, so that cespitous grasses predominate in the landscape, shaping a continuous gramineous layer. The grasslands at the granitic hills of the municipality have an insular present distribution, isolated in patches at hilltops, due to the presence of forests in the slopes. They show a high number of species that can be found in higher numbers in dry areas than in humid areas, and there is a gap in works concerning the characterization of humid grasslands and wetland formations inserted at hilltops. Despite the significant plant diversity of these grasslands, their representation in conservation units at the municipality is virtually inexistent.
Key words: plant diversity, floristic, Pampa, grasslands vegetation.

RESUMO: (Florística e caracterização da vegetação campestre em um morro granítico no sul do Brasil)**.** Foi realizado um estudo florístico e vegetacional nos campos do morro São Pedro, Porto Alegre, Rio Grande do Sul, uma área de elevação granítica, ainda pouco estudada, que conserva importantes remanescentes de vegetação natural da região. Após a realização do estudo, com duração de abril de 2005 a março de 2009, obteve-se a catalogação de 497 espécies de angiospermas nativas distribuídas em quatro tipos de formações campestres principais: campo seco, campo rupestre, campo úmido e banhado. Dentre a lista de espécies, destacam-se *Alstroemeria albescens,* uma espécie nova para a ciência, *Lepuropethalon spathulatum*, uma nova citação para a Região Sul do Brasil, e *Thrasyopsis juergensii*, uma nova citação para o bioma Pampa. Com base nos resultados obtidos e o suporte de outros trabalhos realizados, conclui-se que cerca de 65% das espécies campestres de morros graníticos da região pertencem a sete famílias botânicas principais (Asteraceae, Poaceae, Fabaceae, Cyperaceae, Rubiaceae, Verbenaceae e Apiaceae). As espécies destas famílias também são determinantes na composição fitofisionômica e estrutural da vegetação, predominando na paisagem as gramíneas cespitosas, formando um estrato contínuo de tapete graminoso. Os campos dos morros graníticos do município têm distribuição atual em forma insular, isolado em manchas nos topos destas elevações devido à presença de florestas nas encostas. Apresentam elevado número de espécies que se concentram em maior número nas áreas secas do que nas áreas úmidas, havendo uma lacuna de trabalhos de caracterização de formações de campos úmidos e banhados de topos de morro. Apesar da significativa diversidade vegetal destes campos, sua representatividade em unidades de conservação é praticamente nula no município.
Palavras-chave: diversidade vegetal, florística, Pampa, vegetação campestre.

INTRODUCTION

South Brazilian grasslands, known as *Campos Sulinos*, have been historically highlighted by researchers in botany due to its floristic richness and physiognomic diversity, contrasting with Brazilian forest formations. In Rio Grande do Sul (RS), the southernmost State of this region, the blending of hibernal and aestival species with origin in two main floristic groups, the altitude grasslands of the northern half of the State (*Mata Atlântica* biome) and the *pampean* grasslands of the southern half (*Pampa* biome) results in one of the most important natural pasture formations of the world (IBGE 2004, Jaques & Nabinger 2006, Boldrini 2007). Despite the inexistence of concrete data concerning the richness of these formations, Boldrini (1997) points out the occurrence of approximately three thousand grassland species in RS. The physiognomic aspect of this vegetation is determined by herbaceous species, particularly grasses, with significant contribution of shrub and arboreal species (Overbeck *et al.* 2007).

Today, it is known that the present distribution of grasslands and forests in Southern Brazil, occurring in mosaics on the landscape, is the result of climatic variations in recent geological times and the occurrence of natural and anthropogenic disturbance, such as fire

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and grazing (Klein 1984, Behling *et al.* 2004, Overbeck *et al.* 2007). Other natural factors also contribute to the present distribution of plants in the environment, such as the time of origin of a species at the site, the geomorphology and soil distribution on the landscape, solar irradiation, wind patterns and dispersion syndromes (Good 1974, Rizzini 1979). Through analysis of the proposed classifications of the grassland vegetation of RS, it is possible to observe that variation of the mentioned factors, as the physiognomy imprinted by key species, regional geographic formations distribution, local ecological factors and intensity and periodicity of disturbances are determinant in the recognition of patterns in this vegetation (Lindman 1906, Rambo 1956, IBGE 1973, Boldrini 1997).

The region of Porto Alegre city, RS capital, is one of the better studied in the State, and is considered an important site of occurrence of many plant species (Rambo 1954, Teodoro Luís 1960, Aguiar *et al.* 1986). Its geographic position near the 30°S parallel, a zone of transition between different phytogeographic formations present in South America, represents a contact zone between the two main grassland floristic groups previously mentioned, besides the occurrence of taxa pertaining to other South American floras with austral-Antarctic, Amazonian, Andean, Chaquean and Brazilian Atlantic coast origins (Cabrera & Willink 1973, Porto & Menegat 1999a). The resulting vegetation assembles marked characteristics, shaping a mosaic of vegetation types quite distinct, such as forests, grasslands, wetlands and *restingas* (subtropical moist broadleaf forests), and species showing rare and/or restrict distribution patterns (Brack *et al.* 1998, Boldrini *et al.* 1998, Overbeck *et al.* 2006).

The Brazilian phytogeographical classification, proposed by IBGE (Brazilian Institute of Geography and Statistics), confirms the condition of the flora present at Porto Alegre region as a result of the convergence of different South American floristic groups. The region was considered as an Area of Ecological Tension, result of the interpenetration of Seasonal Semi-deciduous Forest and Savanna phytoecological formations, besides the influence of Pioneer Marine Formation (Teixeira *et al.* 1986). More recently, updates of this classification suggest the alteration of Savanna for Steppe, as it is a more adequate terminology to designate the several types of vegetation present on the region that lack trees (IBGE 2004). However, in spite of the various efforts, there is still disagreement about a definite classification system (Marchiori 2002).

Teixeira *et al.* (1986) also emphasize that the physiognomies of this vegetation are extremely altered, result of a historical process of human occupation, chiefly due to extensive grazing activities. Presently, the pressure to conversion of the last natural remnants in Porto Alegre city is intense, due to the unbridled building expansion and the many uses that humans have been imposing to the environment, occupying and quickly altering even the steepest sites, such as the granitic hills. Aiming to document the diversity of a natural grassland vegetation remnant present at a granitic hill in Porto Alegre city, we carried out a floristic inventory, a general characterization of the vegetation and an analysis of floristic similarity among the identified formation types. The selection of the study site, the *Morro São Pedro*, is due to the fact that it shelters the largest and better conserved natural vegetation remnant of the municipality, and there are few specific information on this subject for the area.

MATERIAL AND METHODS

Study area

Porto Alegre is inserted in the *Depressão Central* physiographic region (Fortes 1959). However, *Morro São Pedro* geologically belongs to a crystalline formation known as *Escudo sul-riograndense*, a granite-based bedrock connected to the *Serra do Sudeste* physiographic region (Rambo 1956). The region is also under the influence of the Seashore formation, due to the contact with Guaíba lake and Patos Lagoon and the proximity to the Seashore Plains (Fig. 1B). Climate corresponds to Cfa subtype, according to Koeppen classification. Mean annual temperature is 19.5°C. Mean annual rainfall is 1330mm, being more pronounced in winter, with possible water shortage in summer (Livi 1999). The municipality is inserted in the Pampa biome, close to its northeastern limits and under the influence of the Mata Atlântica (Brazilian Rainforest) biome (IBGE 2004) (Fig. 1A).

Morro São Pedro is located between 30º08'S and 30°12'S to 51°05'W and 51°07'W, at the extreme southern portion of the municipality (Fig.1C-D). Maximum altitude is 289 m a.s.l. and its total area is 1259 ha (Güntzel *et al.* 1994). The hill cradles important water springs of the micro-hydrographic basins of Salso and Lami streams, both pertaining to Guaíba Lake basin. Geology is shaped by Viamão granite, the primary plutonic unit in Porto Alegre region, which shows characteristic rock outcrops and boulders, with diameter varying from one to six meters (Philipp 2008). Soils at the site belong to five different types from the Argisols, Cambisols and Neosols orders. These soils may show a significant portion of coarse faction (gravel) composed by quartz and classified as dystrophic, i.e. are acid and show low nutrient availability (Schneider *et al.* 2008).

Vegetation cover at the site comprises ca. 692 ha of forests and 440 ha of grasslands, occurring in mosaic (Güntzel *et al.* 1994), (Fig. 1E-F). Grasslands are predominantly distributed at hilltops and northern slopes, while forests are found in larger proportions at southern slopes, and this is a widespread pattern in the granitic hills of the region (Rambo 1956). Historically, this hill has been target of human actions such as logging, quarry and cattle breeding, as have the other hills at the region. What can be presently seen is that the natural vegetation remnant at the area is shaped as a mosaic of different successional stages resulting from several processes of

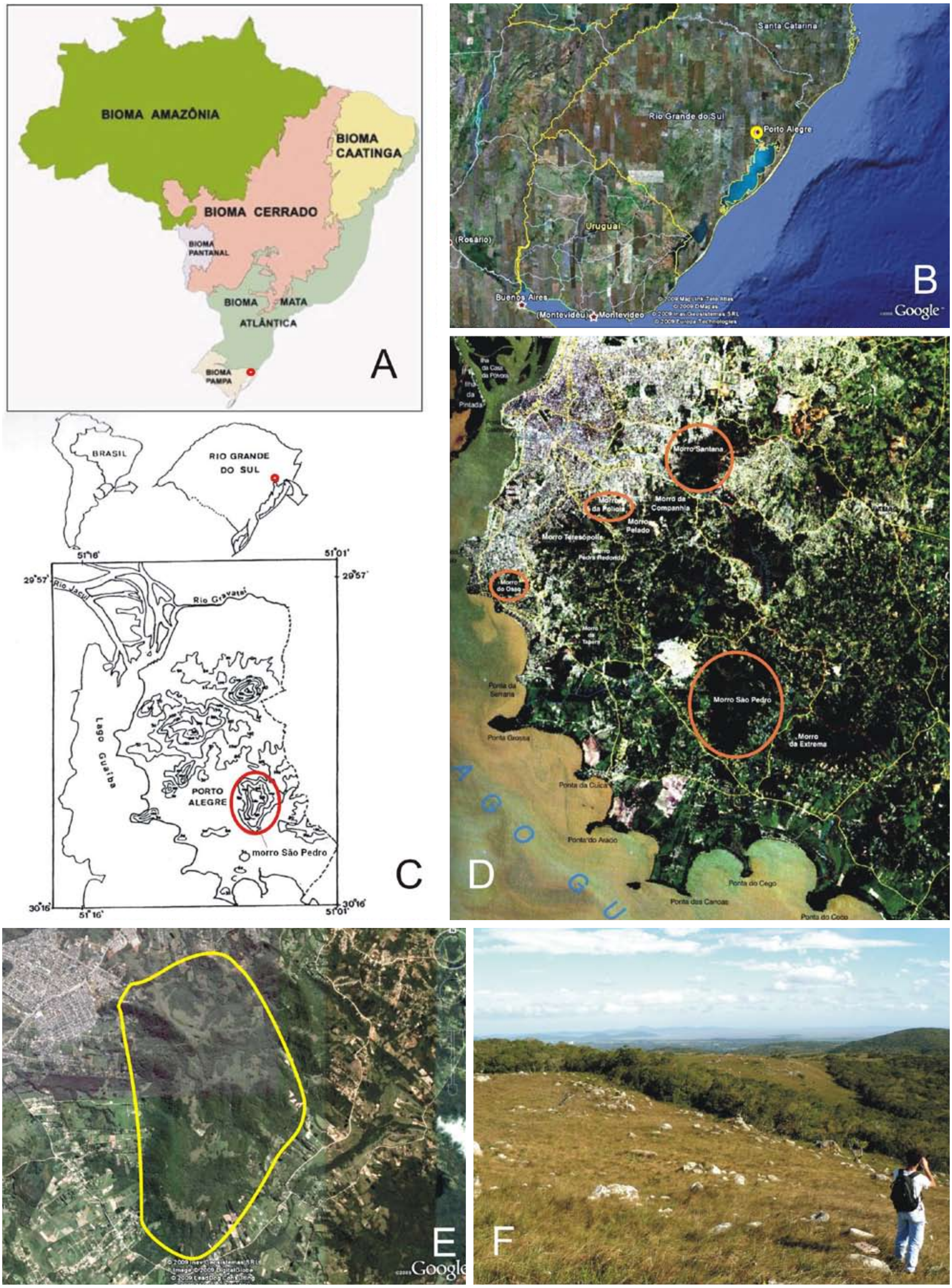

Figure 1. A. Brazil biome map (IBGE 2004). B. Satellite image detailing Southern South America. C. Schematic map of Porto Alegre city and its surroundings in relation to South America, highlighting *Morro São Pedro* (adapted from Brack *et al.* 1998). D. Satellite image of Porto Alegre city, highlighting *Morro do Osso, Morro da Polícia, Morro Santana* and *Morro São Pedro*. E. Satellite image detailing *Morro São Pedro* and its surroundings. F. Detail of the geomorphology and the grassland-forest mosaic present at *Morro São Pedro*.

anthropogenic use. In the absence of disturbance, what can be observed in the natural successional dynamics of grassland vegetation is the development of tall herbaceous and shrub species, so that colonization by pioneer forest species may occur in deeper soils, which results in the forest expansion over the grassland formations due to present climate conditions.

Sampling procedures

The floristic inventory lasted 48 months, starting at April 2005 and ending at March 2009. During this time, 64 days were spent at the study site, distributed in all months, with approximate frequency of 22 days between each field expedition. All grassland areas present at the hill were covered trough the *Caminhamento* sampling method (Filgueiras *et al*. 1994). The survey focused on local angiosperms, samples were deposited at UFRGS ICN Herbarium and voucher material is cited for each species.

For recognition and description of the different vegetation types identified, geomorphologic characteristics were evaluated through analysis of maps, satellite images and literature, and were related to floristic and physiognomic distributional patterns imprinted by key-species. In order to identify distributional patterns of the species, we used information of collection files of ca. 1100 specimens listed throughout our survey, besides field observations. Floristic similarity calculations were based on Jaccard coefficient [ISj = a/(a+b+c)], where **a** = number of species present in both samples, b = number of species restricted to first sample and **c** = number of species restricted to second sample (Krebs 1999).

For species identification, we used available literature, such as local Floras and taxonomic revisions published either in papers or in thesis and dissertations (Barros 1960, Reitz 1965-1989, Irgang 1974, Matzenbacher 1979, Guaglianone 1980, Guglieri & Longhi-Wagner 1987, Longhi-Wagner 1987, Miotto 1988, Miotto & Filho 1988, Zanin *et al*. 1992, Araújo & Longhi-Wagner 1996, Reitz & Reis 1996-2006, Marodin & Ritter 1997, Matzenbacher 1998, Lüdtke & Miotto 2004, Mondin 2004, Ritter & Miotto 2005, Lima 2006, Azevêdo-Gonçalves & Matzenbacher 2007, Hefler 2007, O'Leary *et al.* 2007, Boldrini *et al*. 2008, Trevisan & Boldrini 2008). A revision of UFRGS ICN Herbarium was also carried out, and family specialists were consulted when necessary. The floristic list we present follows the phylogenetic systematics proposed by Stevens (2001 onwards).

RESULTS AND DISCUSSION

Floristic Inventory

We registered the occurrence of 497 native angiosperm taxa, distributed in 66 families and 238 genera (Tab. 1). Families with highest genera number were Asteraceae (42), Poaceae (36), Fabaceae (20), Cyperaceae (12) and Orchidaceae (8), which encompasses 47% of the total genera numbers (Fig. 2A). Families with highest species number were Asteraceae (110), Poaceae (90), Fabaceae (47), Cyperaceae (38), Rubiaceae (17), Verbenaceae (15) and Apiaceae (14), encompassing 66.5% of all species surveyed. The three first families alone correspond to 51% of all the species surveyed (Fig. 2B). Fourteen families presented two species each, and 26 families only one species each, summing up 60% of all families. Genera with highest species number were *Baccharis* (18), *Eupatorium* (15), *Eryngium* and *Paspalum* (11), *Mimosa* and *Vernonia* (10), *Rhynchospora* (8), *Gamochaeta*, *Andropogon* and *Briza* (7), corresponding to 20% of all species (Fig. 2C).

