Universidade Federal do Rio Grande do Sul

Programa de Pós-Graduação em Botânica

Adesmia ser. *Psoraleoides* Burkart (Leguminosae) e a história dos campos do sul do Brasil

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2012

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Tese apresentada ao Programa de Pós-Graduação em Botânica, da Universidade Federal do Rio Grande do Sul, como parte dos requisitos necessários para a obtenção do título de Doutor em Ciências: Botânica.

Orientador: Dra. Silvia Teresinha Sfoggia Miotto

Porto Alegre
Janeiro de 2012

“Quando estivermos seguros de que todos os indivíduos da mesma espécie, da mesma forma que todas as espécies próximas pertencentes a maior parte dos gêneros, descendem de um antepassado comum e não muito distante, provenientes de um determinado local, e quando conhecermos melhor os diversos meios de migração, então, com as informações que a Geologia nos fornece e que continuará fornecendo sobre as antigas modificações climáticas e do nível do mar, estaremos aptos a determinar, de maneira admirável, as rotas de migração que foram seguidas no passado pelos habitantes de todo o mundo.”

Charles Darwin

"Há neste particular uma obscuridade invencível porque não sabemos qual a relação existente entre o surgimento de novas espécies e o tempo."

Balduíno Rambo, S.J.

AGRADECIMENTOS

A imagem do cientista se transformou ao longo do tempo e também a sua metodologia de trabalho. O conceito de um pesquisador que trabalhava só, em seu laboratório, foi substituído por redes de colaboração e pela troca de experiências entre diferentes pesquisadores e instituições, que trabalham juntos para a construção do conhecimento científico. Gostaria de agradecer a todos que de alguma forma colaboraram para a elaboração deste trabalho, em nome das seguintes instituições, colegas, amigos.

Ao Programa de Pós-Graduação em Botânica da Universidade Federal do Rio Grande do Sul pelo apoio durante as atividades acadêmicas.

À CAPES, pela concessão da bolsa de doutorado e de estágio sanduíche no exterior.

À minha orientadora, Dra. Silvia Teresinha Sfoggia Miotto por toda a colaboração e por sua energia contagiante em todos os momentos.

Ao Dr. Richard Toby Pennington pela colaboração e orientação durante a estadia na Escócia, assim como na discussão e elaboração dos artigos que compõem a tese.

À Dra. Tatiana Teixeira de Souza Chies pela colaboração no laboratório de Biologia Molecular e discussão do trabalho.

Aos colegas do laboratório de Taxonomia Vegetal (LabTax), especialmente Adriana Aita, Maria Conceição de Souza, Eduardo Pasini, Jaqueline Durigon, Leandro Dal Ri e Priscila Porto Alegre, pelos momentos de descontração.

Aos colegas do laboratório de Biologia Molecular, especialmente Gustavo Agostini, Eudes Maria Stiehl Alves e Luana Olinda Tacuatiá.

Aos amigos Priscila Crespam, Dávia Talgatti, Marisa Santana e Michel Barros, que compartilharam a moradia e também vários momentos de descontração.

Ao Royal Botanic Garden, Edinburgh, pelo apoio e infraestrutura concedidos durante a estadia na Escócia.

Aos colegas de Edinburgh, especialmente Tiina Sarkinen e Sumudu Rubasinghe, que além de colaboradoras foram também amigas e contribuíram para que aquele período fique na memória.

Ao amigo e colega Dr. Haroldo Cavalcante de Lima, pelo apoio em Edinburgh, pela colaboração e discussões em biogeografia e evolução de leguminosas.

Ao Dr. Marcelo Simon por todo o apoio e colaboração nos estudos moleculares realizados na Embrapa/Cenargen e pelas discussões em sistemática e biogeografia de leguminosas.

Ao Dr. José Francisco Montenegro Valls, pela colaboração na doação de amostras de sementes do gênero *Adesmia*.

À Dra. Beryl B. Simpson pela colaboração no intercâmbio de sequências de DNA e discussões sobre a evolução de *Adesmia*.

A todas as instituições que de alguma forma colaboraram para a execução deste trabalho, especialmente o Parque Nacional da Serra Geral, Parque Nacional de São Joaquim, Parque Nacional do Itaimbezinho, sobretudo ao Michel Omena, chefe do PARNA de São Joaquim, por todo o apoio logístico durante os trabalhos de campo.

A todos os herbários e seus curadores, por disponibilizarem as suas coleções para estudo, especialmente à equipe do MBM, sobretudo ao Osmar Ribas, Clarisse Poliquesi e demais colegas, que prestaram grande apoio durante o trabalho na coleção do herbário e colaboração para o trabalho de campo.

Ao Gustavo Heiden, por toda a colaboração durante a discussão do trabalho, nas viagens de coleta e por estar sempre presente.

Aos meus pais por compreenderem a distância.

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Adesmia rocinhensis, Cambará do Sul, Rio Grande do Sul (Foto: C. Siniscalchi); E. Araranguá, Santa Catariana.

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RESUMO

A flora do Sul do Brasil está distribuída em diferentes ecossistemas, caracterizados pela transição da vegetação entre paisagens tropicais e temperadas. Esta faixa de transição flutuou latitudinalmente ao longo do tempo, como resultado de variações climáticas globais. A heterogeneidade de hábitats proporciona a existência de uma alta diversidade de plantas endêmicas nesta região. Através de análises filogenéticas e datação molecular, foi possível reconhecer *Adesmia* ser. *Psoraleoides* como um grupo monofilético, originado cerca de 11 milhões de anos atrás e que se diversificou há cerca de 3-5 milhões de anos nas terras altas do Sul do Brasil. A recente diversificação deste clado, assim como de outras linhagens de plantas que são distribuídas estritamente na região Subtropical do Brasil, é consistente em tempo, com o período estimado para a expansão de ambientes áridos em todo o mundo. As flutuações climáticas podem ter promovido o isolamento, extinção e diversificação de linhagens através do tempo, na vegetação do Sul do Brasil. Ainda que as condições climáticas atuais sejam mais favoráveis ao avanço das florestas sobre os campos na área estudada, as atividades antrópicas permanecem como a principal ameaça a este ecossistema relictual.

Palavras-chave: Endemismos, evolução de biomas, Leguminosae, campos, subtropical.

ABSTRACT

The Southern Brazilian flora is distributed in different ecosystems, characterized by the vegetation transition between tropical and temperate landscapes. This transition range fluctuated latitudinally over time, as a result of global climate changes. The heterogeneity of habitats allows the existence of a high diversity of endemic plants in this region. Using molecular phylogenetic analyses and dating approaches it was possible to recognize *Adesmia* ser. *Psoraleoides* as a monophyletic group which originated about 11 my ago and diversified about 3-5 my ago in Southern Brazilian Highlands. The recent diversification for this clade and also for other lineages of legumes narrowly distributed in Subtropical Brazil, is consistent in time with the inferred expansions of dry environments worldwide. Climatic fluctuations might have been promoting isolation, extinction and diversification of lineages through the time in Southern Brazilian vegetation. Even though the current climatic conditions are favourable for forests against grasslands in the studied area, anthropogenic activities still been the main threat to this relictual environment.

Keywords: Endemisms, biome evolution, Leguminosae, grasslands, subtropical.

Introdução Geral

Texto baseado na palestra apresentada na "V International Legumes Conference: Advances in the XXI Century", realizada em Buenos Aires, Argentina – Agosto/2010.

INTRODUÇÃO GERAL

Diversidade, endemismos e a história das Leguminosae no sul do Brasil

A paisagem subtropical do sul do Brasil é caracterizada por um mosaico de micro-hábitats que representam uma transição entre formações vegetacionais tropicais e temperadas. As florestas tropicais alcançam seu limite austral no sul do Brasil, onde encontram a vegetação campestre e a floresta ombrófila mista. Considerando as condições climáticas atuais, o clima quente e úmido no sul do Brasil é favorável ao avanço de florestas em detrimento da vegetação campestre, ocupando principalmente os vales próximo aos rios. No sul do Brasil são encontradas as seguintes formações: floresta ombrófila densa, floresta estacional semidecidual, floresta ombrófila mista, campos de altitude tropicais, campos de altitude subtropicais, savanas temperadas e campos de baixa altitude temperados (Oliveira-Filho & Fontes, 2000; Iganci *et al.* 2011). A região subtropical do sul do Brasil reflete o caráter de transição entre os climas tropical e temperado e qualquer variação em relação à umidade e à temperatura é fortemente refletida na sua paisagem. De acordo com períodos mais secos ou úmidos no tempo geológico, formações florestais ou campestres dominaram a paisagem, avançando latitudinalmente quando o clima era favorável para uma ou para a outra. Os fósseis de Araucariaceae encontrados no sul do Brasil e a floresta ombrófila mista que ainda persiste nesta região são evidências que corroboram o domínio das florestas temperadas durante o Terciário, assim como referido para outras regiões ao redor do mundo (Kunzmann 2007). Hoje, a família Araucariaceae está representada por uma única espécie no sul do Brasil, distribuída em regiões de elevada altitude e de baixas temperaturas. Durante o Mioceno, um clima mais seco e quente foi estabelecido, ao mesmo tempo em que importantes eventos geológicos ocorreram na América do Sul, como a elevação dos Andes e transgressões marinhas (Donato *et al.*, 2003). Assim, as florestas temperadas tornaram-se menos diversificadas e tiveram sua distribuição retraída, sendo gradualmente substituídas por uma vegetação seca, herbáceo-arbustiva, que se expandiu e dominou a paisagem entre 25 e 10 milhões de anos atrás (Crayn *et al.*, 2006).

De acordo com a classificação biogeográfica proposta por Cabrera & Willink (1980), a latitude 30^{0}S separa as províncias geográficas setentrionais Atlântica e Paranaense, que pertencem ao domínio Amazônico e são essencialmente florestais e tropicais, daquelas mais austrais, chamadas de Pampeana e Espinhal, que representam uma extensão oriental do domínio Chaquenho. A vegetação campestre encontrada no sul do Rio Grande do Sul é contínua em direção ao Uruguai e à Argentina, e constitui os campos de baixa altitude temperados, conhecidos como Pampa (Cabrera & Willink, *l.c.*). Miotto & Waechter (1996) ressaltaram que as Leguminosae são uma importante família para representar os padrões biogeográficos da flora subtropical. A família está presente em todas as formações vegetacionais do sul do Brasil, englobando 22 tribos e cerca de 660 táxons nativos (Lima *et al.*, 2010). A distribuição das tribos e gêneros de Leguminosae no sul do Brasil e áreas adjacentes foi analisada por Waechter & Miotto (dados não publicados), que encontraram uma distinção clara entre linhagens tipicamente tropicais ou temperadas, com uma marcada delimitação geográfica em torno do paralelo 30^{0}S.

No presente trabalho são adotados conceitos específicos para caracterizar a distribuição geográfica dos táxons. Os campos subtropicais e temperados que estão incluídos na Província Pampeana segundo Cabrera & Willink (1980), são aqui tratados como domínio do Pampa (Forza *et al.*, 2010) e abrangem diferentes formações vegetacionais (biomas). Da mesma forma, foi adotado o conceito de domínio Atlântico abrangendo diferentes formações vegetacionais, segundo Oliveira-Filho & Fontes (2000) e Joly *et al.* (1999). Para caracterizar a área de estudo abrangida por todos os artigos que compõem a presente tese, foi adotado um conceito modificado do termo Campos de Cima da Serra. Este termo foi utilizado originalmente por Fortes (1959), para se referir à uma região fisiográfica localizada no nordeste do estado do Rio Grande do Sul, onde é encontrada a vegetação campestre de altitude. Desta forma, foi ampliado o conceito original para abranger toda a formação campestre localizada sobre a formação Serra Geral, incluindo também aquelas encontradas nos estados de Santa Catarina e do Paraná e que em conjunto formam uma unidade vegetacional.

As espécies de Leguminosae estão distribuídas de forma similar nas formações campestres e florestais, ocupando a ampla diversidade de ambientes encontrada no Brasil subtropical. A maior parte das espécies arbóreas é encontrada nas florestas ombrófila densa e estacional semidecidual, enquanto que as espécies herbáceas e arbustivas são comumente encontradas entre a vegetação campestre no domínio do Pampa (Iganci *et al.*, 2011) e no domínio da Mata Atlântica (Oliveira-Filho & Fontes, 2000). Espécies arbóreas de Leguminosae que apresentam distribuição ampla são usualmente encontradas na floresta ombrófila densa, como por exemplo, *Copaifera trapezifolia* Hayne, *Sclerolobium denudatum* Vogel, *Schizolobium parahyba* (Vell.) Blake, *Andira anthelmia* (Vell.) Benth., *Zollernia ilicifolia* (Brongn.) Vogel, e *Piptadenia gonoacantha* (Mart.) J.F.Macbr. De forma semelhante, as florestas estacionais semideciduais apresentam espécies de Leguminosae de ampla dispersão, com seu limite austral de distribuição no Brasil subtropical, assim como observado em *Parapiptadenia rigida* (Benth.) Brenan, *Apuleia leiocarpa* (Vogel) J.F.Macbr., *Peltophorum dubium* (Spreng.) Taub., *Pterogyne nitens* Tul., *Machaerium glabrum* Vogel, *Albizia niopoides* (Spruce ex Benth.) Burkart e *Gleditsia amorphoides* (Griseb.) Taub. As espécies de Leguminosae caracteristicamente encontradas na floresta ombrófila mista são *Albizia burkartiana* Barneby & J.W.Grimes, *Mimosa balduinii* Burkart, *Mimosa furfuracea*

Benth. e *Mimosa scabrella* Benth. Na região oeste do estado do Rio Grande do Sul, próxima ao limite territorial entre Brasil, Argentina e Uruguai, há uma formação temperada savânica, caracterizada por uma vegetação seca e espinhosa, onde são encontradas as espécies *Vachellia caven* (Molina) Seigler & Ebinger, *Prosopis nigra* (Griseb.) Hieron., *Prosopis affinis* Spreng. e *Parkinsonia aculeata* L.

Enquanto a porção setentrional do Brasil subtropical é caracterizada pela dominância de linhagens de Leguminosae tipicamente tropicais, centradas na floresta ombrófila densa e na floresta estacional semidecidual, as espécies encontradas nos campos de altitude subtropicais (Campos de Cima da Serra) e nos campos de baixa altitude temperados (domínio do Pampa) apresentam uma alta diversidade de gêneros temperados, como por exemplo, *Vicia* L., *Lathyrus* L., *Trifolium* L., e *Adesmia* DC. (séries *Bicolores* Burkart, *Subnudae* Burkart, e *Muricatae* Burkart). Alguns destes gêneros são amplamente distribuídos em regiões temperadas e de elevada altitude ao redor do mundo, mas apresentam espécies endêmicas no sul do Brasil (Iganci *et al.*, 2011). Algumas leguminosas características dos campos temperados de baixa altitude (domínio do Pampa) são as espécies de *Adesmia*, das séries *Bicolores*, *Subnudae* e *Muricatae*: *A. bicolor* (Poir.) DC., *A. incana* Vogel, *A. punctata* (Poir.) DC., *A. securigerifolia* Herter, *A. riograndensis* Miotto e *A. muricata* (Jacq.) DC.; assim como *Lathyrus acutifolius* Vogel, *L. hookeri* G. Don., *L. macrostachhys* Vogel, *Lupinus albescens* Hook. & Arn., *Mimosa bonplandii* (Hook. & Arn.) Benth., *M. chartostegia* Barneby, *M. cruenta* Benth., *M. diffusa* Benth., *M. intricata* Benth., *M. parvipinna* Benth., *M. ramboi* Burkart., *Trifolium polymorphum* Poir., *Vicia linearifolia* Hook. & Arn., *V. pampicola* Burkart, *V. tephrosioides* Vogel, dentre outras (Iganci *et al.*, 2011).

A vegetação encontrada nas regiões de maior altitude no sul do Brasil compartilha ambas as linhagens tipicamente tropicais e temperadas, que se distribuem através dos campos e florestas e concentram a maior parte das espécies exclusivas da flora do sul do Brasil. Como espécies características dos Campos de Cima da Serra, podem ser listadas as espécies do gênero *Adesmia* sér. *Psoraleoides*: *A. tristis* Vogel, *A. reitziana* Burkart, *A. rocinhensis* Burkart, *A. psoraleoides* Burkart, *A. paranensis* Burkart, *A. araujoi* Burkart, *A. vallsii* Miotto, *A. sessilifolia* Iganci & Miotto, *A. sulina* Miotto, *A. ciliata* Vogel, *A. arillata* Miotto; bem como *Chamaecrista incana* (Vogel) H.S. Irwin & Barneby, *Crotalaria hilariana* Benth., *Desmodium craspediferum* A.M.G. Azevedo & Abruzzi de Oliveira, *Lupinus paranensis* C.P. Sm., *L. reitzii* Burkart ex. Pinheiro & Miotto, *L. rubriflorus* Planchuelo, *L. uleanus* C.P. Sm., *Mimosa bathyrrhena* Barneby, *M. chartostegia* Barneby, *M. eriocarpa* Benth., *M. fachinalensis* Burkart, *M. filipetiola* Burkart, *M. glabra* Benth., *M. hatschbachii* Barneby, *M. intricata* Benth., *M. involucrata* Benth., *M. kuhniesteroides* Barneby, *M. lepidorepens* Burkart, *M. murex* Barneby, *M. per-dusenii* Burkart e *Vicia hatschbachii* Burkart ex Vanni & D. Kurtz, *Pomaria stipularis* (Vogel) B.B.Simpson & G.P.Lewis e *P. rubicunda* (Vogel) B.B.Simpson & G.P.Lewis, dentre outras (Iganci *et al.*, 2011).

Uma alta diversidade de espécies endêmicas tem sido destacada para o sul do Brasil (Iganci *et al.*, *l.c.*), as quais estão restritas a fragmentos de vegetação, que oferecem as condições ecológicas necessárias para mantê-las isoladas. As oscilações climáticas como influência na distribuição das espécies, sua vagilidade e a capacidade de ocupar novos ambientes foram discutidas por Dynesius & Roland (2000). Espécies de ampla dispersão geralmente não são seletivas em relação à especificidade de ambientes e ocupam distintos hábitats ao longo de sua distribuição. Isto promove uma grande capacidade de adaptação e sobrevivência das espécies frente à qualquer ameaça. Os autores (*l.c.*) também destacam o aumento da variabilidade e da capacidade de adaptação das espécies através do tempo, atenuando os riscos de extinção. Espécies de ampla dispersão são mais propensas a sobreviver durante variações climáticas desde que tenham colonizado ambientes favoráveis ao longo de uma vasta área geográfica, sendo capazes de manter populações em áreas isoladas (Jansson 2003).

A vegetação campestre do sul do Brasil apresenta uma alta diversidade de espécies endêmicas, sobretudo em relação aos Campos de Cima da Serra, os quais se distribuem estritamente ao longo desta região. Entretanto, é evidente a rápida perda de hábitat natural devido ao uso da terra para a agricultura empresarial, mecanizada, com culturas anuais e pomares (Lopes *et al.*, 2010). Além disso, as condições abióticas atuais são favoráveis ao avanço das formações florestais sobre os campos, tornando-os ainda mais ameaçados (Lindemann, 1906 ; Rambo, 1956; Duarte *et al.*, 2006; Koehler-Santos *et al.*, 2006; Behling & Pillar, 2007). As espécies endêmicas estão concentradas principalmente na borda leste da Serra Geral e na porção central dos estados de Santa Catarina e do Paraná (Iganci *et al.*, 2011), tornando estas áreas prioritárias para estudos de caráter conservacionista.

***Adesmia* ser. *Psoraleoides* e as formações campestres do sul do Brasil**

O gênero *Adesmia* DC. é formalmente classificado em dois subgêneros, *A.* subgen. *Adesmia* e *A.* subgen. *Acanthadesmia* Burkart, e compreende cerca de 240 espécies, exclusivamente distribuídas em regiões temperadas e subtropicais da América do Sul, do norte do Peru até a Terra do Fogo (Burkart, 1967; Ulibarri, 1980; 1986; Miotto & Leitão-Filho, 1993; Lewis *et al.*, 2005). A maior parte das espécies de *Adesmia* é restrita aos Andes, em regiões de elevada altitude e clima semiárido da Argentina e do Chile (Burkart, 1967). De acordo com Schrire *et al.* (2005), os táxons temperados do hemisfério Sul (como por exemplo o clado Adesmia, dentre as leguminosas da tribo Dalbergieae) provavelmente tiveram uma diversificação secundária em direção às formações campestres em regiões tropicais, principalmente em altitudes elevadas.

As espécies brasileiras de *Adesmia* foram recentemente estudadas por Miotto & Leitão Filhos (1993), que reconheceram 18 táxons distribuídos em quatro séries. Dentre estas está *Adesmia* sér. *Psoraleoides*, que compreende 11 espécies com distribuição restrita aos Campos de Cima da Serral (Iganci & Miotto, 2011). O estudo evolutivo de linhagens que apresentam distribuição centrada na vegetação campestre do sul do Brasil é fundamental para a compreensão dos principais eventos que levaram a formação dos biomas atuais. Através de estudos filogenéticos e biogeográficos em *Adesmia* foi possível inferir sobre os principais eventos que guiaram a sua diversificação nas formações abertas do sul da América do Sul, desde os Andes, Patagônia, até os Campos de Cima da Serra, no sul do Brasil.

Transformações históricas: a influência de processos geológicos e climáticos na evolução da biota no sul da América do Sul

Análises descritivas sobre os padrões geográficos da flora do sul do Brasil sugerem uma forte correlação entre mudanças geológicas e climáticas ocorridas ao longo do tempo, e os processos evolutivos que guiaram a formação da paisagem e a sua atual composição florística (Smith, 1962; Rambo, 1953; 1953b; Safford, 2007). Estudos recentes sobre a modificações geológicas e oscilações climáticas no sul da América do Sul têm sido fundamentais para elucidar os eventos mais importantes que podem ter influenciado na formação da flora e da fauna da região (Kvasov e Verbitski, 1981; Webb, 1995; Pascual et al, 1996;. Donato et al, 2003;. Pérez-Losada et al., 2004;. Berreda et al., 2010).

As estimativas cronológicas para as glaciações documentadas para a região da Patagônia estão bem estabelecidas e fornecem um excelente cenário para discutir os processos evolutivos e a diversificação da biota do sul da América do Sul durante o Mioceno e o Plioceno (Mercer 1969, 1976; Ton-That et al. 1999; Coronato et al 2004; Rabassa et al. 2005). Um processo de resfriamento global teve início após o óptimo climático do Mioceno Médio, cerca de 15 milhões de anos atrás, afetando a vegetação de biomas secos e abertos no Neotrópico, como a sugerida expansão do Cerrado (Simon et al. 2009), e dos campos de altitude (Antonelli et al. 2010). Este processo foi seguido por uma subsequente contração desta vegetação durante períodos mais úmidos (Rambo, 1953; Behling, 2002; Safford, 2007).

Além disso, durante o início do Mioceno (~15 Ma), a paisagem do sul da América do Sul começou a ser direcionada para a sua atual conformação através das atividades tectônicas e a formação dos Andes (Donato et al. 2003). Durante o Mioceno Médio e Tardio, quatro extensivas transgressões marinhas sucessivas inundaram a porção central do sul da América do Sul, cobrindo a maior parte das terras baixas (Webb 1995, Donato et al. 2003; Pérez-Losada et al. 2004). Transgressões marinhas são documentadas para o sul da América do Sul, em diferentes períodos geológicos, sendo que uma das mais relevante é registrada para cerca de 12 milhões de anos atrás, durante o Mioceno, quando o mar cobriu uma ampla área continental, incluindo o sul do Brasil, Uruguai e Argentina (Lovejoy et al. 2006). Esta região permaneceu inundada por cerca de dois milhões de anos e ficou conhecida como Mar Paranaense (Donato et al. 2003). Durante este período somente as regiões de maior altitude permaneceram emersas, isolando as populações que previamente possuíam distribuição ampla, em refúgios insulares. Após este período, a paisagem da região foi sucedida por uma ampla planície que se extendeu desde a Patagônia até o centro e norte da Argentina, Uruguai, acompanhando a encosta dos Andes, até o norte da Bolívia, Peru e Venezuela, oferecendo um novo e conspícuo hábitat para plantas e animais (Donato et al. 2003). Ao mesmo tempo (entre

13 e 11 milhões de anos atrás) a passagem de Drake completou sua abertura, separando a América do Sul da Península Antártica, estabelecendo uma corrente oceânica fria (Corrente Circum-Antártica) e iniciando a formação de uma cama de gelo no oeste da Antártica que propiciou um clima mais frio e sazonal durante o Mioceno Médio (Kvasov & Verbitski, 1981; Donato et al. 2003). Mudanças florísticas coincidem com este processo. Através do estabelecimento de um clima mais frio e seco no sul da América do Sul, a distribuição e a diversificação de sua biota foi direcionada para o norte (Barreda et al. 2010). Subsequentemente, uma nova fase distrófica se estabeleceu nos Andes, com importantes consequências ecológicas que resultaram nas condições xéricas e áridas extremas que são atualmente observadas na região central da Cordilheira na Argentina e no Chile, que tiveram consequências importantes sobre a composição de sua biota (Donato et al. 2003). Em concordância com as evidências florísticas, dados sobre mamíferos terrestres demonstram uma grande radiação de espécies pastadoras, em associação com espécies frugívoras, neste período, indicando a presença de ambas formações campestres e arbustivas que provavelmente compunham uma savana (Pascual et al. 1996; Donato et al. 2003).

Os registros mais antigos sobre glaciações na região da Patagônia datam de cerca de sete a cinco milhões de anos atrás, durante o Mioceno Tardio, tornando-se mais frequentes logo após (Rabassa et al., 2005). No mínimo oito glaciações são reportadas para o Plioceno Médio e Tardio, além de muitos eventos geoclimáticos para o final do Plioceno e para o Pleistoceno (Rabassa et al. 2005). Modificações climáticas e ambientais ocorridas durante estes eventos glaciais tiveram grande influência na formação da paisagem e no desenvolvimento dos ecossistemas do sul da América do Sul durante os últimos cinco milhões de anos. Como consequência, houve uma redução de cerca de 100-140 metros no nível do mar durante os episódios de máximo glacial, causando uma exposição parcial da plataforma submarina que causou uma continentalização climática nas áreas adjacentes. Este processo resultou em um aumento de temperaturas extremas e na diminuição da precipitação (Rabassa et al. 2005).

Desta forma, o conhecimento sobre os processos climáticos e geológicos que moldaram a paisagem do sul da América do sul é fundamental para embasar os estudos sobre processos históricos e a diversificação de sua flora. Através de estudos de caráter biogeográfico e evolutivo em linhagens amplamente distribuídas nesta região é possível inferir sobre como estas mudanças na paisagem influenciaram a composição biótica e levaram à formação dos biomas na forma como os observamos hoje.

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Organização geral da tese

A tese está organizada na forma de artigos, que foram produzidos a partir de dados originais. Apesar de abordarem diferentes temas, os estudos se complementam, produzindo uma unidade contínua de ideias e resultados interdependentes entre si. São apresentados três artigos científicos. O primeiro trata da delimitação da vegetação dos Campos de Cima da Serra, através do estudo da diversidade de plantas endêmicas daquela região, e sua relação com as demais formações adjacentes. Este trabalho surgiu da necessidade de caracterizar as formações vegetacionais do sul do Brasil, principalmente em relação às formações campestres. Um alto índice de espécies endêmicas é reportado para os Campos de Cima da Serra, ressaltando a singularidade de sua flora e a importância de sua conservação. O segundo artigo trata especificamente do gênero *Adesmia* ser. *Psoraleoides*, onde é descrita uma nova espécie para a ciência, *Adesmia sessilifolia* Iganci & Miotto, juntamente com uma circunscrição geral e chave para identificação das espécies da série. Esta espécie é encontrada em uma área restrita, na região central do estado do Rio Grande do Sul, ocorrendo sobre formações geológicas relictuais de basalto. O terceiro trata da análise filogenética de *Adesmia* ser. *Psoraleoides*, com enfoque nos processos evolutivos e biogeográficos históricos que guiaram a diversificação deste grupo. É apresentada uma abordagem geral do gênero, buscando compreender os principais eventos que conduziram à atual distribuição dos táxons e suas relações com eventos históricos climáticos e geológicos descritos para o sul da América do Sul. Para cada um dos artigos, seguem as informações sobre os periódicos onde os quais foram publicados ou para os quais se pretende submeter. Os manuscritos foram preparados seguindo as orientações sobre edição e formatação indicadas por cada periódico.

ARTIGO I

Campos de Cima da Serra: the Brazilian Subtropical Highland Grasslands show an unexpected level of plant endemism

Artigo publicado no periódico *Botanical Journal of the Linnean Society* 167(4): 378-393, 2011.

Campos de Cima da Serra: the Brazilian Subtropical Highland Grasslands show an unexpected level of plant endemism

Short running title: Endemism in the Campos de Cima da Serra, Brazil

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ABSTRACT. A high level of endemic flowering plant species is highlighted for the first time for the southern Brazilian flora. We present a comprehensive list of 1020 endemic taxa and analyse their distribution in different biomes focusing on the Subtropical Highland Grasslands (Campos de Cima da Serra). Considering all biomes represented in southern Brazil, around 13% of the flowering plant species are endemic, which accounts for more than 5% of the total endemic taxa of Brazil and about 12% of the endemic taxa from the Atlantic Forest hotspot. Like the High Altitude Tropical Grasslands that are found further north in the southeastern Brazil region, the Subtropical Highland Grasslands are composed by an assemblage of tropical and temperate plant lineages. The Subtropical Highland Grasslands are characterized by their transitional nature and having 296 endemic plant taxa (25% of its flora).

ADDITIONAL KEYWORDS: Angiosperms – Biogeography – Conservation – Endemic Species – Diversity.

INTRODUCTION

South American savannas and grasslands harbour particular floras with a high level of endemism. However, these open vegetations are neglected when compared to the forests concerning the priority given to research and conservation (Burman, 1991; Safford, 1999; 2007; Bilenca & Miñarro, 2004; Overbeck *et al.*, 2007).

The Campos de Cima da Serra are the southern Brazilian Subtropical Highland Grasslands. Studies focusing this biome have suggested that they are neglected in conservation policies, and that information about their biodiversity is lacking (Giulietti *et al.*, 2005; Overbeck *et al.*, 2007). A compilation by Boldrini *et al.* (2009) for the Subtropical Highland Grasslands, including two (Rio Grande do Sul and Santa Catarina) out of the three states which comprise the Southern Brazilian Subtropical Highland Grasslands, estimated the existence of 1161 plant species with 107 (9.21%) considered as endemic. Despite these recent reports, other publications covering grasslands from Brazil have considered the southern Brazilian grasslands as not satisfactorily known (Joly *et al.*, 1999; Alves & Kolbek, 2010). In an attempt to delineate the Campos Rupestres (rocky grasslands embedded within the Tropical Savannas) in comparison with other grass-rich vegetation from South America, Alves & Kolbek (2010) mentioned the high diversity of endemic species that characterize the grassy vegetation in the high altitude mountains of southeastern Brazil (to the north of the area of the current study). However, the Subtropical Highland Grasslands from southern Brazil were not included in their analysis, because the authors (*l.c.*) considered their flora as poorly known and interpreted it as representing a successional phase to forest vegetation.

The present study arises from the necessity to characterize and delimit the Southern Brazilian Subtropical Highland Grasslands and to recognize the distribution of the diversity of their endemic plants. We aim to characterize the southern Brazilian flora looking for candidate plant taxa which could be recognized as indicators of the Subtropical Highland Grasslands biome, and to analyse its floristic similarity with the other adjacent biomes. We address the following questions: How high is the diversity of endemic plants in southern Brazil? Is it possible to characterize the Subtropical Highland Grasslands biome by the means of endemic taxa? Which other biomes is the Subtropical Highland Grasslands related to?

METHODS

Study area: the southern Brazilian Subtropical Highland Grasslands comprise 1.374.000 ha (Boldrini *et al.*, 2009), reaching to around 1.800 m altitude on their eastern edge. This vegetation lies south of the Tropic of Capricorn, between the latitude 24º52'11"S and 29º26'40"S and longitude 49º27'11"W and 53º43'51''W. The Subtropical Highland Grasslands are underlain by effusive rocks of the Serra Geral formation that originated between 120 and 135 mya (Almeida, 2009). The climate is subtropical humid (Cfa) and temperate humid (Cfb) (Peel *et al.*, 2007), with rainfall throughout the year and average temperature between 12ºC (mean minimum temperature in July: 10ºC) and 18ºC (mean maximum temperature in January: 27ºC) (Behling, 2002; Almeida, 2009).

Species list and distribution: two large databases concerning South American vegetation were recently published and cover the study area. The Catálogo de las Plantas Vasculares del Cono Sur (Zuloaga *et al.*, 2008) listed all vascular plants from southern South America, including Argentina, Chile, Paraguay, Uruguay, and the south of Brazil (Paraná, Santa Catarina, and Rio Grande do Sul states). The other database is the List of Species of the Brazilian Flora (Forzza *et al.*, 2010), which covered all known plants and fungi from Brazil. Information from these databases was the source to elaborate a consensus checklist of endemic Angiosperms from southern Brazil in the study presented here. To achieve this consensus list, all names were checked and the taxa assigned as endemic to southern Brazil were assembled in a new checklist. To combine the lists, an exhaustive search was carried out, and each taxon name was checked in nomenclatural databases (IPNI, 2008; Tropicos, 2011), protologues and taxonomic revisions. In addition, the checklist Plantas da Floresta Atlântica (Stehmann *et al.*, 2009), monographs, herbaria records, field observations and personal communications were considered to complement the final list and solve ambiguous and contradictory information amongst the original sources of data. The most recent changes in taxonomy and nomenclature were applied to make lists comparable, according to APG III (2009) for family and genus level and recent taxonomic revisions for genus and species levels. In the same way, data of geographic distribution for each taxon, including the vegetation where they occur, were compiled from the most representative herbaria covering the southern Brazilian flora: HBR, ICN, MBM, PACA, RB, SPF (abbreviations from Thiers, 2010); and from databases of the Missouri Botanical Garden - Brazilian records (MOBOT_BR), Smithsonian Department of Botany - Brazilian records (NMNH_Botany_BR), and The New York Botanical Garden - Brazilian records (NYBG_BR), accessed through Species Link (CRIA, 2011). This review enabled the improvement of the checklist by eliminating the incongruent names from the source lists (not validly published names, synonyms and taxa mistakenly considered as endemics).

The taxa with narrow distributions centred in southern Brazilian vegetation but not endemic to southern Brazil were not included in the present analysis. The vegetation in neighbouring regions (e.g., Tropical Forest and Tropical Highland Grasslands, in Southeast Brazil) was not fully sampled here, leading to the omission of some taxa which were not exclusive to southern Brazil. Similarly, some taxa restricted to Low Altitude Temperate Grasslands and Temperate Shrubland, but not endemic to southern Brazil because their distribution range crosses the political limits with Uruguay and Argentina within the Pampean province, were also not included in the analysis.

Categorization of vegetation: to analyse the distribution of endemics at a finer scale, the vegetation of southern Brazil was classified by a modification of the categories mapped by Leite (2002), who recognized ten different phytoecological units and three transitional vegetation areas in the South of Brazil based on geology, terrain, climate and soil. For the present study, nine categories (biomes) were considered (Fig. 1): Tropical Forest (TRF), Tropical Savanna (TRS), Tropical Coastal Scrub (TCS), High Altitude Tropical Grasslands (HTG, synonymous with Campos de Altitude), Subtropical Seasonal Forest (SSF), Subtropical Mixed Forest (SMF), Subtropical Highland Grasslands (SHG, synonymous with Campos de Cima da Serra), Temperate Shrubland (TES), and Low Altitude Temperate Grasslands (LTG). The main differences of this classification and that of Leite (2002) is the separation of the High Altitude Tropical Grasslands and the Subtropical Highland Grasslands, as well as the Subtropical Scrub and the Low Altitude Temperate Grasslands, and the merging of different seasonal categories applied by Leite (2002) into one single unit called Subtropical Seasonal Forest. Areas defined as transitional by Leite (*l.c.*) and areas not relevant in the context of the current work (Subtropical/Temperate Coastal Scrub and Temperate Savanna) were mapped but not included within the analysis. Since the delimitation of the study area (southern Brazil) is essentially political, some of the biomes listed above are continuous in other Brazilian states or in adjacent countries such as Argentina and Uruguay. For these biomes, only the portion included in southern Brazil was considered and analysed. However, the Subtropical Highland Grasslands, the main subject of this work are completely included with the study area and were therefore analysed completely.

Data analysis: all names were organized in tables, and taxa for which data about geographic distribution were unreliable were excluded from analysis. The information about geographic distribution was organized in floristic matrices, consisting of binary presence-absence data for 965 taxa (descriptors) and nine sampling units (samples). Similarity between different sampling units was calculated by the Sørensen coefficient, and their relationships investigated using the Unweighted Pair Group Method with Arithmetic Mean method (UPGMA), applied in Fitopac 2.1.2.85 (Shepherd, 2010). To test the sharpness of groups, a method developed by Pillar (1999) was applied, using MULTIV 2.4.2 (Pillar, 2006). Separation of floristic groups highlighting the indicator taxa for each sampling units was carried out using WinTWINS 2.3, TWINSPAN for Windows (Hill & Šmilauer, 2005). The taxa which occur exclusively in each sample were considered as biome indicators. A Venn diagram (Venn, 1981) was elaborated to visualise both exclusive and shared endemic taxa among the main floristic areas identified in the dissimilarity analysis, considering four sampling units: Forests (TRF+SSF+SMF+TCS), Pampas (LTG+TES), High Altitude Grasslands (HAG: HTG+SHG) and Tropical Savanna (TRS).

RESULTS

The list of endemic taxa of Angiosperms from southern Brasil, based only on the Catálogo de las Plantas Vasculares del Cono Sur (Zuloaga *et al.*, 2008), resulted in a total of 1249 taxa, including species, subspecies and varieties. On the other hand, considering the list of endemics based only on the List of Species of the Brazilian Flora (Forzza *et al.*, 2010), 981 taxa were considered endemic to Southern Brazil. When compared, the two lists showed only 646 names in common, and 48.27% (603 names) of taxa cited as endemic from southern Brazil by the Catálogo de las Plantas Vasculares del Cono Sur were not considered as endemic in List of Species of the Brazilian Flora. Similarly 34.14% (335 names) listed as endemic from southern Brazil by the List of Species of the Brazilian Flora were not considered endemics in the first list. Summarizing both lists into a single database, 938 names were incongruent, and had to be checked through the review of protologues, taxonomic revisions, analysis of herbarium specimens, and personal communication with experts in specific families.

The consensus list of endemic flowering plants from southern Brazil recognizes 1020 taxa at species, subspecies and variety levels, corresponding to 13% of the total Angiosperms from southern Brazil (7671 taxa) and 5.34% of the total (19090 taxa) endemic flowering plants from Brazil (Forzza *et al.*, 2010). The complete list of endemic flowering plants from southern Brazil is provided as Supplementary Material. The most important families in number of endemic taxa are Asteraceae (115 spp.), Orchidaceae (100 spp.) and

Fabaceae (78 spp.), which are recognized as among the three richest flowering plant families in number of species worldwide. The genera with the highest numbers of endemic taxa in southern Brazil are *Mimosa* L. (Fabaceae) with 45 taxa, and *Baccharis* L. (Asteraceae) and *Begonia* L. (Begoniaceae) with 26 taxa each. Considering only the Subtropical Highland Grasslands, the most important families in number of endemic taxa are Asteraceae (56), Fabaceae (31) and Poaceae (26) and the genera with the highest levels of endemism are *Croton* L. (Euphorbiaceae) with 15 taxa, *Mimosa* (Fabaceae) with 14 taxa and *Nothoscordum* Kunth (Amaryllidaceae) also with 14 taxa.

Eight genera belonging to six families were recognised as endemic in southern Brazil. All of them are monotypic in their current circumscription and are distributed in different vegetation formations as seen in Tab. 1.

Considering the biomes from southern Brazil, the Subtropical Highland Grasslands is the richest one in endemic flowering plants, with 296 endemic taxa. The second richest is the Tropical Forest with 216 endemic taxa, and the third richest the Subtropical Mixed Forest, with 70 endemic taxa. The other endemic taxa are more or less equally distributed amongst the remaining other six biomes. Fifty five taxa were classified as having deficient data of their geographic distribution due the lack of reliability of herbarium records or missing data, and were not considered.

The grasslands of southern Brazil are frequently considered as a single vegetation unit, known as Campos Sulinos (southern Grasslands) encompassing both the Subtropical Highland Grasslands (Campos de Cima da Serra) and the Pampas (Low Altitude Temperate Grasslands plus Subtropical Scrub). However, considering the geographic distribution of the endemic flora emphasizes that few taxa exclusive to Southern Brazil are shared between the Subtropical Highland Grasslands and the Pampas. The Subtropical Highland Grasslands show a transitional pattern, sharing some taxa with the tropical grasslands from further north in Brazil (High Altitude Tropical Grasslands) and some taxa with the temperate grasslands from Pampas. Twenty three taxa are shared with the High Altitude Tropical Grasslands and 12 between the Subtropical Highland Grasslands and the Pampas. However, when the Pampas is compared to the High Altitude Tropical Grasslands from Serra do Mar, no taxa are shared, highlighting the temperate character of Pampas and the tropical nature of Serra do Mar, and the discontinuity of distribution of southern Brazilian endemic taxa between them (Fig. 2A). Besides these shared taxa, the uniqueness of Subtropical Highland Grasslands is emphasised by 296 endemic plant taxa, which could be considered as indicator species to recognize this biome. A complete list of endemic flowering plants from the Subtropical Highland Grasslands is presented in Tab. 2.

A comparison of taxa exclusive to southern Brazil shared between the biomes analysed, shows low floristic similarity as revealed in Tab. 3 (maximum Jaccard index of 0.1599 between Tropical Forest and Subtropical Mixed Forest). The present analysis considered only endemic taxa from southern Brazil (13% of the total flora), which probably has influenced this low degree of similarity. Even though the Subtropical Highland Grasslands share endemic taxa from southern Brazil with all other biomes within this region, there is no one biome to which it has a high degree of floristic similarity. Maximum similarity is with the High Altitude Tropical Grasslands (23 shared taxa), the Tropical Forest (35 shared taxa) and the Subtropical Mixed Forest (40 shared taxa). Cluster analysis based on UPGMA (cophenetic correlation 0.8952) can be visualised in Fig. 3. The first group (forests of Atlantic Domain) is composed by the Tropical Forest, Subtropical Seasonal Forest and Subtropical Mixed Forest, the second group (grasslands of the Atlantic

Domain) is composed by the Subtropical Highland Grasslands (Campos de Cima da Serra) and the High Altitude Tropical Grasslands, and the third group (grasslands and savannas of the Pampas Domain) is composed by the Low Altitude Temperate Grasslands plus the Subtropical Scrub. The Tropical Coastal Scrub (coastal vegetation of Atlantic Domain) and the Tropical Savanna (Cerrado Domain) did not group and remained separated.

The TWINSPAN analysis shows similar results, where in the first partition the Low Altitude Temperate Grasslands and the Subtropical Scrub are separated with an eigenvalue of 0.695 and showing 19 taxa as indicators. The second partition separates the Tropical Forest, Subtropical Seasonal Forest, Subtropical Highland Grasslands, Subtropical Mixed Forest and Tropical Coastal Scrub from the High Altitude Tropical Grasslands plus the Tropical Savanna with an eigenvalue of 0.652 and 165 positive preferential species. Finally, the Subtropical Highland Grasslands emerged from the remaining vegetation formations with an eigenvalue of 0.525 and 97 taxa as positive preferentials.

Fig. 2B shows a Venn diagram of the four groups clustered in the previous analysis, which are also represented in Fig. 4. No southern Brazilian endemic taxa co-occur in all four groups and only two species occur in three different groups: *Mimosa intricata* Benth. (Forests+Pampas+HAG) and *Galianthe verbenoides* (Cham. & Schltdl.) Griseb. (Pampas+HAG+TRS). The High Altitude Grasslands (HTG+SHG) share endemic taxa from southern Brazil with all the three other groups, being weakly related to both Pampas and Tropical Savannas (12 and 11 shared taxa respectively), and sharing more exclusive species with the Forests (76 shared taxa).

DISCUSSION

A previous study concerning endemic plants from southern Brazil includes an analysis of distribution patterns by Marchioretto & Siqueira (1998) of endemic plants from Rio Grande do Sul state, where they listed 65 eudicotyledons within different biomes and five endemic taxa from the Subtropical Highland Grasslands. Later, the total plant diversity from the Subtropical Highland Grasslands was estimated as 1161 plant taxa (including 107 endemic taxa – 9.21%) (Boldrini *et al.*, 2009). In the present study, we demonstrate a remarkably higher level of endemism in the Subtropical Highland Grasslands - 25.31% (296 taxa). This may even exceed endemism in the High Altitude Tropical Grasslands further north in Brazil, where 11% of vascular plant species are endemic to Itatiaia (part of Serra da Mantiqueira range) in southeast Brazil (Martinelli *et al.*, 1989), and from 17 to 31% of species are endemic in the flora of the High Altitude Tropical Grasslands as a whole (Safford, 1999). Most of the genera sampled by Safford (2007) for the southeast Brazilian High Altitude Tropical Grasslands are the same as those found in southern Brazil, however, many exclusive species point out the distinction between them.

The Subtropical Highland Grasslands have a marked diversity of endemic flowering plants, especially at the eastern edge of the plateau of the highlands, e.g. from Campos dos Padres and Serra do Corvo Branco in Santa Catarina state, to Serra da Rocinha and Cambará do Sul, in Rio Grande do Sul State. Even though these grasslands are within the Atlantic Forest Domain (Oliveira-Filho & Fontes, 2000), the results here suggest an endemism centre distinct from the High Altitude Tropical Grasslands in Serra do Mar range, in the northeast of Santa Catarina and the east of Paraná. The Subtropical Highland Grasslands have a high level of endemic plant taxa which should be considered as particularly important for conservation approaches and future studies concerning patterns of diversification in a subtropical transitional environment.

Safford (2007) listed 928 species of vascular plants for the High Altitude Tropical Grasslands from Southeast Brazil, about 21% of which belong to temperate genera. These High Altitude Tropical Grasslands show a genus level similarity of 41.4% (195 genera shared) with the Subtropical Highland Grasslands, but a species level similarity of only 9.1% (149 species shared). Overall, the Subtropical Highland Grasslands present a higher number of temperate taxa, probably reflecting their more southerly latitude and subtropical nature, as well as their more proximal position to the probable migration path of temperate taxa into Brazil (Safford 1999; 2007).

The main groups are the same in the cluster and TWINSPAN analyses. The forest biomes grouped together in both analyses, as well as the two formations that comprise the Pampas. The main differences are related to the Subtropical Highland Grasslands (Campos de Cima da Serra) which remained isolated in the TWINSPAN analysis and not related to the High Altitude Tropical Grasslands, which became grouped with the Tropical Savanna. The exclusive and shared taxa between clustered biomes can be observed in Fig. 2B.

The Atlantic Forest Domain, with a total of 885 endemic taxa in Southern Brazil, corresponds to 11.72% of total endemic plants of the Atlantic Forest hotspot, while the Subtropical Highland Grasslands (SHG) have a total of 296 endemic taxa, corresponding to 4% of total endemic plants of the Atlantic Forest hotspot. This calls into question policies for conservation that reflect a single, widely defined Atlantic Forest Domain (e.g, following the definition of Oliveira-Filho & Fontes, 2000), and suggested that it might be better to consider HTG, SHG, TRF, SSF, SMF and TCS separately. In addition, the Subtropical

Highland Grasslands are frequently considered together with grasslands from the Pampas (LTG+TES), being collectively termed the Campos Sulinos. Beyond the physiognomic distinctiveness between the Subtropical Highland Grasslands and Pampas, our results show a strong floristic distinction between them, and they share only 12 taxa. It is clear that in southern Brazil, different lineages containing endemic taxa are narrowly distributed in different vegetation formations, which are threatened by both human land uses and the increasing predominance of invasive species due the climate changes. It is vital, therefore, that conservation policies directed at preserving full plant diversity take these floristic differences into account.

According to the biogeographic classification of South America by Cabrera & Willink (1980), the latitude 30ºS is the approximate border between the Northern biogeographic provinces Atlántica and Paranense, part of the Amazonian Domain, essentially tropical and dominated by forest; and the southern provinces Pampeana and Espiñal, which represent an extension of the more continental and xerophytic open vegetations of the Chaco Domain.

Although the flora of the high altitude grasslands contains a large number of endemic taxa, phytogeographical connections with similar habitats in the Andes (Rambo, 1951; 1953; 1956; Smith, 1962; Safford, 1999; 2007) and Central Brazil (Smith, 1962) are evident. More than one-third of the flora from southern Brazil clearly belong to temperate Austral-Antarctic and Andean lineages (e.g. *Adesmia* DC., *Araucaria* Juss., *Gunnera* L.), which could be evidence that these groups constitute the major focus of secondary radiation of Andean and Austral-Antarctic taxa into Eastern South America (Rambo, 1953; Safford, 1999; 2007; Waechter, 2002). At the same time, between one half and two-thirds of the genera in Subtropical Highland Grasslands, as well as in the high altitude grasslands in southeast Brazil, may have tropical ancestry as congeneric species grow in tropical regions (Safford, 2007).

Phylogenetic studies of biogeography could help to elucidate these deeper phytogeographical connections. Possible candidate genera are *Lupinus* L., *Mimosa* and *Baccharis*. In *Lupinus* (Fabaceae), many species have a wide distribution in southern Brazil, occurring from the Pampas to the central Brazilian Cerrado (Hughes & Eastwood, 2006) and some species are endemic to the Subtropical Highland Grasslands. In *Mimosa,* many species from southern Brazil are part of lineages which spread from temperate grasslands in lowlands of Argentina and Uruguay, up to the Cerrado (Simon *et al.*, 2009). *Baccharis* has numerous endemic taxa from Southern Brazil, showing distribution patterns related to both temperate and tropical grasslands from Pampas, Subtropical Highland Grasslands and High Altitude Tropical Grasslands (Heiden *et al.*, 2007).

Urtubey *et al.* (2010) analysed the diversity patterns of Asteraceae from South America by a panbiogeographic approach and recognized two main nodes that were interpreted as biotic convergence zones. One of them is located exactly on the transition tropical/temperate area in the subtropics of Brazil, within the Subtropical Highland Grasslands. In this transitional zone, Safford (1999) suggested that climate fluctuations in the Late Tertiary and Quaternary caused floristic changes in the regions now occupied by the high altitude grasslands. In cool-dry periods such as Pleistocene glacial times, they were colonized by both cool-temperate Andean and Austral-Antartic taxa, and xerophilous vegetation from the Brazilian Plateau. In warmer, wetter periods, such as Pleistocene interglacials, more humid-adapted forests would have spread. This picture of alternate dominance of the landscape by forests or grasslands is supported by palaeobotanical evidence (Smith, 1962; Behling, 2002; Safford, 2007).

According to Safford (1999), the presence of shared genera of highly dispersive groups such as Asteraceae and Poaceae between similar habitats can be explained by ecological compatibility of available habitat. However, Safford (1999; 2007) agrees with Rambo (1951; 1953) that the possible explanation of the presence in southern Brazil of Andean and Austral-Antarctic genera that lack efficient longdistance dispersal mechanisms is best explained by the existence of direct terrestrial connections during past periods of favourable climate, at different periods of both early and late Cenozoic, and probable multiple times within the Pleistocene. This hypothesis could also be tested by phylogenies of key exemplar taxa.

The diversification of lineages in the Subtropical Highland Grasslands could have been caused by geographic isolation of vegetation in times of varying climate. In warm, wet conditions favouring the expansion of rain forests, which represents barriers for dispersal of grassland species, allopatry in the grasslands could have been a primary mechanism for species differentiation producing the large numbers of endemic species demonstrated in this study. This hypothesis could be tested by phylogenetic and population genetic studies of genera with numerous endemic species in the Subtropical Highland Grasslands, such as *Adesmia* ser. *Psoraleoides* Burkart (Fabaceae - Miotto & Waechter, 1996).

CONCLUSIONS

An unexpected diversity of endemic plants is listed for the transitional tropical/temperate vegetation zone in southern Brazil. The Subtropical Highland Grasslands are a distinct vegetation type defined by numerous endemic taxa and are restricted to isolated patches surrounded by ecologically and floristically distinct formations.

Collectively, the main vegetation types in southern Brazil that are covered in this paper harbour 1020 endemic flowering plants, which are distributed within nine biomes. Considering all plant taxa endemic to Southern Brazil, few taxa are shared between biomes, but cluster analysis grouped forest biomes (TRF, SSF, SMF and TCS) separated from the High Altitude Grasslands (SHG and HTG), as well as from the Pampas and the Tropical Savanna.

Although the Subtropical Highland Grasslands share taxa with other grasslands and forests, such as the High Altitude Tropical Grasslands and the Low Altitude Temperate Grasslands, they support at least 296 endemic taxa, which is much higher than previous estimates. The transitional character and singularity of the Subtropical Highland Grasslands is indicated by fact that they harbour both tropical and temperate plant lineages and show surprisingly low species level similarities with other southern and southeastern Brazilian grassland systems. Overall, the high number of endemic taxa in the Subtropical Highland Grasslands suggests that this grassland system has been extant for some time in southern Brazil and does not simply represent a successional stage of disturbed forest.

ACKNOWLEDGEMENTS

The authors would like to thank CAPES, FAPESP (2010/00519-8) and CNPq for providing grants and post-graduate scholarship support, and N.D. dos Santos, J.R. Lima and J. Durigon for comments and suggestions in statistics analysis.

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FIGURES:

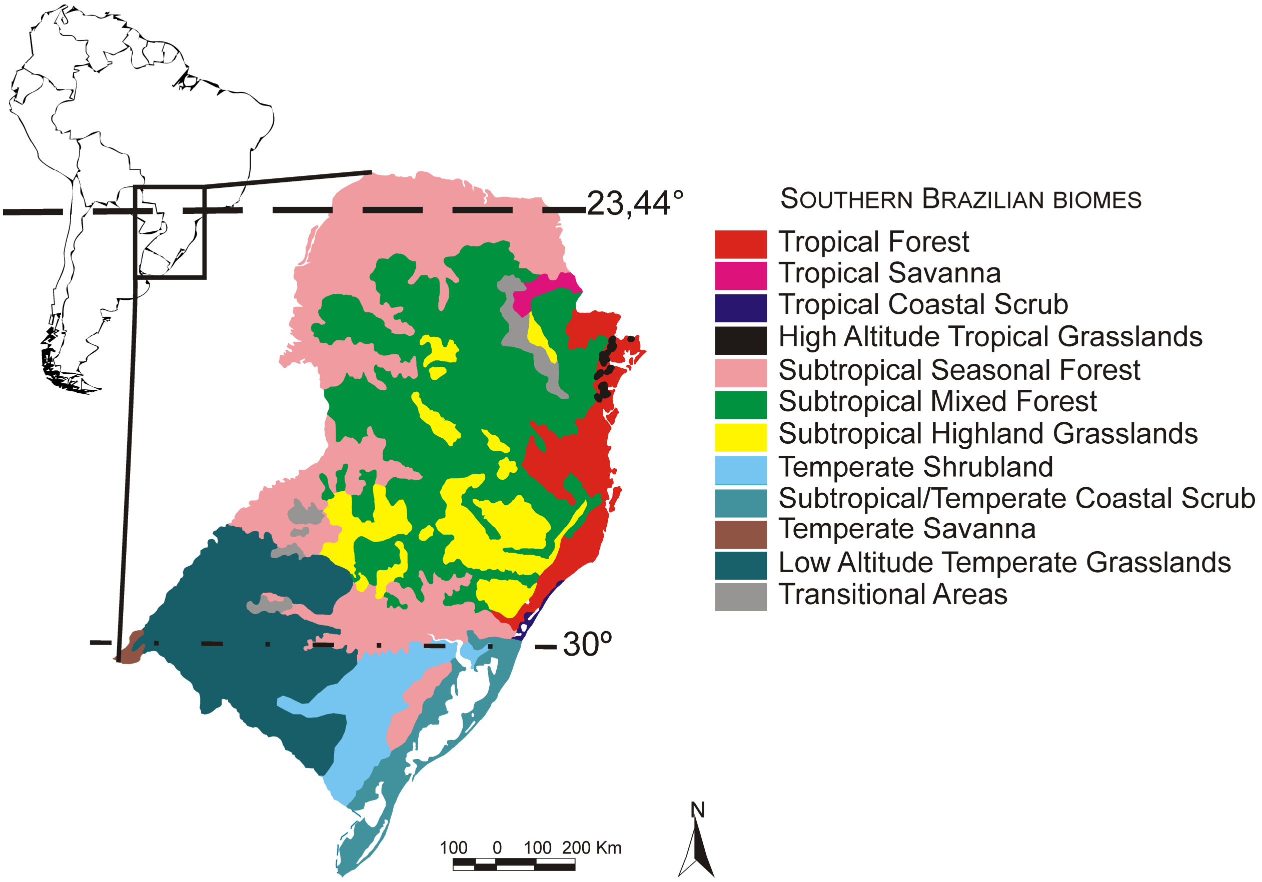

Figure 1. Vegetation in southern Brazil.

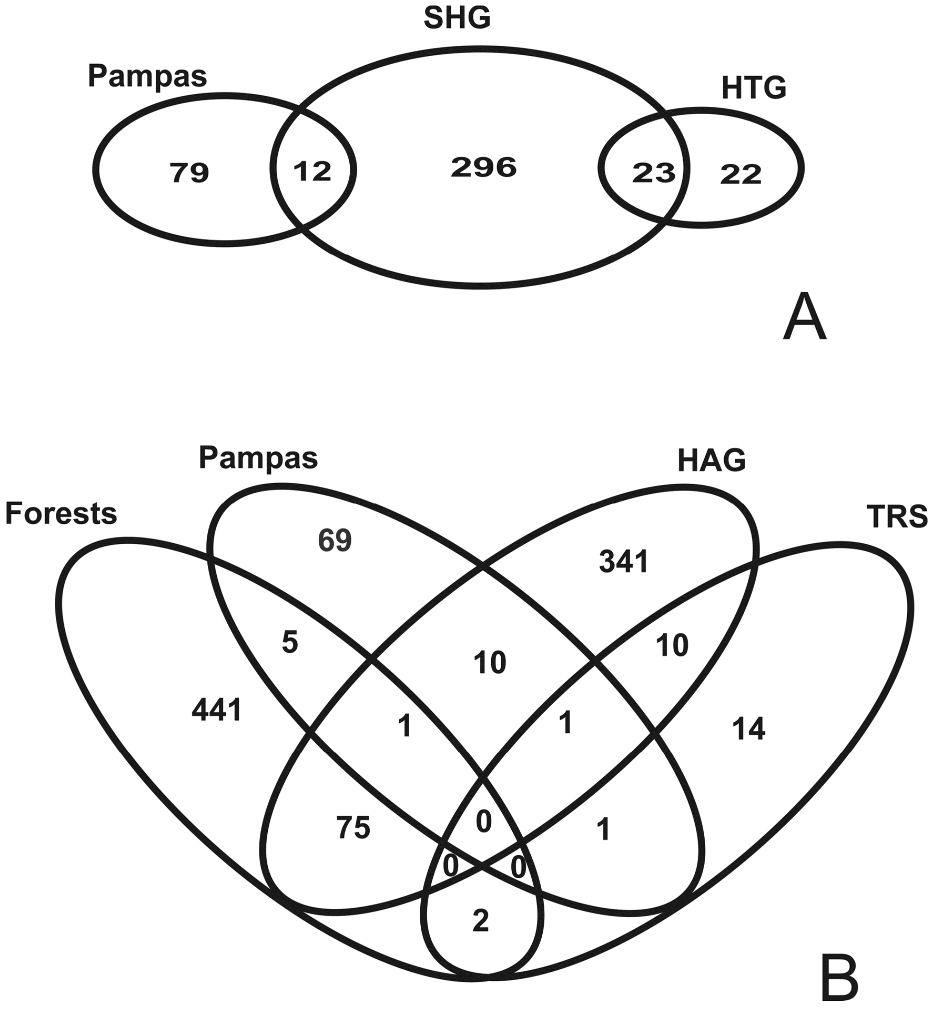

Figure 2. A. Exclusive and shared Southern Brazilian endemic taxa between the grassland formations. B. Distribution of exclusive and shared Southern Brazilian endemic taxa, considering the four major vegetation clusters from southern Brazil. Abbreviations: Pampas – Low Altitude Temperate Grasslands and Temperate Shrubland; SHG – Subtropical Highland Grasslands (Campos de Cima da Serra); HTG: High Altitude Tropical Grasslands; Forests – Tropical Forest, Subtropical Seasonal Forest, Subtropical Mixed Forest and Tropical Coastal Scrubs; HAG – High Altitude Grasslands (SHG plus HTG); TRS – Tropical Savanna.

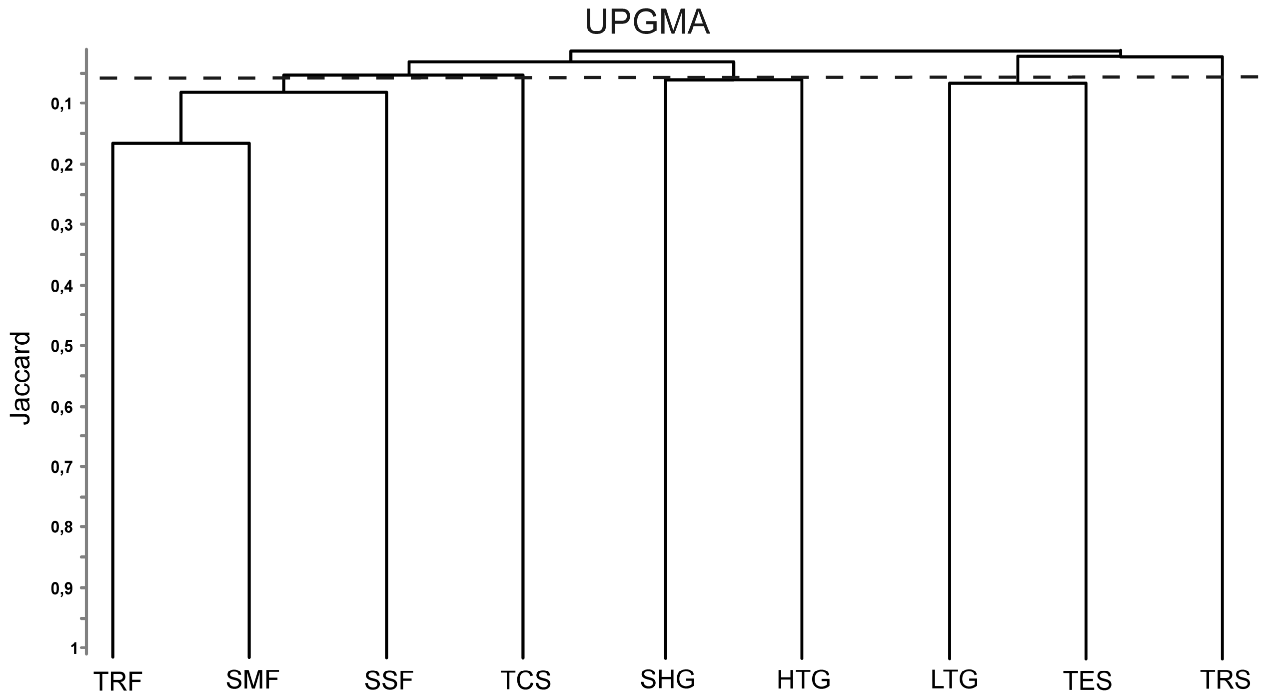

Figure 3. Groups formed in the similarity analysis using Jaccard coefficient and UPGMA as a cluster analysis. Dotted line indicates the groups formed in the analysis of sharpness. Abbreviations: TRF – Tropical Forest; SMF – Subtropical Mixed Forest; SSF – Subtropical Seasonal Forest; TCS – Tropical Coastal Scrub; SHG –Subtropical Highland Grasslands (Campos de Cima da Serra); HTG – High Altitude Tropical Grasslands; LTG – Low Altitude Temperate Grasslands; TES – Temperate Shrubland; TRS – Tropical Savanna.