Plant formations

In order to describe the different grassland formations we propose, it is necessary, beforehand, to recognize local environmental factors, such as relief, soil, drainage and sun exposition, due to their influence over grassland and forest characteristics and distribution at the study area. *Morro São Pedro* presents a series of hilltops at different altitudes combined with hillsides, shaping a smoothly undulated to montane relief, predominantly SW-NE oriented. Ordinarily, at hilltops and hillsides, associations between Cambisols and shallow to moderately deep Neosols occur and, along the hillsides, undifferentiated groupings of deeper Argisols are found (Tab. 2). Drainage varies according to relief, so that water drains easier in convex areas and accumulates at plain hilltops and concave channels at hillsides. Relief, soil type and sun exposition affect water availability and time of permanence at surface and subsurface. Water intake varies in function of rainfall and presence of water springs.

Grassland formations are predominantly distributed at hilltops and upper third portions of hillsides, especially at the northern slope, while forests are distributed mostly at the southern slope. This pattern is related to the presence of shallow soils and higher incidence of solar radiation at hilltops and upper third portions of hillsides and to shading, humidity and deeper soils that occur at the southern slope. Notwithstanding, even at the northern slope or in the hilltops, in areas with depressed relief and deeper soils, forest development occurs, reflecting the present climatic patterns that favor forest expansion.

Based on analysis of these variables and of the distribution patterns of species at the different environments (Tab. 1), four grassland formation types were identified: dry grassland, rocky grassland, humid grassland and wetlands (Figs. 3-6). The following descriptions report the most frequent patterns observed in each formation type. It is important to emphasize that anthropogenic disturbance, especially burning and cattle grazing, are determinant in this vegetation dynamics, influencing its composition, structure and successional dynamics. These influences acting over the

Table 1. Native angiosperm species enrolled in the floristic inventory, distribution by habitat and voucher material (DG, dry grassland; RG, rocky grassland; HG, humid grassland; WL, wetland).

Family/Species	Voucher	DG	RG	HG	WL
Acanthaceae					
Ruellia brevicaulis (Nees) Lindau.	R. Setubal & I. Boldrini, 101 (ICN)	x	x		
Stenandrium diphyllum Nees	R. Setubal, 422 (ICN)	x	x		
Agavaceae					
Clara ophiopogonoides Kunth	R. Setubal & D. Fuhro, 474 (ICN)		x		
Alliaceae					
Nothoscordum gaudichaudianum Kunth	R. Setubal & M. Grings, 482 (ICN)		x		
Nothoscordum inodorum (Aiton) Asch. & Graebn.	R. Setubal *et al.*, 481 (ICN)	x			
Nothoscordum montevidense Beauverd	R. Setubal *et al.*, 483 (ICN)		x		
Alstroemeriaceae					
Alstroemeria albescens M.C. Assis	R. Setubal & D. Fuhro, 201 (ICN)		x		
Amaranthaceae					
Gomphrena graminea Moq.	R. Setubal, 99 (ICN)	x	x		
Pfaffia tuberosa (Sprengel) Hicken	R. Setubal & A. Mello, 261 (ICN)	x	x	x	
Amaryllidaceae					
Hippeastrum breviflorum Herb.	R. Setubal & M. Grings, 96 (ICN)		x	x	
Habranthus pedunculosus Herb.	R. Setubal, 349 (ICN)	x			
Zephyranthes pusilla (Herb.) Dieter.	R. Setubal & J. Bassi, 348 (ICN)		x	x	
Anacardiaceae					
Schinus weinnmanifolius Engl.	R. Setubal *et al.*, 281 (ICN)	x	x		
Apiaceae					
Apium leptophyllum (Pers.) F. Muell. ex Benth.	R. Setubal & A. Mello, 397 (ICN)	x	x	x	
Centella asiatica (L.) Urb.	R. Setubal, 747 (ICN)	x		x	
Centella hirtella Nannf.	R. Setubal, 748 (ICN)	x			
Eryngium balansae H. Wolff	R. Setubal *et al.*, 703 (ICN)	x	x		
Eryngium ciliatum Cham. & Schltdl.	R. Setubal, 142 (ICN)	x	x		
Eryngium ebracteatum Lam.	R. Setubal & J. Bassi, 140 (ICN)				x
Eryngium elegans Cham. & Schltdl.	R. Setubal, 141 (ICN)	x		x	
Eryngium eriophorum Cham. & Schltdl.	R. Setubal, 38 (ICN)		x		
Eryngium horridum Malme	R. Setubal *et al.*, 277 (ICN)	x	x		
Eryngium megapotamicum Malme	R. Setubal, 138 (ICN)	x	x		
Eryngium pandanifolium Cham. et. Schltdl.	R. Setubal *et al.*, 279 (ICN)			x	x
Eryngium panniculatum Cav. & Dombey ex F. Delaroche	R. Setubal & M. Grings, 39 (ICN)	x	x		
Eryngium pristis Cham. & Schltdl.	R. Setubal & J. Bassi, 36 (ICN)	x	x	x	
Eryngium sanguisorba Cham. et. Schltdl.	R. Setubal, 37 (ICN)	x	x		
Apocynaceae					
Asclepias mellodora A. St.-Hil.	R. Setubal & J. Bassi, 283 (ICN)	x	x		
Macrosiphonia longiflora (Desf.) Müll. Arg.	R. Setubal, 97 (ICN)	x	x		
Mandevilla coccinea (Hook. & Arn.) Woodson	R. Setubal & G. Seger, 98 (ICN)	x	x		
Oxypetalum arnottianum H. Buek	R. Setubal & M. Grings, 364 (ICN)	x			
Oxypetalum cf. *dusenii* Malme	R. Setubal *et al.*, 374 (ICN)	x			
Oxypetalum tomentosum Wight ex Hook. & Arn.	R. Setubal, 284 (ICN)	x			
Araliaceae					
Hydrocotile bonariensis Lam.	R. Setubal *et al.*, 697 (ICN)	x			
Hydrocotile exigua (Urb.) Malme	R. Setubal & M. Grings, 645 (ICN)	x			
Arecaceae					
Butia capitata (Mart.) Becc.	R. Setubal & M. Grings, 654 (ICN)	x	x		
Aristolochiaceae					
Aristolochia sessilifolia (Klotzsch) Duch.	R. Setubal *et al.*, 704	x			
Asteraceae					
Achyrocline satureioides (Lam.) DC.	R. Setubal, 57 (ICN)	x			
Acmella bellidioides (Smith in Rees) R.K. Jansen	R. Setubal, 55 (ICN)	x	x	x	
Aspilia montevidensis (Spreng.) Kuntze	R. Setubal, 56 (ICN)	x	x		
Baccharis articulata (Lam.) Pers.	R. Setubal & G. Seger, 156 (ICN)	x	x		
Baccharis caprariaefolia DC.	R. Setubal & A. Mello, 158 (ICN)	x	x		x
Baccharis cognata DC.	R. Setubal, 22 (ICN)	x	x	x	
Baccharis coridifolia DC.	R. Setubal & I. Boldrini, 441 (ICN)	x			
Baccharis dracunculifolia DC.	R. Setubal & M. Grings, 69 (ICN)	x	x	x	
Baccharis incisa Hook. & Arn.	R. Setubal, 68 (ICN)	x	x		
Baccharis leptophylla DC.	R. Setubal *et al.*, 67 (ICN)	x	x		
Baccharis leucopappa DC.	R. Setubal & M. Grings, 66 (ICN)	x	x		
Baccharis ochracea Spreng.	R. Setubal *et al.*, 65 (ICN)	x	x	x	
Baccharis patens Baker	R. Setubal & P. Ferreira, 646 (ICN)	x	x		
Baccharis pentodonta Malme	R. Setubal, 19 (ICN)	x	x		
Baccharis riograndensis Teodoro & Vidal	R. Setubal *et al.*, 20 (ICN)	x	x		
Baccharis sessiliflora Vahl.	R. Setubal, 749 (ICN)	x			
Baccharis spicata (Lam.) Baill.	R. Setubal, 21 (ICN)	x			
Baccharis stenocephalla Baker	R. Setubal, 23 (ICN)	x	x		
Baccharis tridentata Vahl.	R. Setubal & M. Grings, 258 (ICN)	x	x		
Baccharis tridentata var. *subopposita* (DC.) Cabrera	R. Setubal, 157 (ICN)	x	x		
Baccharis trimera (Less.) DC.	R. Setubal, 155 (ICN)	x	x		
Berroa gnaphalioides (Less.) Beauverd	R. Setubal, 750 (ICN)	x	x		
Bidens pilosa L.	R. Setubal, 54 (ICN)	x			
Calea cymosa Less.	R. Setubal *et al.*, 103 (ICN)		x		
Calea uniflora Less.	R. Setubal, 53 (ICN)	x	x		
Chaptalia exscapa (Pers.) Baker	R. Setubal, 751 (ICN)	x	x		
Chaptalia integerrima (Vell.) Burkart	R. Setubal & J. Bassi, 51 (ICN)	x	x	x	

Table 1. cont.

Family/Species	Voucher	DG	RG	HG	WL
Chaptalia nutans (L.) Pol.	R. Setubal & J. Bassi, 52 (ICN)	x			
Chaptalia piloselloides (Vahl) Baker	R. Setubal, 752 (ICN)	x	x	x	
Chevreulia sarmentosa (Pers.) S.F. Blake	R. Setubal, 753 (ICN)	x	x		
Conyza chilensis Spreng.	R. Setubal *et al.*, 50 (ICN)	x	x		
Criscia stricta (Spreng.) Katinas	R. Setubal & J. Bassi, 49 (ICN)	x	x		
Eclipta megapotamica (Spreng.) Sch. Bip. ex S.F. Blake	R. Setubal, 347 (ICN)	x	x	x	x
Enhydra anagallis Gardner	R. Setubal & A. Schneider, 705 (ICN)				x
Erechtites hieraciifolius (L.) Raf. ex DC.	R. Setubal *et al.*, 207 (ICN)	x			
Erechtites valerianifolius (Link ex Spreng.) DC.	R. Setubal, 48 (ICN)	x			
Eupatorium ascendens Sch. Bip. ex Baker	R. Setubal, 754 (ICN)	x		x	
Eupatorium bupleurifolium DC.	R. Setubal, 104 (ICN)			x	x
Eupatorium congestum Hook. & Arn.	R. Setubal & M. Grings, 110 (ICN)	x	x	x	
Eupatorium ericoides DC.	R. Setubal & A. Schneider, 712 (ICN)		x		
Eupatorium intermedium DC.	R. Setubal, 114 (ICN)	x	x		
Eupatorium inulifolium Kunth	R. Setubal, 118 (ICN)	x			
Eupatorium laevigatum Lam.	R. Setubal, 123 (ICN)	x			
Eupatorium lanigerum Hook. & Arn.	R. Setubal *et al.*, 127 (ICN)	x	x	x	
Eupatorium ligulaefolium Hook. & Arn.	R. Setubal *et al.*, 132 (ICN)	x	x	x	
Eupatorium macrocephalum Less.	R. Setubal, 144 (ICN)	x	x		
Eupatorium oblongifolium (Spreng.) Baker	R. Setubal *et al.*, 139 (ICN)	x	x		
Eupatorium spathulatum Hook. & Arn.	R. Setubal, 147 (ICN)		x		
Eupatorium subhastatum Hook. & Arn.	R. Setubal *et al.*, 159 (ICN)	x	x		
Eupatorium tanacetifolium Gillies ex Hook. & Arn.	R. Setubal & G. Seger, 187 (ICN)		x		
Eupatorium verbenaceum DC.	R. Setubal, 186 (ICN)	x	x	x	
Facelis retusa (Lam.) Sch. Bip.	R. Setubal *et al.*, 206 (ICN)	x			
Gamochaeta americana (Mill.) Wedd.	R. Setubal, 755 (ICN)	x	x		
Gamochaeta coarctata (Willd.) Kerguélen	R. Setubal, 756 (ICN)	x			
Gamochaeta filaginea (DC.) Cabrera	R. Setubal & M. Grings, 647 (ICN)	x	x		
Gamochaeta pensylvanica (Willd.) Cabrera	R. Setubal & M. Grings, 648 (ICN)	x			
Gamochaeta simplicicaulis (Willd. ex Spreng.) Cabrera	R. Setubal, 757 (ICN)	x			
Gamochaeta spicata Cabrera	R. Setubal *et al.*, 208 (ICN)	x			
Gamochaeta stachydifolia (Lam.) Cabrera	R. Setubal, 758 (ICN)		x		
Gochnatia orbiculata (Malme) Cabrera	R. Setubal & M. Grings, 47 (ICN)		x		
Grindelia puberula Hook. & Arn.	R. Setubal & P. Ferreira, 649 (ICN)	x			
Heterothalamus psiadioides Less.	R. Setubal & J. Bassi, 45 (ICN)	x	x	x	
Holocheilus brasiliensis (L.) Cabrera	R. Setubal & J. Bassi, 44 (ICN)	x	x	x	
Hypochaeris chillensis (Kunth) Hieron.	R. Setubal *et al.*, 439 (ICN)	x			
Hypochaeris lutea Britton	R. Setubal & J. Bassi, 210 (ICN)		x	x	
Hypochaeris megapotamica Cabrera	R. Setubal & A. Mello, 211 (ICN)	x			
Hysterionica filiformis (Spreng.) Cabrera	R. Setubal, 46 (ICN)		x		
Isostigma peucedanifolium (Spreng.) Less.	R. Setubal & M. Grings, 213 (ICN)	x	x	x	
Lucilia acutifolia (Poir.) Cass.	R. Setubal & M. Grings, 214 (ICN)	x	x	x	
Lucilia nitens Less.	R. Setubal & M. Grings, 215 (ICN)	x	x		
Mikania fulva (Hook. & Arn.) Baker	R. Setubal & M. Grings, 216 (ICN)	x	x	x	
Mikania micrantha Kunth	R. Setubal, 43 (ICN)	x			
Mikania pinnatiloba DC.	R. Setubal *et al.*, 40 (ICN)		x		
Noticastrum gnaphalioides (Baker) Cuatrec.	R. Setubal, 41 (ICN)	x	x		
Orthopappus angustifolius (Sw.) Gleason	R. Setubal *et al.*, 108 (ICN)	x	x		
Pluchea laxiflora Hook. & Arn. ex Baker	R. Setubal & A. Mello, 435 (ICN)	x		x	
Pluchea sagittalis (Lam.) Cabrera	R. Setubal, 759 (ICN)	x			
Porophyllum lanceolatum DC.	R. Setubal & J. Bassi, 218 (ICN)	x	x		
Pterocaulon alopecuroides (Lam.) DC.	R. Setubal *et al.*, 198 (ICN)	x	x		
Pterocaulon angustifolium DC.	R. Setubal *et al.*, 106 (ICN)	x	x		
Pterocaulon polypterum (DC.) Cabrera	R. Setubal & J. Bassi, 107 (ICN)	x	x		
Pterocaulon polystachyum DC.	R. Setubal & M. Grings, 443 (ICN)	x		x	
Schlechtendalia luzulifolia Less.	R. Setubal, 105 (ICN)	x	x	x	
Senecio brasiliensis (Spreng.) Less.	R. Setubal & A. Mello, 149 (ICN)	x			
Senecio heterotrichius DC.	R. Setubal & P. Ferreira, 682 (ICN)	x	x		
Senecio oxyphyllus DC.	R. Setubal *et al.*, 219 (ICN)	x	x		
Senecio selloi (Spreng.) DC.	R. Setubal *et al.*, 220 (ICN)	x	x		
Solidago chilensis Meyen	R. Setubal, 153 (ICN)	x		x	
Soliva pterosperma (Juss.) Less.	R. Setubal, 760 (ICN)	x			
Stenachaenium campestre Baker	R. Setubal, 761 (ICN)	x	x		
Stenachaenium macrocephalum (DC.) Benth. Et Hook.	R. Setubal, 152 (ICN)	x	x		
Stenachaenium riedelii Baker	R. Setubal, 762 (ICN)	x			
Stevia cinerascens Sch. Bip. ex Baker	R. Setubal & M. Grings, 221 (ICN)	x	x		
Stevia cf. *tenuis* Hook. & Arn.	R. Setubal, 763 (ICN)	x	x		
Stevia cf. *veronicae* DC.	R. Setubal *et al.*, 463 (ICN)	x	x		
Symphyopappus reticulatus Baker	R. Setubal *et al.*, 222 (ICN)	x	x		
Trixis verbasciformis Less.	R. Setubal & M. Grings, 442 (ICN)	x	x		
Verbesina sordescens DC.	R. Setubal, 154 (ICN)	x			
Vernonia echioides Less.	R. Setubal, 63 (ICN)			x	x
Vernonia flexuosa Sims	R. Setubal, 62 (ICN)	x	x	x	
Vernonia lucida Less.	R. Setubal & F. Marchett, 64 (ICN)	x	x		
Vernonia macrocephala Less.	R. Setubal & M. Grings, 438 (ICN)	x	x		
Vernonia megapotamica Spreng.	R. Setubal, 61 (ICN)	x		x	
Vernonia nitidula Less.	R. Setubal, 60 (ICN)			x	x
Vernonia nudiflora Less.	R. Setubal & J. Cabral, 58 (ICN)	x	x	x	
Vernonia platensis (Spreng.) Less.	R. Setubal & M. Grings, 59 (ICN)	x		x	

Table 1. cont.

Family/Species	Voucher	DG	RG	HG	WL
Vernonia rubricaulis Bonpl.	R. Setubal, 764 (ICN)	x			
Vernonia squarrosa (Less.) Less.	R. Setubal, 437 (ICN)	x	x		
Viguiera anchusaefolia (DC.) Baker	R. Setubal, 457 (ICN)	x	x		
Viguiera immarginata (DC.) Herter	R. Setubal & M. Grings, 223 (ICN)	x	x	x	
Begoniaceae					
Begonia cucullata Willd.	R. Setubal & G. Seger, 365 (ICN)		x	x	
Boraginaceae					
Antiphytum cruciatum (Cham.) DC.	R. Setubal, 492 (ICN)	x			
Cordia curassavica (Jacq.) Roem. & Schult.	R. Setubal, 366 (ICN)	x			
Cordia monosperma (Jacq.) Roem. & Schult.	R. Setubal & M. Grings, 651 (ICN)	x			
Bromeliaceae					
Dyckia choristaminea Mez.	R. Setubal *et al.*, 82 (ICN)		x		
Dyckia leptostachya Baker	R. Setubal & J. Bassi, 367 (ICN)		x		
Cactaceae					
Cereus hildmannianus K. Schum.	R. Setubal, 765 (ICN)		x		
Opuntia monacantha Haw.	R. Setubal, 362 (ICN)		x		
Parodia ottonis (Lehm.) N.P. Taylor	R. Setubal, 363 (ICN)		x		
Campanulaceae					
Wahlenbergia linarioides (Lam.) A. DC.	R. Setubal, 419 (ICN)	x		x	
Caryophyllaceae					
*Cerastium glomeratum*Thuill.	R. Setubal *et al.*, 420 (ICN)	x			
Cistaceae					
Helianthemum brasiliense (Lam.) Pers.	R. Setubal & P. Ferreira, 643 (ICN)	x			
Commelinaceae					
Commelina erecta L.	R. Setubal & A. Mello, 345 (ICN)	x			
Tradescantia crassula Link & Otto	R. Setubal & G. Seger, 344 (ICN)		x		
Convolvulaceae					
Convolvulus crenatifolius Ruiz & Pav.	R. Setubal, 343 (ICN)	x			
Cuscuta sp.	R. Setubal & J. Cabral, 340 (ICN)	x	x	x	
Dichondra sericea Sw.	R. Setubal & M. Grings, 644 (ICN)	x	x		
Evolvulus sericeus Sw.	R. Setubal, 342 (ICN)	x	x	x	
Ipomoea uruguayensis Meisn. in Mart.	R. Setubal, 341 (ICN)	x			
Crassulaceae					
Crassula longipes (Rose) M. Bywater & Wickens	R. Setubal & M. Grings, 652 (ICN)		x		
Cyperaceae					
Bulbostylis consanguinea Nees	R. Setubal & G. Seger, 35 (ICN)			x	
Bulbostylis juncoides (Vahl) Kük. ex Osten	R. Setubal & I. Boldrini, 33 (ICN)	x	x		
Bulbostylis sphaerocephala (Boeck.) C.B. Clarke	R. Setubal, 34 (ICN)	x		x	x
Bulbostylis subtilis M.G. López	R. Setubal, 766 (ICN)	x	x	x	
Bulbostylis cf. *hirtella* (Schrad. Ex Schult.) Nees ex Urb.	R. Setubal, 767 (ICN)			x	
Carex bonariensis Desf. ex Poir.	R. Setubal, 768 (ICN)			x	
Carex phalaroides Kunth	R. Setubal, 769 (ICN)		x	x	
Carex sororia Kunth	R. Setubal, 770 (ICN)			x	
Cyperus aggregatus (Willd.) Endl.	R. Setubal, 32 (ICN)	x	x		
Cyperus incomtus Kunth	R. Setubal, 771 (ICN)			x	
Cyperus haspan L. var. *haspan*	R. Setubal, 30 (ICN)				x
Cyperus luzulae (L.) Rottb. ex Retz.	R. Setubal, 772 (ICN)			x	
Cyperus reflexus var. *fraternus* (Kunth) Kuntze	R. Setubal, 29 (ICN)	x			x
Cyperus virens Michx.	R. Setubal, 27 (ICN)				x
Eleocharis maculosa (Vahl) Roem. & Schult.	R. Setubal & A. Mello, 28 (ICN)			x	x
Eleocharis minima Kunth	R. Setubal, 773 (ICN)				x
Eleocharis montana (Kunth) Roem & Schult.	R. Setubal & J. Bassi, 25 (ICN)				x
Eleocharis nudipes (Kunth) Palla	R. Setubal & J. Bassi, 26 (ICN)				x
Eleocharis obtusetrigona (Lindl. & Nees) Steud.	R. Setubal, 774 (ICN)				x
Eleocharis viridans Kük. ex Osten	R. Setubal, 775 (ICN)				x
Fimbristylis complanata (Retz.) Link	R. Setubal & M. Rigo, 776	x			
Fimbristylis sp.	R. Setubal, 745 (ICN)			x	x
Fuirena incompleta Nees	R. Setubal, 777 (ICN)			x	
Kyllinga odorata Vahl	R. Setubal, 778 (ICN)			x	
Lipocarpha humboldtiana Nees	R. Setubal, 779 (ICN)			x	x
Pycreus megapotamicus var. *jaeggii* (Boeck.) Guagl.	R. Setubal, 780 (ICN)			x	
Rhynchospora barrosiana Guagl.	R. Setubal, 781 (ICN)	x		x	x
Rhynchospora brownii subsp. a*mericana* Guagl.	R. Setubal, 782 (ICN)			x	
Rhynchospora emaciata (Nees) Boeck.	R. Setubal, 18 (ICN)			x	x
Rhynchospora hieronymii subsp. m*ontevidensis* Guagl.	R. Setubal *et al.*, 451 (ICN)				x
Rhynchospora holoschoenoides (Rich.) Herter	R. Setubal, 783 (ICN)				x
Rhynchospora megapotamica (Spreng.) H. Pfeiff.	R. Setubal & M. Grings, 653 (ICN)			x	
Rhynchospora rugosa (Vahl) Gale	R. Setubal & A. Mello, 24 (ICN)	x	x		
Rhynchospora setigera Griseb.	R. Setubal, 17 (ICN)	x	x		
Scleria balansae Maury	R. Setubal, 784 (ICN)	x		x	
Scleria distans Poir.	R. Setubal, 16 (ICN)			x	x
Scleria sellowiana Kunth	R. Setubal, 785 (ICN)			x	
Scirpus giganteus Kunth	R. Setubal & R. Trevisan, 708 (ICN)				x
Dioscoreaceae					
Dioscorea multiflora Mart.	R. Setubal, 333 (ICN)	x	x		
Droseraceae					
Drosera brevifolia Pursh	R. Setubal, 334 (ICN)			x	x
Ericaceae					
Agarista eucalyptoides (Cham. & Schltdl.) G. Don	R. Setubal, 386 (ICN)	x	x		

Table 1. cont.

Family/Species	Voucher	DG	RG	HG	WL
Euphorbiaceae					
Acalypha communis Müll. Arg.	R. Setubal, 335 (ICN)	x	x		
Bernardia multicaulis Müll. Arg.	R. Setubal, 786 (ICN)	x	x	x	
Bernardia sp.	R. Setubal, 787 (ICN)		x		
Croton gnaphalii Baill.	R. Setubal & M. Grings, 336 (ICN)	x	x		
Croton thermarum Müll. Arg.	R. Setubal & A. Mello, 337 (ICN)	x	x		
Croton sp.	R. Setubal & M. Grings, 472 (ICN)		x		
Euphorbia selloi (Klotzsch & Garcke) Boiss.	R. Setubal, 338 (ICN)	x	x		
Tragia bahiensis Müll. Arg.	R. Setubal & M. Grings, 453 (ICN)		x		
Tragia uberabana Müll. Arg.	R. Setubal & M. Grings, 454 (ICN)		x		
Fabaceae					
Aeschynomene falcata (Poir.) DC.	R. Setubal, 789 (ICN)	x	x		
Aeschynomene histrix Poir. var. *histrix*	R. Setubal, 160 (ICN)	x	x		
Centrosema virginianum (L.) Benth.	R. Setubal, 161 (ICN)	x	x		
Chamaecrista nictitans (L.) Moench subsp. *patellaria* var. *ramosa*	R. Setubal, 162 (ICN)	x	x		
Chamaecrista repens (Vogel) H.S. Irwin & Barneby	R. Setubal, 164 (ICN)	x	x		
Clitoria nana Benth.	R. Setubal, 790 (ICN)	x	x		
Collaea stenophylla (Hook. & Arn.) Benth.	R. Setubal, 163 (ICN)	x	x	x	
Crotalaria tweediana Benth.	R. Setubal & I. Boldrini, 165 (ICN)	x	x		
Desmanthus virgatus (L.) Willd.	R. Setubal & J. Bassi, 166 (ICN)	x	x	x	
Desmodium adscendens (Sw.) DC.	R. Setubal & J. Bassi, 167 (ICN)	x		x	x
Desmodium arechavaletae Burkart	R. Setubal & M. Grings, 416 (ICN)		x		
Desmodium barbatum Wall.	R. Setubal *et al*., 711 (ICN)	x			
Desmodium cuneatum Hook. & Arn.	R. Setubal, 168 (ICN)	x	x		
Desmodium incanum DC.	R. Setubal & J. Bassi, 169 (ICN)	x	x		
Desmodium uncinatum (Jacq.) DC.	R. Setubal *et al*., 698 (ICN)	x			
Eriosema tacuaremboense Arechav.	R. Setubal, 170 (ICN)	x	x		
Galactia gracillima Benth.	R. Setubal, 791 (ICN)	x	x		
Galactia neesii var. *australis* Malme	R. Setubal & A. Mello, 171 (ICN)	x	x	x	
Galactia pretiosa Burkart var. *pretiosa*	R. Setubal, 172 (ICN)	x	x	x	
Lathyrus nervosus Boiss.	R. Setubal, 173 (ICN)		x	x	
Lupinus bracteolaris Desr.	R. Setubal & A. Mello, 174 (ICN)	x	x		
Lupinus lanatus Benth.	R. Setubal, 792 (ICN)		x		
Lupinus linearifolius Larrañaga	R. Setubal & M. Grings, 455 (ICN)	x	x		
Macroptilium erythroloma (Mart. ex Benth.) Urb.	R. Setubal *et al*., 445 (ICN)	x			
Macroptilium prostratum (Benth.) Urb.	R. Setubal, 176 (ICN)	x	x		
Mimosa acerba Benth.	R. Setubal, 459 (ICN)	x	x		
Mimosa bimucronata (DC.) Kuntze	R. Setubal, 396 (ICN)	x		x	
Mimosa cruenta Benth. var. cruenta	R. Setubal, 440 (ICN)	x	x	x	
Mimosa daleoides Benth.	R. Setubal & G. Seger, 479 (ICN)	x	x		
Mimosa dolens var. *rigida* (Benth.) Barneby	R. Setubal, 793 (ICN)	x	x		
Mimosa parvipinna Benth.	R. Setubal & M. Grings, 466 (ICN)	x	x		
Mimosa schleidenii Herter	R. Setubal & M. Grings, 685 (ICN)	x	x		
Mimosa cf. *flagellaris* Benth.	R. Setubal, 794 (ICN)	x	x	x	
Mimosa cf. *simulans* Burkart	R. Setubal & M. Grings, 486 (ICN)	x	x		
Mimosa sp.	R. Setubal, 795 (ICN)	x	x		
Poiretia tetraphylla (Poir.) Burkart	R. Setubal & M. Grings, 177 (ICN)	x	x	x	
Rhynchosia corylifolia Mart. ex Benth.	R. Setubal, 178 (ICN)	x	x		
Rhynchosia diversifolia Micheli	R. Setubal & J. Bassi, 179 (ICN)	x	x		
Rhynchosia hauthalli (Kuntze) Grear	R. Setubal & A. Mello, 180 (ICN)	x	x		
Rhynchosia lateritia Burkart	R. Setubal, 796 (ICN)	x			
Stylosanthes leiocarpa Vogel	R. Setubal *et al*., 706 (ICN)	x	x		
Stylosanthes montevidensis Vogel	R. Setubal & M. Grings, 181 (ICN)	x	x	x	
Trifolium polymorphum Poir.	R. Setubal *et al*., 182 (ICN)	x	x		
Vigna peduncularis (Kunth) Fawc. & Rendle	R. Setubal & M. Grings, 183 (ICN)	x	x		
Zornia burkartii Vanni	R. Setubal, 798 (ICN)	x	x		
Zornia lanata Mohlenbr.	R. Setubal, 799 (ICN)	x	x		
Zornia orbiculata Mohlenbr.	R. Setubal *et al*., 461 (ICN)	x	x	x	
Gentianaceae					
Zygostigma australe (Cham. & Schltdl.) Griseb.	R. Setubal, 425 (ICN)	x	x	x	
Gesneriaceae					
Sinningia allagophylla (Mart.) Wiehler	R. Setubal, 80 (ICN)	x	x		
Sinningia macrostachya (Lindl.) Chautems	R. Setubal & P. Ferreira, 655 (ICN)		x		
Hypericaceae					
Hypericum caprifoliatum Cham. & Schltdl.	R. Setubal & I. Boldrini, 79 (ICN)	x			
Hypericum connatum Lam.	R. Setubal & J. Bassi, 384 (ICN)	x			
Hypericum myrianthum Cham. & Schltdl.	R. Setubal, 800 (ICN)	x			
Hypericum piriai Arechav.	R. Setubal *et al*., 418 (ICN)		x		
Hypoxidaceae					
Hypoxis decumbens L.	R. Setubal, 385 (ICN)	x		x	
Iridaceae					
Cypella coelestis (Lehm.) Diels	R. Setubal, 122 (ICN)				x
Cypella herbertii Hook.	R. Setubal, 121 (ICN)	x	x		
Gelasine elongata (Graham) Ravenna	R. Setubal, 120 (ICN)	x	x	x	
Herbertia pulchella Sweet	R. Setubal & M. S. Rigo, 741 (ICN)	x	x	x	
Sisyrinchium micranthum Cav.	R. Setubal & A. Mello, 119 (ICN)	x	x		
Sisyrinchium minutiflorum Klatt	R. Setubal & A. Mello, 117 (ICN)		x		
Sisyrinchium palmifolium L.	R. Setubal, 126 (ICN)	x	x	x	
Sisyrinchium scariosum I. M. Johnst.	R. Setubal, 124 (ICN)		x		

Table 1. cont.