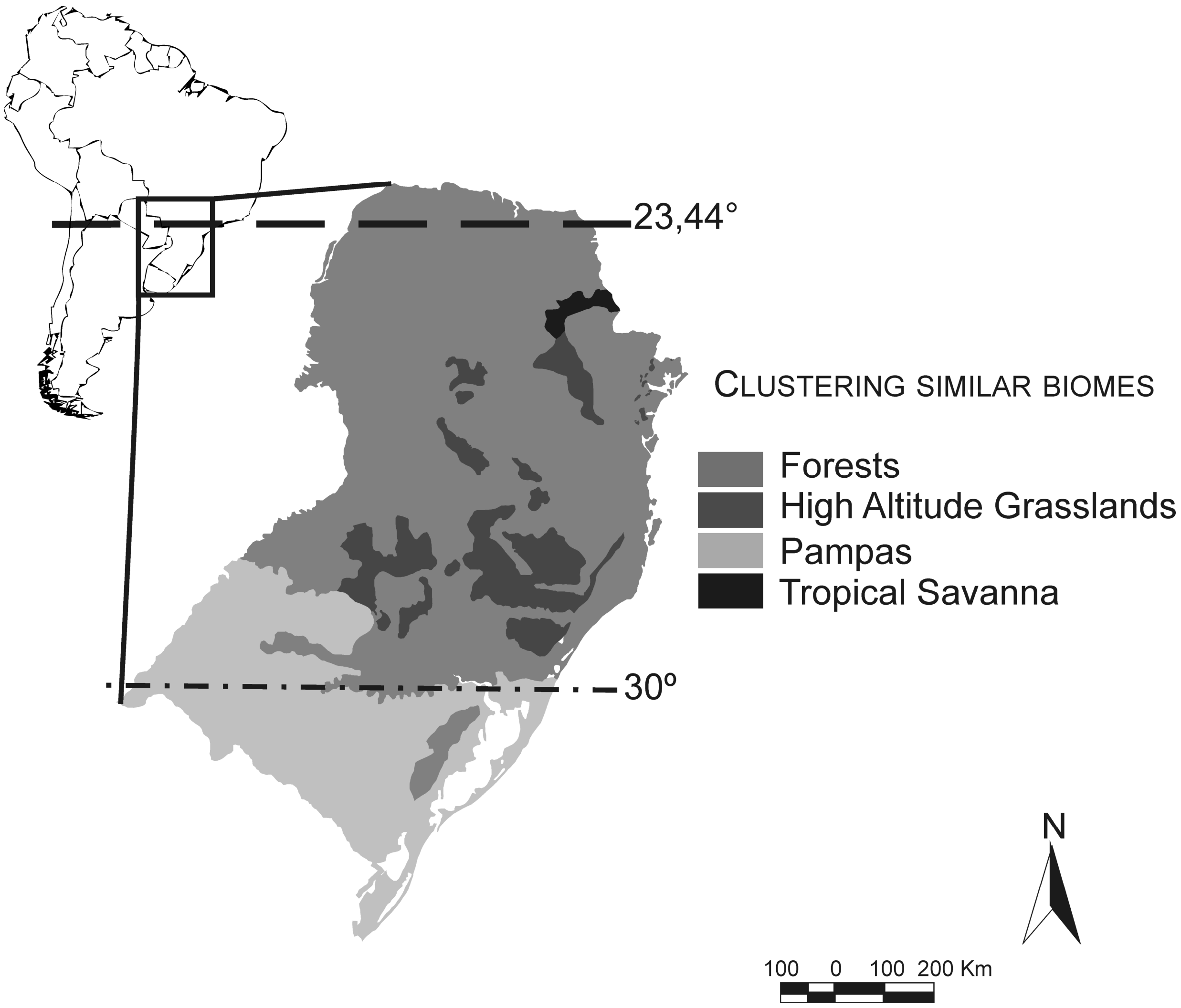

Figure 4. Vegetation in southern Brazil grouping the most similar biomes recognized by cluster analysis of endemic flowering plants.

Supplementary Material: List of endemic flowering plants from Southern Brazil and their distribution in different vegetation formations. Abbreviations: TRF – Tropical Forest; SSF – Subtropical Seasonal Forest; SHG – Subtropical Highland Grasslands (Campos de Cima da Serra); HTG – High Altitude Tropical Grasslands; SMF – Subtropical Mixed Forest; TCS – Tropical Coastal Scrub; LTG – Low Altitude Temperate Grasslands; TES – Temperate Shrubland; TRS – Tropical Savanna.

TABLES:

Table 1. Species belonging to monotypic genera in Southern Brazil. Abbreviations: TES – Temperate Shrubland; TCS – Tropical Coastal Scrub; LTG – Low Altitude Temperate Grasslands; TRF – Tropical Forest; SMF – Subtropical Mixed Forest.

Family	**Species**	**Biomes**
Fabaceae	*Sellocharis paradoxa* Taub.	TES
Iridaceae	*Kelissa brasiliensis* (Baker) Ravenna	TES
	Onira unguiculata (Baker) Ravenna	LTG TCS
Malvaceae	*Calyptraemalva catharinensis* Krapov.	TRF
	Tropidococcus pinnatipartitus (A.St.-Hil. & Naudin) Krapov.	SMF TRF
Myrtaceae	*Curitiba prismatica* (D.Legrand) Salywon & Landrum	SMF
Rutaceae	*Raulinoa echinata* R.S.Cowan	TRF
Verbenaceae	*Verbenoxylum reitzii* (Moldenke) Tronc.	TRF

Table 2. Endemic flowering plants from the Subtropical Highland Grasslands, Southern Brazil.

ALSTROEMERIACEAE	*Alstroemeria malmeana* Kraenzl.
AMARYLLIDACEAE	*Hippeastrum santacatarina* (Traub) Dutilh
	Nothoscordum aparadense Ravenna
	Nothoscordum cambarense Ravenna
	Nothoscordum capivarinum Ravenna
	Nothoscordum catharinense Ravenna
	Nothoscordum collinum Ravenna
	Nothoscordum curvipes Ravenna
	Nothoscordum exile Ravenna
	Nothoscordum gracilipes Ravenna
	Nothoscordum leptogynum Ravenna

	Nothoscordum luteomajus Ravenna
	Nothoscordum nutans Ravenna
	Nothoscordum stenandrum Ravenna
	Nothoscordum tibaginum Ravenna
	Nothoscordum uruguaianum Ravenna
	Zephyranthes lagesiana Ravenna
	Zephyranthes paranaensis Ravenna
ANACARDIACEAE	*Schinus spinosus* Engl.
APIACEAE	*Eryngium corallinum* Mathias & Constance
	Eryngium falcifolium Irgang
	Eryngium ramboanum Mathias & Constance
	Eryngium smithii Mathias & Constance
	Eryngium urbanianum H.Wolff
	Eryngium zosterifolium H.Wolff
	Lilaeopsis tenuis A.W.Hill
APOCYNACEAE	*Oxypetalum coalitum* E.Fourn.
	Oxypetalum malmei Hoehne
	Oxypetalum morilloanum Fontella
ASTERACEAE	*Achyrocline luisiana* Deble
	Austroeupatorium rosmarinaceum (Cabrera & Vittet) R.M.King & H.Rob.
	Baccharis apicifoliosa A.A.Schneid. & Boldrini
	Baccharis chionolaenoides D.B.Falkenb. & Deble
	Baccharis deblei A.S.Oliveira & Marchiori
	Baccharis hypericifolia Baker
	Baccharis megapotamica var. *weirii* (Baker) G.M.Barroso
	Baccharis pseudovillosa Teodoro & Vidal
	Baccharis scabrifolia G.Heiden
	Baccharis scopulorum A.A.Schneid. & G.Heiden
	Baccharis trilobata A.S.Oliveira & Marchiori
	Baccharis uleana Malag.
	Baccharis wagenitzii (F.H.Hellw.) Joch.Müll.
	Barrosoa ramboi (Cabrera) R.M.King & H.Rob.
	Calea ilienii Malme
	Calea monocephala Dusén
	Carelia ramboi Cabrera
	Chromolaena kleinii (Cabrera) R.M.King & H.Rob.
	Chromolaena oinopolepis (Malme) R.M.King & H.Rob.
	Chromolaena palmaris (Sch.Bip. ex Baker) R.M.King & H.Rob.
	Chromolaena umbelliformis (Dusén ex Malme) R.M.King & H.Rob.

	Chrysolaena nicolackii H.Rob.
	Conyza reitziana Cabrera
	Dendrophorbium subnemoralis (Dusén) A.M.Teles
	Gochnatia argyrea (Dusén ex Malme) Cabrera
	Hatschbachiella polyclada (Dusén ex Malme) R.M.King & H.Rob.
	Heterocondylus reitzii R.M.King & H.Rob.
	Hieracium commersonii var. *megapotamicum* Malme
	Hieracium ignatianum Baker
	Hieracium urvillei Sch.Bip.
	Holocheilus monocephalus Mondin
	Hysterionica pinnatiloba Matzenb. & Sobral
	Hysterionica pinnatisecta Matzenb. & Sobral
	Lepidaploa pseudomuricata H.Rob.
	Leptostelma catharinensis (Cabrera) A.M.Teles & Sobral
	Lessingianthus reitzianus (Cabrera) H.Rob.
	Malmeanthus catharinensis R.M.King & H.Rob.
	Mikania nana W.C.Holmes
	Neocabreria catharinensis (Cabrera) R.M.King & H.Rob.
	Noticastrum decumbens (Baker) Cuatrec.
	Panphalea araucariophila Cabrera
	Panphalea ramboi Cabrera
	Panphalea smithii Cabrera
	Perezia catharinensis Cabrera
	Perezia eryngioides (Cabrera) Crisci & Martic.
	Senecio conyzaefolius Baker
	Senecio promatensis Matzenb.
	Senecio ramboanus Cabrera
	Senecio rauchii Matzenb.
	Stevia tenuis Hook. & Arn.
	Vernonanthura perangusta (Malme) A.J.Veja & Dematt.
	Vernonanthura rigiophylla (Kuntze) H.Rob.
	Vernonia viminea Ekman ex Malme
	Viguiera meridionalis Magenta
	Viguiera paranensis (Malme) J.U.Santos
	Viguiera santacatarinense (H.Rob. & A.J.Moore) A.A.Sáenz
BROMELIACEAE	*Dyckia cabrerae* L.B.Sm. & Reitz
	Dyckia crocea L.B.Sm.
	Dyckia dusenii L.B.Sm.
	Dyckia fosteriana var. *robustior* L.B.Sm.

	Dyckia frigida Hook.f.
	Dyckia ibiramensis Reitz
	Dyckia irmgardiae L.B.Sm.
	Dyckia remotiflora var. *angustior* L.B.Sm.
CACTACEAE	*Frailea curvispina* Buining & Brederoo
	Parodia carambeiensis (Buining & Brederoo) Hofacker
	Parodia haselbergii subsp. *graessneri* (K.Schum) Hofacker & P.J.Braun
	Parodia haselbergii (Haage ex Rümpler) F.H.Brandt subsp. *haselbergii*
	Parodia rechensis (Buining) F.H.Brandt
CAMPANULACEAE	*Lobelia paranaensis* R.Braga
	Siphocampylus densidentatus E.Wimm.
CARYOPHYLLACEAE	*Paronychia revoluta* C.E.Carneiro & Furlan
CYPERACEAE	*Eleocharis kleinii* Barros
	Rhynchospora pseudomacrostachya Gerry Moore, Guagl. & Zartman
	Rhynchospora smithii W.W.Thomas
	Schoenus lymansmithii M.T.Strong
ERICACEAE	*Gaultheria ulei* Sleumer
	Gaultheria corvensis (R.R.Silva & Cervi) G.O.Romão & Kin.-Gouv.
ERIOCAULACEAE	*Eriocaulon magnificum* Ruhland var. *magnificum*
	Eriocaulon ulaei var. *radiosum* Ruhland
	Eriocaulon ulaei Ruhland var. *ulaei*
	Paepalanthus albovaginatus Silveira var. *albovaginatus*
	Paepalanthus albovaginatus var. *albobracteatus* Tissot-Sq.
	Paepalanthus albovaginatus var. *fuscobracteatus* Tissot-Sq.
	Paepalanthus bellus Moldenke
	Paepalanthus catharinae Ruhland var. *catharinae*
	Paepalanthus leiseringii var. *kleinii* Moldenke & L.B.Sm.
	Paepalanthus tessmannii Moldenke
	Syngonanthus caulescens var. *proliferus* Moldenke
ESCALLONIACEAE	*Escallonia ledifolia* Sleumer
EUPHORBIACEAE	*Acalypha apetiolata* Allem & Waechter
	Bernardia alarici Allem & Irgang
	Bernardia flexuosa Pax & K.Hoffm.
	Bernardia geniculata Allem & Waechter
	Bernardia hagelundii Allem & Irgang
	Chiropetalum foliosum (Müll.Arg.) Pax & K.Hoffm.
	Chiropetalum molle (Baill.) Pax & K.Hoffm.

	Chiropetalum phalacradenium (J.W.Ingram) L.B.Sm. & Downs
	Croton calyciglandulosus Allem
	Croton catharinensis L.B.Sm. & Downs
	Croton confinis L.B.Sm. & Downs
	Croton dusenii Croizat
	Croton ericoideus Baill.
	Croton helichrysum Baill.
	Croton ichthygaster L.B.Sm. & Downs
	Croton kleinii L.B.Sm. & Downs
	Croton leptophyllus Müll.Arg.
	Croton myrianthus Müll.Arg.
	Croton patrum L.B.Sm. & Downs
	Croton polygonoides L.B.Sm. & Downs
	Croton quintasii Allem
	Croton ramboi Allem
	Croton thymelinus Baill.
FABACEAE	*Adesmia araujoi* Burkart
	Adesmia arillata Miotto
	Adesmia ciliata Vogel
	Adesmia paranensis Burkart
	Adesmia psoraleoides Vogel
	Adesmia reitziana Burkart
	Adesmia rocinhensis Burkart
	Adesmia sulina Miotto
	Adesmia tristis Vogel
	Adesmia vallsii Miotto
	Crotalaria hilariana Benth.
	Desmodium craspediferum A.M.G.Azevedo & Abruzzi de Oliveira
	Lupinus paranensis C.P.Sm.
	Lupinus reitzii Burkart ex. M.Pinheiro & Miotto
	Lupinus rubriflorus Planchuelo
	Mimosa bathyrrhena Barneby
	Mimosa chartostegia Barneby
	Mimosa dolens var. *pangloea* Barneby
	Mimosa dryandroides var. *extratropica* Barneby
	Mimosa eriocarpa Benth.
	Mimosa glabra Benth.
	Mimosa hatschbachii Barneby
	Mimosa involucrata Benth.

	Mimosa kuhnisteroides Barneby
	Mimosa macrocalyx var. *pectinata* Burkart
	Mimosa oblonga var. *pinetorum* Barneby
	Mimosa pseudolepidota (Burkart) Barneby
	Mimosa regnellii var. *exuta* Barneby
	Mimosa regnellii var. *grossiseta* Barneby
	Vicia graminea var. *nigricarpa* N.R.Bastos & Miotto
	Vicia hatschbachii Burkart ex Vanni & D.B.Kurtz
GESNERIACEAE	*Sinningia leopoldii* (Scheidw. ex Planch.) Chautems
HYPERICACEAE	*Hypericum cordatum* subsp. *kleinii* N.Robson
IRIDACEAE	*Calydorea basaltica* Ravenna
	Calydorea crocoides Ravenna
	Cypella aquatilis Ravenna
	Sisyrinchium bromelioides R.C.Foster subsp. *bromelioides*
	Sisyrinchium coalitum Ravenna
	Sisyrinchium decumbens Ravenna
	Sisyrinchium densiflorum Ravenna
	Sisyrinchium rambonis R.C.Foster
LAMIACEAE	*Cunila fasciculata* Benth.
	Cunila platyphylla Epling
	Cunila tenuifolia Epling
	Glechon elliptica C.Pereira & Hatschbach
	Hedeoma polygalifolia Benth.
	Hesperozygis kleinii Epling & Játiva
	Hesperozygis rhododon Epling
	Hesperozygis spathulata Epling
	Hyptis apertiflora Epling
	Peltodon rugosus Tolm.
	Rhabdocaulon erythrostachys Epling
	Salvia congestiflora Epling
	Salvia cordata Benth.
	Salvia scoparia Epling
LINACEAE	*Linum smithii* Mildner
LYTHRACEAE	*Cuphea hatschbachii* Lourteig
	Cuphea iguazuensis Lourteig
MALVACEAE	*Modiolastrum palustre* (Ekman) Krapov.
	Pavonia commutata Garcke
	Pavonia ramboi Krapov. & Cristóbal
	Pavonia reitzii Krapov. & Cristóbal
	Pavonia renifolia Krapov.
MELASTOMATACEAE	*Leandra camporum* Brade

	Leandra dusenii Cogn.
	Leandra luctatoris Wurdack
	Tibouchina kleinii Wurdack
MYRTACEAE	*Psidium reptans* (D.Legrand) Soares-Silva & Proença
ONAGRACEAE	*Fuchsia hatschbachii* P.E.Berry
ORCHIDACEAE	*Brachystele bicrinita* Szlach.
	Cyclopogon vittatus Dutra ex Pabst
	Cyrtopodium brandonianum subsp. *lageanum* J.A.N.Bat. & Bianch.
	Cyrtopodium kleinii J.A.N.Bat. & Bianch.
	Habenaria dutraei Schltr.
	Habenaria schnittmeyeri Schltr.
	Habenaria ulaei Cogn.
	Pelexia burgeri Schltr.
	Pelexia robusta (Kraenzl.) Schltr.
	Pelexia tenuior Schltr.
	Sarcoglottis glaucescens Schltr.
	Sarcoglottis juergensii Schltr.
	Stigmatosema garayana Szlach.
	Stigmatosema hatschbachii (Pabst) Garay
	Veyretia undulata Szlach.
OXALIDACEAE	*Oxalis bisecta* Norlind
	Oxalis praetexta Progel
PLANTAGINACEAE	*Mecardonia pubescens* Rossow
	Plantago turficola Rahn
	Scoparia pinnatifida Cham.
POACEAE	*Agrostis ramboi* Parodi
	Aulonemia ulei (Hack.) McClure & L.B.Sm.
	Bothriochloa velutina M.Marchi & Longhi-Wagner
	Briza brachychaete Ekman
	Briza scabra (Nees ex Steud.) Ekman
	Calamagrostis longiaristata var. *minor* Kämpf
	Calamagrostis reitzii Swallen
	Chusquea hatschbachii L.G.Clark & Blong
	Chusquea windischii L.G.Clark
	Digitaria purpurea Swallen
	Eustachys paranensis A.M.Molina
	Melica spartinoides L.B.Sm.
	Panicum magnispicula Zuloaga, Morrone & Valls
	Paspalum barretoi Canto-Dorow, Valls & Longhi-Wagner
	Paspalum ramboi I.L.Barreto

	Paspalum redondense Swallen
	Piptochaetium alpinum L.B.Sm.
	Piptochaetium palustre Muj.-Sall. & Longhi-Wagner
	Poa reitzii Swallen
	Poa umbrosa Trin.
	Stipa brasiliensis A.Zanin & Longhi-Wagner
	Stipa planaltina A.Zanin & Longhi-Wagner
	Stipa rhizomata A.Zanin & Longhi-Wagner
	Stipa vallsii A.Zanin & Longhi-Wagner
	Thrasyopsis juergensii (Hack.) Soderstr. & A.G. Burm.
	Trisetum juergensii Hack.
POLYGALACEAE	*Polygala altomontana* Lüdtke, Boldrini & Miotto
	Polygala densiracemosa Lüdtke & Miotto
POLYGONACEAE	*Rumex sellowianus* Rech.f.
PORTULACACEAE	*Portulaca diegoi* Mattos
	Portulaca hatschbachii D.Legrand
RUBIACEAE	*Galianthe elegans* E.L.Cabral
	Galianthe latistipula E.L.Cabral
	Galianthe reitzii E.L.Cabral
	Galium hatschbachii Dempster
	Galium ramboi Dempster
	Galium rubidiflorum Dempster
	Galium smithreitzii Dempster
	Oldenlandia dusenii Standl.
SCROPHULARIACEAE	*Buddleja cestriflora* Cham.
	Buddleja cuneata Cham.
	Buddleja hatschbachii E.M.Norman & L.B.Sm.
	Buddleja kleinii E.M.Norman & L.B.Sm.
	Buddleja ramboi L.B.Sm.
SOLANACEAE	*Calibrachoa cordifolia* Stehmann & L.W.Aguiar
	Calibrachoa dusenii (R.E.Fr.) Stehmann & Semir
	Calibrachoa sellowiana (Sendtn.) Wijsman
	Calibrachoa sendtneriana (R.E.Fr.) Stehmann & Semir
	Calibrachoa serrulata (L.B.Sm. & Downs) Stehmann & Semir
	Calibrachoa spathulata (L.B.Sm. & Downs) Stehmann & Semir
	Nierembergia hatschbachii A.A.Cocucci & Hunz.
	Petunia saxicola L.B.Sm. & Downs
VALERIANACEAE	*Valeriana bornmuelleri* Pilg.
	Valeriana chamaedryfolia Cham. & Schltdl.

	Valeriana eichleriana (Muell.) Graebn.
	Valeriana glechomifolia F.G.Mey.
	Valeriana muelleri Graebn.
VERBENACEAE	*Glandularia catharinae* (Moldenke) N.O'Leary & P.Peralta
	Glandularia dusenii (Moldenke) N.O'Leary & P.Peralta
	Glandularia hatschbachii (Moldenke) N.O'Leary & P.Peralta
	Lippia paranensis (Moldenke) T.R.S. Silva & Salimena
	Verbena caniuensis Moldenke
	Verbena subpetiolata N.O'Leary
XYRIDACEAE	*Xyris dissitifolia* Kral & Wand.
	Xyris hatschbachii L.B.Sm. & Downs

Table 3. Comparison between the endemic flora from nine different vegetation formations in Southern Brazil. **Boldface** = number of endemic taxa from southern Brazil by vegetation formation; plain text = number of exclusive taxa from southern Brazil shared by pairs of vegetation formations; *italics* = indices of similarity (Sørensen coefficient). Abbreviations: TRF – Tropical Forest; SSF – Subtropical Seasonal Forest; SHG – Subtropical Highland Grasslands (Campos de Cima da Serra); HTG – High Altitude Tropical Grasslands; SMF – Subtropical Mixed Forest; TCS – Tropical Coastal Scrubs; LTG – Low Altitude Temperate Grasslands; TES – Temperate Shrubland; TRS – Tropical Savanna.

Vegetation formations	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
TRF	**217**	*0.0638*	*0.0488*	*0.0026*	*0.1599*	*0.0667*	*0*	*0*	*0.0055*
SSF	25	**39**	*0.0229*	*0*	*0.0901*	*0.0530*	*0*	*0.0152*	*0.0096*
SHG	35	11	**296**	*0.0529*	*0.0729*	*0.0327*	*0.0068*	*0.0218*	*0.0256*
HTG	1	0	23	**22**	*0*	*0*	*0*	*0*	*0*
SMF	71	21	40	0	**70**	*0.0216*	*0*	*0.0043*	*0.0100*
TCS	25	7	15	0	5	**25**	*0.0215*	*0*	*0*
LTG	0	0	3	0	0	2	**25**	*0.0588*	*0*
TES	0	2	10	0	1	0	5	**39**	*0.0247*
TRS	2	1	11	0	2	0	0	2	**13**

Supplementary Material: List of endemic flowering plants from Southern Brazil and their distribution in different vegetation formations. Abbreviations: TRF – Tropical Forest; SSF – Subtropical Seasonal Forest; SHG – Subtropical Highland Grasslands; HTG – High Altitude Tropical Grasslands; SMF – Subtropical Mixed Forest; TCS – Tropical Coastal Scrubs; LTG – Low Altitude Temperate Grasslands; TES – Temperate Scrubs; TRS – Tropical Savanna.

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
ACANTHACEAE	*Aphelandra liboniana* Linden ex. Hook.f.	1	0	0	0	0	0	0	0	0
	Dyschoriste smithii Leonard	0	1	0	0	0	0	0	0	0
	Dyschoriste tweediana (Nees) Kuntze	0	0	0	0	0	0			0
	Justicia araucariensis Profice	0	1	0	0	0	0	0	0	0
	Justicia hatschbachii var. *catharinensis* (Rizzini) Wassh. & L.B.Sm.	1	1	0	0	0	0	0	0	0
	Justicia hatschbachii (Rizzini) Wassh. & L.B.Sm. var. *hatschbachii*	1	1	0	0	0	0	0	0	0
	Justicia kleinii Wassh. & L.B.Sm.	1	0	0	0	0	0	0	0	0
	Justicia paranaensis (Rizzini) Wassh. & L.B.Sm.	1	0	0	0	0	0	0	0	0
	Ruellia kleinii C.Ezcurra & Wassh.	1	0	0	0	0	0	0	0	0
	Ruellia reitzii Wassh. & L.B.Sm.	1	0	0	0	0	0	0	0	0
	Staurogyne alba Braz & R.Monteiro	1	0	0	0	0	0	0	0	0
	Staurogyne eustachya Lindau	1	0	0	0	0	0	0	0	0
	Stenandrium tenellum Nees	1	0	0	0	0	0	0	0	0
ALSTROEMERIACEAE	*Alstroemeria albescens* M.C.Assis	0	0	0	0	0	0	0	1	0
	Alstroemeria amabilis M.C.Assis	0	0	0	1	0	0	0	0	0
	Alstroemeria malmeana Kraenzl.	0	0	1	0	0	0	0	0	0
	Alstroemeria ribeirensis Ravenna									
	Alstroemeria sellowiana Seub.	0	0	1	1	0	0	0	0	0
AMARANTHACEAE	*Alternanthera praelonga* var. *australis* Pedersen	0	0	0	0	0	1	1	0	0
	Gomphrena riparia Pedersen	0	1	0	0	0	0	0	0	0
AMARYLLIDACEAE	*Habranthus concinnus* Ravenna	0	1	0	0	0	0	0	0	0
	Habranthus ruber Ravenna	0	0	0	0	0	0			0
	Hippeastrum marumbiense (Ravenna) Van Scheepen	1	0	0	0	0	0	0	0	0
	Hippeastrum papilio (Ravenna) Van Scheepen	0	1	0	0	0	0	0	0	0
	Hippeastrum santacatarina (Traub) Dutilh	0	0	1	0	0	0	0	0	0
	Nothoscordum aparadense Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum cambarense Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum capivarinum Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum catharinense Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum collinum Ravenna	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Nothoscordum curvipes Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum exile Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum gracilipes Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum ibiramense Ravenna	1	0	0	0	0	0	0	0	0
	Nothoscordum leptogynum Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum luteomajus Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum nutans Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum portoalegrense Ravenna	0	0	0	0	0	0	0	1	0
	Nothoscordum sengesianum Ravenna	0	0	0	0	0	0	0	0	1
	Nothoscordum stenandrum Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum tibaginum Ravenna	0	0	1	0	0	0	0	0	0
	Nothoscordum uruguaianum Ravenna	0	0	1	0	0	0	0	0	0
	Zephyranthes amoena Ravenna	0	1	0	0	0	0	0	0	0
	Zephyranthes capivarina Ravenna	0	1	0	0	0	0	0	0	0
	Zephyranthes gratissima Ravenna	0	1	0	0	0	0	0	0	0
	Zephyranthes lagesiana Ravenna	0	0	1	0	0	0	0	0	0
	Zephyranthes microstigma Ravenna	0	0	0	0	0	0	1	0	0
	Zephyranthes paranaensis Ravenna	0	0	1	0	0	0	0	0	0
	Zephyranthes uruguaianica Ravenna	0	0	0	0	0	0	1	0	0
ANACARDIACEAE	*Schinus spinosus* Engl.	0	0	1	0	0	0	0	0	0
APIACEAE	*Eryngium corallinum* Mathias & Constance	0	0	1	0	0	0	0	0	0
	Eryngium dusenii H.Wolff	0	1	0	0	0	0	0	0	0
	Eryngium falcifolium Irgang	0	0	1	0	0	0	0	0	0
	Eryngium ombrophilum Dusén & H.Wolff	1	0	0	0	0	0	0	0	0
	Eryngium ramboanum Mathias & Constance	0	0	1	0	0	0	0	0	0
	Eryngium raulinii Mathias & Constance	1	0	0	0	0	0	0	0	0
	Eryngium smithii Mathias & Constance	0	0	1	0	0	0	0	0	0
	Eryngium urbanianum H.Wolff	0	0	1	0	0	0	0	0	0
	Eryngium zosterifolium H.Wolff	0	0	1	0	0	0	0	0	0
	Lilaeopsis tenuis A.W.Hill	0	0	1	0	0	0	0	0	0
APOCYNACEAE	*Ditassa edmundoi* Fontella & C.Valente	0	0	0	0	1	0	0	0	0
	Jobinia hatschbachii Fontella & E.A.Schwartz	0	0	0	0	1	0	0	0	0
	Jobinia paranaensis Fontella & C.Valente	1	0	0	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Macroscepis dutrae (Malme) Morillo									
	Marsdenia hatschbachii Morillo	1	0	0	0	0	0	0	0	0
	Matelea dusenii Morillo	0	0	0	0	1	0	0	0	0
	Matelea hatschbachii (Fontella & C.Valente) Morillo	1	0	0	0	0	0	0	0	0
	Matelea pyrrhotricha (Decne.) Fontella	1	0	0	0	0	0	0	0	0
	Matelea reitzii Fontella	0	0	0	0	1	0	0	0	0
	Orthosia dusenii (Malme) Fontella	1	0	0	0	0	0	0	0	0
	Orthosia hatschbachii Fontella & Goes	0	0	0	0	1	0	0	0	0
	Orthosia latipes (Decne.) Malme	0	0	0	0	1	0	0	0	0
	Orthosia loandensis Fontella & C.Valente	1	0	0	0	0	0	0	0	0
	Oxypetalum coalitum E.Fourn.	0	0	1	0	0	0	0	0	0
	Oxypetalum dusenii Malme	0	0	1	1	0	0	0	0	0
	Oxypetalum insigne var. *bresolinii* Fontella	1	0	1	0	1	1	0	0	0
	Oxypetalum kleinii Fontella & Marquete	1	0	0	0	0	0	0	0	0
	Oxypetalum malmei Hoehne	0	0	1	0	0	0	0	0	0
	Oxypetalum morilloanum Fontella	0	0	1	0	0	0	0	0	0
	Oxypetalum oblanceolatum Farinaccio & Mello-Silva	0	0	0	0	1	0	0	0	0
	Oxypetalum obtusifolium Malme	0	0	1	0	1	0	0	0	0
	Oxypetalum rariflorum Malme	0	0	1	0	1	0	0	0	0
	Oxypetalum reitzii Fontella & Marquete	1	0	0	0	0	0	0	0	0
APODANTHACEAE	*Pilostyles stawiarskii* Vattimo-Gil	1	0	0	0	0	0	0	0	0
AQUIFOLIACEAE	*Ilex microdonta* Reissek	1	0	0	0	1	0	0	0	0
ARACEAE	*Anthurium lacerdae* Reitz	1	0	0	0	0	0	0	0	0
	Anthurium pilonense Reitz	1	0	0	0	0	0	0	0	0
	Asterostigma reticulatum E.G.Gonç.	0	0	0	0	1	0	0	0	0
	Philodendron renauxii Reitz	1	0	0	0	0	0	0	0	0
ARECACEAE	*Butia catarinensis* Noblick & Lorenzi	0	0	0	0	0	1	0	0	0
	Butia eriospatha (Mart. ex Drude) Becc.	0	0	1	0	1	0	0	0	0
	Butia pubispatha Noblick & Lorenzi	0	0	0	0	0	0	0	0	1
	Trithrinax acanthocoma Drude	0	0	1	0	1	0	0	0	0
ASPARAGACEAE	*Clara gracilis* R.C.Lopes & Andreata									
ASTERACEAE	*Achyrocline anabelae* Deble	0	0	0	0	0	0	0	1	0
	Achyrocline crassiuscula (Malme) Deble & Marchiori	0	0	0	0	0	1	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Achyrocline luisiana Deble	0	0	1	0	0	0	0	0	0
	Achyrocline marchiorii Deble	0	0	0	0	0	0	1	0	0
	Austrobrickellia bakerianum (B.L.Rob.) R.M.King & H.Rob.									
	Austroeupatorium rosmarinaceum (Cabrera & Vittet) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Baccharis angusticeps Dusén ex Malme	0	0	0	1	0	0	0	0	0
	Baccharis apicifoliosa A.A.Schneid. & Boldrini	0	0	1	0	0	0	0	0	0
	Baccharis aracatubensis Malag.	0	0	0	1	0	0	0	0	0
	Baccharis chionolaenoides D.B.Falkenb. & Deble	0	0	1	0	0	0	0	0	0
	Baccharis coronata Giuliano	0	0	0	1	0	0	0	0	0
	Baccharis deblei A.S.Oliveira & Marchiori	0	0	1	0	0	0	0	0	0
	Baccharis dunensis A.A.Schneid. & G.Heiden	0	0	0	0	0	1	0	0	0
	Baccharis flexuosiramosa A.A.Schneid. & Boldrini	1	0	0	0	1	0	0	0	0
	Baccharis hyemalis Deble	0	0	0	0	0	0	0	1	0
	Baccharis hypericifolia Baker	0	0	1	0	0	0	0	0	0
	Baccharis inexpectata Deble & A.S.Oliveira	0	0	0	0	0	0	1	0	0
	Baccharis lymanii G.M.Barroso ex G.Heiden	0	0	1	1	0	0	0	0	0
	Baccharis megapotamica var. *weirii* (Baker) G.M.Barroso	0	0	1	0	0	0	0	0	0
	Baccharis multifolia A.S.Oliveira, Deble & Marchiori	0	0	0	0	0	0	1	0	0
	Baccharis nummularia Heering ex Malme	0	0	1	0	1	0	0	0	0
	Baccharis pampeana A.S.Oliveira, Deble & Marchiori	0	0	0	0	0	0	1	0	0
	Baccharis psammophila Malme	0	0	0	0	0	1	0	0	0
	Baccharis pseudovillosa Teodoro & Vidal	0	0	1	0	0	0	0	0	0
	Baccharis ramboi G.Heiden & Macias	0	0	1	0	0	1	0	0	0
	Baccharis scabrifolia G.Heiden	0	0	1	0	0	0	0	0	0
	Baccharis scopulorum A.A.Schneid. & G.Heiden	0	0	1	0	0	0	0	0	0
	Baccharis suberectifolia A.S.Oliveira & Deble	0	0	0	0	0	0	0	0	1
	Baccharis trilobata A.S.Oliveira & Marchiori	0	0	1	0	0	0	0	0	0
	Baccharis uleana Malag.	0	0	1	0	0	0	0	0	0
	Baccharis urvilleana Brongn.	0	0	0	0	0	1	0	0	0
	Baccharis wagenitzii (F.H.Hellw.) Joch.Müll.	0	0	1	0	0	0	0	0	0
	Barrosoa ramboi (Cabrera) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Brickellia gentianoides B.L.Rob.									
	Calea ilienii Malme	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Calea monocephala Dusén	0	0	1	0	0	0	0	0	0
	Campovassouria barbosae H.Rob.	0	0	1	1	0	0	0	0	0
	Campuloclinium tubaraoense (Hieron.) R.M.King & H.Rob.	1	0	0	0	0	1	0	0	0
	Carelia ramboi Cabrera	0	0	1	0	0	0	0	0	0
	Chromolaena angusticeps (Malme) R.M.King & H.Rob.	0	0	1	0	0	0	1	1	0
	Chromolaena kleinii (Cabrera) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Chromolaena oinopolepis (Malme) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Chromolaena palmaris (Sch.Bip. ex Baker) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Chromolaena umbelliformis (Dusén ex Malme) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Chrysolaena nicolackii H.Rob.	0	0	1	0	0	0	0	0	0
	Conyza reitziana Cabrera	0	0	1	0	0	0	0	0	0
	Conyza retirensis Cabrera	0	0	1	0	0	1	0	0	0
	Dendrophorbium catharinense (Dusén ex Cabrera) C.Jeffrey	0	1	0	0	0	0	0	0	0
	Dendrophorbium limosum C.Jeffrey	1	0	0	0	0	0	0	0	0
	Dendrophorbium paranense (Malme) Matzenb. & Baptista	1	0	1	0	0	0	0	0	0
	Dendrophorbium subnemoralis (Dusén) A.M.Teles	0	0	1	0	0	0	0	0	0
	Fleischmannia laxicephala (Cabrera) R.M.King & H.Rob.	1	0	0	0	0	0	0	0	0
	Gamochaeta camaquaensis Deble	0	0	0	0	0	0	0	1	0
	Gamochaeta diffusa Deble & Marchiori	0	0	0	0	0	1	0	0	0
	Gamochaeta erecta Deble	0	0	0	0	0	0	0	1	0
	Gamochaeta girardiana Deble & A.S.Oliveira	0	0	0	0	0	0	0	1	0
	Gochnatia argyrea (Dusén ex Malme) Cabrera	0	0	1	0	0	0	0	0	0
	Gochnatia mollisima (Malme) Cabrera	1	0	0	0	0	0	0	0	0
	Graphistylis serrana (Zardini) B.Nord.	0	0	1	1	0	0	0	0	0
	Grindelia atlântica Deble & Oliveira-Deble									
	Grindelia gaucha Deble & Oliveira-Deble	0	0	0	0	0	0	0	1	0
	Hatschbachiella polyclada (Dusén ex Malme) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Heterocondylus reitzii R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Hieracium commersonii var. *megapotamicum* Malme	0	0	1	0	0	0	0	0	0
	Hieracium ignatianum Baker	0	0	1	0	0	0	0	0	0
	Hieracium urvillei Sch.Bip.	0	0	1	0	0	0	0	0	0
	Holocheilus monocephalus Mondin	0	0	1	0	0	0	0	0	0
	Hypochaeris catharinensis Cabrera	0	0	1	1	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Hysterionica pinnatiloba Matzenb. & Sobral	0	0	1	0	0	0	0	0	0
	Hysterionica pinnatisecta Matzb. & Sobral	0	0	1	0	0	0	0	0	0
	Koanophyllum lobatifolium (Cabrera) R.M.King & H.Rob.	1	0	0	0	0	0	0	0	0
	Lepidaploa pseudomuricata H.Rob.	0	0	1	0	0	0	0	0	0
	Leptostelma catharinensis (Cabrera) A.M.Teles & Sobral	0	0	1	0	0	0	0	0	0
	Lessingianthus arachniolepis (Ekman & Dusén) H.Rob.	0	0	1	0	0	0	0	0	1
	Lessingianthus constrictus (Matzenb. & Mafiol.) Dematt.	0	0	0	0	0	1	0	0	0
	Lessingianthus reitzianus (Cabrera) H.Rob.	0	0	1	0	0	0	0	0	0
	Lessingianthus westermanii (Ekman & Dusén ex Malme) H.Rob.	0	0	1	0	0	0	0	0	1
	Macropodina reitzii R.M.King & H.Rob.	0	0	0	0	1	0	0	0	0
	Malmeanthus catharinensis R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Mikania nana W.C.Holmes	0	0	1	0	0	0	0	0	0
	Mikania orleansensis Hieron.	1	1	0	0	0	0	0	0	0
	Mikania paranensis Dusén	0	0	0	0	1	0	0	0	0
	Mikania pseudohoffmanniana var. *microphylla* G.M.Barroso ex W.C.Holmes	0	0	0	0	1	0	0	0	0
	Mikania viminea DC.	0	1	0	0	0	0	0	0	0
	Neocabreria catharinensis (Cabrera) R.M.King & H.Rob.	0	0	1	0	0	0	0	0	0
	Noticastrum decumbens (Baker) Cuatrec.	0	0	1	0	0	0	0	0	0
	Noticastrum hatschbachii Zardini	0	0	1	0	0	1	0	0	0
	Noticastrum psammophilum (Klatt) Cuatrec.	0	0	0	0	0	1	0	0	0
	Panphalea araucariophila Cabrera	0	0	1	0	0	0	0	0	0
	Panphalea ramboi Cabrera	0	0	1	0	0	0	0	0	0
	Panphalea smithii Cabrera	0	0	1	0	0	0	0	0	0
	Perezia catharinensis Cabrera	0	0	1	0	0	0	0	0	0
	Perezia eryngioides (Cabrera) Crisci & Martic.	0	0	1	0	0	0	0	0	0
	Piptocarpha ramboi G.Lom.Sm.	0	0	0	0	1	0	0	0	0
	Senecio conyzaefolius Baker	0	0	1	0	0	0	0	0	0
	Senecio hilarianus Cabrera									
	Senecio promatensis Matzenb.	0	0	1	0	0	0	0	0	0
	Senecio ramboanus Cabrera	0	0	1	0	0	0	0	0	0
	Senecio rauchii Matzenb.	0	0	1	0	0	0	0	0	0
	Senecio reitzianus Cabrera	0	0	0	0	0	1	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Senecio riograndensis Matzenb.	0	0	0	0	0	0	0	1	0
	Senecio stigophlebius Baker	0	0	0	0	1	0	0	0	0
	Senecio subarnicoides Cabrera	0	0	1	1	0	0	0	0	0
	Smallanthus araucariophilus Mondin	0	0	0	0	1	0	0	0	0
	Smallanthus riograndensis Mondin	0	0	0	0	1	0	0	0	0
	Stevia tenuis Hook. & Arn.	0	0	1	0	0	0	0	0	0
	Steyermarkina dusenii (Malme) R.M.King & H.Rob.	1	0	0	0	1	0	0	0	0
	Symphyopappus casarettoi B.L.Rob.	0	0	1	0	0	1	0	0	0
	Symphyopappus reitzii (Cabrera) R.M.King & H.Rob.	1	0	0	0	0	0	0	0	0
	Trichocline catharinensis Cabrera	0	0	1	1	0	0	0	0	0
	Trixis thyrsoidea Dusén ex Malme	1	0	0	0	0	0	0	0	0
	Vernonanthura perangusta (Malme) A.J.Veja & Dematt.	0	0	1	0	0	0	0	0	0
	Vernonanthura rigiophylla (Kuntze) H.Rob.	0	0	1	0	0	0	0	0	0
	Vernonia viminea Ekman ex Malme	0	0	1	0	0	0	0	0	0
	Viguiera meridionalis Magenta	0	0	1	0	0	0	0	0	0
	Viguiera paranensis (Malme) J.U.Santos	0	0	1	0	0	0	0	0	0
	Viguiera santacatarinense (H.Rob. & A.J.Moore) A.A.Sáenz	0	0	1	0	0	0	0	0	0
BEGONIACEAE	*Begonia barkleyana* L.B.Sm.	1	0	0	0	0	0	0	0	0
	Begonia biguassuensis Brade	1	0	0	0	0	0	0	0	0
	Begonia calvescens (Brade ex L.B.Sm. & R.C.Sm.) E.L.Jacques & Mamede	1	0	1	0	0	0	0	0	0
	Begonia campos-portoana Brade	1	0	0	0	0	0	0	0	0
	Begonia catharinensis Brade	1	0	0	0	0	0	0	0	0
	Begonia echinosepala Regel var. *echinosepala*	1	0	0	0	0	0	0	0	0
	Begonia echinosepala var. *elongatifolia* Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia fuscocaulis Brade	1	0	0	0	0	0	0	0	0
	Begonia garuvae L.B.Sm. & R.C.Sm.	1	0	0	0	0	0	0	0	0
	Begonia hammoniae Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia hilariana A.DC.	1	0	0	0	0	0	0	0	0
	Begonia insularis Brade	1	0	0	0	0	0	0	0	0
	Begonia isopterocarpa Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia itupavensis Brade	1	0	0	0	0	0	0	0	0
	Begonia konder-reisiana L.B.Sm. & R.C.Sm.	1	0	0	0	0	0	0	0	0
	Begonia lineolata Brade	1	0	0	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Begonia parvistipulata Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia pilgeriana Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia pluvialis L.B.Sm. ex S.F.Sm. & Wassh.	1	0	0	0	0	0	0	0	0
	Begonia polyandra Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia rupium Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia scharffii Hook.f.	1	0	0	0	0	0	0	0	0
	Begonia serranegrae L.B.Sm. ex S.F.Sm. & Wassh.	1	0	0	0	0	0	0	0	0
	Begonia solitudinis Brade	1	0	0	0	0	0	0	0	0
	Begonia squamipes Irmsch.	1	0	0	0	0	0	0	0	0
	Begonia stenolepis L.B.Sm. & R.C.Sm.	1	0	0	0	0	0	0	0	0
BERBERIDACEAE	*Berberis kleinii* Mattos	0	0	0	0	1	0	0	0	0
BIGNONIACEAE	*Adenocalymma dusenii* Kraenzl.	1	0	0	0	0	0	0	0	0
	Handroanthus catarinensis (A.H.Gentry) S.O.Grose	0	0	0	1	0	0	0	0	0
BORAGINACEAE	*Euploca krapovickasii* J.I.M.Melo & Semir	0	0	0	0	0	0	1	0	0
	Moritzia ciliata DC. ex Meisn.	0	0	0	0	0	0	0	1	0
	Moritzia dusenii I.M.Johnst.	0	0	1	0	1	0	0	0	0
BRASSICACEAE	*Polypsecadium brasiliense* (O.E.Schulz) Al-Shehbaz									
BROMELIACEAE	*Aechmea blumenavii* var. *alba* Reitz	1	0	0	0	1	0	0	0	0
	Aechmea blumenavii Reitz var. *blumenavii*	1	0	0	0	1	0	0	0	0
	Aechmea calyculata var. *variegata* Strehl	1	0	0	0	1	0	0	0	0
	Aechmea comata (Gaudich.) Baker	1	0	0	0	0	1	0	0	0
	Aechmea gamosepala var. *nivea* Reitz	1	0	0	0	1	1	0	0	0
	Aechmea guaratubensis E.Pereira	1	0	0	0	0	0	0	0	0
	Aechmea joannis var. *alvipetala* Strehl	0	1	0	0	0	0	0	0	0
	Aechmea joannis Strehl var. *joannis*	0	0	0	0	1	0	0	0	0
	Aechmea kertesziae Reitz var. *kertesziae*	1	0	1	0	0	1	0	0	0
	Aechmea kertesziae var. *viridi-aurata* Reitz	1	0	1	0	0	1	0	0	0
	Aechmea kleinii Reitz	1	0	0	0	1	0	0	0	0
	Aechmea leppardii Philcox	1	0	0	0	0	0	0	0	0
	Aechmea nudicaulis var. *flavomarginata* E.Pereira	1	1	1	0	1	1	0	0	0
	Aechmea ornata var. *nationalis* Reitz	1	1	0	0	0	1	0	0	0
	Aechmea pimenti-velosoi var. *glabra* Reitz	1	0	0	0	0	1	0	0	0
	Aechmea pimenti-velosoi Reitz var. *pimenti-velosoi*	1	0	0	0	0	1	0	0	0

Families	**Species list**	**TRF**	**SSF**	**SHG**	**HTG**	**SMF**	**TCS**	**LTG**	**TES**	**TRS**
	Aechmea recurvata var. *albobracteata* Strehl	1	0	1	0	1	0	0	0	0
	Aechmea recurvata var. *benrathii* (Mez) Reitz	1	0	1	0	1	0	0	0	0
	Aechmea rubroaristata Leme & Fraga	0	0	0	1	0	0	0	0	0
	Aechmea winkleri Reitz	1	1	0	0	0	0	0	0	0
	Dyckia agudensis Irgang & Sobral	0	1	0	0	0	0	0	0	0
	Dyckia alba S.Winkl.	0	0	0	0	0	0	0	1	0
	Dyckia cabrerae L.B.Sm. & Reitz	0	0	1	0	0	0	0	0	0
	Dyckia crocea L.B.Sm.	0	0	1	0	0	0	0	0	0
	Dyckia delicata Larocca & Sobral	0	1	0	0	0	0	0	0	0
	Dyckia deltoidea (L.B.Sm.) L.B.Sm.	0	0	0	0	0	0	0	0	1
	Dyckia domfelicianensis Strehl	0	0	0	0	0	0	0	1	0
	Dyckia dusenii L.B.Sm.	0	0	1	0	0	0	0	0	0
	Dyckia elisabethae S.Winkl.	0	0	0	0	0	0	0	1	0
	Dyckia fosteriana var. *robustior* L.B.Sm.	0	0	1	0	0	0	0	0	0
	Dyckia frigida Hook.f.	0	0	1	0	0	0	0	0	0
	Dyckia hatschbachii L.B.Sm.	0	0	0	0	0	1	0	0	0
	Dyckia hebdingii L.B.Sm.	0	0	0	0	0	0	0	1	0
	Dyckia ibicuiensis Strehl	0	0	0	0	0	0	1	0	0
	Dyckia ibiramensis Reitz	0	0	1	0	0	0	0	0	0
	Dyckia irmgardiae L.B.Sm.	0	0	1	0	0	0	0	0	0
	Dyckia julianae Strehl	0	0	0	0	0	0	0	1	0
	Dyckia maritima Baker	0	0	1	0	0	1	0	0	0
	Dyckia polycladus L.B.Sm.									
	Dyckia racinae L.B.Sm.									
	Dyckia reitzii L.B.Sm.	0	0	1	1	0	0	0	0	0
	Dyckia remotiflora var. *angustior* L.B.Sm.	0	0	1	0	0	0	0	0	0
	Dyckia retardata S.Winkl.	0	1	0	0	0	0	0	1	0
	Dyckia retroflexa S.Winkl.									
	Dyckia rigida Strehl	0	0	0	0	1	0	0	0	0
	Edmundoa lindenii var. *rosea* (E.Morren) Leme	1	1	0	0	0	1	0	0	0
	Nidularium catarinense Leme	0	0	0	0	1	0	0	0	0
	Nidularium innocentii var. *striatum* Wittm.	1	0	0	0	0	1	0	0	0
	Quesnelia imbricata L.B.Sm.	1	0	1	0	0	0	0	0	0

Families	**Species list**	**TRF**	**SSF**	**SHG**	**HTG**	**SMF**	**TCS**	**LTG**	**TES**	**TRS**
	Tillandsia afonsoana Strehl	0	1	0	0	0	0	0	0	0
	Tillandsia bella Strehl	0	0	0	0	0	0	0	1	0
	Tillandsia itaubensis Strehl	0	1	0	0	0	0	0	0	0
	Tillandsia jonesii Strehl	0	1	0	0	0	0	0	0	0
	Tillandsia montana Reitz	1	0	0	0	0	0	0	0	0
	Tillandsia polzii Ehlers	0	0	0	0	0	0	0	1	0
	Tillandsia pseudomontana W.Weber & Ehlers	1	0	0	0	0	0	0	0	0
	Tillandsia rohdenardinii Strehl	0	1	0	0	0	0	0	0	0
	Tillandsia seideliana E.Pereira	1	0	0	0	0	0	0	0	0
	Tillandsia stricta var. *disticha* L.B.Sm.	1	1	1	0	1	1	0	0	0
	Tillandsia toropiensis Rauh	0	1	0	0	0	0	0	0	0
	Tillandsia winkleri Strehl	1	0	0	0	0	0	0	0	0
	Vriesea biguassuensis Reitz	1	0	0	0	1	0	0	0	0
	Vriesea declinata Leme	1	0	0	0	1	0	0	0	0
	Vriesea pinottii Reitz	1	0	0	0	0	1	0	0	0
	Vriesea reitzii Leme & A.F.Costa	0	0	0	0	1	0	0	0	0
	Vriesea triangularis Reitz	1	0	0	0	0	0	0	0	0
CACTACEAE	*Frailea buenekeri* W.R.Abraham	0	0	0	0	0	0	1	0	0
	Frailea curvispina Buining & Brederoo	0	0	1	0	0	0	0	0	0
	Frailea mammifera Buining & Brederoo	0	0	0	0	0	0	1	0	0
	Frailea pygmaea subsp. *albicolumnaris* (F.Ritter) Hofacker	0	0	0	0	0	0	1	1	0
	Frailea pygmaea subsp. *fulviseta* (Buining & Brederoo) P.J.Braun & Esteves	0	0	0	0	0	0	1	1	0
	Gymnocalycium horstii Buining subsp. *horstii*	0	0	1	0	0	0	0	1	0
	Gymnocalycium horstii subsp. *bueneckeri* (Swales) J.P.Braun & Hofacker	0	0	0	0	0	0	1	0	0
	Hatiora gaertneri (Regel) Barthlott	1	0	0	0	0	0	0	0	0
	Hatiora rosea (Lagerh.) Barthlott	1	0	0	0	0	0	0	0	0
	Parodia alacriportana Backeb. & Voll	0	0	1	0	0	0	0	1	0
	Parodia carambeiensis (Buining & Brederoo) Hofacker	0	0	1	0	0	0	0	0	0
	Parodia crassigibba (F.Ritter) N.P.Taylor	0	0	0	0	0	0	0	1	0
	Parodia fusca (F.Ritter) Hofacker & P.J.Braun	0	0	0	0	0	0	1	0	0
	Parodia gaucha M.Machado & Larocca	0	0	0	0	0	0	0	1	0
	Parodia haselbergii subsp. *graessneri* (K.Schum) Hofacker & P.J.Braun	0	0	1	0	0	0	0	0	0
	Parodia haselbergii (Haage ex Rümpler) F.H.Brandt subsp. *haselbergii*	0	0	1	0	0	0	0	0	0

Families	**Species list**	**TRF**	**SSF**	**SHG**	**HTG**	**SMF**	**TCS**	**LTG**	**TES**	**TRS**
	Parodia horstii (F.Ritter) N.P.Taylor	0	1	0	0	0	0	0	0	0
	Parodia leninghausii (Haage) F.H.Brandt	0	1	0	0	0	0	0	0	0
	Parodia magnifica (F.Ritter) F.H.Brandt	0	1	0	0	0	0	0	0	0
	Parodia muricata (Otto) Hofacker	0	0	0	0	0	0	1	0	0
	Parodia neohorstii (S.Theun.) N.P.Taylor	0	0	0	0	0	0	0	1	0
	Parodia ottonis subsp. *horstii* (F.Ritter) Hofacker	0	0	0	0	0	0	1	1	0
	Parodia oxycostata (Buining & Brederoo) Hofacker	0	0	0	0	0	0	0	1	0
	Parodia oxycostata subsp. *gracilis* (F.Ritter) Hofacker	0	0	0	0	0	0	0	1	0
	Parodia rechensis (Buining) F.H.Brandt	0	0	1	0	0	0	0	0	0
	Parodia rudibuenekeri (W.R.Abraham) Hofacker & P.J.Braun	0	0	0	0	0	0	0	1	0
	Parodia schumanniana subsp. *claviceps* (F.Ritter) Hofacker & P.J.Braun	0	0	0	0	0	0			0
	Parodia scopa subsp. *neobuenekeri* (F.Ritter) Hofacker & P.J.Braun	0	0	0	0	0	0	0	1	0
	Parodia scopa subsp. *succinea* (F.Ritter) Hofacker & P.J.Braun	0	0	0	0	0	0	0	1	0
	Parodia stockingeri (Prestlé) Hofacker & P.J.Braun	0	0	0	0	0	0	1	0	0
	Parodia tenuicylindrica (F.Ritter) D.R.Hunt.	0	0	0	0	0	0	1	0	0
	Rhipsalis agudoensis N.P.Taylor	1	0	0	0	0	0	0	0	0
CALYCERACEAE	*Boopis juergensii* Pilg.	0	1	0	0	0	0	0	0	0
CAMPANULACEAE	*Lobelia langeana* Dusén	1	0	0	0	0	0	0	0	0
	Lobelia paranaensis R.Braga	0	0	1	0	0	0	0	0	0
	Siphocampylus densidentatus E.Wimm.	0	0	1	0	0	0	0	0	0
	Siphocampylus fulgens Lebas	1	0	0	0	0	0	0	0	0
CANELLACEAE	*Cinnamodendron axillare* (Nees ex Mart.) Endl. ex Walp.	1	0	0	0	0	0	0	0	0
CARYOPHYLLACEAE	*Paronychia revoluta* C.E.Carneiro & Furlan	0	0	1	0	0	0	0	0	0
CLEOMACEAE	*Cleome crenopetala* DC.	1	0	0	0	1	0	0	0	0
CLETHRACEAE	*Clethra uleana* Sleumer	1	0	0	0	0	0	0	0	0
COMBRETACEAE	*Terminalia reitzii* Exell	1	0	0	0	0	0	0	0	0
	Terminalia uleana Engl. ex. Alwan & Stace	1	0	0	0	0	0	0	0	0
COMMELINACEAE	*Dichorisandra paranaensis* D.Maia, Cervi & Tardivo	1	1	0	0	0	0	0	0	0
	Tradescantia cerinthoides Kunth	0	0	1	0	0	0	0	1	0
CONVOLVULACEAE	*Ipomoea uruguayensis* Meisn.	0	0	0	0	0	0	0	1	0
CUCURBITACEAE	*Cayaponia alarici* M.L.Porto	1	1	0	0	1	0	0	0	0
	Cayaponia biflora Cogn. ex Harms	1	0	0	0	1	0	0	0	1
	Cayaponia laxa Cogn. ex Harms	0	0	0	0	1	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Cayaponia ulei Cogn. ex Harms	1	0	0	0	0	0	0	0	0
	Wilbrandia longisepala Cogn.	1	1	0	0	1	0	0	0	0
CYCLANTHACEAE	*Asplundia glaucophylla* Harling	1	0	0	0	0	0	0	0	0
	Asplundia polymera subsp. *retzii* Harling	1	0	0	0	0	0	0	0	0
CYPERACEAE	*Cyperus inops* C.B.Clarke	1	0	0	0	0	0	0	0	0
	Eleocharis kleinii Barros	0	0	1	0	0	0	0	0	0
	Eleocharis laeviglumis R.Trevis. & Boldrini	0	0	0	0	0	1	0	0	0
	Machaerina austrobrasiliensis M.T.Strong	1	0	0	0	1	0	0	0	0
	Rhynchospora pseudomacrostachya Gerry Moore, Guagl. & Zartman	0	0	1	0	0	0	0	0	0
	Rhynchospora semihirsuta Boeckeler	0	0	0	1	0	0	0	0	0
	Rhynchospora smithii W.W.Thomas	0	0	1	0	0	0	0	0	0
	Schoenus lymansmithii M.T.Strong	0	0	1	0	0	0	0	0	0
	Scleria colorata Core	0	0	0	0	0	1	0	0	0
	Scleria filiculmis Boeckeler	1	0	0	0	1	0	0	0	0
DIOSCOREACEAE	*Dioscorea beecheyi* R.Knuth									
	Dioscorea commutata R.Knuth	1	0	0	0	0	0	0	0	0
	Dioscorea curitybensis R.Knuth	0	0	0	0	1	0	0	0	0
	Dioscorea fractiflexa R.Knuth	0	0	0	0	1	0	0	0	0
	Dioscorea microcephala Uline	0	0	0	0	0	0	0	1	0
	Dioscorea pallidinervia R.Knuth	1	0	0	0	0	0	0	0	0
	Dioscorea tubuliflora Uline ex R.Knuth									
ELAEOCARPACEAE	*Crinodendron brasiliense* Reitz & L.B.Sm.	0	0	0	0	1	0	0	0	0
ERICACEAE	*Agarista niederleinii* var. *acutifolia* Judd	0	0	1	1	0	0	0	0	0
	Agarista niederleinii (Sleumer) Judd var. *niederleinii*	0	0	1	1	0	0	0	0	0
	Gaultheria ulei Sleumer	0	0	1	0	0	0	0	0	0
	Gaultheria corvensis (R.R.Silva & Cervi) G.O.Romão & Kin.-Gouv.	0	0	1	0	0	0	0	0	0
	Gaylussacia arassatubensis R.R.Silva & Cervi	0	0	0	1	0	0	0	0	0
	Gaylussacia caratuvensis R.R.Silva & Cervi	0	0	0	1	0	0	0	0	0
	Gaylussacia paranaensis G.O.Romão & Kin.-Gouv.	0	0	0	1	0	0	0	0	0
ERIOCAULACEAE	*Eriocaulon candidum* Moldenke	0	0	0	0	0	1	0	0	0
	Eriocaulon magnificum Ruhland var. *magnificum*	0	0	1	0	0	0	0	0	0
	Eriocaulon megapotamicum Malme									
	Eriocaulon reitzii Moldenke & L.B.Sm.	0	0	0	0	0	1	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Eriocaulon ulaei var. *radiosum* Ruhland	0	0	1	0	0	0	0	0	0
	Eriocaulon ulaei Ruhland var. *ulaei*	0	0	1	0	0	0	0	0	0
	Paepalanthus albovaginatus Silveira var. *albovaginatus*	0	0	1	0	0	0	0	0	0
	Paepalanthus albovaginatus var. *albobracteatus* Tissot-Sq.	0	0	1	0	0	0	0	0	0
	Paepalanthus albovaginatus var. *fuscobracteatus* Tissot-Sq.	0	0	1	0	0	0	0	0	0
	Paepalanthus bellus Moldenke	0	0	1	0	0	0	0	0	0
	Paepalanthus catharinae Ruhland var. *catharinae*	0	0	1	0	0	0	0	0	0
	Paepalanthus catharinae var. *hatschbachii* (Moldenke) Moldenke & L.B.Sm.	0	0	1	1	0	0	0	0	0
	Paepalanthus decorus Abbiatti	0	0	0	0	0	0			0
	Paepalanthus leiseringii var. *kleinii* Moldenke & L.B.Sm.	0	0	1	0	0	0	0	0	0
	Paepalanthus tessmannii Moldenke	0	0	1	0	0	0	0	0	0
	Syngonanthus caulescens var. *proliferus* Moldenke	0	0	1	0	0	0	0	0	0
	Syngonanthus chrysanthus var. *castrensis* Moldenke & L.B.Sm.	0	0	0	0	0	1	0	0	0
ERYTHROXYLACEAE	*Erythroxylum substriatum* O.E. Schulz									
ESCALLONIACEAE	*Escallonia ledifolia* Sleumer	0	0	1	0	0	0	0	0	0
	Escallonia petrophila Rambo & Sleumer	1	0	0	0	0	0	0	0	0
EUPHORBIACEAE	*Acalypha apetiolata* Allem & Waechter	0	0	1	0	0	0	0	0	0
	Acalypha sehnemii Allem & Irgang	0	0	0	0	0	0	1	0	0
	Acalypha uleana L.B.Sm. & Downs	1	0	0	0	0	0	0	0	0
	Bernardia alarici Allem & Irgang	0	0	1	0	0	0	0	0	0
	Bernardia flexuosa Pax & K.Hoffm.	0	0	1	0	0	0	0	0	0
	Bernardia geniculata Allem & Waechter	0	0	1	0	0	0	0	0	0
	Bernardia hagelundii Allem & Irgang	0	0	1	0	0	0	0	0	0
	Chiropetalum anisotrichum (Müll.Arg.) Pax & K.Hoffm.	0	1	0	0	0	0	0	0	0
	Chiropetalum foliosum (Müll.Arg.) Pax & K.Hoffm.	0	0	1	0	0	0	0	1	0
	Chiropetalum molle (Baill.) Pax & K.Hoffm.	0	0	1	0	0	0	0	0	0
	Chiropetalum phalacradenium (J.W.Ingram) L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Chiropetalum pilosistylum (Allem & Irgang) Radcl.-Sm. & Govaerts									
	Chiropetalum ramboi (Allem & Irgang) Radcl.-Sm. & Govaerts									
	Colliguaja brasiliensis Klotzsch ex Baill.	1	1	0	0	0	0	0	0	0
	Croton bresolinii L.B.Sm. & Downs	1	0	1	0	0	0	0	0	0
	Croton calyciglandulosus Allem	0	0	0	0	0	0	0	1	0