Family/Species	Voucher	DG	RG	HG	WL
Sisyrinchium sellowianum Klatt	R. Setubal & J. Bassi, 125 (ICN)		x		
Sisyrinchium vaginatum Spreng.	R. Setubal, 129 (ICN)	x	x	x	
Trimezia spathata (Baker) Ravenna	R. Setubal, 130 (ICN)	x	x		
Juncaceae					
Juncus bufonius L.	R. Setubal, 802 (ICN)			x	x
Juncus microcephalus Kunth	R. Setubal & A. Mello, 383 (ICN)				x
Juncus tenuis Willd.	R. Setubal, 803 (ICN)			x	x
Lamiaceae					
Glechon ciliata Benth.	R. Setubal, 372 (ICN)	x	x	x	
Hyptis brevipes Poit.	R. Setubal *et al.*, 471 (ICN)	x			
Hyptis fasciculata subsp. f*astigiata* (Benth.) Harley	R. Setubal & A. Mello, 470 (ICN)			x	
Hyptis lorentziana O. Hoffm.	R. Setubal, 804 (ICN)	x			
Hyptis mutabilis (Rich.) Briq.	R. Setubal & J. Bassi, 382 (ICN)	x			
Hyptis stricta Benth.	R. Setubal & M. Grings, 381 (ICN)		x		
Hyptis aff. *balansae* Briq.	R. Setubal & A. Mello, 468 (ICN)			x	
Salvia procurrens Benth.	R. Setubal & M. Grings, 373 (ICN)	x			
Lentibulariaceae					
Utricularia subulata L.	R. Setubal & J. Bassi, 488 (ICN)				x
Utricularia tridentata Sylvén	R. Setubal & J. Bassi, 489 (ICN)				x
Linaceae					
Cliococca selaginoides (Lam.) C.M. Rogers & Mildner	R. Setubal & M. Grings, 74 (ICN)	x	x		
Linum burkartii Mildner	R. Setubal, 805 (ICN)		x		
Lythraceae					
Cuphea carthagenensis (Jacq.) J.F. Macbr.	R. Setubal & A. Mello, 370 (ICN)	x		x	
Cuphea thymoides Cham. & Schltdl.	R. Setubal & J. Bassi, 371 (ICN)	x			
Malpighiaceae					
Galphimia australis Chodat	R. Setubal & M. Grings, 73 (ICN)	x	x		
Janusia guaranitica (A. St.-Hil.) A. Juss.	R. Setubal, 369 (ICN)	x			
Malvaceae					
Abutilon malachroides A. St.-Hil. & Naudin	R. Setubal & A. Mello, 81 (ICN)	x	x		
Abutilon umbelliflorum A. St.-Hil.	R. Setubal, 476 (ICN)	x			
Krapovickasia urticifolia (A. St.-Hil.) Fryxell	R. Setubal, 84 (ICN)	x	x		
Melochia pilosa (Mill.) Fawc. & Rendle	R. Setubal & J. Bassi, 276 (ICN)	x	x		
Pavonia friesii Krapov.	R. Setubal & G. Seger, 83 (ICN)	x	x		
Sida regnellii R.E. Fr.	R. Setubal, 806 (ICN)	x			
Sida urens L.	R. Setubal, 807 (ICN)	x			
Sida viarum A. St.-Hil.	R. Setubal, 808 (ICN)	x			
Waltheria douradinha A. St.-Hil.	R. Setubal & M. Grings, 361 (ICN)	x	x		
Wissadula glechomatifolia (St. Hil.) R. E. Fries	R. Setubal & A. Mello, 87 (ICN)	x	x	x	
Melastomataceae					
Tibouchina gracilis (Bonpl.) Cogn.	R. Setubal, 262 (ICN)	x	x	x	
Tibouchina urbanii Cogn.	R. Setubal, 467 (ICN)				x
Menyanthaceae					
Nymphoides indica (L.) Kuntze	R. Setubal, 809 (ICN)				x
Moraceae					
Dorstenia brasiliensis Lam.	R. Setubal, 810 (ICN)	x	x		
Myrsinaceae					
Anagallis minima (L.) E.H.L. Krause	R. Setubal & A. Mello, 417 (ICN)		x	x	
Myrtaceae					
Campomanesia aurea Berg	R. Setubal, 265 (ICN)	x	x		
Eugenia dimorpha O. Berg	R. Setubal & M. S. Rigo, 689 (ICN)	x	x		
Myrcia verticillaris O. Berg	R. Setubal *et al.*, 267 (ICN)	x			
Psidium incanum (O. Berg) Burret	R. Setubal & M. Grings, 269 (ICN)		x		
Psidium luridum (Spreng.) Burret	R. Setubal & M. Grings, 268 (ICN)		x		
Onagraceae					
Ludwigia caparosa (Cambess.) H. Hara	R. Setubal & A. Mello, 272 (ICN)				x
Ludwigia peruviana (L.) H. Hara	R. Setubal & J. Bassi, 270 (ICN)				x
Oenothera mollissima L.	R. Setubal *et al.*, 464 (ICN)	x		x	
Oenothera ravenii W. Dietr.	R. Setubal & A. Mello, 271 (ICN)			x	
Orchidaceae					
Cyrtopodium sp.	R. Setubal & M. Grings, 88 (ICN)		x		
Epidendrum fulgens Brongn.	R. Setubal, 95 (ICN)		x		
Habenaria edwallii Cogn.	R. Setubal, 811 (ICN)			x	
Habenaria parviflora Lindl.	R. Setubal, 91 (ICN)	x		x	
Habenaria cf. *secunda* Lindl.	R. Setubal, 90 (ICN)	x		x	
Liparis vexillifera (Lex.) Cogn.	R. Setubal, 92 (ICN)		x		
Pelexia cf. *bonariensis* (Lindl.) Schltr.	R. Setubal, 89 (ICN)			x	
Prescotia densiflora Lindl.	R. Setubal & M. Grings, 72 (ICN)		x		
Sacoila lanceolata (Aubl.) Garay	R. Setubal, 94 (ICN)	x	x		
Skeptrostachys arechavaletanii (Barb. Rodr.) Garay	R. Setubal & J. Bassi, 93 (ICN)	x	x		
Orobanchaceae					
Buchnera longifolia Kunth	R. Setubal & D. Fuhro, 446 (ICN)	x	x	x	
Castilleja arvensis Cham. & Schl.	R. Setubal *et al.*, 275 (ICN)		x		
Oxalidaceae					
Oxalis bipartita A. St.-Hil.	R. Setubal & G. Seger, 353 (ICN)			x	x
Oxalis brasiliensis G. Lodd.	R. Setubal, 354 (ICN)	x	x		
Oxalis eriocarpa DC.	R. Setubal, 273 (ICN)		x		
Oxalis perdicaria (Molina) Bertero	R. Setubal & I. Boldrini, 430 (ICN)		x		
Parnassiaceae					
Lepuropetalon spathulatum (Muehl.) Eliot	R. Setubal & M. Grings, 657 (ICN)		x	x	

Table 1. cont.

Family/Species	Voucher	DG	RG	HG	WL
Passifloraceae					
Passiflora foetida L.	R. Setubal, 355 (ICN)		x		
Phyllanthaceae					
Phyllanthus niruri L.	R. Setubal, 788 (ICN)	x		x	
Plantaginaceae					
Angelonia integerrima Spreng.	R. Setubal, 359 (ICN)	x	x		
Gratiola peruviana L.	R. Setubal & A. Mello, 433 (ICN)		x		
Mecardonia tenella (Cham. & Schltdl.) Pennell	R. Setubal, 812 (ICN)		x	x	
Plantago australis Lam.	R. Setubal, 356 (ICN)	x			
Plantago myosuros Lam.	R. Setubal & A. Mello, 423 (ICN)		x		
Scoparia dulcis L.	R. Setubal, 813 (ICN)	x			
Scoparia ericacea Cham. & Schltdl.	R. Setubal *et al.*, 487 (ICN)		x		
Poaceae					
Agrostis tandilensis (Kuntze) Parodi	R. Setubal & I. Boldrini, 224 (ICN)		x		
Andropogon bicornis L.	R. Setubal *et al.*, 395 (ICN)	x			
Andropogon glaucophyllus	R. Setubal, 814 (ICN)		x		
Andropogon lateralis Nees	R. Setubal, 225 (ICN)	x	x	x	
Andropogon leucostachyus Kunth	R. Setubal & M. Grings, 226 (ICN)	x			
Andropogon macrothrix Trin.	R. Setubal & I. Boldrini, 432 (ICN)			x	
Andropogon selloanus (Hack.) Hack.	R. Setubal, 227 (ICN)	x			
Andropogon virgatus Desv. ex Ham.	R. Setubal & M. Grings, 228 (ICN)			x	x
Aristida circinalis Lindm.	R. Setubal & I. Boldrini, 658 (ICN)	x			
Aristida filifolia (Arechav.) Herter	R. Setubal & I. Boldrini, 680 (ICN)	x	x		
Aristida flaccida Trin. & Rupr.	R. Setubal & I. Boldrini, 694 (ICN)	x	x		
Aristida jubata (Arechav.) Herter	R. Setubal *et al.*, 229 (ICN)	x	x		
Aristida laevis (Nees) Kunth	R. Setubal, 681 (ICN)	x	x	x	
Aristida teretifolia Arechav.	R. Setubal *et al.*, 376 (ICN)		x		
Axonopus affinis Chase	R. Setubal & I. Boldrini, 695 (ICN)			x	
Axonopus compressus (Sw.) P. Beauv.	R. Setubal & I. Boldrini, 710 (ICN)	x			
Axonopus polystachyus G.A. Black	R. Setubal, 815 (ICN)	x			
Axonopus purpusii (Mez) Chase	R. Setubal & A. Mello, 428 (ICN)			x	
Axonopus siccus (Nees) Kuhlm.	R. Setubal *et al.*, 679 (ICN)	x			
Axonopus suffultus (Mikan ex Trin.) Parodi	R. Setubal *et al.*, 230 (ICN)	x	x		
Bothriochloa laguroides (DC.) Herter	R. Setubal & I. Boldrini, 431 (ICN)	x			
Briza calotheca (Trin.) Hack.	R. Setubal, 677 (ICN)	x			
Briza lamarckiana Nees	R. Setubal & G. Seger, 676 (ICN)	x			
Briza poaemorpha (J. Presl) Henrard	R. Setubal & A. Mello, 674 (ICN)	x			
Briza rufa (J. Presl) Steud.	R. Setubal, 816 (ICN)	x			
Briza subaristata Lam.	R. Setubal, 672 (ICN)	x	x	x	
Briza uniolae (Nees) Nees ex Steud.	R. Setubal & J. Bassi, 673 (ICN)	x	x	x	
Calamagrostis alba (J. Presl) Steud.	R. Setubal & A. Mello, 231 (ICN)	x	x	x	
Calamagrostis viridiflavescens (Poir.) Steud. var. *viridiflavescens*	R. Setubal, 234 (ICN)	x	x		
Coelorachis selloana (Hack.) A. Camus	R. Setubal & I. Boldrini, 671 (ICN)	x	x		
Danthonia cirrata Hack. & Arechav.	R. Setubal, 232 (ICN)	x			
Dichanthelium sabulorum (Lam.) Gould. & C.A. Clark	R. Setubal, 626 (ICN)	x	x	x	x
Elyonurus candidus (Trin.) Hack.	R. Setubal, 235 (ICN)	x	x	x	
Eragrostis airoides Nees	R. Setubal & J. Cabral, 670 (ICN)			x	x
Eragrostis bahiensis Schrad. ex Schult.	R. Setubal, 237 (ICN)	x			
Eragrostis neesii Trin.	R. Setubal & J. Bassi, 238 (ICN)		x		
Eragrostis sp.	R. Setubal & J. Bassi, 240 (ICN)			x	
Eriochrysis cayennensis P. Beauv.	R. Setubal & G. Seger, 667 (ICN)			x	x
Eustachys distichophylla (Lag.) Nees	R. Setubal, 683 (ICN)	x			
Eustachys uliginosa (Hack.) Herter	R. Setubal, 684 (ICN)	x	x	x	
Gymnopogon burchellii (Munro ex Doell) Ekman	R. Setubal & G. Seger, 241 (ICN)	x	x	x	
Ischaemum minus J. Presl	R. Setubal & A. Mello, 668 (ICN)				x
Leptocoryphium lanatum (Kunth) Nees	R. Setubal *et al.*, 243 (ICN)	x	x		
Luziola peruviana Juss. ex J. F. Gmel.	R. Setubal & M. Grings, 656 (ICN)				x
Melica brasiliana Ard.	R. Setubal & G. Seger, 666 (ICN)	x			
Microchloa indica (L. f.) P. Beauv.	R. Setubal, 817 (ICN)		x		
Panicum aquaticum Poir.	R. Setubal, 244 (ICN)				x
Panicum grumosum Nees	R. Setubal, 744 (ICN)				x
Panicum olyroides Kunth var. *olyroides*	R. Setubal, 614 (ICN)	x			
Panicum parvifolium Lam.	R. Setubal, 245 (ICN)				x
Paspalum conjugatum P.J. Bergius	R. Setubal, 253 (ICN)				x
Paspalum ionanthum Chase	R. Setubal & A. Mello, 189 (ICN)	x	x	x	
Paspalum maculosum Trin.	R. Setubal, 191 (ICN)	x		x	x
Paspalum mandiocanum Trin.	R. Setubal & I. Boldrini, 190 (ICN)	x		x	
Paspalum notatum Flügge	R. Setubal, 818 (ICN)	x			
Paspalum plicatulum Michx.	R. Setubal, 193 (ICN)	x	x	x	x
Paspalum polyphyllum Nees ex Trin.	R. Setubal *et al.*, 192 (ICN)	x			
Paspalum pumilum Nees	R. Setubal, 820 (ICN)			x	
Paspalum quarinii Morrone & Zuloaga	R. Setubal, 188 (ICN)			x	
Paspalum urvillei Steud.	R. Setubal & M. Grings, 194 (ICN)	x		x	x
Paspalum cf. *plicatulum* Michx.	R. Setubal & M. Grings, 606 (ICN)	x			
Phalaris angusta Nees ex Trin.	R. Setubal *et al.*, 252 (ICN)		x		
Piptochaetium montevidense (Spreng.) Parodi	R. Setubal & J. Bassi, 663 (ICN)	x	x	x	
Piptochaetium ruprechtianum E. Desv.	R. Setubal & I. Boldrini, 662 (ICN)	x			
Polypogon chilensis (Kunth) Pilg.	R. Setubal & J. Bassi, 251 (ICN)	x			
Saccharum angustifolium (Nees) Trin.	R. Setubal *et al.*, 250 (ICN)	x			

Table 1. cont.

Family/Species	Voucher	DG	RG	HG	WL
Saccharum asperum (Nees) Steud.	R. Setubal & M. Grings, 377 (ICN)	x			
Saccharum villosum Steud.	R. Setubal, 248 (ICN)	x		x	x
Schizachyrium imberbe (Hack.) A. Camus	R. Setubal & I. Boldrini, 701 (ICN)	x	x		
Schizachyrium microstachyum (Desv. ex Ham.) Roseng., B.R. Arrill. & Izag.	R. Setubal & M. Grings, 247 (ICN)	x	x		
Schizachyrium microstachyum subsp. *elongatum* (Hack.) Roseng., B.R. Arrill. & Izag.	R. Setubal, 821 (ICN)	x			
Schizachyrium tenerum Nees	R. Setubal *et al.*, 249 (ICN)	x	x	x	
Setaria parviflora (Poir.) Kerguélen	R. Setubal & A. Mello, 661 (ICN)	x	x	x	
Setaria vaginata Spreng.	R. Setubal & A. Mello, 660 (ICN)	x		x	
Sorghastrum albescens (E. Fourn.) Beetle	R. Setubal, 254 (ICN)	x	x	x	
Sporobolus camporum Swallen	R. Setubal & M. Grings, 255 (ICN)		x		
Sporobolus indicus (L.) R. Br.	R. Setubal & I. Boldrini, 659 (ICN)	x			
Steinchisma decipiens (Nees ex Trin.) W.V. Br.	R. Setubal, 822 (ICN)			x	
Steinchisma hians (Elliott) Nash	R. Setubal, 823 (ICN)			x	
Steinchisma laxa (Sw.) Zuloaga	R. Setubal, 256 (ICN)				x
Stipa filiculmis Delile	R. Setubal, 196 (ICN)	x	x		
Stipa filifolia Nees	R. Setubal & I. Boldrini, 702 (ICN)	x	x		
Stipa juergensii Hack.	R. Setubal & I. Boldrini, 195 (ICN)	x			
Stipa megapotamia Spreng. ex Trin.	R. Setubal, 824 (ICN)	x			
Stipa melanosperma J. Presl.	R. Setubal, 197 (ICN)	x	x		
Stipa nutans Hack.	R. Setubal & I. Boldrini, 199 (ICN)	x		x	
Thrasyopsis juergensii (Hack.) Soderstr. & A.G. Burm.	R. Setubal *et al.*, 76 (ICN)		x		
Trachypogon montufarii (Kunth) Nees var. *montufarii*	R. Setubal & I. Boldrini, 257 (ICN)	x	x		
Trachypogon montufarii var. *mollis* (Nees) Andersson	R. Setubal, 825 (ICN)	x	x	x	
Tripogon spicatus (Nees) Ekman	R. Setubal, 819 (ICN)		x		
Polygalaceae					
Monnina oblongifolia Arechav.	R. Setubal, 116 (ICN)	x	x		
Polygala adenophylla A. St.-Hil. & Moq.	R. Setubal, 109 (ICN)	x	x		
Polygala brasiliensis L.	R. Setubal & A. Mello, 112 (ICN)			x	
Polygala extraaxillaris Chodat	R. Setubal, 111 (ICN)	x		x	
Polygala leptocaulis Torr. & A. Gray	R. Setubal & A. Mello, 113 (ICN)			x	
Polygala molluginifolia A. St.-Hil. & Moq.	R. Setubal & G. Seger, 115 (ICN)	x		x	
Polygala pulchella A. St.-Hil. & Moq.	R. Setubal, 826 (ICN)			x	
Polygonaceae					
Polygonum punctatum Elliott	R. Setubal, 484 (ICN)				x
Pontederiaceae					
Heteranthera reniformis Ruiz & Pav.	R. Setubal, 827 (ICN)				x
Rubiaceae					
Coccocypselum lanceolatum (Ruiz & Pav.) Pers.	R. Setubal, 135 (ICN)	x			
Diodia alata Nees & Mart.	R. Setubal, 137 (ICN)	x			
Diodia apiculata (Willd. ex Roem. & Schult.) K. Schum.	R. Setubal *et al.*, 136 (ICN)	x			
Diodia dasycephala Cham. & Schltdl.	R. Setubal, 829 (ICN)	x			
Diodia saponariifolia (Cham. & Schltdl.) K. Schum.	R. Setubal, 148 (ICN)				x
Galianthe fastigiata Griseb.	R. Setubal, 146 (ICN)	x	x	x	
Galium hirtum (Lam.) K. Schum.	R. Setubal & M. Grings, 687 (ICN)	x	x	x	
Galium humile Cham. & Schltdl.	R. Setubal, 830 (ICN)	x	x	x	
Galium megapotamicum (Spreng.) Ehrend.	R. Setubal & M. Grings, 686 (ICN)	x	x	x	
Galium richardianum (Gillies ex Hook. & Arn.) Hicken	R. Setubal, 831 (ICN)	x	x		
Richardia brasiliensis Gomes	R. Setubal, 832 (ICN)	x			
Richardia grandiflora (Cham. & Schltdl.) Steud.	R. Setubal, 145 (ICN)	x	x		
Richardia humistrata (Cham. & Schltdl.) Steud.	R. Setubal & J. Bassi, 143 (ICN)	x	x		
Richardia stellaris (Cham. & Schltdl.) Steud.	R. Setubal, 833 (ICN)	x			
Spermacoce capitata (Ruiz & Pav.) DC.	R. Setubal, 134 (ICN)	x	x		
Spermacoce eryngioides Cham. & Schltdl.	R. Setubal, 828 (ICN)	x			
Spermacoce verticillata (L.) G. Mey	R. Setubal & J. Bassi, 131 (ICN)	x	x		
Sapindaceae					
Dodonaea viscosa Jacq.	R. Setubal & A. Mello, 358 (ICN)	x			
Scrophulariaceae					
Buddleia brasiliensis Jacq. ex Spreng.	R. Setubal, 834 (ICN)	x			
Buddleia thyrsoides Lam.	R. Setubal *et al.*, 346 (ICN)		x		
Smilacaceae					
Smilax campestris Griseb.	R. Setubal & J. Bassi, 360 (ICN)	x	x	x	
Solanaceae					
Calibrachoa excellens R. E. Fries	R. Setubal, 835 (ICN)	x	x		
Calibrachoa ovalifolia (Miers) Stehmann & Semir	R. Setubal, 836 (ICN)	x	x		
Nicotiana bonariensis Lehm.	R. Setubal & A. Mello, 77 (ICN)	x		x	
Petunia integrifolia (Hook.) Schinz & Thell.	R. Setubal, 837 (ICN)	x	x		
Solanum commersonii Dunal	R. Setubal, 838 (ICN)	x			
Solanum sisymbrifolium Lam.	R. Setubal & G. Seger, 388 (ICN)	x			
Solanum viarum Dunal	R. Setubal, 839 (ICN)	x			
Turneraceae					
Piriqueta selloi Urb.	R. Setubal, 71 (ICN)	x	x		
Turnera sidoides L.	R. Setubal *et al.*, 70 (ICN)	x	x		
Verbenaceae					
Glandularia marrubioides (Cham.) Tronc.	R. Setubal, 447 (ICN)	x	x		
Glandularia phlogiflora (Cham.) Schnack & Covas	R. Setubal, 840 (ICN)	x			
Glandularia thymoides (Cham.) N. O'Leary	R. Setubal, 394 (ICN)	x	x	x	
Lantana camara L.	R. Setubal & J. Bassi, 391 (ICN)	x	x		

Table 1. cont.

Family/Species	Voucher	DG	RG	HG	WL
Lantana megapotamica (Spreng.) Tronc.	R. Setubal, 841 (ICN)	x	x		
Lantana montevidensis (Spreng.) Briq.	R. Setubal & J. Bassi, 390 (ICN)	x	x		
Lippia hieracifolia Cham.	R. Setubal, 393 (ICN)	x	x	x	
Lippia aff. *pusila*	R. Setubal & M. Grings, 616 (ICN)	x	x		
Stachytarpheta cayennensis (Rich.) Vahl	R. Setubal & J. Bassi, 392 (ICN)	x	x		
Verbena ephedroides Cham.	R. Setubal, 842 (ICN)		x		
Verbena intermedia Gillies & Hook. ex Hook.	R. Setubal, 604 (ICN)	x		x	
Verbena litoralis Kunth	R. Setubal, 843 (ICN)			x	
Verbena montevidensis Spreng.	R. Setubal, 844 (ICN)	x			
Verbena rigida Spreng.	R. Setubal, 845 (ICN)	x		x	
Verbena cf. *hispida* Ruiz & Pav.	R. Setubal, 846 (ICN)	x			
Violaceae					
Hybanthus parviflorus (Mutis ex L. f.) Baill.	R. Setubal, 378 (ICN)	x			

grassland vegetation are described at the end of this topic. Furthermore, we emphasize that the proposed vegetation formations are not uniform, so that interpenetration zones may occur due to micro-variations of the aforementioned factors.

Dry grasslands are well distributed along the granitic hill, being the formation that covers the largest area. Usually, these formations cover smoothly undulated relief, also occurring in plain to strongly undulated areas, with or without rock outcrops (Fig. 3A-C). This vegetation type seems to occupy all mentioned soil types, covering areas in which drainage varies from well drained to moderately drained, where situations of quick water removal or prolonged saturation after rainfall may occur. We registered 370 species in this formation. Predominating in the physiognomy were cespitous grass species such as *Andropogon lateralis, Aristida filifolia, Sorghastrum albescens* and *Stipa melanosperma* (Fig. 3E), subshrubs such as *Collaea stenophylla* (Fig. 3F) and *Desmanthus virgatus*, and herbaceous species such as *Eryngium pristis* (Fig. 3 G), *Centrosema virginianum*, *Richardia grandiflora* (Fig. 3D) and *Vernonia flexuosa*. In some areas, shrub species of *Baccharis* and *Eupatorium*, that alongside *Heterothalamus psiadioides*, *Mimosa daleoides*, *Hyptis mutabilis, Dodonaea viscosa,* shape the shrubland formation (locally known as *vassourais*) (Fig. 3H-I), may be very abundant. This formation is more commonly observed at slopes were the original forest was removed, representing an early stage of forest succession, and in areas of grassland-forest transition. However, shrublands were also observed in areas were grassland vegetation predominated. In the absence of disturbances such as fire and grazing, the establishment of pioneer forest species in shrublands is observed, which leads to the formation of insular forest patches, characterizing the forest expansion over the grasslands (Muller & Forneck 2004).

Rocky grasslands are predominantly distributed at hilltops and steep slopes, and are well distributed along the hill. They occur in strongly undulated to montane relief, and are characterized by the occurrence of rock outcrops, boulders and slabs (Fig. 4A-D). They cover shallow to moderately deep Neosols and Cambisols, marked by the absence of B horizon or the occurrence of a Bi horizon, being well drained and with fast water removal after rainfall. We registered 287 species in this formation. Predominating in the physiognomy were herbaceous species such as *Eryngium eriophorum*, *Eupatorium tanacetifolium* (Fig. 4I), *Hysterionica filiformis* (Fig. 4F), *Schlechtendalia luzulifolia* (Fig. 4 G), *Rhynchospora setigera*, *Mandevilla coccinea* (Fig. 4H), *Aristida filifolia, Axonopus suffultus*, *Elyonurus candidus*, *Schizachyrium imberbe* and *Stipa filiculmis*, and shrub species such as *Mimosa* spp. and *Eugenia dimorpha* (Fig. 8H). Species exclusive to this formation are *Alstroemeria albescens* (Fig. 7C)*, Eupatorium tanacetifolium*, *Liparis vexillifera* (Fig. 4E)*, Dyckia choristaminea* (Fig.7E), *Parodia ottonis* (Fig. 7I), *Desmodium arechavaletae*, *Linum burkartii, Epidendrum fulgens* and *Thrasyopsis juergensii* (Fig. 7A). At moister zones, were water and sediment accumulate between rocks, and at humid layers formed by mosses, species such as *Gamochaeta stachydifolia*, *Dyckia leptostachya, Crassula longipes*, *Drosera brevifolia*, *Lepuropetalon spathulatum* (Fig. 7G) and *Microchloa indica* can be found.

Humid grasslands are present in areas of plain and concave relief, which enable water accumulation from rainfall or local water springs. These formations occupy small areas, are less frequent than dry and rocky grasslands but are also well distributed along the hill (Fig. 5A-D). They cover areas with moderately deep to deep Cambisols and Argisols, presenting imperfect drainage, with constant humidity along the year and the possibility of a water layer to be formed in high precipitation periods. A dark-colored A horizon was observed, rich in organic matter, probably due to a larger degrading time it suffers in this particular environment. We registered 157 species in this formation. Predominating in the physiognomy were characteristic herbaceous species such as *Eryngium elegans, Sisyrinchium palmifolium* (Fig. 5G), *Andropogon macrothrix, A. virgatus, Axonopus affinis, Eriochrysis cayennensis* (Fig. 5H), *Paspalum maculosum*, *P. pumilum, P. quarinii* (Fig. 5I), *Saccharum villosum* and *Schizachyrium tenerum.* Some frequent species, but of lesser expression, are *Chaptalia piloselloides, Drosera brevifolia* (Fig. 5F) and *Verbena intermedia*. There is also another differentiated class of humid grasslands, present in concave channels and water-flowing hillsides. These channels shape deeper valleys beyond median height quotas of the hillsides, known as talvegs. The physiognomy at these sites stands out by the presence of herbaceous species such

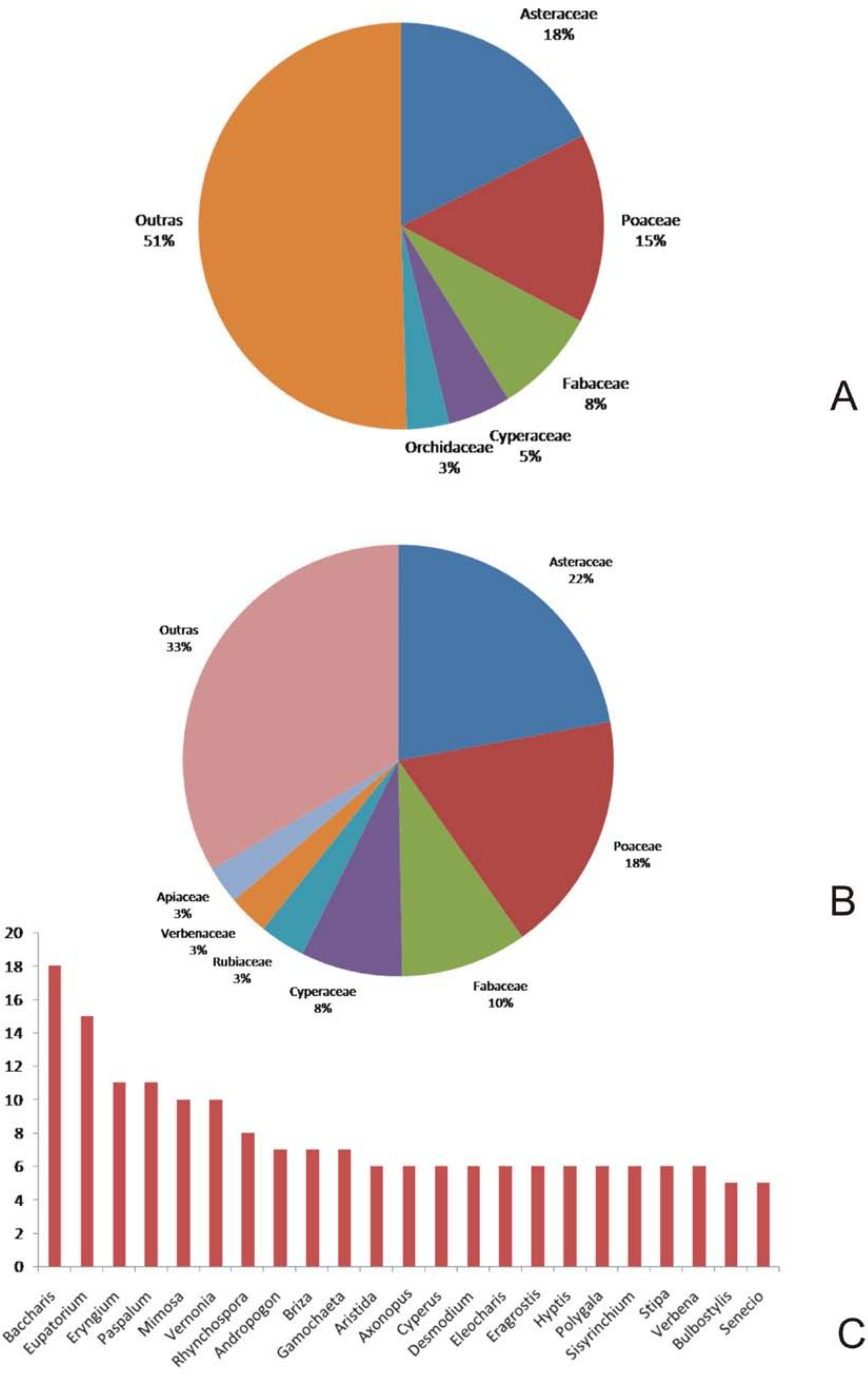

Figure 2. A. Families with most genera registered in the floristic inventory. B. Families with most species registered in the floristic inventory. C. Genera with highest richness and respective species number registered in the floristic inventory.

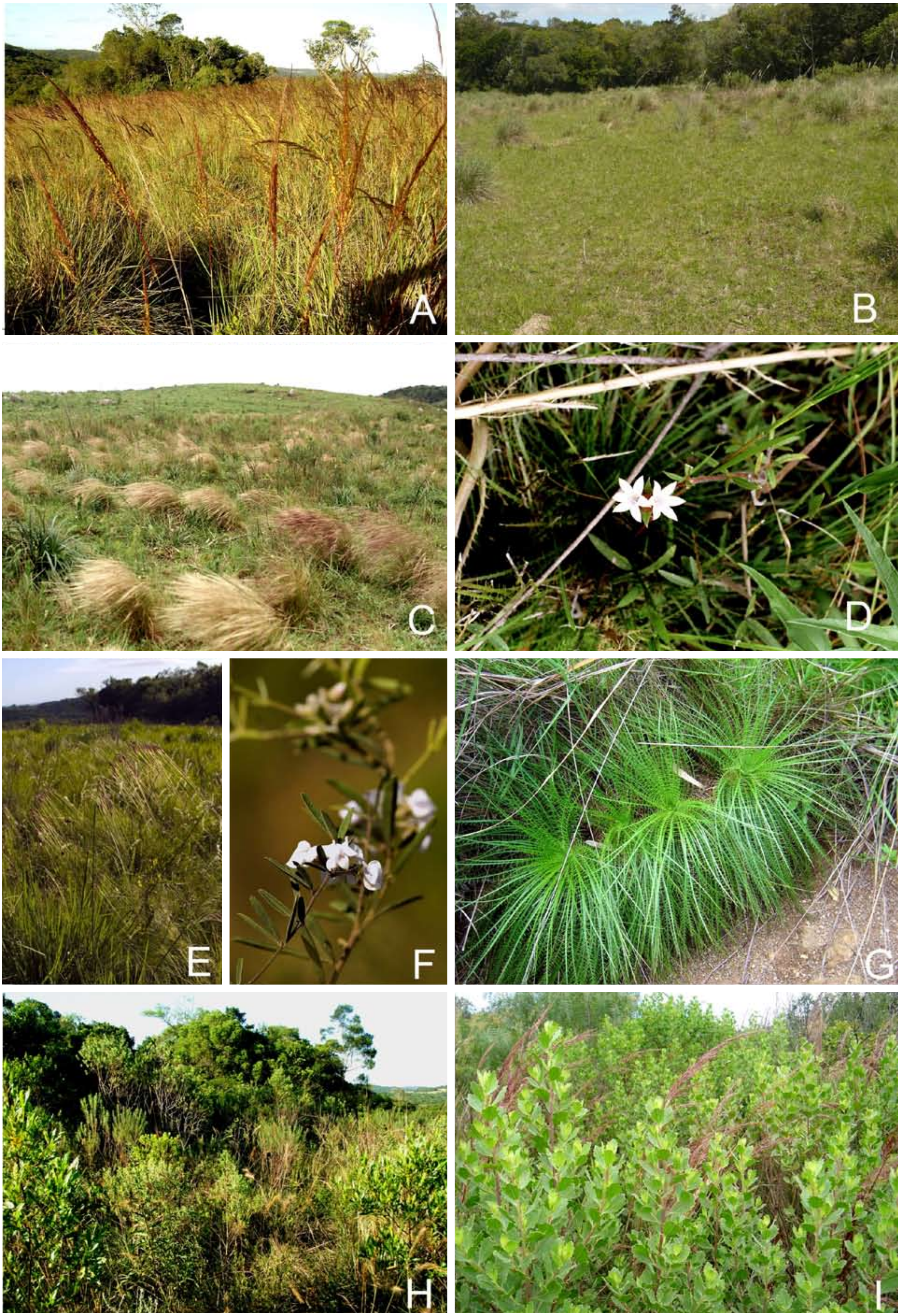

Figure 3. A-C. Dry grassland phytophysiognomies. D. *Richardia grandiflora.* E. *Stipa melanosperma.* F. *Collaea stenophylla*. G. *Eryngium pristis*. H. Shrubland phytophysiognomy. I. *Baccharis tridentata* var. *subopposita*.