Families	**Species list**	**TRF**	**SSF**	**SHG**	**HTG**	**SMF**	**TCS**	**LTG**	**TES**	**TRS**
	Croton calycireduplicatus Allem	0	0	1	0	0	0	0	0	0
	Croton catharinensis L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Croton confinis L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Croton dusenii Croizat	0	0	1	0	0	0	0	0	0
	Croton ericoideus Baill.	0	0	1	0	0	0	0	0	0
	Croton helichrysum Baill.	0	0	1	0	0	0	0	0	0
	Croton ichthygaster L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Croton kleinii L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Croton leptophyllus Müll.Arg.	0	0	1	0	0	0	0	0	0
	Croton microphyllinus Radcl.-Sm. & Govaerts									
	Croton myrianthus Müll.Arg.	0	0	1	0	0	0	0	0	0
	Croton patrum L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Croton polygonoides L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Croton pygmaeus L.R.Lima	0	0	0	0	0	0	0	1	0
	Croton quintasii Allem	0	0	1	0	0	0	0	0	0
	Croton ramboi Allem	0	0	1	0	0	0	0	0	0
	Croton thymelinus Baill.	0	0	1	0	0	0	0	0	0
	Croton viridulus (Croizat) Radcl.-Sm. & Govaerts	0	0	1	0	0	0	0	0	1
	Dalechampia riparia L.B.Sm. & Downs	1	0	0	0	1	0	0	0	0
	Ditaxis sellowiana Pax & K.Hoffm.									
	Euphorbia paranensis Dusén	0	0	1	0	1	0	0	0	0
	Stillingia dusenii Pax & K.Hoffm.	0	0	0	0	0	0	0	0	1
FABACEAE	*Adesmia araujoi* Burkart	0	0	1	0	0	0	0	0	0
	Adesmia arillata Miotto	0	0	1	0	0	0	0	0	0
	Adesmia ciliata Vogel	0	0	1	0	0	0	0	0	0
	Adesmia paranensis Burkart	0	0	1	0	0	0	0	0	0
	Adesmia psoraleoides Vogel	0	0	1	0	0	0	0	0	0
	Adesmia reitziana Burkart	0	0	1	0	0	0	0	0	0
	Adesmia rocinhensis Burkart	0	0	1	0	0	0	0	0	0
	Adesmia sulina Miotto	0	0	1	0	0	0	0	0	0
	Adesmia tristis Vogel	0	0	1	0	0	0	0	0	0
	Adesmia vallsii Miotto	0	0	1	0	0	0	0	0	0
	Aeschynomene fructipendula Abruzzi de Oliveira	1	0	1	0	0	1	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Albizia burkartiana Barneby & J.W.Grimes	1	0	0	0	1	0	0	0	0
	Chamaecrista incana (Vogel) H.S.Irwin & Barneby	0	0	1	0	0	0	0	0	1
	Crotalaria hilariana Benth.	0	0	1	0	0	0	0	0	0
	Desmodium craspediferum A.M.G.Azevedo & Abruzzi de Oliveira	0	0	1	0	0	0	0	0	0
	Desmodium triarticulatum Malme	0	1	0	0	1	0	0	0	0
	Inga lentiscifolia Benth.	1	0	0	0	1	0	0	0	0
	Lecointea hatschbachii Barneby	1	0	0	0	0	0	0	0	0
	Lonchocarpus grazielae M.J.Silva & A.M.G.Azevedo	0	1	0	0	0	1	0	0	0
	Lonchocarpus torrensis N.F.Mattos	1	0	0	0	0	0	0	0	0
	Lupinus paranensis C.P.Sm.	0	0	1	0	0	0	0	0	0
	Lupinus reitzii Burkart ex. M.Pinheiro & Miotto	0	0	1	0	0	0	0	0	0
	Lupinus rubriflorus Planchuelo	0	0	1	0	0	0	0	0	0
	Lupinus uleanus C.P.Sm.	0	0	1	1	0	0	0	0	0
	Machaerium hatschbachii Rudd	0	1	0	0	1	0	0	0	0
	Mimosa atlantica Barneby									
	Mimosa balduinii Burkart	1	0	0	0	0	0	0	0	0
	Mimosa bathyrrhena Barneby	0	0	1	0	0	0	0	0	0
	Mimosa callidryas Barneby	1	0	0	0	0	0	0	0	0
	Mimosa catharinensis Burkart	0	0	0	0	0	1	0	0	0
	Mimosa chaetosphaera Barneby	1	0	0	0	0	0	0	0	0
	Mimosa chartostegia Barneby	0	0	1	0	0	0	0	0	0
	Mimosa congestifolia Burkart	1	0	0	0	0	0	0	0	0
	Mimosa coniflora Burkart	1	0	0	0	0	0	0	0	0
	Mimosa deceptrix Barneby	1	0	0	0	0	0	0	0	0
	Mimosa dolens var. *pangloea* Barneby	0	0	1	0	0	0	0	0	0
	Mimosa dolens var. *uncta* Barneby	0	0	0	0	0	0	0	0	1
	Mimosa dolens var. *rigescens* (Benth.) Barneby	0	0	1	0	0	0	0	0	1
	Mimosa dryandroides var. *extratropica* Barneby	0	0	1	0	0	0	0	0	0
	Mimosa eriocarpa Benth.	0	0	1	0	0	0	0	0	0
	Mimosa fachinalensis Burkart	1	0	1	0	0	0	0	0	0
	Mimosa glabra Benth.	0	0	1	0	0	0	0	0	0
	Mimosa glycyrrhizoides Barneby	1	0	0	0	0	0	0	0	0
	Mimosa hatschbachii Barneby	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Mimosa intricata Benth.	0	1	1	0	0	0	0	1	0
	Mimosa involucrata Benth.	0	0	1	0	0	0	0	0	0
	Mimosa kermesina Otto & A.Dietr.									
	Mimosa kuhnisteroides Barneby	0	0	1	0	0	0	0	0	0
	Mimosa lasiocephala Benth.									
	Mimosa lepidorepens Burkart	0	0	0	1	0	0	0	0	0
	Mimosa macrocalyx var. *pectinata* Burkart	0	0	1	0	0	0	0	0	0
	Mimosa micropteris var. *pungens* (Burkart) Barneby	1	0	0	0	0	0	0	0	0
	Mimosa murex Barneby	0	0	0	1	0	0	0	0	0
	Mimosa oblonga var. *pinetorum* Barneby	0	0	1	0	0	0	0	0	0
	Mimosa paranapiacabae Barneby	0	0	0	1	0	0	0	0	0
	Mimosa per-dusenii Burkart	0	0	1	0	0	0	0	0	1
	Mimosa prionopus Barneby	1	0	1	0	0	0	0	0	0
	Mimosa pseudocallosa Burkart	1	0	0	0	0	0	0	0	0
	Mimosa pseudolepidota (Burkart) Barneby	0	0	1	0	0	0	0	0	0
	Mimosa pseudotrachycarpa Barneby	0	1	1	0	0	0	0	0	0
	Mimosa ramentacea Burkart	1	0	1	0	0	0	0	0	0
	Mimosa reduviosa Barneby	0	0	0	0	0	0	0	0	1
	Mimosa regnellii var. *exuta* Barneby	0	0	1	0	0	0	0	0	0
	Mimosa regnellii var. *grossiseta* Barneby	0	0	1	0	0	0	0	0	0
	Mimosa serra Burkart	1	0	1	0	0	0	0	0	0
	Mimosa sparsa Benth.	0	1	0	0	0	0	0	0	0
	Mimosa sparsiformis Barneby	0	1	1	0	1	0	0	0	0
	Mimosa strobiliflora Burkart	1	0	0	0	0	0	0	0	0
	Mimosa taimbensis Burkart	1	0	0	0	0	0	0	0	0
	Mimosa urticaria Barneby	0	0	0	0	1	0	0	0	0
	Piptadenia affinis Burkart	1	0	0	0	0	0	0	0	0
	Senegalia catharinensis (Burkart ex Barth & Yoneshigue) Seigler & Ebinger	1	0	0	0	0	0	0	0	0
	Senegalia magnibracteosa (Burkart) Seigler & Ebinger	0	0	0	0	1	0	0	0	0
	Sellocharis paradoxa Taub.	0	0	0	0	0	0	0	1	0
	Senna organensis var. *extratropica* H.S.Irwin & Barneby	0	0	1	0	1	0	0	0	0
	Senna pendula var. *recondita* H.S.Irwin & Barneby	1	1	1	0	1	1	0	0	0
	Vicia gramínea var. *nigricarpa* N.R.Bastos & Miotto	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Vicia hatschbachii Burkart ex Vanni & D.B.Kurtz	0	0	1	0	0	0	0	0	0
GERANIACEAE	*Geranium arachnoideum* A.St.-Hil.	1	0	1	0	0	0	0	0	0
GESNERIACEAE	*Napeanthus reitzii* (L.B.Sm.) B.L.Burtt & Leeuwenb.	1	0	0	0	0	0	0	0	0
	Nematanthus australis Chautems	1	0	0	0	0	0	0	0	0
	Sinningia curtiflora (Malme) Chautems	1	0	0	0	0	1	0	0	0
	Sinningia leopoldii (Scheidw. ex Planch.) Chautems	0	0	1	0	0	0	0	0	0
	Sinningia lineata (Hjelmq.) Chautems	0	1	0	0	0	0	0	0	0
	Sinningia nivalis Chautems	0	0	0	0	1	0	0	0	0
GUNNERACEAE	*Gunnera manicata* Linden	1	0	0	0	1	0	0	0	0
HYPERICACEAE	*Hypericum campestre* subsp. *pauciflorum* N.Robson	0	0	1	1	0	0	0	0	0
	Hypericum cordatum subsp. *kleinii* N.Robson	0	0	1	0	0	0	0	0	0
	Hypericum microlicioides L.B.Sm.	0	0	1	1	0	0	0	0	0
	Hypericum pedersenii N.Robson	0	0	0	0	0	0	0	1	0
	Hypericum salvadorense N.Robson									
IRIDACEAE	*Calydorea basaltica* Ravenna	0	0	1	0	0	0	0	0	0
	Calydorea crocoides Ravenna	0	0	1	0	0	0	0	0	0
	Cypella aquatilis Ravenna	0	0	1	0	0	0	0	0	0
	Cypella discolor Ravenna	0	0	0	0	0	0			0
	Cypella pabstiana Ravenna									
	Cypella pusilla (Link & Otto) Benth. & Hook.f. ex B.D.Jacks.									
	Herbertia zebrina Deble	0	0	0	0	0	0	0	1	0
	Kelissa brasiliensis (Baker) Ravenna	0	0	0	0	0	0	0	1	0
	Neomarica latifolia (Ravenna) A.Gil	1	0	0	0	0	0	0	0	0
	Onira unguiculata (Baker) Ravenna	0	0	0	0	0	1	1	0	0
	Sisyrinchium bromelioides R.C.Foster subsp. *bromelioides*	0	0	1	0	0	0	0	0	0
	Sisyrinchium coalitum Ravenna	0	0	1	0	0	0	0	0	0
	Sisyrinchium decumbens Ravenna	0	0	1	0	0	0	0	0	0
	Sisyrinchium densiflorum Ravenna	0	0	1	0	0	0	0	0	0
	Sisyrinchium pendulum Ravenna	0	0	1	1	0	0	0	0	0
	Sisyrinchium rambonis R.C.Foster	0	0	1	0	0	0	0	0	0
	Sisyrinchium teleanthum Ravenna	0	0	0	1	0	0	0	0	0
LAMIACEAE	*Aegiphila australis* Moldenke	0	0	0	0	0	1	0	0	0
	Cunila fasciculata Benth.	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Cunila incisa Benth.	0	1	1	0	1	0	0	0	0
	Cunila platyphylla Epling	0	0	1	0	0	0	0	0	0
	Cunila tenuifolia Epling	0	0	1	0	0	0	0	0	0
	Glechon elliptica C.Pereira & Hatschbach	0	0	1	0	0	0	0	0	0
	Hedeoma polygalifolia Benth.	0	0	1	0	0	0	0	0	0
	Hesperozygis dimidiata Epling & Mathias	0	0	0	1	0	0	0	0	0
	Hesperozygis kleinii Epling & Játiva	0	0	1	0	0	0	0	0	0
	Hesperozygis rhododon Epling	0	0	1	0	0	0	0	0	0
	Hesperozygis ringens (Benth.) Epling	1	0	1	0	0	0	0	0	0
	Hesperozygis spathulata Epling	0	0	1	0	0	0	0	0	0
	Hoehnea parvula (Epling) Epling	0	0	1	1	0	0	0	0	0
	Hyptis apertiflora Epling	0	0	1	0	0	0	0	0	0
	Hyptis tetracephala Bordignon	1	0	1	0	0	1	0	0	0
	Peltodon rugosus Tolm.	0	0	1	0	0	0	0	0	0
	Rhabdocaulon erythrostachys Epling	0	0	1	0	0	0	0	0	0
	Salvia congestiflora Epling	0	0	1	0	0	0	0	0	0
	Salvia cordata Benth.	0	0	1	0	0	0	0	0	0
	Salvia curta Epling	1	0	0	0	0	0	0	0	0
	Salvia propinqua Benth.									
	Salvia regnelliana Briq.	0	0	0	0	1	0	0	0	0
	Salvia scoparia Epling	0	0	1	0	0	0	0	0	0
	Salvia tenuiflora Epling	1	0	0	0	0	0	0	0	0
LAURACEAE	*Cinnamomum hatschbachii* Vattimo	1	0	0	0	0	0	0	0	0
LINACEAE	*Linum smithii* Mildner	0	0	1	0	0	0	0	0	0
LOASACEAE	*Blumenbachia catharinensis* Urb. & Gilg	1	0	0	0	0	0	0	0	0
	Blumenbachia eichleri Urb.	1	0	0	0	0	0	0	0	0
	Blumenbachia exalata Weigend	0	1	0	0	0	1	0	0	0
	Blumenbachia scabra (Miers) Urb.	1	0	0	0	0	0	0	0	0
LOGANIACEAE	*Spigelia araucariensis* E.F.Guim. & Fontella	1	0	0	0	0	0	0	0	0
	Spigelia catarinensis E.F.Guim. & Fontella	1	0	0	0	0	0	0	0	0
	Spigelia kleinii var. *paranaensis* E.F.Guim. & Fontella	1	0	1	0	0	0	0	0	0
	Spigelia vestita L.B.Sm.	0	0	0	0	1	0	0	0	0
LYTHRACEAE	*Cuphea dusenii* Koehne									

Families	**Species list**	**TRF**	**SSF**	**SHG**	**HTG**	**SMF**	**TCS**	**LTG**	**TES**	**TRS**
	Cuphea hatschbachii Lourteig	0	0	1	0	0	0	0	0	0
	Cuphea iguazuensis Lourteig	0	0	1	0	0	0	0	0	0
	Cuphea linifolia (A.St.-Hil.) Koehne	0	0	1	0	1	0	0	0	0
	Cuphea paranensis Bacig.	0	0	0	0	0	0	0	0	1
	Cuphea urbaniana Koehne	1	1	1	0	1	0	0	0	0
MALPIGHIACEAE	*Banisteriopsis pseudojanusia* (Nied.) B.Gates	1	0	0	0	0	0	0	0	0
	Heteropterys dusenii Nied.	0	0	1	0	0	0	0	0	1
	Peixotoa catarinensis C.E.Anderson	0	0	0	0	0	1	0	0	0
MALVACEAE	*Abutilon darwinii* Hook.f.	0	0	0	0	1	0	0	0	0
	Abutilon muelleri-friderici Gürke & K.Schum.	0	0	0	0	1	0	0	0	0
	Byttneria implacabilis Cristóbal	1	0	0	0	0	0	0	0	0
	Byttneria triadenia Cristóbal	1	0	0	0	0	0	0	0	0
	Calyptraemalva catharinensis Krapov.	1	0	0	0	0	0	0	0	0
	Modiolastrum palustre (Ekman) Krapov.	0	0	1	0	0	0	0	0	0
	Monteiroa bullata (Ekman) Krapov.	1	1	0	0	1	0	0	0	0
	Monteiroa catharinensis Krapov.	1	0	0	0	1	0	0	0	0
	Monteiroa dusenii (Ekman) Krapov.	1	0	0	0	1	0	0	0	0
	Monteiroa hatschbachii Krapov.	1	0	0	0	1	0	0	0	0
	Monteiroa ptarmicifolia (A.St.-Hil. & Naudin) Krapov.	1	0	0	0	1	0	0	0	0
	Monteiroa reitzii Krapov.	1	0	0	0	1	0	0	0	0
	Monteiroa smithii Krapov.	1	0	0	0	0	0	0	0	0
	Monteiroa triangularifolia Krapov.	1	0	0	0	1	0	0	0	0
	Pavonia commutata Garcke	0	0	1	0	0	0	0	0	0
	Pavonia horrida Krapov.	1	0	0	0	0	0	0	0	0
	Pavonia pedersenii Fryxell	0	0	0	0	0	0	1	0	0
	Pavonia ramboi Krapov. & Cristóbal	0	0	1	0	0	0	0	0	0
	Pavonia reitzii Krapov. & Cristóbal	0	0	1	0	0	0	0	0	0
	Pavonia renifolia Krapov.	0	0	1	0	0	0	0	0	0
	Pavonia stenopetala Krapov.	1	0	0	0	0	0	0	0	0
	Sida ascendens A.St.Hil.									
	Sida pseudorubifolia Krapov. & Bueno	0	0	0	0	0	0	1	0	0
	Sida reitzii Krapov.	1	1	0	0	1	0	0	0	0
	Tropidococcus pinnatipartitus (A.St.-Hil. & Naudin) Krapov.	1	0	0	0	1	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
MARANTACEAE	*Saranthe ustulata* Petersen	1	0	0	0	0	0	0	0	0
MELASTOMATACEAE	*Leandra balduinii* Brade	0	0	0	0	1	0	0	0	0
	Leandra camporum Brade	0	0	1	0	0	0	0	0	0
	Leandra catharinensis Cogn.	0	0	0	0	1	0	0	0	0
	Leandra cordigera var. *transiens* Wurdack	1	0	1	0	1	0	0	0	0
	Leandra dusenii Cogn.	0	0	1	0	0	0	0	0	0
	Leandra hatschbachii Brade	1	0	0	0	0	0	0	0	0
	Leandra humilis var. *glabrata* (Cogn.) Wurdack	1	0	1	0	0	0	0	0	0
	Leandra luctatoris Wurdack	0	0	1	0	0	0	0	0	0
	Leandra microphylla Cogn.	0	0	1	0	0	0	0	0	1
	Leandra neglecta Brade	0	0	0	1	0	0	0	0	0
	Leandra opaca Brade	0	0	0	0	1	0	0	0	0
	Leandra planifilamentosa Brade	0	0	0	0	1	0	0	0	0
	Leandra ramboi Brade	0	0	0	0	1	0	0	0	0
	Leandra riograndensis (Brade) Wurdack	1	0	0	0	1	0	0	0	0
	Leandra ulaei Cogn.	1	0	0	0	0	0	0	0	0
	Leandra urbaniana Cogn.	1	0	0	0	0	0	0	0	0
	Miconia lagunensis Ule	1	0	0	0	0	0	0	0	0
	Miconia ramboi Brade	1	0	0	0	0	0	0	0	0
	Ossaea flaccida Brade	0	0	0	0	1	0	0	0	0
	Ossaea ramboi Brade	0	0	0	0	1	0	0	0	0
	Tibouchina asperior (Cham.) Cogn.	1	0	0	0	0	0	0	0	0
	Tibouchina dusenii Cogn.	0	0	0	1	0	0	0	0	0
	Tibouchina kleinii Wurdack	0	0	1	0	0	0	0	0	0
	Tibouchina pilosa var. *glandulosa* Wurdack	1	0	0	0	0	0	0	0	0
	Tibouchina ramboi Brade	1	0	1	0	0	0	0	0	0
	Tibouchina rupestris Cogn.	0	1	1	0	0	0	0	0	0
MENISPERMACEAE	*Disciphania contraversa* Barneby	1	0	0	0	1	0	0	0	0
MONIMIACEAE	*Mollinedia eugeniifolia* Perkins	1	0	0	0	0	0	0	0	0
	Mollinedia howeana Perkins	1	0	0	0	0	0	0	0	0
MYRTACEAE	*Calyptranthes dusenii* Kausel									
	Calyptranthes hatschbachii D.Legrand	1	0	0	0	0	0	0	0	0
	Calyptranthes pileata D.Legrand var. *pileata*	1	0	0	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Calyptranthes pileata var. *riograndensis* D.Legrand	1	1	0	0	0	0	0	0	0
	Campomanesia xanthocarpa var. *littoralis* (D.Legrand) Landrum	1	1	0	0	0	0	0	0	0
	Curitiba prismatica (D.Legrand) Salywon & Landrum	0	0	0	0	1	0	0	0	0
	Eugenia angelyana Mattos	1	0	0	0	0	0	0	0	0
	Eugenia bacopari D.Legrand	1	0	0	0	0	1	0	0	0
	Eugenia catharinensis D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia coaetanea O.Berg.	0	0	0	0	1	0	0	0	0
	Eugenia convexinervia D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia dimorpha O.Berg	1	0	1	0	1	0	0	0	0
	Eugenia hamiltonii (Mattos) Mattos	0	0	0	0	0	0	0	1	1
	Eugenia hamoniana Mattos									
	Eugenia imaruiensis D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia joenssonii Kausel	1	0	0	0	0	0	0	0	0
	Eugenia kleinii var. *aristata* D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia lepida Mattos & D.Legrand	0	0	0	0	1	0	0	0	0
	Eugenia malacantha D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia mattosii D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia minutifolia (Mattos & D.Legrand) Mattos	1	0	0	0	0	0	0	0	0
	Eugenia myrciariifolia Soares-Silva & Sobral	0	1	0	0	0	0	0	0	0
	Eugenia neotristis Sobral	1	0	0	0	0	1	0	0	0
	Eugenia oeidocarpa O.Berg.	0	0	0	0	1	0	0	0	0
	Eugenia pachyclada D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia platysema O.Berg	1	0	0	0	0	0	0	0	0
	Eugenia pseudomalacantha D.Legrand	1	0	0	0	0	0	0	0	0
	Eugenia pyriformis var. *argentea* Mattos & D.Legrand	1	1	0	0	1	0	0	0	1
	Eugenia rostrifolia D.Legrand	1	0	0	0	1	0	0	0	0
	Eugenia rotundicosta D.Legrand	1	0	0	0	1	0	0	0	0
	Eugenia sclerocalyx D.Legrand	1	0	0	0	1	0	0	0	0
	Marlierea krapovickae D.Legrand	1	0	0	0	0	0	0	0	0
	Myrceugenia bocaiuvensis Mattos	1	0	0	0	0	0	0	0	0
	Myrceugenia cucullata D.Legrand	1	0	0	0	1	0	0	0	0
	Myrceugenia foveolata (O.Berg) Sobral	1	0	0	0	1	0	0	0	0
	Myrceugenia gertii Landrum	1	0	0	0	1	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Myrceugenia hatschbachii Landrum	1	0	0	0	1	0	0	0	0
	Myrceugenia mesomischa (Burret) D.Legrand & Kausel	0	0	0	0	1	0	0	1	0
	Myrceugenia pilotantha var. *nothorufa* (D.Legrand) Landrum	1	0	0	0	1	0	0	0	0
	Myrceugenia smithii Landrum	1	0	0	0	1	0	0	0	0
	Myrceugenia venosa D.Legrand	0	0	0	0	1	0	0	0	0
	Myrcia atropilosa (O.Berg) N.Silveira									
	Myrcia dichrophylla D.Legrand	1	0	0	0	0	1	0	0	0
	Myrcia flagellaris (D.Legrand) Sobral	1	0	0	0	0	0	0	0	0
	Myrcia hatschbachii D.Legrand	1	0	0	0	1	0	0	0	0
	Myrcia lajeana D.Legrand	1	0	0	0	1	0	0	0	0
	Myrcia selloi var. *microsiphonata* (D.Legrand) N.Silveira	1	0	0	0	0	1	0	0	0
	Myrcia squamata (Mattos & D.Legrand) Mattos	1	0	0	0	0	0	0	0	0
	Myrciaria plinioides D.Legrand	1	0	0	0	0	0	0	0	0
	Neomitranthes cordifolia (D.Legrand) D.Legrand	1	0	0	0	0	1	0	0	0
	Neomitranthes gemballae (D.Legrand) D.Legrand	1	0	0	0	1	0	0	0	0
	Plinia cordifolia (D.Legrand) Sobral	1	0	0	0	0	0	0	0	0
	Plinia hatschbachii (Mattos) Sobral	1	0	0	0	0	0	0	0	0
	Psidium reptans (D.Legrand) Soares-Silva & Proença	0	0	1	0	0	0	0	0	0
OCHNACEAE	*Ouratea australis* Ule									
	Ouratea pulchella (Planch.) Engl.									
ONAGRACEAE	*Fuchsia hatschbachii* P.E.Berry	0	0	1	0	0	0	0	0	0
	Fuchsia regia subsp. *reitzii* P.E.Berry	1	0	0	0	1	0	0	0	0
	Oenothera catharinensis Cambess.	0	0	0	0	0	1	0	0	0
ORCHIDACEAE	*Acianthera acuminatipetala* (A.Samp.) Luer	1	0	0	0	0	0	0	0	0
	Acianthera adirii (Brade) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Acianthera alborosea (Kraenzl.) Luer	1	0	0	0	0	0	0	0	0
	Acianthera antennata (Garay) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Acianthera asaroides (Kraenzl.) Pridgeon & M.W.Chase									
	Acianthera aveniformis (Hoehne) C.N.Gonç. & Waechter	0	0	0	0	1	0	0	0	0
	Acianthera dutrae (Pabst) C.N.Gonç. & Waechter	0	0	0	0	1	0	0	0	0
	Acianthera gouveiae (A.Samp.) F.Barros & L.Guimarães									
	Acianthera gracilisepala (Brade) Luer	0	1	0	0	0	0	0	0	0
	Acianthera karlii (Pabst) C.N.Gonç. & Waechter	1	0	0	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Acianthera langeana (Kraenzl.) Pridgeon & M.N.Chase	0	0	0	0	1	0	0	0	0
	Acianthera marumbyana (Garay) Luer	1	0	0	0	0	0	0	0	0
	Acianthera murexoidea (Pabst) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Acianthera perdusenii (Hoehne) F.Barros & L.Guimarães									
	Acianthera tristis (Barb.Rodr.) Priedgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Acianthera violaceomaculata (Hoehne) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Anathallis caroli (Schltr.) F.Barros & Barberena	0	1	0	0	0	0	0	0	0
	Anathallis gert-hatschbachii (Hoene) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Anathallis globifera (Pabst) F.Barros & Barberena	1	0	0	0	0	0	0	0	0
	Anathallis kleinii (Pabst) Luer	1	0	0	0	0	0	0	0	0
	Anathallis malmeana (Dutra ex Pabst) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Anathallis microblephara (Schltr.) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Anathallis pabstii (Garay) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Anathallis petersiana (Schltr.) Priedgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Anathallis stictophylla (Schltr.) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Anathallis ypirangae (Kraenzl.) Pridgeon & M.W.Chase	1	0	0	0	0	0	0	0	0
	Baptistonia leinigii (Pabst) Chiron & V.P.Castro	1	0	0	0	0	0	0	0	0
	Baptistonia riograndensis (Cogn.) Chiron & V.P.Castro	1	0	0	0	0	0	0	0	0
	Bipinnula ctenopetala Schltr.	0	0	0	0	0	0			0
	Brachystele bicrinita Szlach.	0	0	1	0	0	0	0	0	0
	Brachystele scabrilingua Szlach.									
	Capanemia paranaensis Schltr.									
	Capanemia riograndensis Pabst	1	0	0	0	0	0	0	0	0
	Capanemia spathuliglossa Pabst	1	0	0	0	0	0	0	0	0
	Catasetum triodon Rchb.f.	0	0	0	0	1	0	0	0	0
	Codonorchis canisioi Mansf.	0	1	0	0	0	0	0	0	0
	Constantia australis (Cogn.) Porto & Brade	1	0	0	0	0	0	0	0	0
	Coppensia pontagrossensis (Campacci) Campacci	0	0	0	0	0	0	0	0	1
	Cyclopogon alexandrae (Kraenzl.) Schltr.	0	0	0	0	1	0	0	0	0
	Cyclopogon dusenii Schltr.	0	0	0	0	1	0	0	0	0
	Cyclopogon hatschbachii Schltr.	1	0	0	0	0	0	0	0	0
	Cyclopogon trifasciatus Schltr.	0	0	0	0	1	0	0	0	0
	Cyclopogon vittatus Dutra ex Pabst	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Cyrtopodium brandonianum subsp. *lageanum* J.A.N.Bat. & Bianch.	0	0	1	0	0	0	0	0	0
	Cyrtopodium kleinii J.A.N.Bat. & Bianch.	0	0	1	0	0	0	0	0	0
	Cyrtopodium witeckii L.C.Menezes	0	0	0	0	0	0	1	0	0
	Epidendrum pseudavicula Kraenzl.	0	0	1	0	0	0	0	0	1
	Eurystyles splendissima Szlach.									
	Gomesa paranaensis Kraenzl.	1	0	0	0	0	0	0	0	0
	Grobya fascifera Rchb.f.	1	0	0	0	1	0	0	0	0
	Grobya guieselii F.Barros & Lourenço	1	0	0	0	0	0	0	0	0
	Habenaria crassipes Schltr.	0	0	1	1	0	0	0	0	0
	Habenaria dutraei Schltr.	0	0	1	0	0	0	0	0	0
	Habenaria macrodactyla Kraenzl.	0	0	0	0	0	0	0	0	1
	Habenaria piraquarensis Hoehne	0	0	0	1	0	0	0	0	0
	Habenaria schnittmeyeri Schltr.	0	0	1	0	0	0	0	0	0
	Habenaria ulaei Cogn.	0	0	1	0	0	0	0	0	0
	Hapalorchis stellaris Szlach.	0	0	0	0	0	0	0	1	0
	Malaxis pabstii (Schltr.) Pabst									
	Maxillaria binotii De Wild.									
	Octomeria caetensis Pabst	1	0	0	0	0	0	0	0	0
	Octomeria fibrifera Schltr.	1	0	0	0	0	0	0	0	0
	Octomeria rhodoglossa Schltr.									
	Octomeria riograndensis Schltr.	1	0	0	0	0	0	0	0	0
	Octomeria rohrii Pabst	1	0	0	0	1	0	0	0	0
	Octomeria sancti-angeli Kraenzl.	1	0	0	0	0	0	0	0	0
	Octomeria unguiculata Schltr.	1	0	0	0	0	0	0	0	0
	Ornithocephalus brachystachyus Schltr.	1	0	0	0	0	0	0	0	0
	Pabstiella mirabilis (Schltr.) Brieger & Senghas	1	0	0	0	0	0	0	0	0
	Pelexia burgeri Schltr.	0	0	1	0	0	0	0	0	0
	Pelexia gracilis Schltr.									
	Pelexia incurvidens Schltr.									
	Pelexia robusta (Kraenzl.) Schltr.	0	0	1	0	0	0	0	0	0
	Pelexia tenuior Schltr.	0	0	1	0	0	0	0	0	0
	Pleurobotryum albopurpureum (Kraenzl.) Pabst	0	0	0	0	1	0	0	0	0
	Pleurothallis ipyrangana Schltr.	0	0	0	0	1	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Pleurothallis vellozoana Schltr.	0	0	0	0	1	0	0	0	0
	Promenaea acuminata Schltr.	1	0	0	0	0	0	0	0	0
	Promenaea albescens Schltr.	1	0	0	0	0	0	0	0	0
	Promenaea catharinensis Schltr.	1	0	0	0	0	0	0	0	0
	Promenaea dusenii Schltr.	1	0	0	0	0	0	0	0	0
	Promenaea nigricans Königer & J.G.Weinm.bis									
	Promenaea paranaensis Schltr.	1	0	0	0	1	0	0	0	0
	Promenaea riograndensis Schltr.	1	0	0	0	1	0	0	0	0
	Prosthechea fausta (Rchb.f. ex Cogn.) W.E.Higgins	1	0	0	0	1	0	0	0	0
	Rodrigueziopsis eleutherosepala (Barb.Rodr.) Schltr.	1	0	0	0	1	0	0	0	0
	Rudolfiella lindmaniana (Kraenzl.) Hoehne									
	Sarcoglottis glaucescens Schltr.	0	0	1	0	0	0	0	0	0
	Sarcoglottis juergensii Schltr.	0	0	1	0	0	0	0	0	0
	Specklinia bacillaris (Pabst) Luer	0	0	0	0	1	0	0	0	0
	Stelis aquinoana Schltr.	1	0	0	0	0	0	0	0	0
	Stelis pumila Pridgeon & M.W.Chase									
	Stelis reitzii Garay									
	Stigmatosema draculoides Szlach.	0	0	0	0	0	0	0	0	1
	Stigmatosema garayana Szlach.	0	0	1	0	0	0	0	0	0
	Stigmatosema hatschbachii (Pabst) Garay	0	0	1	0	0	0	0	0	0
	Triphora santamariensis Portalet	0	1	0	0	0	0	0	0	0
	Veyretia undulata Szlach.	0	0	1	0	0	0	0	0	0
	Zygostates dasyrhiza (Kraenzl.) Schltr.	1	0	0	0	1	0	0	0	0
	Zygostates pustulata (Kraenzl.) Schltr.	1	0	0	0	0	0	0	0	0
OROBANCHACEAE	*Velloziella westermanii* Dusén	0	0	0	1	0	0	0	0	0
OXALIDACEAE	*Oxalis bifrons* subsp. *littoralis* Lourteig	0	0	0	0	0	1	0	0	0
	Oxalis bisecta Norlind	0	0	1	0	0	0	0	0	0
	Oxalis hepatica Norlind	0	0	1	0	1	0	0	0	0
	Oxalis irreperta Lourteig	0	0	1	0	1	0	0	0	0
	Oxalis neuwiedii subsp. *pardoensis* Lourteig	0	0	1	0	1	0	0	0	0
	Oxalis odonellii Lourteig	0	0	1	0	1	0	0	0	0
	Oxalis paranaensis Lourteig	1	0	0	0	1	0	0	0	0
	Oxalis praetexta Progel	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Oxalis rhombeo-ovata subsp. *sustenta* Lourteig	0	1	0	0	1	0	0	0	0
	Oxalis sarmentosa Zucc.	0	0	1	0	1	0	0	0	0
	Oxalis serpens var. *catharinensis* Lourteig	0	0	1	0	1	0	0	0	0
	Oxalis serpens A.St.-Hil. var. *serpens*	0	0	1	0	1	0	0	0	0
	Oxalis telmatica Lourteig	1	0	1	0	0	0	0	0	0
PASSIFLORACEAE	*Passiflora catharinensis* Sacco	1	0	0	0	0	0	0	0	0
	Passiflora reitzii Sacco	1	0	0	0	0	0	0	0	0
	Passiflora urubiciensis Cervi	1	0	0	0	0	0	0	0	0
PICRAMNIACEAE	*Picramnia excelsa* Kuhlm. ex Pirani	0	0	0	0	1	0	0	0	0
PIPERACEAE	*Peperomia ibiramana* Yunck.	1	0	0	0	0	0	0	0	0
	Peperomia lyman-smithii Yunck. var. *lyman-smithii*	1	0	0	0	0	0	0	0	0
	Peperomia lyman-smithii var. *macrophylla* Yunck.	1	0	0	0	0	0	0	0	0
	Peperomia morungavana Yunck.	1	0	0	0	0	0	0	0	0
	Peperomia nudifolia C.DC.	1	0	0	0	0	0	0	0	0
	Peperomia pseudobcordata Yunck.	1	0	0	0	0	0	0	0	0
	Peperomia ramboi Yunck.	1	0	0	0	0	0	0	0	0
	Peperomia renifolia Dahlst.	1	0	0	0	0	0	0	0	0
	Peperomia retivenulosa Yunck.	1	0	0	0	0	0	0	0	0
	Peperomia schenkiana Dahlst.	1	0	0	0	0	0	0	0	0
	Peperomia subemarginata Yunck.	1	0	0	0	0	0	0	0	0
	Piper hatschbachii Yunck.	1	0	0	0	0	0	0	0	0
	Piper kleinii Yunck.	1	0	0	0	0	0	0	0	0
	Piper ulei C.DC.	1	0	0	0	0	0	0	0	0
PLANTAGINACEAE	*Mecardonia pubescens* Rossow	0	0	1	0	0	0	0	0	0
	Plantago turficola Rahn	0	0	1	0	0	0	0	0	0
	Scoparia elliptica Cham.	1	0	1	1	0	0	0	0	0
	Scoparia pinnatifida Cham.	0	0	1	0	0	0	0	0	0
POACEAE	*Agrostis ramboi* Parodi	0	0	1	0	0	0	0	0	0
	Andropogon barretoi Norrmann & Quarín	0	0	0	0	0	0	1	0	0
	Aristida riograndensis Severo & Boldrini	0	0	0	0	0	0	0	1	0
	Aulonemia ulei (Hack.) McClure & L.B.Sm.	0	0	1	0	0	0	0	0	0
	Bothriochloa velutina M.Marchi & Longhi-Wagner	0	0	1	0	0	0	0	0	0
	Briza brachychaete Ekman	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Briza scabra (Nees ex Steud.) Ekman	0	0	1	0	0	0	1	0	0
	Calamagrostis longiaristata var. *minor* Kämpf	0	0	1	0	0	0	0	0	0
	Calamagrostis reitzii Swallen	0	0	1	0	0	0	0	0	0
	Chusquea bambusoides var. *minor* McClure & L.B.Sm.	1	1	0	0	0	0	0	0	0
	Chusquea gracilis McClure & L.B.Sm.	0	0	0	0	1	0	0	0	0
	Chusquea hatschbachii L.G.Clark & Blong	0	0	1	0	0	0	0	0	0
	Chusquea mimosa subsp. *australis* L.G.Clark	0	0	1	0	1	0	0	0	0
	Chusquea mimosa McClure & L.B.Sm. subsp. *mimosa*	0	0	1	0	1	0	0	0	0
	Chusquea nudiramea L.G.Clark	1	0	1	0	0	0	0	0	0
	Chusquea tenella var. *latifolia* Dutra	0	1	0	0	0	0	0	0	0
	Chusquea windischii L.G.Clark	0	0	1	0	0	0	0	0	0
	Digitaria connivens var. *pilosa* Canto-Dorow & Longhi-Wagner	0	0	0	0	0	1	0	0	0
	Digitaria myriostachya (Hack.) Henrard	0	0	0	0	0	1	0	0	0
	Digitaria purpurea Swallen	0	0	1	0	0	0	0	0	0
	Eustachys paranensis A.M.Molina	0	0	1	0	0	0	0	0	0
	Melica riograndensis Longhi-Wagner & Valls	0	0	0	0	0	0	1	0	0
	Melica spartinoides L.B.Sm.	0	0	1	0	0	0	0	0	0
	Merostachys ciliata McClure & L.B.Sm.	0	1	0	0	0	0	0	0	0
	Merostachys glauca McClure & L.B.Sm.	0	1	0	0	0	0	0	0	0
	Merostachys kleinii Send.	0	1	0	0	0	0	0	0	0
	Merostachys pilifera Send.	0	0	0	0	1	0	0	0	0
	Merostachys vestita McClure & L.B.Sm.	0	0	0	0	1	0	0	0	0
	Panicum bresolinii L.B.Sm. & Wassh.	1	0	0	0	0	1	0	0	0
	Panicum magnispicula Zuloaga, Morrone & Valls	0	0	1	0	0	0	0	0	0
	Paspalum barretoi Canto-Dorow, Valls & Longhi-Wagner	0	0	1	0	0	0	0	0	0
	Paspalum filifolium Nees ex Steud.	0	0	1	1	0	0	0	0	0
	Paspalum laurentii R.C.Oliveira & Valls	0	0	0	0	0	0	0	1	0
	Paspalum ramboi I.L.Barreto	0	0	1	0	0	0	0	0	0
	Paspalum redondense Swallen	0	0	1	0	0	0	0	0	0
	Piptochaetium alpinum L.B.Sm.	0	0	1	0	0	0	0	0	0
	Piptochaetium palustre Muj.-Sall. & Longhi-Wagner	0	0	1	0	0	0	0	0	0
	Poa reitzii Swallen	0	0	1	0	0	0	0	0	0
	Poa umbrosa Trin.	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Sporobolus nudiramus Boechat & Longhi-Wagner	0	0	0	0	0	0	0	0	1
	Stipa brasiliensis A.Zanin & Longhi-Wagner	0	0	1	0	0	0	0	0	0
	Stipa planaltina A.Zanin & Longhi-Wagner	0	0	1	0	0	0	0	0	0
	Stipa rhizomata A.Zanin & Longhi-Wagner	0	0	1	0	0	0	0	0	0
	Stipa vallsii A.Zanin & Longhi-Wagner	0	0	1	0	0	0	0	0	0
	Thrasyopsis juergensii (Hack.) Soderstr. & A.G. Burm.	0	0	1	0	0	0	0	0	0
	Tridens riograndensis Acedo & Llamas	0	0	0	0	0	0	1	0	0
	Trisetum juergensii Hack.	0	0	1	0	0	0	0	0	0
PODOSTEMACEAE	*Podostemum irgangii* C.T.Philbrick & Novelo	0	0	0	0	1	0	0	0	0
	Wettsteiniola pinnata Suess.	0	1	0	0	0	0	0	0	0
POLYGALACEAE	*Monnina itapoanensis* F.M.S.Vianna & Marques	0	0	0	0	0	1	0	0	0
	Polygala altomontana Lüdtke, Boldrini & Miotto	0	0	1	0	0	0	0	0	0
	Polygala densiracemosa Lüdtke & Miotto	0	0	1	0	0	0	0	0	0
	Polygala riograndensis Lüdtke & Miotto	0	0	0	0	0	0	0	1	0
	Polygala subverticillata Chodat	1	0	1	0	0	0	0	0	0
POLYGONACEAE	*Rumex sellowianus* Rech.f.	0	0	1	0	0	0	0	0	0
	Ruprechtia paranensis Pendry	1	1	0	0	0	0	0	0	0
PORTULACACEAE	*Portulaca diegoi* Mattos	0	0	1	0	0	0	0	0	0
	Portulaca hatschbachii D.Legrand	0	0	1	0	0	0	0	0	0
PRIMULACEAE	*Ardisia catharinensis* Mez	1	0	0	0	0	0	0	0	0
	Myrsine altomontana M.F.Freitas & Kin.-Gouv.	1	0	0	0	0	0	0	0	0
	Stylogyne dusenii Ricketson & Pipoly	1	0	0	0	0	0	0	0	0
PROTEACEAE	*Euplassa nebularis* Rambo & Sleumer	1	0	0	0	0	0	0	0	0
	Roupala asplenioides Sleumer	1	0	1	0	0	0	0	0	0
	Roupala pallida K.Schum.	0	0	0	0	0	1	0	0	0
RANUNCULACEAE	*Ranunculus catharinensis* Lourteig	0	0	1	0	0	0	0	0	0
ROSACEAE	*Agrimonia hirsuta* Bong. ex. C.A.Mey.	0	0	0	0	1	0	0	0	0
RUBIACEAE	*Coccocypselum pulchellum* Cham.	0	0	0	0	1	0	0	0	0
	Galianthe elegans E.L.Cabral	0	0	1	0	0	0	0	0	0
	Galianthe gertii E.L.Cabral	0	0	0	1	0	0	0	0	0
	Galianthe latistipula E.L.Cabral	0	0	1	0	0	0	0	0	0
	Galianthe reitzii E.L.Cabral	0	0	1	0	0	0	0	0	0
	Galianthe verbenoides (Cham. & Schltdl.) Griseb.	0	0	1	0	0	0	0	1	1