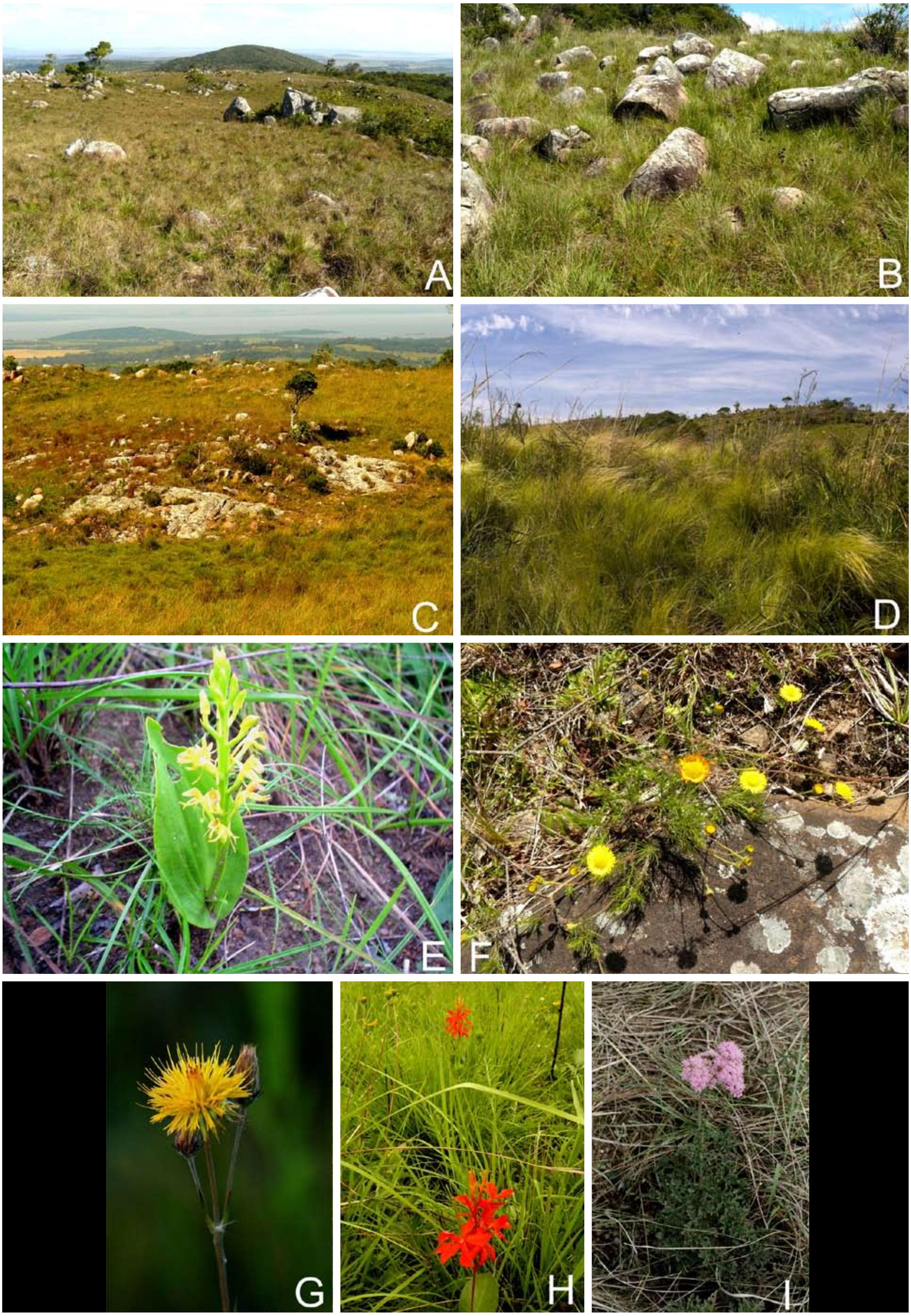

Figure 4. A-D. Rocky grassland phytophysiognomies. E. *Liparis vexillifera*. F. *Hysterionica filiformis*. G. *Schlechtendalia luzulifolia*. H. *Mandevilla coccinea*. I. *Eupatorium tanacetifolium*.

Table 2. Descriptive chart of the five soil types present at *Morro São Pedro* (adapted from Schneider *et al.* 2008).

Soils	Depth	Horizons	Color	Relief	Draining
Red Argisols	deep, thickness of 1,50m or more up to the altered rock	A-Bt-C	dark reddish in Bt horizon; A horizon grayish	undulated to smoothly undulated	well drained
Red-Yellow Argisols	deep, thickness of 1,50m or more up to the altered rock	A-Bt-C	red-yellowish in Bt horizon	undulated to smoothly undulated	well drained to moderately drained
Haplic Cambisols	shallow, less than 1m, up to deep	A-Bi-C	grayish in A horizon; reddish or yellowish in B horizon; C horizon variegated (red, yellow, gray, white)	undulated to strongly undulated	well drained to moderately drained
Litholic Neosols	shallow, with rocky layer starting at 50cm or less from the surface	A-C-R ou A-R	dark brown-reddish in A horizon and usually variegated in C horizon (red, yellow, grayish)	strongly undulated to montane	well drained
Regolitic Neosols	shallow to moderately deep, with rocky layer located deeper than 50cm	A-C-R ou A-R	brown in A horizon and usually variegated in C horizon (red, yellow, grayish)	strongly undulated to montane	well drained

as *Eupatorium bupleurifolium*, *Vernonia nitidula* and *Mimosa bimucronata* (Fig. 5E), among other species that show smaller cover values, already mentioned for the humid grasslands of plain areas.

Wetlands are also well distributed in areas with plain and concave relief. These formations are the rarest in occurrence, being sparsely distributed along the hill (Fig. 6A-D). They occur over deep but poorly drained Argisols. This situation seems to be associated to local water springs, which could explain the constant water intake and subsequent formation of water layer even in water shortage situations at summer, a differing characteristic between this formation and the humid grasslands. We registered 57 species in this formation. Predominating in the physiognomy were herbaceous species such as *Eryngium pandanifolium* (Fig. 6E), *Eryngium ebracteatum*, *Scirpus giganteus*, *Juncus microcephalus*, *Ludwigia* spp., *Ischaemum minus* (Fig. 6G), *Panicum aquaticum* and *P. grumosum*. Some exclusive species are *Enhydra anagalis, Eleocharis nudipes, Scirpus giganteus*, *Utricularia* spp., *Nymphoides indica, Cypella coelestis* (Fig. 6F), *Panicum grumosum* and *Heteranthera reniformis*. In some wetland areas typical moist-related arboreal species may occur, such as *Erythrina crista-gali*, *Mimosa bimucronata* and *Cephalanthus glabratus*. We emphasize that this formation presents sites with physiognomy, composition and structure of great specificity, where each location usually shows a particular species assemblage.

The floristic similarity analysis between the different grassland formations described, estimated with Jaccard coefficient, indicates two groups of greater similarity (Tab. 3). One comprises dry and rocky grasslands (51%), while the other comprises humid grasslands and wetlands (14%). The humid grasslands are located at an intermediary position between the formations, with similarity indexes ranging from 24% (dry grasslands), 21% (rocky grasslands) and 14% (wetlands). Wetlands showed a moderate association to humid grasslands and no similarity with dry and rocky grasslands, being the formation that presented the higher proportion of exclusive species.

As previously mentioned, disturbances such as fire and gazing are determinant to composition and structure of these grassland formations. Aiming to perform a 'cleaning', by removing shrubs and allowing sprouting of herbaceous species for cattle feeding, humans generate periodic burning events of this vegetation. Burning events in grassland formations lead to a nearly complete incineration of plant aerial portions, so that all that remains are tufts of cespitous grasses such as *Sorghastrum albescens*, rosulate species, especially *Eryngium* spp. (Fig. 7A), arboreal species such as *Butia capitata* and *Agarista eucalyptoides* and underground organs like xylopodia and lignified storage roots. Grazing intensity, burning periodicity and post-fire time shape a vegetation mosaic in different successional stages and in constant development. In the absence of disturbance, there is a succession trend towards the dominance of tall and cespitous species, but a few areas of lower vegetation, with rhizomatous and stoloniferous species, also occur and seem to be natural (Fig. 7B-E). There are also cultivated areas, with exotic forage species such as *Urochloa* spp., as well as areas degraded by soil extraction, where ruderal and adventiceous species predominate.

Another vegetation situation that deserves mentioning is the presence of forest arboreal species occurring singly in grassland areas, especially in cracks between rocks (Fig. 7F). Some of these species are *Enterolobium contortisiliquum, Myrsine guianensis* and *Maytenus cassineformis*, which may occur in association with shrub species present at shrublands. *Enterolobium contortisiliquum* seems to play an important role as a core to the establishment of insular forest patches, because the developing of shrub and arboreal species may be seen under its canopy (Fig. 7G). Intensity of the forest advance over grasslands process is modulated by

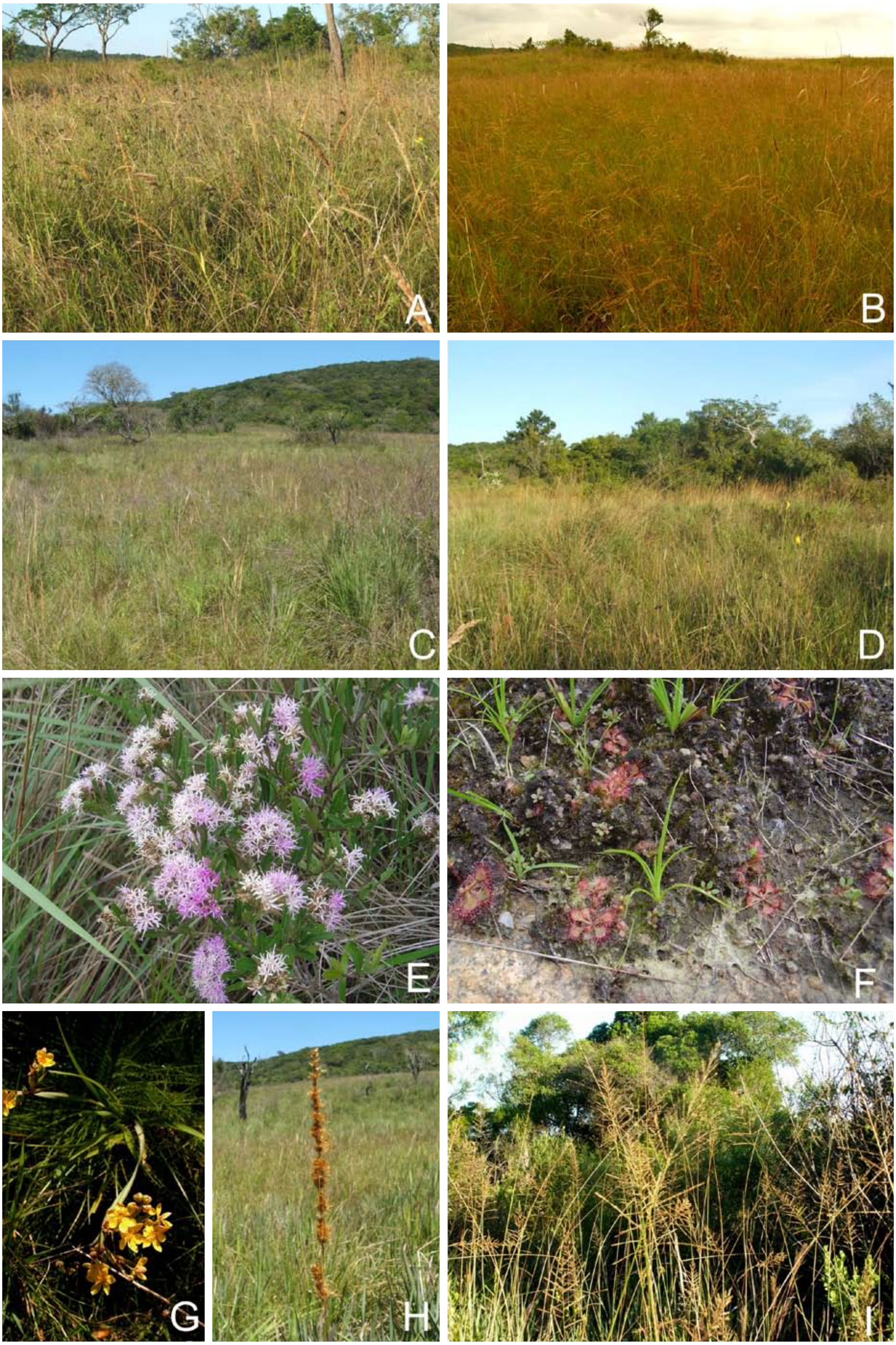

Figure 5. A-D. Humid grassland phytophysiognomies. E. *Vernonia nitidula*. F. *Drosera brevifolia*. G. *Sisyrinchium palmifolium*. H. *Eriochrysis cayennensis*. I. *Paspalum quarinii*.

Table 3. Floristic similarity coefficient (Jaccard Index), total species number and percentage of exclusive species calculated for the grassland formations at *Morro São Pedro*. (DG, dry grassland; RG, rocky grassland; MG, humid grassland; WL, wetland).

	DG	RG	HG	WL	Species total	Exclusive species and relative percentage
DG	1	-	-	-	370	107 (29%)
RC	0.51	1	-	-	287	57 (20%)
HG	0.24	0.21	1	-	157	29 (18%)
WL	0.03	0.01	0.14	1	57	30 (52%)

periodical burning, which hampers its establishment.

Extinction-threatened, rare, endemic and exotic species

Among the 497 native species registered in the inventory, 13 are enlisted in the Official List of the Extinction Threatened Flora of Rio Grande do Sul (Rio Grande do Sul, 2003), four categorized as Endangered and nine as Vulnerable (Tab. 4). The preferential habitat for all these species was the rocky grasslands. Besides these, we highlight the presence of *Regnellidium diphyllum* (Fig. 6H) in wetlands, an aquatic pteridophyta that belongs to Marsileaceae family and is considered Vulnerable in RS.

Concerning rare species and endemism, Rambo (1957), revising *Eryngium* species in RS, registered *Eryngium ciliatum* with geographic distribution restricted to Uruguay and RS. This author pointed out the species as endemic to the dry and gramineous formations of the State, which was corroborated by Irgang (1974), who considered the species restricted to *Depressão Central*, *Missões* and *Campanha* physiographic regions. *Eryngium megapotamicum* has its geographical distribution restricted to the State, and is present at *Depressão Central* and *Planalto Rio-grandense* regions (Irgang *op. cit.*).

Barroso & Bueno (2002) registered *Baccharis ochracea* with a geographic distribution restricted to Uruguay and Brazil, where it was found only in RS and *Santa Catarina* (SC) States. Marchioretto & Siqueira (1998) pointed out *Baccharis riograndensis* as endemic to RS, with distribution restricted to *Depressão Central*, *Campanha* and *Encosta Inferior do Nordeste* regions.

Table 4. Extinction threatened species enrolled in the floristic inventory, according to the Official List of the Extinction-Threatened Flora of Rio Grande do Sul (Cat., Category; VU, Vulnerable; EN, Endangered).

Nº	Family	Species	Cat.
1	Amaranthaceae	*Gomphrena graminea*	VU
2	Apocynaceae	*Mandevilla coccinea*	VU
3	Arecaceae	*Butia capitata*	EN
4	Asteraceae	*Gochnatia orbiculata*	EN
5	Asteraceae	*Mikania pinnatiloba*	VU
6	Asteraceae	*Schlechtendalia luzulifolia*	EN
7	Asteraceae	*Stenachaenium macrocephalum*	VU
8	Bromeliaceae	*Dyckia choristaminea*	EN
9	Cactaceae	*Parodia ottonis*	VU
10	Malvaceae	*Waltheria douradinha*	VU
11	Moraceae	*Dorstenia brasiliensis*	VU
12	Myrtaceae	*Eugenia dimorpha*	VU
13	Poaceae	*Thrasyopsis juergensii*	VU

Matzenbacher (2003) highlighted *Criscia stricta* as a genus of Brazilian origin, presently monotypic, with distribution restricted to RS, Uruguay and Buenos Aires Province (Fig. 8B). *Gochnatia orbiculata* has occurrence restricted to Porto Alegre region in RS (Mondin 1996). Barroso & Bueno (*op. cit.*) registered *Heterothalamus psiadioides* as endemic to RS and SC. In the latter, the species is considered very rare, being recorded only in *restingas* at Garopaba. In RS, the species was described as an anthropogenic pioneer, very abundant in altered areas at *Morro da Polícia* and *Parque Saint Hillaire* (Rambo 1956). Ritter (2002) indicates *Mikania pinnatiloba* as exclusive to dry grasslands, frequently near rock outcrops. The author registered that, in spite of being well distributed in RS, the species is not very frequent. Rambo (1952) affirms that *M. pinnatiloba* is a grassland species endemic to the State and surrounding regions, and can also be found in Uruguay. Ritter & Waechter (2004) confirmed this distribution at the surrounding regions in Southern Brazil, so that this is the species northern limit (Fig. 8F). Rambo (1954), Mondin (1996) and Matzenbacher (2003) cited *Schlechtendalia luzulifolia* as endemic to Uruguay, northeastern Argentina and southern half of RS, with Porto Alegre region as its northern limit.

Haussen (1992) indicates that the bromeliad *Dyckia leptostachya* is distributed between center-western and Southern Brazil. In RS, there are records of the species only for Torres, Viamão and Porto Alegre. *Dyckia choristaminea* is cited as endemic to RS, with occurrence restricted to Porto Alegre and Viamão (Fig. 8E).

Oliveira (1983) indicated *Desmodium arechavaletae* as a species of rare occurrence in RS. Its geographical distribution is recorded for grassland areas at *Planalto Médio* and *Missões* formations, and there is only one record of the species for *Morro da Polícia*, in Porto Alegre, collected by Malme.

Sobral (2003) indicates *Eugenia dimorpha* as endemic to the State, occurring in grasslands at *Depressão Central* and *Serra do Sudeste* formations. It is the only known Myrtaceae that has its distribution restricted to RS (Fig. 8H).

Lepuropethalon spathulatum is distributed in Central and South America, chiefly along the Andes, and is recorded only for Southeastern Brazil (Burkart 1969), so that this is a new citation of the species for Southern Brazil (Fig. 8G).

Thrasyopsis jurgensii has a distribution in RS traditionally linked to the plateau region, in grasslands at Vacaria and Bom Jesus municipalities. The only record

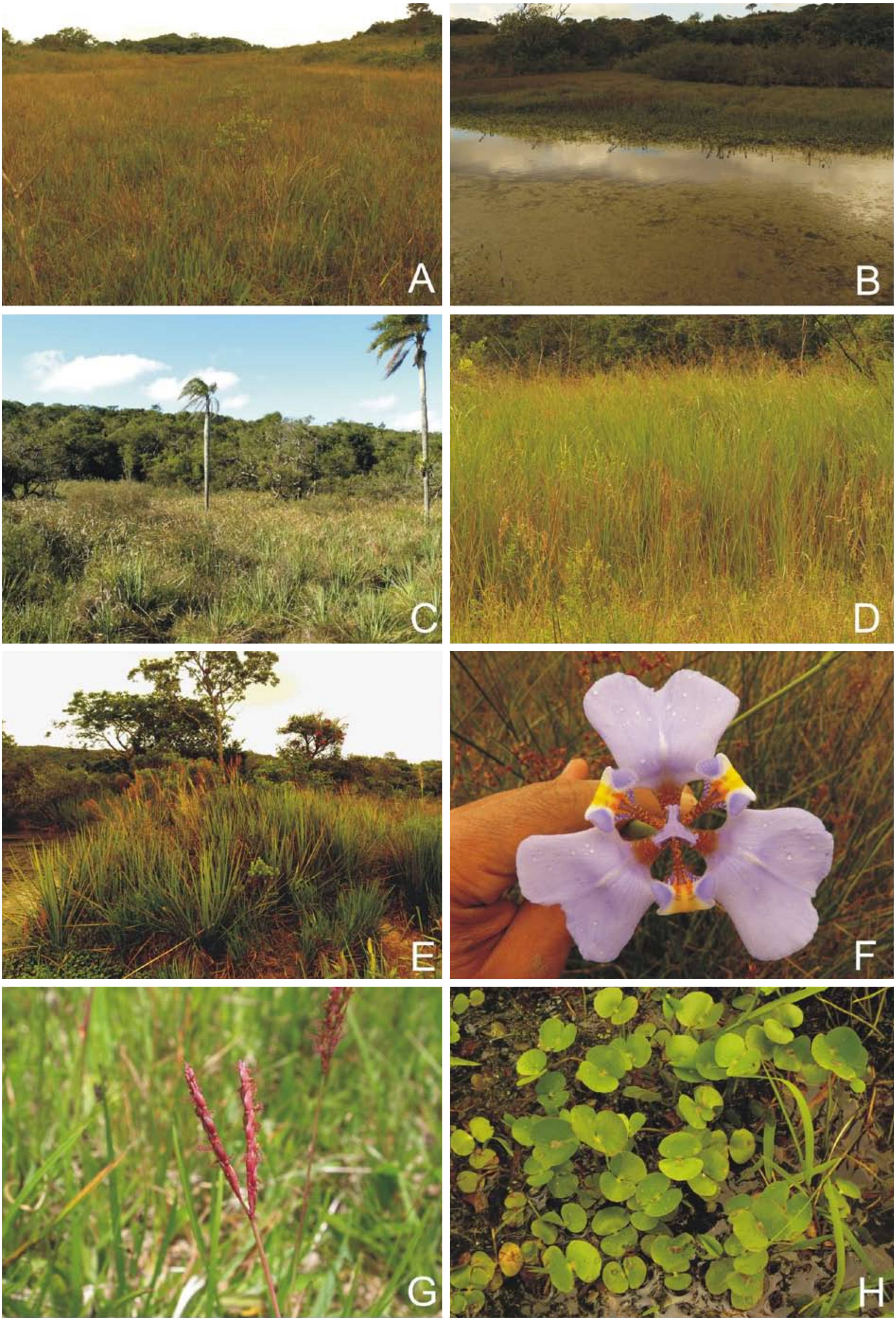

Figure 6. A-D. Wetlands grassland phytophysiognomies. E. *Eryngium pandanifolium*. F. *Cypella coelestis*. G. *Ischaemum minus*. H. *Regnellidium diphyllum*.

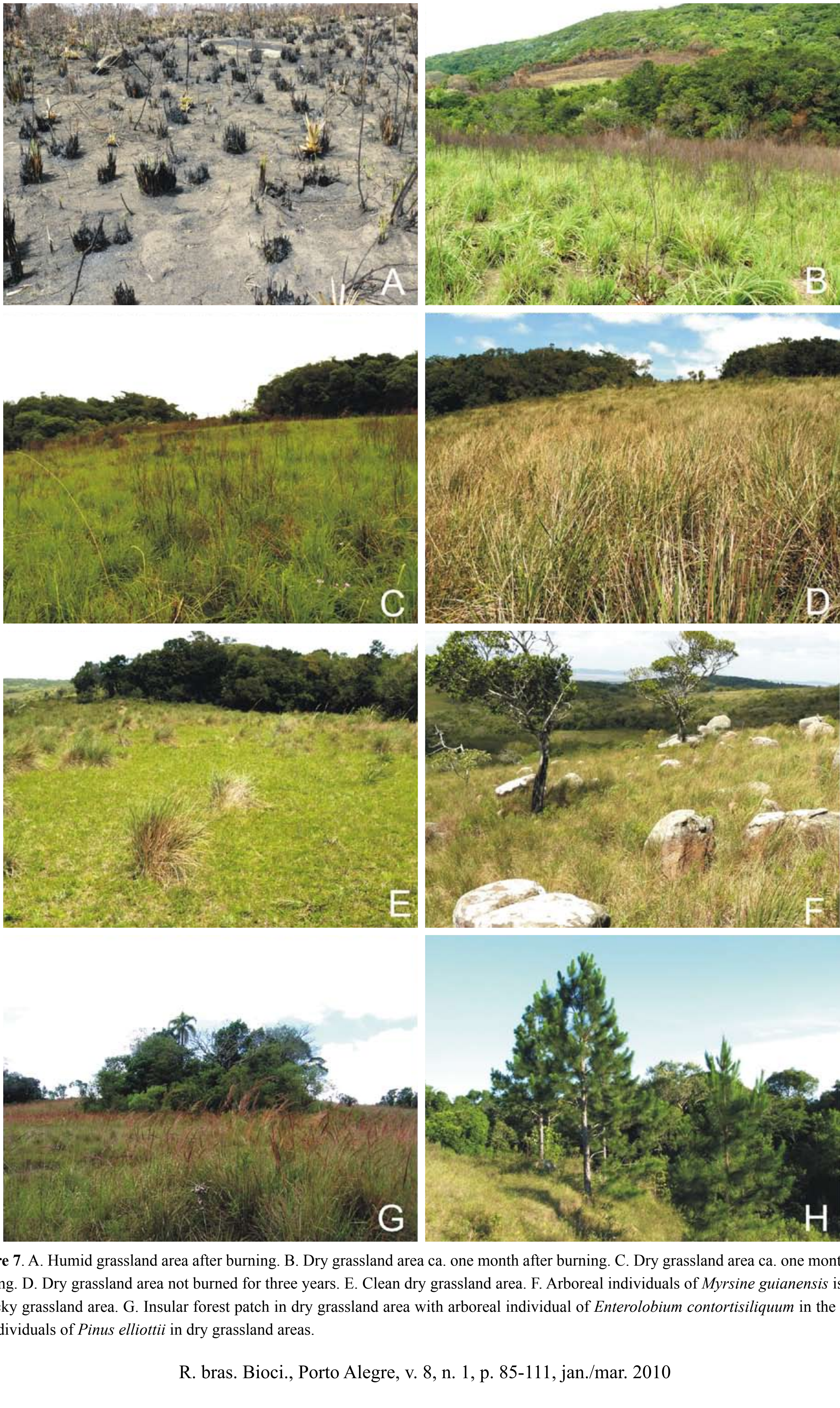

Figure 7. A. Humid grassland area after burning. B. Dry grassland area ca. one month after burning. C. Dry grassland area ca. one month after burning. D. Dry grassland area not burned for three years. E. Clean dry grassland area. F. Arboreal individuals of *Myrsine guianensis* isolated in rocky grassland area. G. Insular forest patch in dry grassland area with arboreal individual of *Enterolobium contortisiliquum* in the center. H. Individuals of *Pinus elliottii* in dry grassland areas.

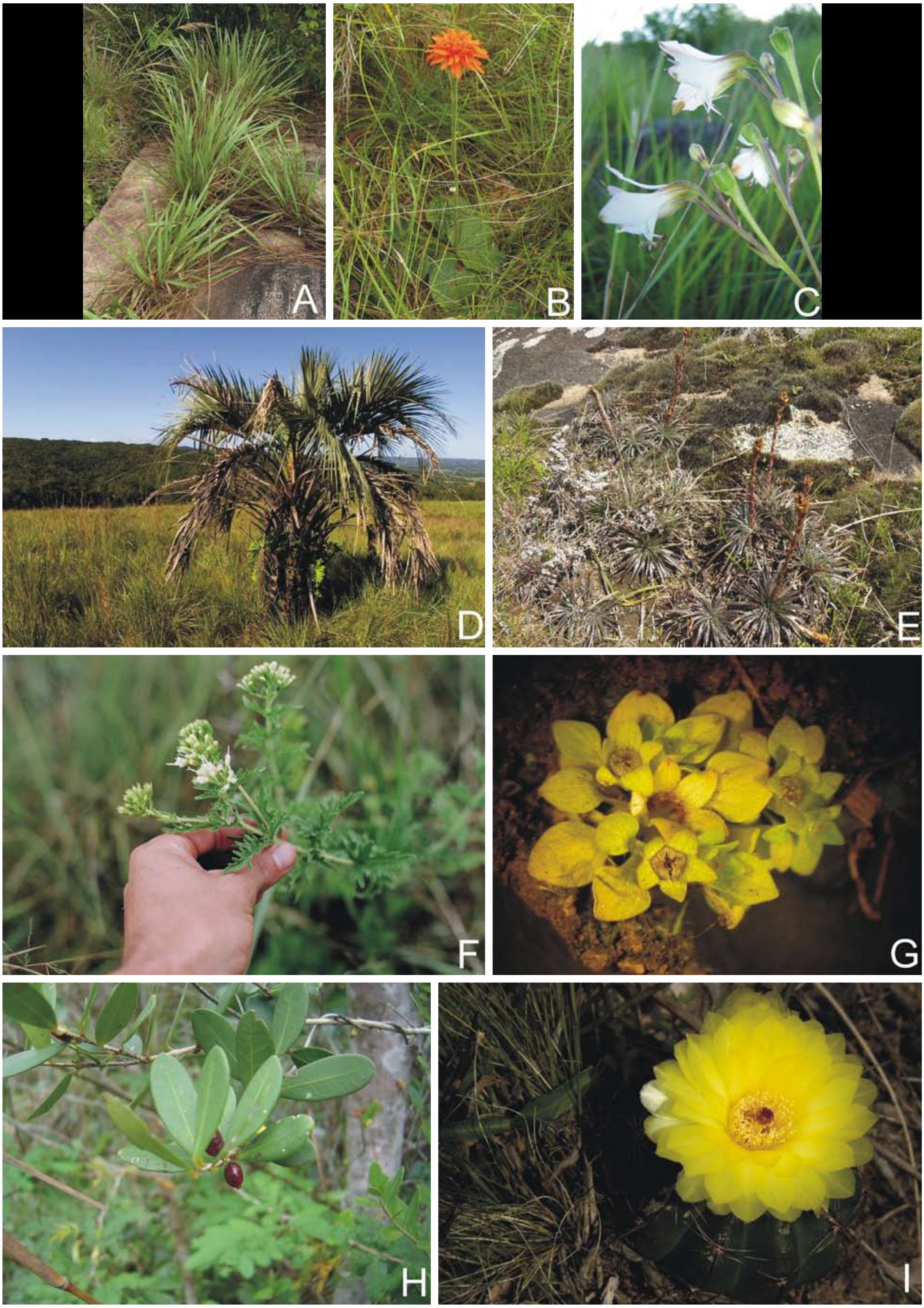

Figure 8. A. *Thrasyopsis jurgensii*. B. *Criscia stricta*. C. *Alstroemeria albescens*. D. *Butia capitata*. E. *Dyckia choristaminea*. F. *Mikania pinnatiloba*. G. *Lepuropethalon spathulatum*. H. *Eugenia dimorpha*. I. *Parodia ottonis*.

Table 5. Exotic species accounted for in the floristic survey, distribution by habitat and voucher material deposited in herbarium (DG, dry grassland; RG, rocky grassland; HG, humid grassland; WL, wetland).