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Galium hatschbachii Dempster	0	0	1	0	0	0	0	0	0
	Galium muelleri (K.Schum.) Dempster	0	0	0	0	1	0	0	0	0
	Galium ramboi Dempster	0	0	1	0	0	0	0	0	0
	Galium rubidiflorum Dempster	0	0	1	0	0	0	0	0	0
	Galium smithreitzii Dempster	0	0	1	0	0	0	0	0	0
	Manettia paranensis Standl.	1	0	1	0	0	0	0	0	0
	Oldenlandia dusenii Standl.	0	0	1	0	0	0	0	0	0
	Palicourea australis C.M.Taylor	0	0	0	0	1	0	0	0	0
	Psychotria fractistipula L.B.Sm., R.M.Klein & Delprete	1	1	0	0	1	0	0	0	0
	Relbunium humilioides M.L.Porto & Ehrend.	0	0	0	0	1	0	0	0	0
	Relbunium longipedunculatum Mariath & Ehrend.	0	0	1	0	1	0	0	0	0
	Rudgea nivosa André									
RUTACEAE	*Raulinoa echinata* R.S.Cowan	1	0	0	0	0	0	0	0	0
	Zanthoxylum kleinii (R.S.Cowan) P.G.Waterman	0	0	0	0	1	0	0	0	0
SANTALACEAE	*Arjona megapotamica* Malme	0	0	1	0	0	0	0	1	0
	Phoradendron pachyneuron Kuijt	1	0	0	0	0	0	0	0	0
SAPINDACEAE	*Serjania decemstriata* Radlk.	1	0	0	0	0	0	0	0	0
	Serjania paranensis Ferrucci & Acev.-Rodr.	0	1	0	0	0	0	0	0	0
	Serjania punctulata Radlk.	0	1	0	0	0	0	0	0	0
	Serjania unidentata Acev.-Rodr.	1	0	1	0	0	0	0	0	0
SCROPHULARIACEAE	*Buddleja cestriflora* Cham.	0	0	1	0	0	0	0	0	0
	Buddleja cuneata Cham.	0	0	1	0	0	0	0	0	0
	Buddleja hatschbachii E.M.Norman & L.B.Sm.	0	0	1	0	0	0	0	0	0
	Buddleja kleinii E.M.Norman & L.B.Sm.	0	0	1	0	0	0	0	0	0
	Buddleja ramboi L.B.Sm.	0	0	1	0	0	0	0	0	0
SOLANACEAE	*Calibrachoa cordifolia* Stehmann & L.W.Aguiar	0	0	1	0	0	0	0	0	0
	Calibrachoa dusenii (R.E.Fr.) Stehmann & Semir	0	0	1	0	0	0	0	0	0
	Calibrachoa eglandulata Stehmann & Semir	0	0	1	0	1	0	0	0	0
	Calibrachoa ericifolia (R.E.Fr.) Wijsman	0	0	1	0	0	0	0	0	1
	Calibrachoa sellowiana (Sendtn.) Wijsman	0	0	1	0	0	0	0	0	0
	Calibrachoa sendtneriana (R.E.Fr.) Stehmann & Semir	0	0	1	0	0	0	0	0	0
	Calibrachoa serrulata (L.B.Sm. & Downs) Stehmann & Semir	0	0	1	0	0	0	0	0	0
	Calibrachoa spathulata (L.B.Sm. & Downs) Stehmann & Semir	0	0	1	0	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Nicotiana azambujae L.B.Sm. & Downs	1	0	0	0	0	0	0	0	0
	Nicotiana forgetiana Hort.Sand. ex Hemsl.	1	0	0	0	1	0	0	0	0
	Nicotiana mutabilis Stehmann & Semir	1	0	0	0	0	0	0	0	0
	Nierembergia hatschbachii A.A.Cocucci & Hunz.	0	0	1	0	0	0	0	0	0
	Nierembergia riograndensis Hunz. & A.A.Cocucci	0	0	0	0	0	0	1	1	0
	Petunia altiplana T.Ando & Hashim.	0	0	1	0	1	0	0	0	0
	Petunia bajeensis T.Ando & Hashim.	0	0	0	0	0	0	1	0	0
	Petunia bonjardinensis T.Ando & Hashim.	0	0	1	0	1	0	0	0	0
	Petunia exserta Stehmann	0	0	0	0	0	0	0	1	0
	Petunia reitzii L.B.Sm. & Downs	0	0	1	0	1	0	0	0	0
	Petunia saxicola L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Petunia scheideana L.B.Sm. & Downs	1	0	1	0	1	0	0	0	0
	Petunia secreta Stehmann & Semir	0	0	0	0	0	0	0	1	0
	Solanum alatirameum Bitter	1	0	0	0	0	0	0	0	0
	Solanum aparadense L.A.Mentz & M.Nee	0	0	0	0	1	0	0	0	0
	Solanum bistellatum L.B.Sm. & Downs	1	0	0	0	0	0	0	0	0
	Solanum gertii S.Knapp	1	0	0	0	0	0	0	0	0
	Solanum matadori L.B.Sm. & Downs	1	0	0	0	1	0	0	0	0
	Solanum paranense Dusén	1	1	0	0	1	0	0	0	0
	Solanum pelagicum Bohs	1	0	0	0	0	1	0	0	0
	Solanum reineckii Briq.	0	0	1	0	0	1	0	0	0
	Solanum reitzii L.B.Sm. & Downs	1	1	0	0	1	0	0	0	0
	Solanum setosissimum Bitter ex L.A.Mentz & M.Nee	1	0	0	0	1	0	0	0	0
	Solanum subhastatum L.B.Sm. & Downs	0	0	0	0	1	0	0	0	0
	Solanum viscosissimum Sendth.	0	0	0	0	1	0	0	0	0
SYMPLOCACEAE	*Symplocos bidana* Aranha	1	0	0	0	0	0	0	0	0
	Symplocos incrassata Aranha	1	0	0	0	0	0	0	0	0
THYMELAEACEAE	*Daphnopsis pseudosalix* Domke	1	0	0	0	0	0	0	0	0
TROPAEOLACEAE	*Tropaeolum pentaphyllum* subsp. *megapetaloides* Sparre	0	0	0	0	1	0	0	0	0
	Tropaeolum sanctae-catharinae Sparre	1	0	0	0	0	0	0	0	0
URTICACEAE	*Pilea aparadensis* P.Brack	0	0	1	0	1	0	0	0	0
	Pilea flammula P.Brack	0	1	1	0	1	0	0	0	0
	Pilea hydra P.Brack	0	1	1	0	1	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
VALERIANACEAE	*Valeriana bornmuelleri* Pilg.	0	0	1	0	0	0	0	0	0
	Valeriana catharinensis Graebn.	0	0	1	1	0	0	0	0	0
	Valeriana chamaedryfolia Cham. & Schltdl.	0	0	1	0	0	0	0	0	0
	Valeriana eichleriana (Muell.) Graebn.	0	0	1	0	0	0	0	0	0
	Valeriana eupatoria Sobral	0	0	1	0	1	0	0	0	0
	Valeriana glechomifolia F.G.Mey.	0	0	1	0	0	0	0	0	0
	Valeriana muelleri Graebn.	0	0	1	0	0	0	0	0	0
	Valeriana tajuvensis Sobral	1	0	1	0	0	0	0	0	0
	Valeriana ulei Graebn.	0	0	1	1	0	0	0	0	0
VERBENACEAE	*Aloysia brasiliensis* Moldenke	0	0	0	0	1	0	0	0	0
	Aloysia dusenii Moldenke	0	1	0	0	1	0	0	0	0
	Aloysia hatschbachii Moldenke	0	0	1	0	1	0	0	0	0
	Aloysia polygalifolia Cham.	1	1	0	0	1	0	0	0	0
	Glandularia catharinae (Moldenke) N.O'Leary & P.Peralta	0	0	1	0	0	0	0	0	0
	Glandularia dusenii (Moldenke) N.O'Leary & P.Peralta	0	0	1	0	0	0	0	0	0
	Glandularia guaibensis P.Peralta & Thode	0	0	0	0	0	1	0	0	0
	Glandularia hatschbachii (Moldenke) N.O'Leary & P.Peralta	0	0	1	0	0	0	0	0	0
	Glandularia humifusa (Cham.) Botta	0	0	1	0	0	0	0	1	0
	Glandularia lobata var. *glabrata* (Moldenke) P.Peralta & Thode	0	0	1	0	0	0	1	0	0
	Glandularia rectiloba (Moldenke) P.Peralta & Thode	0	0	0	0	0	0	1	0	0
	Glandularia tessmannii (Moldenke) P.Peralta & Thode	0	0	1	0	0	1	0	0	0
	Lippia campestris Moldenke	0	0	0	0	0	0	0	0	1
	Lippia paranensis (Moldenke) T.R.S. Silva & Salimena	0	0	1	0	0	0	0	0	0
	Lippia ramboi Moldenke	0	0	1	0	0	0	0	1	0
	Verbena caniuensis Moldenke	0	0	1	0	0	0	0	0	0
	Verbena subpetiolata N.O'Leary	0	0	1	0	0	0	0	0	0
	Verbenoxylum reitzii (Moldenke) Tronc.	1	0	0	0	0	0	0	0	0
VOCHYSIACEAE	*Callisthene inundata* O.L.Bueno, A.D.Nilson & R.G.Magalh.	0	1	0	0	0	0	0	0	0
WINTERACEAE	*Drimys angustifolia* Miers	1	0	0	0	1	0	0	0	0
XYRIDACEAE	*Xyris dissitifolia* Kral & Wand.	0	0	1	0	0	0	0	0	0
	Xyris hatschbachii L.B.Sm. & Downs	0	0	1	0	0	0	0	0	0
	Xyris lucida Malme	0	0	0	1	0	0	0	0	0
	Xyris piraquarae L.B.Sm. & Downs	0	0	0	1	0	0	0	0	0

Families	Species list	TRF	SSF	SHG	HTG	SMF	TCS	LTG	TES	TRS
	Xyris reitzii L.B.Sm. & Downs	0	0	1	1	0	0	0	0	0

ARTIGO II

Adesmia sessilifolia (Leguminosae), a new species from a relictual landscape in Southern Brazil

Artigo publicado no periódico *Phytotaxa* 26: 21-24, 2011.

Adesmia sessilifolia (Leguminosae), a new species from a relictual landscape in Southern Brazil[1]

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Abstract

In the context of a taxonomic study of *Adesmia* ser. *Psoraleoides*, an endemic group from southern Brazilian grasslands, the new species *Adesmia sessilifolia* was discovered. The species occurs in a restricted area which represents relictual connections in geomorphology within the southern Brazilian highlands. *Adesmia sessilifolia* resembles *A. paranensis* by having glabrous branches and leaves, pilose inflorescences, and seeds with arils, but differs in size and in the sessile leaves with apparent nerves in both surfaces, as well as by flowering and fruiting periods and geographic distribution. Descriptions and illustrations are provided together with a key for identification of the species of *Adesmia* ser. *Psoraleoides*.

Key words. *Adesmia* ser. *Psoraleoides*, Fabaceae, grasslands, taxonomy.

Introduction

The genus *Adesmia* DC. was circumscribed in the monogeneric tribe Adesmieae (Polhill 1981a), based on diagnostic characters such as the free filaments of stamens and lomentaceous pods. The genus was in an isolated position, distant from the tribe Dalbergieae (*sensu* Polhill 1981b). However, the most recent circumscription of Dalbergieae *s.l.*, based on molecular analysis and morphological data, supports the Adesmia clade containing the genera *Adesmia*, *Amicia* Kunth, *Zornia* J.F. Gmel., *Poiretia* Vent., *Nissolia* Jacq. and *Chaetocalyx* DC., about 360 species in total, as a sister to the Pterocarpus and Dalbergia clades (Lavin *et al*. 2001, Klitgaard & Lavin 2005). The Adesmia clade is defined by the following synapomorphies: presence of herbaceous species (modified in same taxa), leaves with few opposite leaflets and pedicel confluent with the calyx (modified only in some species of *Nissolia*) (Lavin *et al*. 2001).

The genus *Adesmia* is endemic to South America, comprises about 230 species, and is widespread in Central Chile, South and West Argentina, extending through the Andean valleys to Bolivia and Southern Peru, as well as Uruguay and Southern Brazil (Burkart 1967). The basal *Adesmia* lineages contain the high-Andes and temperate species, with estimated divergence time around 34.5 ± 2.4 Mya (Schrire *et al*. 2005). The temperate taxa from Southern hemisphere (as the Adesmia clade within Dalbergioid Legumes) probably had a secondary diversification through the grass biome in tropical regions, occupying tropical areas mainly in higher altitudes (Schrire *l.c.*).

In Southern Brazil, the genus *Adesmia* is represented by 17 species, belonging to subgenus *Adesmia* and divided into four series: *Muricatae* Burkart, *Subnudae* Burkart, *Bicolores* Burkart and *Psoraleoides* Burkart (Miotto 1993, Miotto & Leitão Filho 1993).

Adesmia ser. *Psoraleoides* comprises eleven species with distribution restricted to the highlands of Southern Brazil, mainly in patches of grasslands and rock outcrops amongst forests dominated by *Araucaria angustifolia* (Bertol.) Kuntze (Miotto & Leitão Filho 1993, Miotto & Waechter 1996). The species are characterized by being perennial herbs, shrubs and subshrubs, with pinnate leaves, fruit a plane hemicraspedium, with persistent semireplum and several ovules, and seeds with developed aril in most species.

Key to species of *Adesmia* ser. *Psoraleoides*

1.Slightly lignified plants, subshrubs and shrubs.

2.Pedicels erect, even during the fruiting. Leaflets 1.6-5.0 x 0.6-2.2 mm, generally conduplicate ……………………..…………...........………….……………………. *A. tristis*

2'.Pedicels reflex after anthesis. Leaflets 6.0-20.0 x 2.1-10.0 mm, generally flat.

3.Branches and leaves glabrous, only the inflorescences pubescent.

4. Plants up to 35 cm tall; leaflets 10-13 x 5-8 mm, pinnately nerved ……………………………...…...………………………….. *A. sessilifolia*

4'. Plants 70-90 cm tall; leaflets 5.5-15 x 2-4.8 mm, single-nerved ……………………………………………………...…… *A. paranensis*

3'.Branches, leaves and inflorescences pubescent.

5.Inflorescences lax; flowers 7-9(-10) mm length …...….. *A. rocinhensis*

5’.Inflorescences dense; flowers 14-19.5 mm length.

6.Plants with leaf scars prominent and persistent stipules; short racemes, corymbose, aril absent ...………….………. *A. reitziana*

6’.Plants without leaf scars; long racemes, seeds with developed aril ……………………………..…..…………. *A. psoraleoides*

1’.Herbaceous plants, erect, ascending, decumbent, procumbent to prostrate.

7.Axillary flowers at the base of racemes ……..………..…………….. *A. araujoi*

7’.Racemes or panicles without axillary flowers.

8.Leaflets broadly elliptic, suborbicular or obovate, 3.0-7.0 mm wide.

9.Leaves with 2-4(-5) pairs of leaflets. Pedicels 6.5-7.5 mm length. Hemicraspedium with 2-4(-5) orbicular articles …......………..….. *A. valsii*

9’.Leaves with (3-4-)5-8(-9) pairs of leaflets. Pedicels 1.5-5.0 mm length. Hemicraspedium with (2-3-)4-7 subquadrangular articles ……….. *A. sulina*

8’.Leaflets elliptic, oblong, obovate or rarely ovate, 0.7-2.8(-4.0) mm wide.

10.Hemicraspedium with articles 2.5-3.5 mm long and 1.6-3.3 mm wide. Seeds with very short aril …..…..…………………...…………... *A. ciliata*

10’.Hemicraspedium with articles 3.5-4.8 mm long and 2.7-3.5 mm wide. Seeds with well-developed aril …..……..……………………….. *A. arillata*

Adesmia sessilifolia **Iganci & Miotto, *sp. nov.* (Figure 1)**

Ad Adesmia ser. Psoraleoides pertinens, A. paranensis Burkart similis, sed foliis sessili (non longi petiolata), foliola ovate-lanceolate (non oblongis), visibilibus venis ramosis (vs. mediana visibilibus sola) et 35 cm alta (vs. 70-90 cm alta) differt.

Type:–Brazil Rio Grande do Sul, São Francisco de Assis, em campo, 16.I.1991, fl. and fr., *Z. Machado 1236* (holotype ICN; isotype K).

Small and ramose shrublets, up to 35 cm, perennial, with xylopodium, stems slightly lignified and branches glabrous except for brownish trichomes covering the inflorescences. Leaves paripinnate, sessile, 6-8 pairs of leaflets; leaflets ovate-lanceolate, 10-13x5-8 mm, obtuse and mucronate at the apex, both surfaces completely glabrous, chartaceous, glands absent, primary and secondary nerves pronounced. Stipules lanceolate, 4 mm long. Short racemes, few-flowered, 4-9 cm long; bracts 5-6 mm long, triangular to lanceolate; pedicels 2-5 mm long, initially erects, curved after anthesis. Flowers yellow, 10-14 mm long; calyx 8-9 mm long, pubescent, campanulate, teeth 5, these 6-7 mm long; banner 9-11x10-14 mm, ovate to suborbicular, glabrous; wings 10-12 mm long, glabrous; keel 10-12 mm length, glabrous; stamens 10, filaments free; ovary 6-7 mm long, sessile, sericeous, style 8 mm long, stigma punctiform. Fruit type hemicraspedia, dark brown, with 4-6 articles, subquadrangular, 4x4 mm. Seeds subdeltoid, 2 mm in diameter, with a developed dark brown aril.

Distribution: Brazil: Rio Grande do Sul. *Adesmia sessilifolia* occurs in central-western of Rio Grande do Sul state, in grasslands above outcrops of basalt close to sandy soils.

Etymology: Refers to the morphology of the sessile leaves.

Additional specimens examined (paratypes): Brazil, Rio Grande do Sul: Santiago, litossolo sobre basalto, 23.III.1991, fr., J.F.M. Valls, Gomes, Moraes & Oliveira 12864 (ICN, CEN); Quevedos, estrada Jarí-Quevedos., 9.XII.2004, fl. and fr., S. Bordignon, R, Cancelli & R. Backes s.n. (ICN).

Discussion: *Adesmia sessilifolia* is similar to *A. paranensis* by having branches and leaves glabrous, pilose inflorescence and seeds with developed dark brown aril, but it differs in the size (up to 35 cm) of the leaflets, by having sessile leaves with rounded leaflets with pronounced nerves on both surfaces. Flowers and fruits appear later in the summer (December to March), compared with *A. paranensis* (October to December - rare in February). In addition, *A. sessilifolia* differs in its geographic distribution, occurring in grassland on basaltic relicts in central-western of Rio Grande do Sul state, while *A. paranensis* is restricted to the core area of the fields on basalt, at higher altitudes, between 840 and 1300 m, in the states of Santa Catarina and Parana.

Acknowledgments

The authors would like to thank Dr Bente Klitgaard for the valuable comments on the manuscript; CNPq and Capes for the financial support for research and grants.