Family / Species	Voucher	DG	RG	HG	WL
Agavaceae					
Furcraea sp.	R. Setubal, 861		x		
Asteraceae					
Chrysanthemum myconis L.	R. Setubal *et al.*, 205 (ICN)	x			
Crepis japonica (L.) Benth.	R. Setubal & M. Grings, 444 (ICN)	x			
Senecio madagascariensis Poir.	R. Setubal, 151 (ICN)	x			
Fabaceae					
Vicia angustifolia Clos	R. Setubal, 797 (ICN)	x		x	
Iridaceae					
Dietes bicolor Sw. ex Klatt	R. Setubal, 801 (ICN)	x			
Myrsinaceae					
Anagallis arvensis L.	R. Setubal & J. Bassi, 421 (ICN)	x			
Poaceae					
Briza minor L.	R. Setubal & A. Mello, 675 (ICN)		x	x	
Cynodon dactylon (L.) Pers.	R. Setubal & I. Boldrini, 699 (ICN)	x			
Digitaria ciliaris (Retz.) Koeler	R. Setubal & J. Cabral, 236 (ICN)	x			
Eleusine tristachya (Lam.) Lam.	R. Setubal & M. Rigo, 688 (ICN)	x			
Eragrostis pilosa (L.) P. Beauv.	R. Setubal *et al.*, 239 (ICN)		x		
Eragrostis plana Nees	R. Setubal & M. Grings, 669 (ICN)	x	x		
Lolium multiflorum Lam.	R. Setubal & I. Boldrini, 709 (ICN)	x		x	
Melinis minutiflora P. Beauv.	R. Setubal, 665 (ICN)	x			
Melinis repens (Willd.) Zizka	R. Setubal, 664 (ICN)		x		
Urochloa decumbens (Stapf) R.D. Webster	R. Setubal, 429 (ICN)	x			
Urochloa plantaginea (Link) R.D. Webster	R. Setubal & M. Grings, 427 (ICN)	x			

for this species outside this area is, to the present moment, at *Morro São Pedro*, in outcrops at rocky grasslands (Fig. 8A).

Alstroemeria albescens is a new species, discovered during this study (Assis 2009). It was found in few areas of the hill, in rocky grassland formations, and has no other record of occurrence (Fig. 8C).

Eighteen exotic species were registered in our surveys (Tab. 5). Only in wetland formations we found no exotic species, followed by humid grasslands (3), rocky grasslands (5) and dry grasslands (14). Poaceae stands out with 11 species, and among them, we highlight *Eragrostis plana, Melinis minutiflora* and *M. repens*, due to their invasive behavior (Overbeck *et al.* 2007). These species were present at heavily disturbed areas, such as road and trail edges, places were the soil was removed or constructions. Another exotic species that deserves attention, due to its dispersion efficiency over the grasslands, is *Pinus elliottii,* which is already well disseminated in some areas of the hill (Fig. 7H).

The floristic inventory of the grassland formations at *Morro São Pedro* is one of the largest continuous surveys accomplished in the granitic hills of Porto Alegre region. This result is related to the sampling effort dedicated to the floristic inventory of this formation, one of the largest continuous remnants of grassland vegetation among the granitic hills of the region. The following discussion is based on the results gathered along this work, on literature revision and on the author's personal observation of grassland formations present at similar granitic hills. It is interesting to highlight that occurrence of the rare and threatened species mentioned, alongside the specific richness we found, reinforce a relatively good conservation status of the grassland vegetation studied, in spite of the historic human occupation process that the hill has suffered.

Analysis of four floristic studies (Boldrini *et al*. 1998 – *Morro da Polícia*; Sestren-Bastos 2006 – *Morro do Osso*; Overbeck *et al.* 2006 – *Morro Santana*), including ours (Fig. 1D), reveals that the seven most important families comprehend two thirds of the grassland species at the granitic hills of Porto Alegre region (Tab. 6). The floristic relevance of Asteraceae, Poaceae, Fabaceae and Cyperaceae in the composition of this vegetation has already been confirmed in previously accomplished studies at the area (Matzenbacher 1985; Welker & Longhi-Wagner 2007; Miotto *et al*. 2008; Trevisan *et al*. 2008; Silveira & Longhi-Wagner 2009). However, we emphasize that further investigation is needed in families with intermediary contribution, such as Rubiaceae, Verbenaceae and Apiaceae, as well as in families considered contribute less to floristic richness, such as Iridaceae, Malvaceae and Orchidaceae. Recently, Eggers (2008) carried out the first survey of Iridaceae in RS, registering 14 species at *Parque Estadual de Itapuã*, a conservation unit that harbors ecosystems similar to those present at our study site, evidencing a still underestimated contribution of the family, which also seems to be the case of the previously mentioned families.

Families with highest botanic richness play an important role in the physiognomic composition of the grassland formations studied. Poaceae has an important value for the landscape due to the abundant occurrence of cespitous species, such as *Axonopus suffultus, Elyonurus candidus, Sorghastrum albescens*, *Stipa melanosperma* and *Trachypogon montufarii,* present in dry areas, and *Ischaemum minus* and *Schizachyrium tenerum* in humid areas. Asteraceae has a marked physiognomic value

Table 6. Species number of the seven botanical families with higher richness values and total species number registered in four floristic surveys of the grassland vegetation in granitic hills at Porto Alegre city.

	Morro do Osso	Morro da Policia	Morro Santana	Morro São Pedro
Asteraceae	50	79	42	110
Poaceae	20	84	40	90
Fabaceae	25	36	16	47
Cyperaceae	2	12	12	38
Rubiaceae	6	9	9	17
Verbenaceae	8	5	4	15
Apiaceae	6	5	5	14
Percentage (mean 69%)	57%	78%	75%	66%
Species total	205	294	170	497

due to shrub species of *Baccharis* and *Eupatorium,* characterizing shrublands in dry areas, besides herbaceous species with showy capitula such as *Senecio* spp. and *Vernonia* spp., distributed in all grassland formations types. Fabaceae contributes with species presenting frequent but rare and patchy distributions, such as *Macroptilium prostratum* and *Centrosema virginianum*, typical of dry grasslands, and shrub species of *Mimosa* spp., very common in rocky grassland areas. Cyperaceae stands out in humid grasslands and wetlands, represented by many species of *Bulbostylis*, *Cyperus* and *Eleocharis*, expressing a physiognomic contribution similar to the one imprinted by grasses in dry grasslands. Apiaceae also stands out, given the determinant contribution of *Eryngium* spp. in the physiognomy of dry grasslands (*E. pristis, E. sanguisorba*), rocky grasslands (*E. eriophorum*), humid grasslands (*E. elegans*) and wetlands (*E. panniculatum*).

Besides the physiognomic constitution, the mentioned species also define structural patterns of the vegetation. The studies carried out by Boldrini *et al*. (1998) and Overbeck *et al.* (2006) corroborate this observation, highlighting the predominance of cespitous grasses when compared to rhizomatous and stoloniferous species such as *Paspalum notatum* and *Axonopus* spp., notoriously mentioned in phytosociological studies of grassland vegetation in RS (Caporal & Boldrini 2007; Freitas *et al.* 2009; Ferreira & Setubal 2009). Studies as those made by Boldrini & Eggers (1996), Nabinger (2006) and Carvalho *et al.* (2007) already documented the undeniable influence of anthropological use through cattle breeding over species selection and, consequently, over grassland vegetation structure. Besides herbivory, fire is also a disturbance factor of major influence in this process. Overbeck *et al.* (2005) pointed out, through survey carried out at *Morro Santana*, that even after successive burning events in grasslands, short term plant succession tends towards the domination of the same cespitous grass species, which show tolerance adaptations for this regime, and this pattern was also seen at *Morro São Pedro* during our study. Considering both disturbances types and the results obtained in the mentioned papers, the hypothesis that better explains the predominance of cespitous species may be related to a historic selection of species with tolerance to the periodical burning regime. However, we emphasize that more studies concerning succession dynamics of this vegetation, whether or not imposed by human management, are necessary in order to determine how many different factors affect composition and structure of grasslands, and how they influence and regulate forest expansion.

A singular aspect of the grassland vegetation present at the granitic hills of Porto Alegre region is their insular distribution, in patches at hilltops. This natural disjunction, result of forest expansion in the extant climate, have isolated these grasslands in fragments of varying and, not yet completely known, specific composition. Rambo (1954), analyzing migratory events of different local floras, postulated that grassland species, part of the first established vegetation at the region, underwent isolation and speciation processes in these hills when they were islands, during ocean transgression time, denominating this pattern as 'insular flora'. Besides the lack of modern evidence corroborating his theory, the fact is that grassland vegetation at the granitic hills of Porto Alegre region presents different species distribution patterns, with not yet clarified cases of rarity and endemism. The finding of a new species (*Alstroemeria albescens*), as well as taxa such as *Thrasyopsis juergensii* and *Lepuropetalon spathulatum*, both registered for Porto Alegre region only at *Morro São Pedro*, goes against the absence of species mentioned in other floristic surveys. It is the case of *Moritzia ciliata*, a Boraginaceae typically present at rocky grasslands and considered endemic to the hills of the region, as well as *Agenium villosum*, mentioned as an important asset in grassland vegetation cover at *Morro da Polícia* (Boldrini *et al.* 1998), both not registered in our inventory. These patterns highlight the possible existence of particular evolution processes acting in the grassland vegetation at these hills, as these natural remnants maintain important records concerning expansion and retraction dynamics of this vegetation, including possible speciation and extinction events, as well as the influence of anthropogenic actions. Further studies in granitic hills of *Serra do Sudeste* formation, and even in other grassland formations in Southern and Southeastern Brazil, are necessary for a better comprehension of species distributions, in order to have a better understanding of rare, endemic and disjoint taxa distribution. Another interesting and yet unknown theme is to determine the contribution of the different phytogeographic contingents in the composition of the regional flora. In spite of Rambo (1954) mentioning Central Brazil as the main migration center of the local grassland species, through the altitude grasslands route, the actual contribution of the different floristic units present at the region remain unknown, due to the lack of a specific evaluation.

Total species richness of grassland formations at the granitic hills can be considered significant when compared to total numbers of the regional flora. Aguiar *et al*. (1986) inventoried ca. 520 grassland species in 10 granitic hills of the region. Overbeck *et al.* (2006), based on analysis of several floristic surveys at *Morro Santana*, estimated the occurrence of 450-500 grassland species in 220 ha. We emphasize that the floristic list we present does not comprise all the grassland species that grow in this hill, and we estimate that the total richness at the site might reach 600 angiosperms species. Furthermore, there is no floristic inventory concerning Bryophyte and Pteridophyte, which present significant ecological importance for the local vegetation and must be known in order to compile an approximate number representing the real diversity of grassland plants at *Morro São Pedro*. By comparing the present floristic knowledge concerning grassland formations at the granitic hills of the region with the works of Rambo (1954) and Teodoro Luis (1960), which pointed out, respectively, the occurrence of 1288 and 1490 species present in different natural vegetation types at Porto Alegre region, the significant contribution of grassland formations in this total stands out. If only the species found in the present study are taken into account, we may infer that approximately one third of the regional flora is represented in the grassland vegetation of the granitic hills. Moreover, when compared to the 3000 grassland species estimated for RS (Boldrini 1997), the grassland flora at *Morro São Pedro* corresponds to 16 % of this total. The contribution to the better knowledge of the grassland species of the region presented in this paper implies that these remnants cradle a significant sample of the taxonomic diversity of grassland species present in RS, including rare and range-limited species.

The analysis of studies concerning general vegetation characterization of the region indicates that, until now, there are no suggestions of detailing approaches for grassland formations of Porto Alegre granitic hills. The phytogeographic characterization IBGE proposes (Teixeira *et al.* 1986; IBGE 2004) presents rather general vegetation descriptions and, in spite of mentioning the existence of phytoecological formations such as Savanna and Steppe in the region, does not specifically mentions grassland formations at granitic hilltops, referring only to those present at lower and smoother hills locally known as *coxilhas*. Results presented by Brack *et al.* (1998), Porto & Menegat (1999b) and Hasenack *et al.* (2008) characterize grassland formations at these hilltops simply as 'grasslands', assigning adjectives such as 'dry' and 'rocky' in their descriptions. The studies carried out by Boldrini *et al*. (1998) and Overbeck *et al.* (2006) represented great importance for the knowledge of the quali-quantitative variation of this vegetation. However, humid grassland and wetland formations at hilltops are not mentioned in neither of them. So, the case study concerning *Morro São Pedro* is a pioneer study in the detailed description of these formations, which limits otherwise possible comparisons with previous surveys concerning similar vegetation. We understand that future ecological studies, concerning the relative contribution of species for the cover of the different grassland vegetation types we suggested, as well as the acknowledgement of patterns influencing their distribution, will allow researchers to find more clarifying results. Thus, identification of the variables determining organization of different vegetation units, as well as their relative importance in determining these patterns, will be possible.

Overall, the suggested classification methods for grassland vegetation in RS, based on environmental, physiognomical and distributional characters, are not a consensus among researches, and do not express its variations (Marchiori 2002). This problem is directly related to the complexity of this vegetation, defined by its evolutionary history, specific richness, ecological amplitude, structural variability and anthropogenic use, which complicates the elaboration of a synthetic description. Recently, Ferreira & Setubal (2009), studying a natural grassland remnant at the northern coast of RS, presented a detailed classification and zoning proposition of these formations. Besides the contributions in this article and in the present one, in the sense that both point out new aspects to be analyzed in future descriptive surveys of grassland formations, a larger effort of related researchers is needed, especially concerning the development of appropriate sampling techniques that assist on vegetation description, including the anthropogenic factor, since human interference plays a key role in the maintenance of grassland vegetation present conditions.

Besides the lack of surveys that comparatively evaluate species richness between dry and humid grassland in formations analogous to the ones found at *Morro São Pedro*, based on our results and in personal observation of similar formations, we conclude that specific richness is higher at dry and rocky grasslands in the granitic hills of Porto Alegre region. This can be explained by the smaller areas that humid formations occupy, and because they are more limiting for species colonization. However, data analysis indicates significant species exclusiveness in wetland formations (52 %) when compared to the remaining formations. The permanent or seasonal water saturation situation of the soil in these areas is probably the determinant limiting factor to colonization of species present in the other formations. However, further studies are needed in order to evaluate these patterns.

In order to update the real knowledge concerning this vegetation, revision of previous floristic surveys that include species nomenclatural adjustment is needed, aiming to produce a total checklist for these formations. By doing so, general analyses concerning floristic richness and distributional patterns on the different granitic hills of the region will be possible. Despite the advances of characterization surveys aiming to better comprehend the regional vegetation, we emphasize the need of further investigation of the correlation between biotic and abiotic factors that affect its present variation and, in order to do so, more specific surveys and multivariate analyses are needed.

Finally, we emphasize that it is necessary to understand the granitic hills of Porto Alegre as key elements on the landscape structure, constituting the sites cradling the principal remnants of local biodiversity. It is alarming to find that, besides the existence of three Conservation Units implemented at the granitic hills (*Parque Natural Morro do Osso* with 127 hectares, but only 27 ha already expropriated, *Reserva Particular do Patrimônio Natural Costa do Cerro*, located at *Morro São Pedro* with 8 ha and *Reserva Biológica do Lami*, comprising *Morro Ponta do Cego* with 21 ha), the effectively implemented protection sums up 56 ha (0.45 %) of the 12307 ha that these formations cover in Porto Alegre (Güntzel *et al.* 1994), and this percentage covers virtually no grassland vegetation. The negligence of attention concerning these natural grasslands of high biological richness, which represents a singular genetic and evolutionary heritage of the region, must be reversed, also because they provide the maintenance of countless environmental services essential to life, as geological and hydrological processes. It is necessary to implement strategies that take into account the conservational needs and the sustainable human use, aiming to maintain environmental processes and stimulate socioeconomic activities like ecological tourism. We reinforce the immediate necessity of consolidating conservational strategies that join public and private authorities. The implementation of a monitoring and eradication program for exotic invasive species is also necessary, especially concerning *Pinus elliottii*, already widespread at grasslands in the area, and special attention should be given to rocky grasslands, habitat of most of the extinction-threatened species mentioned, and to the humid areas related to water springs. Furthermore, we emphasize both the potentiality and the need for further biological studies at *Morro São Pedro*, the largest and better conserved remnant of natural vegetation at Porto Alegre city.

CONCLUSIONS

Based on our results and on support from other papers we conclude that:

- Ca. 65% of the grassland species present in the granitic hills of the region belong to seven main botanical families (Asteraceae, Poaceae, Fabaceae, Cyperaceae, Rubiaceae, Verbenaceae e Apiaceae);
- The species belonging to these families are also determinant in the vegetation phytophysiognomical and structural composition, so that cespitous grasses predominate in the landscape, shaping a continuous gramineous layer;
- The grasslands at the granitic hills of the municipality have an insular present distribution, isolated in patches at hilltops and surrounded by forests in the slopes and plains;
- They show a high number of species that can be found in higher numbers in dry areas than in humid areas, and there is a gap in works concerning the characterization of humid grasslands and wetland formations inserted at hilltops;
- Despite the significant plant diversity of these grasslands, their representativeness in conservation units at the municipality is virtually inexistent.

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