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Illustrations

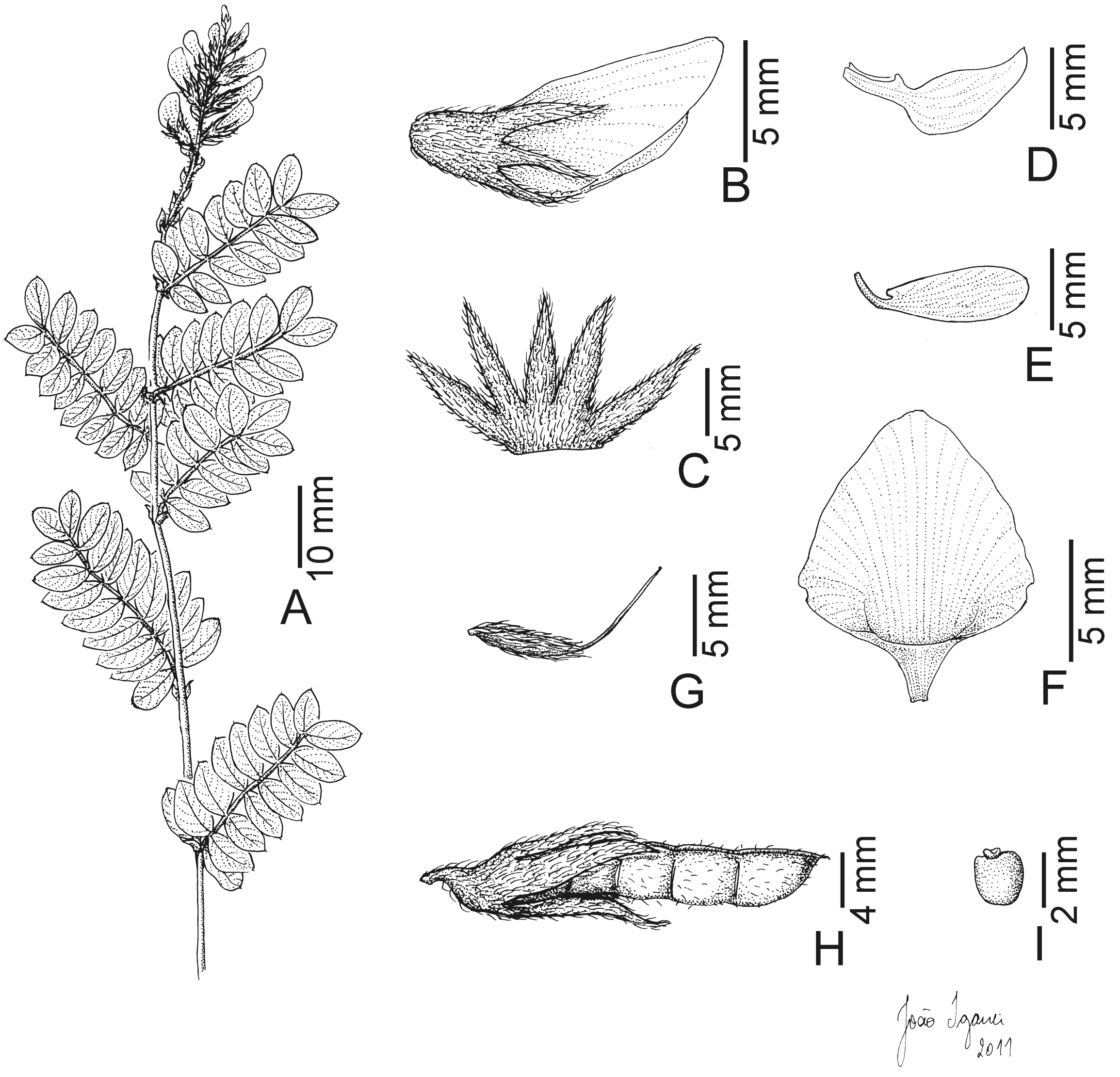

Figure 1. *Adesmia sessilifolia*. A. Branch. B. Flower. C. Calyx. D. Keel. E. Wing. F. Banner. G. Gynoecium. H. Pod. I. Seed. A-G from *Z. Machado 1236*, ICN; H-I from *Valls et al. 12864*, ICN, CEN. Drown by J.R.V. Iganci.

ARTIGO III

Diversification history of *Adesmia* ser. *Psoraleoides* (Leguminosae): evolutionary processes and the colonization of the southern Brazilian highland grasslands

Artigo a ser submetido para o periódico *American Journal of Botany*.

DIVERSIFICATION HISTORY OF *ADESMIA* SER. *PSORALEOIDES* (LEGUMINOSAE): EVOLUTIONARY PROCESSES AND THE COLONIZATION OF THE SOUTHERN BRAZILIAN HIGHLAND GRASSLANDS[1]

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Footnote Page

[1] Manuscript received _______; revision accepted _______.

The authors thank CAPES and CNPq for providing grants and post-graduate scholarship support, and M. Simon, H.C. de Lima and G. Heiden for comments and suggestions on the analyses and discussion of the manuscript.

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Abstract page

- *Premise of the study*: A molecular phylogeny of *Adesmia* ser. *Psoraleoides* is presented with the aim of analyzing its diversification history, and to infer about the evolutionary process of the genus in relation to the broader evolutionary events that guided the transformations over time and led to the current vegetation patterns and landscapes in southern South America.
- *Methods*: All species of *Adesmia* ser. *Psoraleoides* were sampled, including multiple accesses for each species, plus other species of the genus covering all its geographic distribution range. The analyses were based on molecular phylogenetics of nuclear and plastid DNA data.
- *Key results*: It is possible to recognize *Adesmia* ser. *Psoraleoides* as a monophyletic group with good support, nested to the series *Bicolores*, *Muricatae*, *Subnudae*, *Longisetae* and *Candidae*. Most species within *A.* ser. *Psoraleoides* diversified around 5-3 Mya.
- *Conclusions*: Although *Adesmia* ser. *Psoraleoides* represents a recent lineage diversified over the southern Brazilian grasslands, it could be considered as a relictual lineage threatened by human land uses and climate changes.

Keywords: biogeography; Campos de Cima da Serra; dating analysis; Fabaceae; phylogeny.

INTRODUCTION

Integrative analyses concerning different biological disciplines and including a comprehensive knowledge of the timing and nature of climatic and geological events have been providing new perspectives on the evolutionary history of biomes (Byrne et al., 2008). Phylogenetic studies provide analytical sources of measuring how the evolutionary history presents a geographic structuring of lineages and how it fits a biogeographic scenario, which involve events of different ages that can be tested by calibrating phylogenies with a time dimension (Pennington and Dick, 2004; Pennington et al., 2006). The reintegration of historical evidences into phylogenetic studies provides new sources of data to explain the complex history of current scenarios and connects them to the evolutionary events that led to these patterns over the time (Donogue, 2008).

The "Campos de Cima da Serra" (CCS) is a subtropical grassland in the highlands of Southern Brazil. Though previously often considered as a single vegetation unit, including the more southerly and low altitude temperate pampas grasslands, known as "Campos Sulinos" (southern Grasslands), Iganci et al. (2011) made a strong case that the CCS is a distinct subtropical formation characterized by 25% plant species endemism.

This paper presents the first phylogenetic biogeographic study of the CCS grasslands, focusing on a clade of Leguminosae, *Adesmia* ser. *Psoraleoides*, that is comprised of species restricted to the CCS. The apparent affinities of the CCS flora with that of the Andes has been explored by several studies (Rambo, 1951, 1953, 1956; Smith, 1962; Safford, 1999, 2007; Iganci et al., 2011), but not in an explicitly phylogenetic context. Around one-third of the genera found in the southern Brazilian flora as a whole are related to lineages assumed to be temperate Austral-Antarctic and Andean in origin (Rambo, 1951, 1953, 1956; Smith, 1962;

Safford, 1999, 2007; Waechter, 2002; Iganci et al., 2011). Many authors have assumed that Eastern South American species in these groups are therefore secondary radiations of Andean and Austral-Antarctic (Rambo, 1953; Safford, 1999, 2007; Waechter, 2002). One aim of this paper is to test this scenario in a phylogenetic context for *Adesmia*, and also to examine the tempo of diversification for *Adesmia* ser. *Psoraleoides* in the CCS.

Recent circumscription of Dalbergieae s.l., based on molecular and morphological analysis supports an Adesmia clade as sister to the Pterocarpus and Dalbergia clades (Lavin et al., 2001; Klitgaard and Lavin, 2005). The Adesmia clade comprises the genera *Adesmia* DC., *Amicia* Kunth, *Zornia* J.F.Gmel., *Poiretia* Vent., *Nissolia* Jacq. and *Chaetocalyx* DC., and is defined by the presence of herbaceous species (modified in some taxa), leaves with few opposite leaflets and pedicel confluent with the calyx (except only in some species of *Nissolia*), as synapomorphies (Lavin et al., 2001). About 83% of the genera and 92% of the species in Adesmia clade are endemic to the New World, where most taxa grow in tropical biomes as for most of Dalbergioid legumes (Schrire et al., 2005). *Adesmia* comprises around 240 species, and is formally subdivided into two subgenera (*Adesmia* subgen. *Adesmia* and *A.* subgen. *Acanthadesmia* Burkart), and 43 series, based on morphological affinities (Burkart, 1967; Lewis et al., 2005). Most of its species are concentrated along the Andes spreading in temperate areas from north of Peru to "Tierra del Fuego", the southern tip of South America, and it is the most species-rich genus of Leguminosae from temperate South America (Burkart, 1967).

The northeast limit of *Adesmia* is in the CCS. Almost all eleven species of *Adesmia* ser. *Psoraleoides* Burkart are endemic to the CCS, growing mainly in patches of grasslands and rock outcrops amongst forests dominated by *Araucaria angustifolia* (Bertol.) Kuntze (Miotto and Leitão Filho, 1993; Miotto and Waechter, 1996; Iganci and Miotto, 2011). Given this endemism and that other species in *Adesmia* are found both in the Andes and more southern grasslands, *Adesmia* ser. *Psoraleoides* makes an excellent taxonomic group to study the biogeographic affinities of the CCS flora and its diversification.

Adesmia ser. *Psoraleioides* was described based on morphological traits (Burkart, 1967), being circumscribed by perennial herbs, shrubs and subshrubs; erect, ascending, decumbent, or prostrate, not stoloniferous; without spines; branches and pinnate leaves pubescent, viscous or glabrous. Racemes simple or frondose, elongated, or brief to subcorimbose. Flowers yellow with red-brownish nectar guides; ten free stamens with uniform anthers. Fruit a plane hemicraspedium, pluri-articulated, with persistent semireplum; articules muricate or pubescent; seeds with a developed aril in most species (Miotto and Leitão Filho, 1993). Even though those morphological characters as a whole have been considered as enough data to circumscribe the series, they are not synapomorphies and each one might be shared with species from other unrelated series (Burkart, 1967). The series comprises the following species: *Adesmia araujoi* Burkart, *A. arillata* Miotto, *A. ciliata* Vogel, *A. paranensis* Burkart, *A. psoraleoides* Burkart, *A. reitziana* Burkart, *A. rocinhensis* Burkart, *A. sessilifolia* Iganci & Miotto, *A. sulina* Miotto, *A. tristis* Vogel, and *A. vallsii* Miotto (Miotto and Leitão Filho, 1993; Iganci and Miotto, 2011).One aim of this study – a key prerequisite of the subsequent biogeographic analysis – is to evaluate the monophyly of *Adesmia* ser. *Psoraleoides* and how it relates to other species of *Adesmia* from other geographic areas.

Historical geologic and climate records give us an excellent scenario to discuss the evolutionary processes and the diversification occurred during Miocene and Pliocene in the southern South America. A global cooling process began after the Mid-Miocene climatic optimum, around 15 Mya, affecting the vegetation of dry open biomes in the Neotropics, as the suggested expansion of the Cerrado (Simon et al., 2009), and the high altitude grasslands (Antonelli et al., 2010), followed by subsequent contractions during wetter periods (Behling, 2002; Safford, 2007). Furthermore, beginning with the Miocene (~15 Mya), southern South American landscapes initiated to steer the current configuration of the Andean tectonic-magmatic belt (Donato et al., 2003). During the Middle and Late Miocene, four successive and extensive Atlantic marine transgressions, known as the Paranean Sea, flooded the central part of southern South America covering most of the lower areas around 12 Mya (Webb, 1995; Donato et al., 2003; Pérez-Losada et al., 2004). Thus, the area flooded by the Paranean Sea was succeeded by likewise widespread plains, extending from northern Patagonia northward, reaching central and northern Argentina, Uruguay, along the eastern slopes of the rising Andes of northern Bolivia, southern Peru and Venezuela, and also in the upper Amazon basin, and providing a new conspicuous habitat for plants and animals (Donato et al., 2003). At the same time (~13–11 Mya) the Drake Passage finished opening, separating South America from the Antarctic Peninsula, establishing the cool Circum-Antarctic Current, and initiating an ice sheet formation in West Antarctica and supporting a cooler and seasonal climate during the Middle Miocene (Kvasov and Verbitski, 1981; Donato et al., 2003).

Major floristic turnovers coincide with this process, leading to cooler, drier, and more seasonal climates in southern South America and forcing the evolution and distribution of its biota northward (Barreda et al., 2010). Subsequently a new Andean diastrophic phase, with marked ecological consequences that resulted in the extremely xeric conditions presently existing in the Central Cordillera of Argentina and Chile, and also affected the biota, installed the very arid and extreme climatic conditions prevalent in this area today (Donato et al., 2003). In agreement with the floristic evidence, land-mammal communities show a remarkable radiation of grazer species, in association with frugivorous, at this time, indicating the presence of both woodlands and grasslands, which were probably provided by a savannah (Pascual et al., 1996; Donato et al., 2003).

Those climate fluctuations during the Cenozoic (Neogene and Quaternary) also caused floristic changes in the Southern Brazilian vegetation, where the subtropical highland grasslands were colonized by both cool-temperate Andean and Austral-Antarctic taxa during cool-dry periods (Safford, 1999). In warmer, wetter ages, such as Pleistocene interglacials, more humid-adapted forests would have spread (Rambo, 1953; Smith, 1962; Behling, 2002; Safford, 2007). These processes drove the landscape and climatic evolution of South America, causing compositional changes on its flora and fauna, such as the processes of isolation and recolonization between higher and lower areas that can be estimated based on molecular phylogenetic and dating analysis (Pérez-Losada et al., 2004).

Time calibrated molecular phylogenies have been highlighted as important tools to test diversification hypothesis containing a strong temporal prediction, and contributing to the knowledge of evolutionary processes of species-rich biomes evolution (Pennington et al., 2006, 2010; Crisp and Cook, 2007; Simon et al., 2009; Antonelli and Sanmartín, 2011). Understanding the evolutionary history of biome-specific taxa, and estimating the diversification ages of single clades represented by biome-specific species, can provide means of inferring about the origins of the biome itself (Pennington et al., 2006).

Here we present a molecular phylogeny including all species of *Adesmia* ser. *Psoraleoides*, and multiple samples for most of species, plus specimens from all main geographic areas where the genus occurs. We aim to analyze the diversification history of *Adesmia* ser. *Psoraleoides*, providing a time frame for the diversification of major clades. We also infer about the evolutionary process in *Adesmia*, in relation to the broader evolutionary events that guided the transformations over time and led to the current vegetation patterns and landscapes in southern South America. We address the following questions: Is the *Adesmia* ser. *Psoraleoides* a natural, monophyletic group? Which is the sister group of *Adesmia* ser. *Psoraleoides* and where is it from? What can be inferred about the evolutionary history of the series in relation to the historical events that led to the present South American landscapes? What can be inferred about the evolutionary history of the Southern Brazilian highland grasslands (CCS), based on the evolution of *Adesmia* ser. *Psoraleoides*?

MATERIALS AND METHODS

Taxon sampling–In total, 53 accessions of *Adesmia* ser. *Psoraleoides*, representing all the eleven species of the series and completely covering its geographic range were sampled. In addition, accessions of 35 southern South American *Adesmia* species representing as much as possible of the whole geographic distribution of the genus were included. Twenty-one accessions representing the five other genera which comprise the Adesmia clade were used as outgroups. Combining different accessions were used to construct the matrices due limitations on amplification and sequencing for each DNA region. Plant material was mostly sampled from the wild (silica gel - dried leaves), and from cultivated specimens obtained from seeds collected in the wild and held in national collections, for few rare species which were not found in the field. Most collections were from the CCS, which covers 1.374.000 ha (Boldrini et al., 2009), reaching to around 1.800 m altitude on their eastern edge, covering the effusive rocks of the Serra Geral formation, between the latitude 24º52’11”S and 29º26’40”S and longitude 49º27’11”W and 53º43’51’’W (Iganci et al., 2011). The climate subtropical humid (Cfa) and temperate humid (Cfb) (Peel et al., 2007) and the average temperature between 12ºC (mean minimum temperature in July: 10ºC) and 18ºC (mean maximum temperature in January: 27ºC) (Behling, 2002; Almeida, 2009). Those issues are important to allow the species to reach the northern distribution of the genus *Adesmia* in Southern Brazil (Burkart, 1967). All collections plus georeferenced herbarium records for *Adesmia* ser. *Psoraleoides* were mapped using DIVA-GIS (Hijmans et al., 2004), and the most species rich areas were indicated. Taxa sampled, voucher information and GenBank accession numbers are listed in Appendix 1.

DNA extraction, amplifications and sequencing–Total DNA was isolated from 0.3 g of silica gel-dried leaf tissue using a modified CTAB extraction method (Doyle and Doyle, 1987). The molecular markers analyzed were the nuclear ribosomal 5.8S and flanking internal transcribed spacers –ITS1 and ITS2 (Delgado-Salinas et al., 1999), and three chloroplast (cpDNA) regions: the *trnK* intron including *matK* (Lavin et al., 2000, 2001, Wojciechowski et al., 2004), *rbcL* (Olmstead et al., 1992, Kajita et al., 2001), and *rps16* (Oxelman et al., 1997). Polymerase chain reaction (PCR) was conducted with a reaction volume of 25 µL containing ~20 ng of DNA template, 1xBuffer, 2 µM $MgCl_2$, 1 µM of each dNTP, 10 pmol of each primer and 1 U of *Taq* DNA Polymerase (CenBiot, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil). For *matK* amplifications it was also added 1 µL of DMSO and 1 µL of BSA. PCR conditions were as follow for *ITS*: 95ºC for 4 min, 35 cycles of 30 s at 94ºC, 30 s at 58ºC and 2 min at 72ºC, followed by a final extension of 7 min at 72ºC; *matK*: 95ºC for 4 min, 35 cycles of 30 s at 94ºC, 30 s at 50ºC and 2 min at 72ºC, followed by a final extension of 7 min at 72ºC; *rbcL*: 95ºC for 2 min, 30 cycles of 30 s at 95ºC, 30 s at 53ºC and 1:30 min at 72ºC, followed by a final extension of 7 min at 72ºC; *rps16*: 95ºC for 4 min, 35 cycles of 30 s at 94ºC, 30 s at 50ºC and 2 min at 72ºC, followed by a final extension of 7 min at 72ºC. PCR products were cleaned using exonuclease I and shrimp alkaline phosphatase (Exo/SAP) and sequenced using BigDye v.3.1 chemistry (Applied Biosystems, Warrington, UK). For the *matK* region, the samples were amplified in two parts and sequenced in eight reactions, using both the two outer and the two innermost primers for amplifying, and the same plus four internal primers for sequencing the whole fragment (see Lavin et al., 2000, 2001, for details). Consensus sequences from sequence strands were assembled using Sequencher (v. 3.1; GeneCodes Corp., Ann Arbor, Michigan, USA), and then imported to BioEdit (Hall, 1999) for manual editing. The few indels (insertions and deletions) within the matrices were treated as missing data due to the low phylogenetic information provided by them.

Phylogenetic analyses–All DNA regions were first analyzed independently (individual results on Tab. 1 and on SI1), and the cpDNA regions were concatenated in a single matrix since resulting trees showed no incongruent clades. Because of problems in PCR and sequencing of some accessions in some regions, the combined matrix comprised 29 accessions for which all data for all regions were available. This combined plastid DNA matrix was analyzed and the resultant phylogenetic trees compared with those arising from analysis of the *ITS* data. A single matrix containing both *ITS* and cpDNA data was also analyzed after consideration of incongruence between nuclear and plastid partitions. Because sampling across *Adesmia* and outgroups was widest in the *matK* dataset and because this locus has been used extensively for phylogenetic dating in legumes, a *matK*-only analysis was used to investigate *Adesmia* biogeography.

Parsimony analyses were conducted using the program PAUP* version 4.0b10 (Swofford, 2003). All the Maximum Parsimony (MP) analyses used a first step heuristic search with 1000 random addition replicates, tree bisection-reconnection (TBR) branch swapping and multrees on, with all character states unordered and equally weighted. A second stage search used all trees saved from the initial search, branch-swapped using TBR with multrees and steepest descent implemented, saving a maximum of 5000 most-parsimonious trees. Strict, 50% majority-rule and Adams consensus trees were calculated from all most parsimonious trees. Branch support was measured using MP bootstrap analysis with 1000 bootstraps replicates of new heuristic searches (TBR branch swapping, multrees and steepest descent implemented). Bayesian analyses were performed using MrBayes 3.1.2 (Ronquist and Huelsenbeck, 2003). The best-fit models of sequence evolution were chosen using the Akaike Information Criterion (AIC) implemented in the program Modeltest (Posada and Crandall, 1998). The GTR + G nucleotide substitution model was chosen for *matK* and cpDNA analyses, and TIM + G for *ITS* analysis. Bayesian analyses were initiated from random starting trees, in two independent runs of 10000000 generations and four chains. In each run, trees were sampled every 100 generations, log-likelihood scores were compared for convergence, and the first 25 % trees were discarded as burn-in. Then, 50 % majority-rule consensus and Bayesian posterior probabilities were generated for the resulting trees. Divergence times were estimated for *matK* dataset using a Bayesian MCMC analysis conducted in BEAST version 1.6.1 package (Drummond and Rambaut, 2007) under the uncorrelated lognormal relaxed molecular clock approach. The nucleotide substitution model for *matK* matched that used in Bayesian analysis. Divergence times within the Adesmia clade were based on an initial higher level family-wide dated phylogenetic study of a large *matK* data set, using 839 terminal taxa and 23 fossil constraints (Simon et al., 2009). In our study, three secondary calibration points were taken from dates inferred by Simon et al. (2009) and used for estimating divergence dates in BEAST using a normal distribution prior: the most recent common ancestor of *Adesmia* and *Chaetocalyx* (mean estimate of 40.9 Mya); the most recent common ancestor of *Poiretia* and *Zornia* (mean estimate of 23.3 Mya); and the most recent common ancestor of *Nissolia* and *Chaetocalyx* (mean estimate of 12.3 Mya). Three separate runs were set and 10,000,000 generations were performed, sampling every 100 generations. Results were accessed in Tracer version 1.4 (Drummond and Rambaut, 2007), and data from multiple runs were combined after exclusion of burn-in trees.

RESULTS AND DISCUSSION

Nuclear data–The alignment of *ITS* sequences included 49 terminal taxa, and 643 characters of which 153 (23.8%) were potentially phylogenetic informative. The parsimony analysis yielded 601 equally most parsimonious trees of 283 steps, CI = 0.65 and RI = 0.78. The results are summarized on Table 1, with number of potentially informative characters, number of most-parsimonious trees, tree lengths, and the consistency and retention indices (CI and RI, respectively) for strict consensus trees resulting from MP analyses.

The *ITS* phylogenetic analysis suggests that *Adesmia* ser. *Psoraleoides* is monophyletic (Fig. 3) with high parsimony Bootstrap support (100%) and Bayesian posterior probabilities (1.0). This result is in agreement with other morphological and ecological characters that circumscribe *Adesmia* ser. *Psoraleoides*, including the absence of stamens fused with the banner, and self-pollination in all species within the series (Burkart, 1967; Miotto and Leitão Filho, 1993; Tedesco et al., 2000). *Adesmia tristis* is placed as sister to all other species within the series (Bootstrap support of 57.8 and Bayesian posterior probability of 0.93). This result is in agreement with the presence of distinct morphological characters in *A. tristis*, such as the straight pedicels even in fruit, which are exclusive for this species within the series but is shared with species from other series within the genus (Burkart, 1967).

Plastid data–Plastid markers (*matK*, *rps16* and *rbcL*) were combined into a single matrix for 29 terminal taxa analyzed, and totaling 3546 characters, of which 128 (3.6%) were potentially phylogenetic informative. Results obtained with the combined plastid matrix are given in Tab.1. The parsimony analysis yielded 5034 equally most parsimonious trees of 156 steps, CI = 0.86 and RI = 0.72. The monophyly of *Adesmia* ser. *Psoraleoides* is also supported by Bootstrap value (100%) and Bayesian posterior probabilities (1.0) with similar topologies. Strict consensus tree is shown in Fig. 4.

Another analysis was performed for the coding region of *matK*, where a wider sample of the genus *Adesmia* was included, covering all its geographical range, plus samples from the other five genus which together with *Adesmia* comprise the Adesmia clade (Fig. 5). The matrix included 88 terminal taxa, and 1573 characters, of which 356 (22.6) were potentially phylogenetic informative. The parsimony ratchet analysis yielded 10000 equally most parsimonious trees of 483 steps, CI = 0.84 and RI = 0.96. This analysis also confirmed *Adesmia* ser. *Psoraleoides* as a monophyletic group well supported by parsimony Bootstrap analysis (90.8 %) and by Bayesian posterior probabilities (0.99). Differently from *ITS* analysis, according to *matK* analysis *Adesmia reitziana* was placed as sister to the other species within the series (Bootstrap support of 63.6 and Bayesian posterior probability of 0.90), while *Adesmia tristis* is placed between other species of the series. *Adesmia reitziana* is a threatened species known from only few small populations near the eastern edge of the "Serra Geral" range, in Santa Catarina state.

Phylogenetic relationships of Adesmia ser. Psoraleoides–The molecular phylogenetic analysis confirmed *Adesmia* ser. *Psoraleoides* as a monophyletic group (Figs. 3-5), agreeing with the previous morphological circumscriptions (Burkart, 1967; Miotto and Leitão Filho, 1993; Iganci and Miotto, 2011). A set of morphological characters is usually indicated to circumscribe *Adesmia* ser. *Psoraleoides*, but individually these characters are not synapomorphies, being shared with other species over different series of the genus. Even though the presence of these characters in different lineages refers to multiple origins in different clades, they were properly used together to characterize the series in previous systematic revisions (Burkart, 1967; Miotto and Leitão Filho, 1993).

In comparing the *ITS* and cpDNA analyses, some incongruence is observed. In the *ITS* analysis, *Adesmia tristis* is placed as sister to all other species within the series, though with relatively weak bootstrap support. *Adesmia tristis* is widespread through the CCS, and the result from *ITS* is in agreement with its distinct morphological characters, which are exclusive for this species within *Adesmia* ser. *Psoraleoides* but are shared with other species of *Adesmia*. In the combined cpDNA analysis, *A. tristis* is embedded within the other species of the series while *Adesmia reitziana* is placed as sister to the remaining species of the series, though with weak Bootstrap support (76.5%), but high Bayesian posterior probabilities (1.0). The analyses of *matK* places *Adesmia* ser. *Psoraleoides* next to species of *Adesmia* ser. *Bicolores* Burkart*, A.* ser. *Muricatae* Burkart*, A.* ser. *Subnudae* Burkart*, A.* ser. *Longisetae* Burkart and *A.* ser. *Candidae* Burkart (Figs. 5-6), which are spread over the lowland grasslands from the Pampas Domain in Argentina, Uruguay and Southern Brazil, and the Patagonia in Argentina. *Adesmia* ser. *Bicolores* comprises the most morphologically similar species to *Adesmia* ser. *Psoraleoides*, but differing by stoloniferous plants, radicants in the nodes, and presenting flowers with two stamens fused to the banner (Miotto and Leitão Filho, 1993).

Biogeography and diversification ages–*Adesmia* ser. *Psoraleoides* comprises eleven species mostly endemic from the "Campos de Cima da Serra" (CCS), in southern Brazil (Iganci et al., 2011; Iganci and Miotto, 2011). A few collections for *Adesmia tristis* and *Adesmia araujoi* are recorded from the Pampas Domain and may represent recent dispersal to this adjacent formation. The analysis of species richness within the CCS showed two main distribution centers, which represent the most species rich remaining areas of the CCS (Fig. 2). These areas represent the eastern edge and the central portion of the "Serra Geral" range, and are still harboring most of plant diversity of CCS, but the patches of vegetation are strongly threatened by human land uses and the natural increase of forests over the grasslands (Iganci et al., 2011).

The dated phylogeny based on *matK* sequences shows a strong geographically structured diversification of the genus *Adesmia* (Fig. 6). The basally branching lineages of the genus are spread in the arid and semi-arid formations of the Andes from Bolivia, through Chile and down to the lower altitude in the southernmost Argentinean Patagonia. *Adesmia* ser. *Psoraleoides* is a much more recent lineages of *Adesmia*, with estimated divergence from its sister clade, *Adesmia* ser. *Bicolores*, around 11 Mya. A geographically intermediate distribution is occupied by other lineages that occur mostly in the lowland temperate grasslands (Pampas) from Argentina and Uruguay, and reaching its northern distribution in the southern Brazilian Pampas. One of these lineages is represented by *Adesmia* ser. *Bicolores* which has most species spreading in the Pampas from Uruguay, Argentina and southern Brazil, including one widespread species, *Adesmia latifolia* (Spreng.) Vogel, which bridges the distribution gap, growing along the coastal vegetation in southern Brazil up to the highlands of the CCS (Fig. 6). The presence of *A. latifolia* in CCS, the area of distribution of *Adesmia* ser. *Psoraleoides*, must represent a recent secondary contact between species of these two series.

Previous considerations about the diversification of plant lineages in the southern Brazilian grasslands include the essentially descriptive analysis by Rambo (1953), who considered the highland grasslands and its endemic taxa as the most ancient plant lineages that colonized this environment, during the late Cretaceous and the first Cenozoic glaciations (see also Miotto and Waechter, 1996). The estimation of diversification ages for the main lineages within *Adesmia* show that *Adesmia* ser. *Psoraleoides* is much more recent than described by Rambo (1953), with the crown group date of 6-5 Mya implying that most of the current species diversified between late Miocene and early Pliocene (Fig. 6). The recent diversification within *Adesmia* ser. *Psoraleoides* is reflected on the lack of phylogenetic resolution for some clades. However, the absence of heterozygote sequences does not allow inferring about gene introgression.

The eleven species of *Adesmia* ser. *Psoraleoides* are found in a very restrict area which comprises the CCS in southern Brazil. Even though most species occupy small patches of grasslands, rarely presenting large populations, almost all of them co-occur sympatrically, as it is observed in Figure 2. Few data about mode of reproduction and chromosome counts have been described for Brazilian species of *Adesmia* (Miotto and Forni-Martins, 1994; Tedesco et al., 2000). No numerical differences in chromosome were found, but the peculiarities in floral morphology and mode of reproduction could be focused in an attempt to elucidate the process. The evolutionary events that have been driven the speciation within the series are subject for future works, and are probably related to local vicariance caused by Pleistocene climate oscillations. The current geographic distribution of some species, such as *Adesmia rocinhensis*, reflects the recent habitat fragmentation and the threat of ancient lineages which were wider spread over the grasslands of CCS. This species occurs in three disjunct populations, completely isolated from each other by patches of forest and agricultural areas.

Plant lineages with disjunct distribution presenting close related species in southern Andes, temperate lowlands from Southern Argentina, and Subtropical Brazil, have been recognized as an important component of southern Brazilian flora (Smith, 1962; Rambo, 1953, Safford, 2007; Iganci et al., 2011). As an example, the genus *Butia* (Becc.) Becc. (Arecaceae) is widespread within south-eastern South American grasslands and split out from its sister, *Jubaea* Kunth, from southern Andes, around 14.5 Mya (Meerow et al., 2009). Rambo (1953b) also highlights other disjunct lineages, including the genera *Acaena* Mutis ex L., *Drimys* J.R. Forst. & G. Forst., *Fuchsia* L., *Griselinia* J.R. Forst. & G. Forst., *Podocarpus* L'Hér. ex Pers., with close related species occurring in both Southern Brazil and Andes. Most of these genera have their northern distribution in Southern Brazil and few of them spread to the dry vegetation in Central and Southeast Brazil (Smith, 1962). Moreover, Rambo (1953) highlighted the insular character of the subtropical grasslands and temperate shrublands from southern Brazil and north of Uruguay, which comprises both Andean and Brazilian lineages (Iganci et al. 2011). Rambo (1953) refers to physical isolation due marine transgressions when he discusses about isolation of the flora. Recent researches and new produced data suggest that the evolutionary history of those lineages was a complex, stepwise process in a different time scale from that suggested by Rambo (1953) and Smith (1962). The processes that drove the landscape and climatic evolution of South America, causing compositional changes on its flora and fauna, such as the processes of isolation and recolonization between higher and lower areas that can be estimated based on molecular phylogenetic and dating analysis (Donato et al., 2003; Pérez-Losada et al., 2004). However, few researches have been directed to the understanding the evolutionary patterns of southern South American biomes.

Recent reports for the geological and climate transitions in southern South America have been elucidating the most important events that must have influenced the flora and fauna of this region (Kvasov and Verbitski, 1981; Webb, 1995; Pascual et al., 1996; Donato et al., 2003; Pérez-Losada et al., 2004; Berreda et al., 2010).

The phylogenetic and dating analyses of *Adesmia* here shown, suggest a strongly geographically structured phylogeny that supports the idea of dispersal followed by extinction events in southern South America. The diversification ages estimated for the main clades which represent the geographic shifts within the genus are in agreement with major historical events, as the submerging of major lowland areas by a marine transgression during the formation of the Paranean Sea, which might have promoted the isolation of previously continuous subpopulations in higher elevation areas, such the southern Brazilian CCS (Fig. 4). Similarly to the results described by Donato et al. (2003) and Pérez-Losada et al. (2004), geographically intermediate lineages in *Adesmia* (represented by blue clades in Fig. 4) must have radiated spreading through the lowland grasslands after the marine transgression drained back to the sea, around 10 Mya, recolonizing massive areas and getting secondary contact with other lineages previously isolated by the sea. It is reported an expansion of dry environments worldwide between around 10 Mya and 5 Mya (Simon et al., 2009), which probably also occurred through the southern South American grasslands. Subsequent climate cycles during the late Miocene, Pliocene and Pleistocene probably had a strong influence on species distribution over the subtropical grasslands, isolating populations within grassland-forest patches and promoting the main diversification events over the CCS, as it is seem in most species within *Adesmia* ser. *Psoraleoides*. Future studies focusing in a broad approach of comparative analysis concerning independent lineages with similar distribution patterns could bring an overview and detailed evidences about the evolutionary processes that drove the current distribution of southern South American biota and historical events that led to its current landscapes.

CONCLUSION

Almost all species of *Adesmia* ser. *Psoraleoides* are endemic to the Southern Brazilian Highland Grasslands and the dated phylogenetic inference of this group showed a relative recent diversification over this formation. The origin of *Adesmia* ser. *Psoraleoides* as monophyletic is in agreement with Iganci *et al*. (2011) on the unity and delimitation of the Subtropical Highland Grasslands in Southern Brazil.

During the middle Miocene, the genus *Adesmia* appears to have started its major radiation in the Andes and southern South America. Subsequent movement from this area may have been facilitated by the geological modifications and favorable climates that contributed to the colonization of dry and cold areas further north, reaching the southern Brazilian grasslands. The resulting continuous distribution may have been fragmented by geological and climate events during the late Miocene and Early Pliocene, isolating the lineages in the higher elevation areas. Isolated lineages, such as *Adesmia* ser. *Psoraleoides*, may have subsequently diversified more recently, potentially driven by climate changes during glacial/interglacial periods. This recent origin for subtropical grassland endemics matches the pattern found by Simon et al. (2009) for the Cerrado, where lineages started to diversify less than 10 Mya, with most of them diversifying at 4 Mya or less, which coincides with the expansion of the savanna biome worldwide.

The distribution pattern of *Adesmia* ser. *Psoraleoides* is similar to other endemics from the CCS in having related lineages occurring in southern Andes. Other endemic plant lineages which have been described to the CCS (Rambo, 1953; Iganci et al., 2011) need similar studies to test for congruence in diversification histories, contributing to the understand of evolutionary processes within these grasslands. According to Donato et al. (2003), the current distribution of southern South American biota represents a complex history of extinction, dispersal, and vicariant events, which could be linked to major historical events in the geobiotic evolution of South America.

The remaining richest grasslands in species number of *Adesmia* ser. *Psoraleoides* are found in central Santa Catarina and Paraná states, in the localities known as the “Campos de

Palmas” and “Água Doce”, as well as the eastern edge of the “Serra Geral” range in “Rio Grande do Sul” and “Santa Catarina” states. Even though this area has being highlighted as harboring a large number of endemic plant species (Iganci et al., 2011), probably originated by recent historical climate events, these grasslands are still threatened by human land uses and it is lacking protected areas to ensure the conservation of those rare and exclusive lineages. Conservation efforts should be directed to protect the biodiversity over the grasslands of the CCS as one of the last remaining references of past evolutionary connections between the whole grasslands from southern South America.

SUPPLEMENTARY INFORMATION

SI1. Individual results for cpDNA regions analyzed in the combined dataset.

SI2. Supplementary method - Patterns of geographical distribution within *Adesmia.*

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TABLE

TABLE 1. Summary of the lengths and indices of the resulting strict consensus tree in parsimony analyses of separated and combined datasets.

Data partition	Nº. of characters	Nº. of variable characters (%)	Nº. of parsimony informative characters (%)	Nº. of most-parsimonious trees	Tree length	CI	RI
ITS	643	83 (1.29)	52 (0.8)	601	131	0.70	0.83
matK	2664	255 (9.2)	63 (2.3)	3869	261	0.73	0.47
rps16	421	58 (13.4)	20 (4.6)	3975	64	0.50	0.21
rbcL	639	236 (36.9)	79 (12.3)	3781	298	0.67	0.15
cpDNA combined matrix	3546	128 (3.6)	40(1.12)	5034	156	0.86	0.72
Global combined matrix	4178	199 (4.76)	90 (2.15)	432	248	0.86	0.84
matK’	1573	356 (22.6)	212 (13.4)	10000	483	0.84	0.96

CI and RI are, respectively, the consistency and retention indices.
matK’: analysis of Adesmia clade.

APPENDIX 1. Voucher information and GenBank accession numbers for taxa sampled in this study. Voucher specimens are deposited in the herbaria CEN = EMBRAPA Recursos Genéticos e Biotecnologia – CENARGEN; F = Field Museum of Natural History; FHO = University of Oxford; HUEFS = Universidade Estadual de Feira de Santana; ICN = Universidade Federal do Rio Grande do Sul; K = Royal Botanic Gardens, Kew; MEXU = Universidad Nacional Autónoma de México; MO = Missouri Botanical Garden; MONT = Montana State University; NY = New York Botanical Garden; TEX = University of Texas at Austin. ***Taxon***, *Voucher specimen*, Collection country, HERBARIUM, GenBank accessions*.

**Amostras indicadas pelo código* xxxx *ainda não possuem número de acesso no GenBank; amostras indicadas por* § *tratam-se de sequências inéditas produzidas pela Dra. Beryl B. Simpson e aguardam dados sobre material-testemunho.*

DNA region: *ITS – Adesmia araujoi* Burkart, *JFM Valls 10730-B5*, Brazil, CEN, xxxx; ***Adesmia arillata* Miotto**, *JVR Iganci 592*, Brazil, ICN, xxxx; ***Adesmia arillata* Miotto**, *JRV Iganci 780*, Brazil, ICN, xxxx; ***Adesmia arillata* Miotto**, *JRV Iganci 809*, Brasil, ICN, xxxx; ***Adesmia arillata* Miotto**, *JRV Iganci 810*, Brazil, ICN, xxxx; ***Adesmia arillata* Miotto**, *JFM Valls 11318-B4*, CEN, xxxx; ***Adesmia ciliata* Vogel**, *JRV Iganci 384*, Brazil, ICN, xxxx; ***Adesmia ciliata* Vogel**, *JRV Iganci 773*, Brazil, ICN, xxxx; ***Adesmia ciliata* Vogel**, *JRV Iganci 774*, Brazil, ICN, xxxx; ***Adesmia ciliata* Vogel**, *JRV Iganci 808*, Brazil, ICN, xxxx; ***Adesmia ciliata* Vogel**, *JRV Iganci 816*, Brazil, ICN, xxxx; ***Adesmia latifolia* (Spreng.) Vogel**, *JRV Iganci 485*, Brazil, ICN, xxxx; ***Adesmia latifolia* (Spreng.) Vogel**, *JRV Iganci 487*, Brazil, ICN, xxxx; ***Adesmia paranensis* Burkart**, *JRV Iganci 617*, Brazil, ICN, xxxx; ***Adesmia paranensis* Burkart**, *JRV Iganci 777*, Brazil, ICN, xxxx; ***Adesmia paranensis* Burkart**, *JRV Iganci 781*, Brazil, ICN, xxxx; ***Adesmia psoraleoides* Vogel**, *JRV Iganci 499*, Brazil, ICN, xxxx; ***Adesmia psoraleoides* Vogel**, *JRV Iganci 771*, Brazil, ICN, xxxx; ***Adesmia***

psoraleoides **Vogel**, *JRV Iganci 778*, Brazil, ICN, xxxx; ***Adesmia psoraleoides*** **Vogel**, *JRV Iganci 796a*, Brazil, ICN, xxxx; ***Adesmia psoraleoides*** **Vogel**, *JRV Iganci 811*, Brazil, ICN, xxxx; ***Adesmia punctata*** **(Poir.) DC.**, *JRV Iganci 760*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 501*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 649*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 650*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 651*, Brazil, ICN, xxxx; ***Adesmia rocinhensis*** **Burkart**, *JRV Iganci 625*, Brazil, ICN, xxxx; ***Adesmia rocinhensis*** **Burkart**, *JRV Iganci 628*, Brazil, ICN, xxxx; ***Adesmia rocinhensis*** **Burkart**, *JRV Iganci 820a*, Brazil, ICN, xxxx; ***Adesmia securigerifolia*** **Herter** §, B3, xxxx; ***Adesmia sulina*** **Miotto**, *JFM Valls 11334-B6*, Brazil, CEN, xxxx; ***Adesmia tristis*** **Vogel**, *JRV Iganci 599*, Brazil, ICN, xxxx; ***Adesmia tristis*** **Vogel**, *JRV Iganci 766*, Brazil, ICN, xxxx; ***Adesmia tristis*** **Vogel**, *JRV Iganci 779*, Brazil, ICN, xxxx; ***Adesmia tristis*** **Vogel**, *JRV Iganci 785*, Brazil, ICN, xxxx; ***Adesmia tristis*** **Vogel**, *JRV Iganci 790*, Brazil, ICN, xxxx; ***Adesmia tristis*** **Vogel**, *JRV Iganci 800*, Brazil, ICN, xxxx; ***Adesmia tristis*** **Vogel**, *JRV Iganci 812*, Brazil, ICN, xxxx; ***Adesmia valsii*** **Miotto**, *JFM Valls 11465-B12*, Brazil, ICN, xxxx.

DNA regions: *matK*/*rps16*/*rbcL* – *Adesmia araujoi* **Burkart**, *JFM Valls 10730-B5*, Brazil, CEN, xxxx/xxxx/xxxx; ***Adesmia arillata*** **Miotto**, *JRV Iganci 780*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia arillata*** **Miotto**, *JRV Iganci 809*, Brazil, ICN, xxxx; ***Adesmia arillata*** **Miotto**, *JFM Valls 11318-B4*, Brazil, CEN, xxxx/xxxx/xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 348*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 773*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 774*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 814*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia latifolia*** **(Spreng.) Vogel**, *JRV Iganci 485*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia latifolia*** **(Spreng.) Vogel**, *JRV Iganci 487*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia***

***paranensis* Burkart**, *JRV Iganci 777*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia psoraleoides* Vogel**, *JRV Iganci 771b*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia psoraleoides* Vogel**, *JRV Iganci 778*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia psoraleoides* Vogel**, *JRV Iganci 796a*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia psoraleoides* Vogel**, *JRV Iganci 811*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia reitziana* Burkart**, *JRV Iganci 649*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia reitziana* Burkart**, *JRV Iganci 651*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia reitziana* Burkart**, *JRV Iganci 652*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia rocinhensis* Burkart**, *JRV Iganci 625*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia rocinhensis* Burkart**, *JRV Iganci 628*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia securigerifolia* Herter** §, B3, xxxx/xxxx/xxxx; ***Adesmia sulina* Miotto**, *JFM Valls 11334-B6*, Brazil, CEN, xxxx/xxxx/xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 766*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 779*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 785*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 790*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 800*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 812*, Brazil, ICN, xxxx/xxxx/xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 818*, Brazil, ICN, xxxx/xxxx/xxxx.

DNA region : *matK’* – *Adesmia araujoi* Burkart, *JFM Valls 10730-B5*, Brazil, CEN, xxxx; ***Adesmia arillata* Miotto**, *JRV Iganci 592*, Brazil, ICN, xxxx; ***Adesmia arillata* Miotto**, *JRV Iganci 780*, Brazil, ICN, xxxx; ***Adesmia arillata* Miotto**, *JRV Iganci 809*, Brazil, ICN, xxxx; ***Adesmia arillata* Miotto**, *JFM Valls 11318-B4*, Brazil, CEN, xxxx; ***Adesmia bicolor* (Poir.) DC.** §, xxxx; ***Adesmia bicolor* (Poir.) DC.**, *B Simpson A48*, Uruguay, TEX, JN835375; ***Adesmia candida* Hook.f.**, *B Simpson A264*, Argentina, TEX, JN835374; ***Adesmia ciliata* Vogel**, *JRV Iganci 348*, Brazil, ICN, xxxx; ***Adesmia ciliata* Vogel**, *JRV Iganci 384*, Brazil, ICN, xxxx; ***Adesmia ciliata* Vogel**, *JRV Iganci 773*, Brazil, ICN, xxxx; ***Adesmia ciliata***

Vogel, *JRV Iganci 774*, Brazil, ICN, xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 808*, Brazil, ICN, xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 814*, Brazil, ICN, xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 816*, Brazil, ICN, xxxx; ***Adesmia ciliata*** **Vogel**, *JRV Iganci 823*, Brazil, ICN, xxxx; ***Adesmia concinna*** **Phil.** §, xxxx; ***Adesmia corymbosa*** **Clos**, *B Simpson A266*, Argentina, TEX, JN835373; ***Adesmia cuneata*** **Meyen** §, xxxx; ***Adesmia echinus*** **C.Presl** §, xxxx; ***Adesmia emarginata*** **Clos** §, xxxx; ***Adesmia eremophila*** **Phil.** §, xxxx; ***Adesmia erinacea*** **Phil.** §, xxxx; ***Adesmia exilis*** **Clos** §, xxxx; ***Adesmia frigida*** **Phil.** §, xxxx; ***Adesmia fuentesii*** **Grandjot**, *Grandjot s.n. A187*, Chile, NY, JN835377; ***Adesmia glutinosa*** **Hook. & Arn.** §, xxxx; ***Adesmia gracilis*** **Meyen ex Vogel** §, xxxx; ***Adesmia grandiflora*** **Gillies ex Hook. & Arn.**, *B Simpson A251*, Argentina, TEX, JN835372; ***Adesmia lanata*** **Hook.f.**, *Lavin 8256*, Argentina, MONT, AF270863; ***Adesmia lanata*** **Hook.f.** 2 §, xxxx; ***Adesmia latifolia*** **(Spreng.) Vogel**, *B Simpson A54*, Uruguay, TEX, JN835376; ***Adesmia latifolia*** **(Spreng.) Vogel**, *JRV Iganci 485*, Brazil, ICN, xxxx; ***Adesmia latifolia*** **(Spreng.) Vogel**, *JRV Iganci 487*, Brazil, ICN, xxxx; ***Adesmia longiseta*** **DC.**, *B. Simpson A227*, Chile, TEX, JN835371; ***Adesmia mucronata*** **Hook. & Arn.** §, xxxx; ***Adesmia paranensis*** **Burkart**, *JRV Iganci 617*, Brazil, ICN, xxxx; ***Adesmia paranensis*** **Burkart**, *JRV Iganci 777*, Brazil, ICN, xxxx; ***Adesmia paranensis*** **Burkart**, *JRV Iganci 781*, Brazil, ICN, xxxx; ***Adesmia psoraleoides*** **Vogel**, *JRV Iganci 499*, Brazil, ICN, xxxx; ***Adesmia psoraleoides*** **Vogel**, *JRV Iganci 771*, Brazil, ICN, xxxx; ***Adesmia psoraleoides*** **Vogel**, *JRV Iganci 778*, Brazil, ICN, xxxx; ***Adesmia psoraleoides*** **Vogel**, *JRV Iganci 796*, Brazil, ICN, xxxx; ***Adesmia psoraleoides*** **Vogel**, *JRV Iganci 811*, Brazil, ICN, xxxx; ***Adesmia punctata*** **(Poir.) DC.**, *JRV Iganci 760*, Brazil, ICN, xxxx; ***Adesmia rahmeri*** **Phil.** §, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 501*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 649*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 650*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 651*, Brazil, ICN, xxxx; ***Adesmia reitziana*** **Burkart**, *JRV Iganci 652*, Brazil, ICN, xxxx; ***Adesmia retusa* Griseb.** §, xxxx; ***Adesmia rocinhensis* Burkart**, *JRV Iganci 625*, Brazil, ICN, xxxx; ***Adesmia rocinhensis* Burkart**, *JRV Iganci 628*, Brazil, ICN, xxxx; ***Adesmia rocinhensis* Burkart**, *JRV Iganci 628_2*, Brazil, ICN, xxxx; ***Adesmia salicornioides* Speg.**, *D Benjamini 550 - A163*, Chile, TEX, JN835370; ***Adesmia securigerifolia* Herter** §, B3, xxxx; ***Adesmia sulina* Miotto**, *JFM Valls 11334-B6*, Brazil, CEN, xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 766*, Brazil, ICN, xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 779*, Brazil, ICN, xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 785*, Brazil, ICN, xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 790*, Brazil, ICN, xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 800*, Brazil, ICN, xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 812*, Brazil, ICN, xxxx; ***Adesmia tristis* Vogel**, *JRV Iganci 818*, Brazil, ICN, xxxx; ***Adesmia volckmannii* Phil.**, *Lavin 8245*, Argentina, MONT, AF142690; ***Adesmia volckmannii* Phil.** §, xxxx; ***Amicia andicola* (Griseb.) Harms**, *Särkinen 2132*, Bolivia, FHO, HM027913; ***Amicia fimbriata* Harms ex Kuntze**, *Särkinen 2036*, Argentina, FHO, HM027914; ***Amicia glandulosa* Kunth**, *Pennington 654*, Ecuador, K, AF203583; ***Amicia lobbiana* Benth. ex Rusby 1**, *Särkinen 2057*, Bolivia, FHO, HM027915; ***Amicia lobbiana* Benth. ex Rusby 2**, *Särkinen 2229*, Peru, FHO, HM027916; ***Amicia medicaginea* Griseb.**, *Särkinen 2038*, Argentina, FHO, HM027917; ***Amicia micrantha* Harms ex Kuntze**, *Särkinen 2085*, Bolivia, FHO, HM027918; ***Amicia zygomeris* DC.**, *Contreras s.n.*, Mexico, MEXU, HM027919; ***Chaetocalyx brasiliensis* (Vogel) Benth.**, *Ventura 14977*, Mexico, MO, AF270866; ***Chaetocalyx latisiliqua* (Poir.) Benth. ex Hemsl.**, *Lewis 2354*, Ecuador, K, K25176; ***Chaetocalyx nigricans* Burkart**, *Vani 2955*, Argentina, F, AF203585; ***Chaetocalyx scandens* (L.) Urb.**, *CIAT 20536*, Brazil, MONT, AF270865; ***Nissolia hirsuta* DC.**, *Roe 1904*, Mexico, F, AF270868; ***Nissolia schottii* (Torr.) A.Gray**, *Joyal 2094*, Mexico, NY, AF270867; ***Poiretia angustifolia* Vogel**, *Lavin 8256*, Argentina, MONT, AF270864; ***Poiretia tetraphylla* (Poir.) Burkart**, *STS Miotto*, Brazil, ICN, HM027921; ***Zornia areolata* Mohlenbr.**, *Clarkson 9215*, Australia, K, HM027922; ***Zornia***

harmsiana* Standl.**, *Harley 21512*, Brazil, K, HM027923; ***Zornia leptophylla* (Benth.) Pittier**, *LP de Queiroz*, Brazil, HUEFS, HM027924; ***Zornia sericea* Moric.**, *Simon 691*, Brazil, FHO, HM027925; ***Zornia sp., *Lavin 5039*, Mexico, MONT, AF203584.

FIGURES

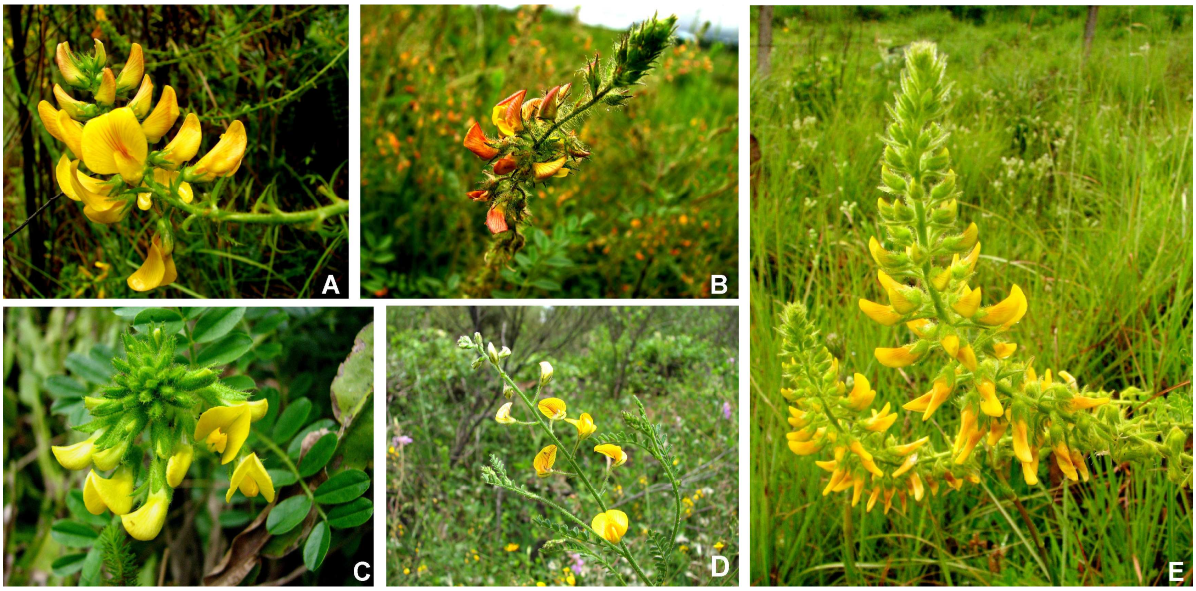

Figure 1. Morphological diversity in *Adesmia* ser. *Psoraleoides*. A. *Adesmia paranensis* Burkat; B. *Adesmia rocinhensis* Burkart; C. *Adesmia reitziana* Burkart; D. *Adesmia tristis* Vogel; E. *Adesmia psoraleoides* Burkart.

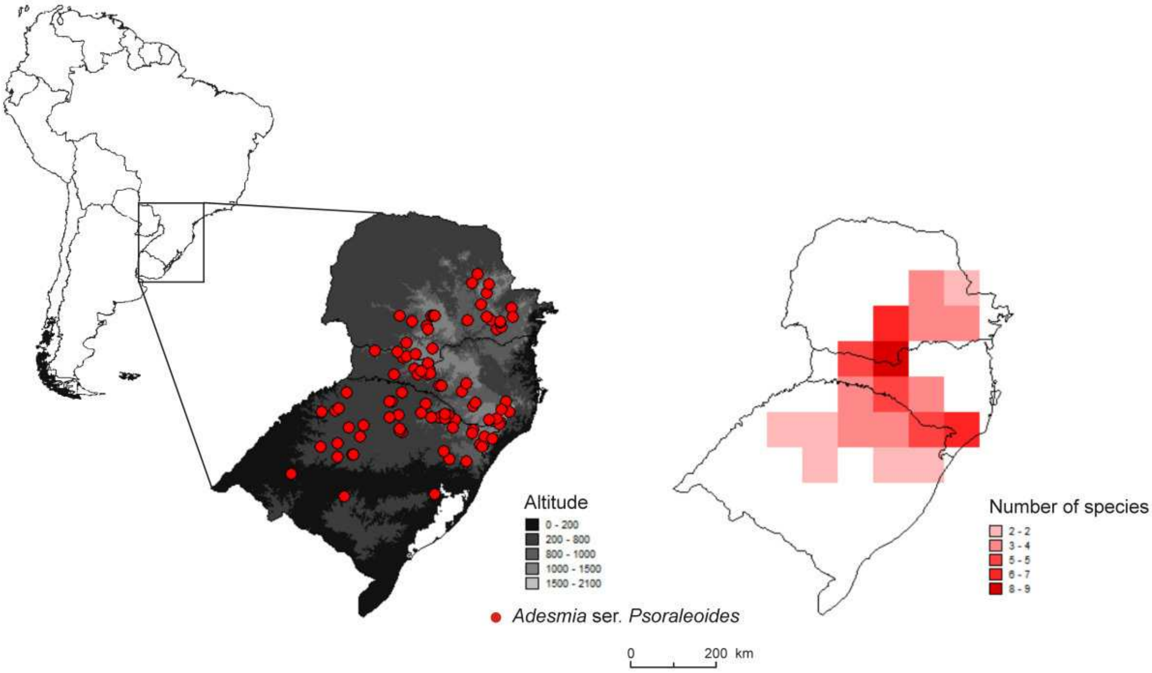

Figure 2. Geographic distribution of *Adesmia* ser. *Psoraleoides* in Southern Brazil (left) and the estimation of the richest areas in species number, within the "Campos de Cima da Serra" – CCS (right).

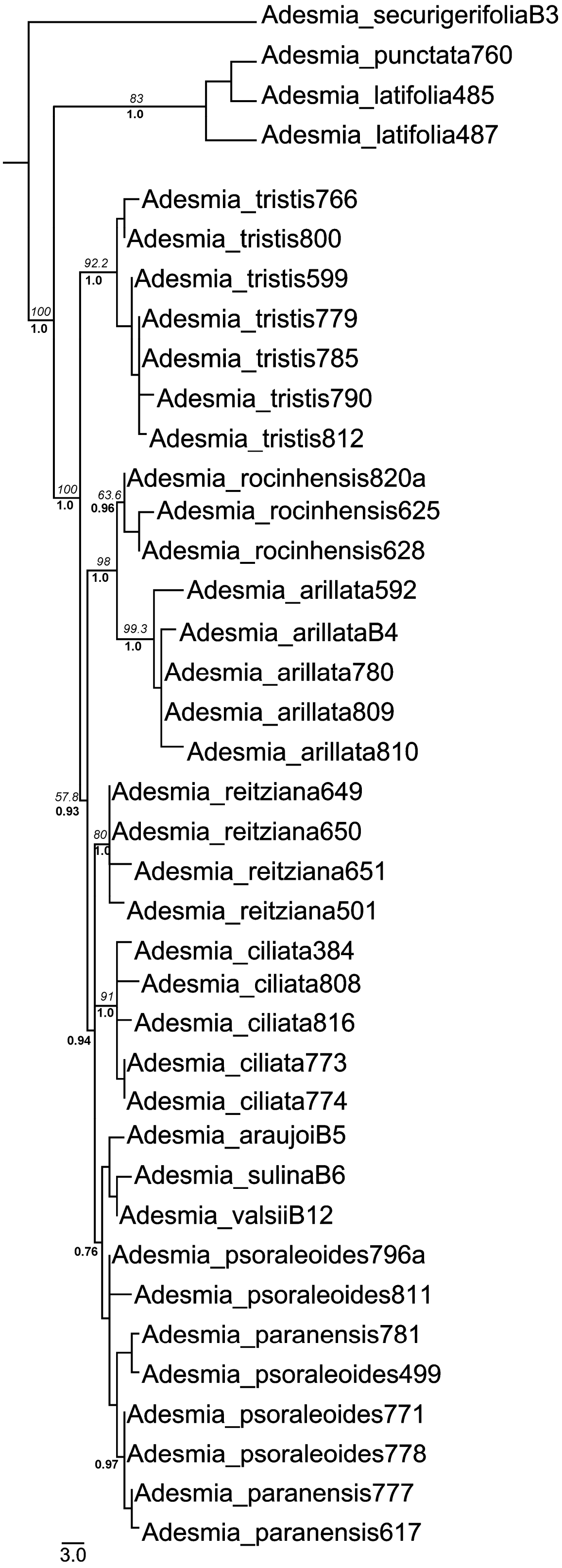

Figure 3. Phylogeny of *Adesmia* ser. *Psoraleoides* Burkart based on DNA sequences of the nuclear ribosomal 5.8S and flanking internal transcribed spacers (ITS1 and ITS2). One of the 601 most parsimonious trees. Numbers above and below nodes are Bootstrap percentages and posterior probabilities from parsimony and Bayesian analysis respectively.

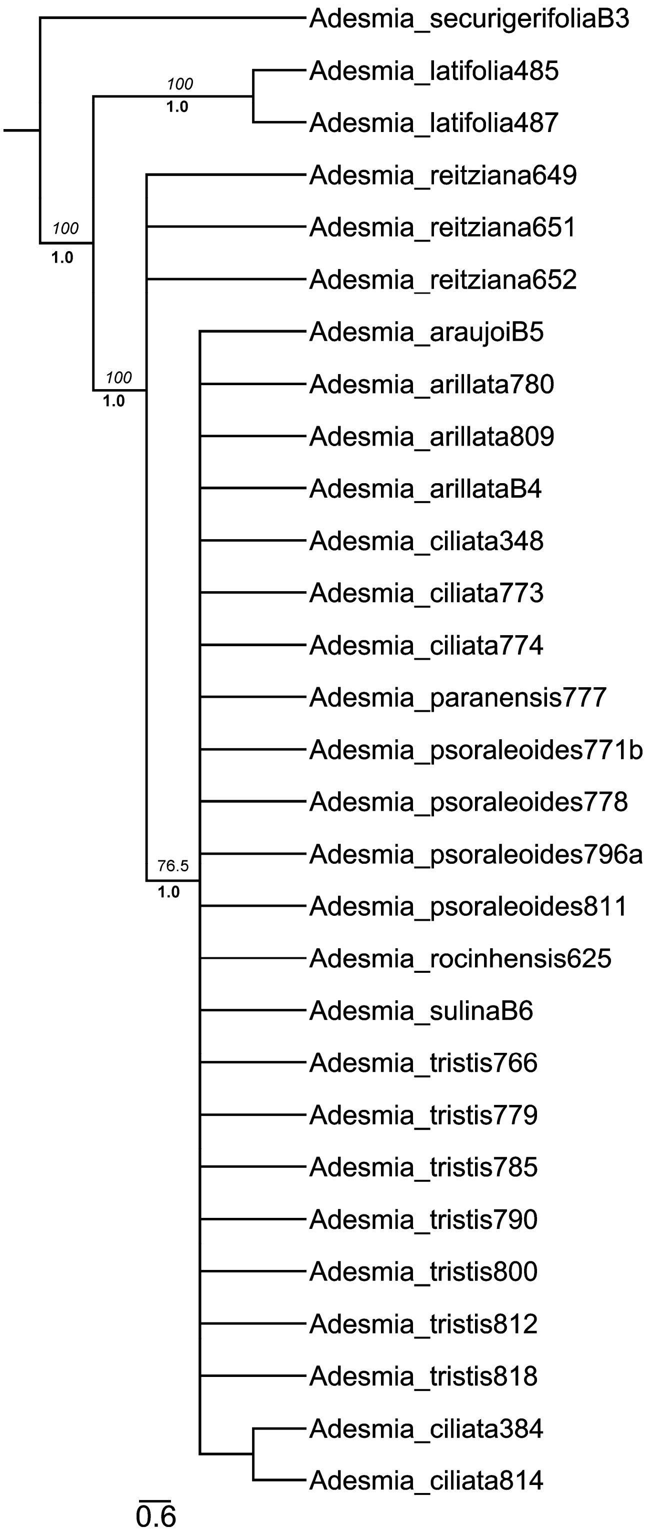

Figure 4. Phylogeny of *Adesmia* ser. *Psoraleoides* Burkart based on cpDNA sequences of the combined plastid markers *matK*, *rps16* and *rbcL*. Strict consensus tree of the 5034 most parsimonious trees produced in parsimony analysis. Numbers above and below nodes are Bootstrap percentages and posterior probabilities from parsimony and Bayesian analysis respectively.

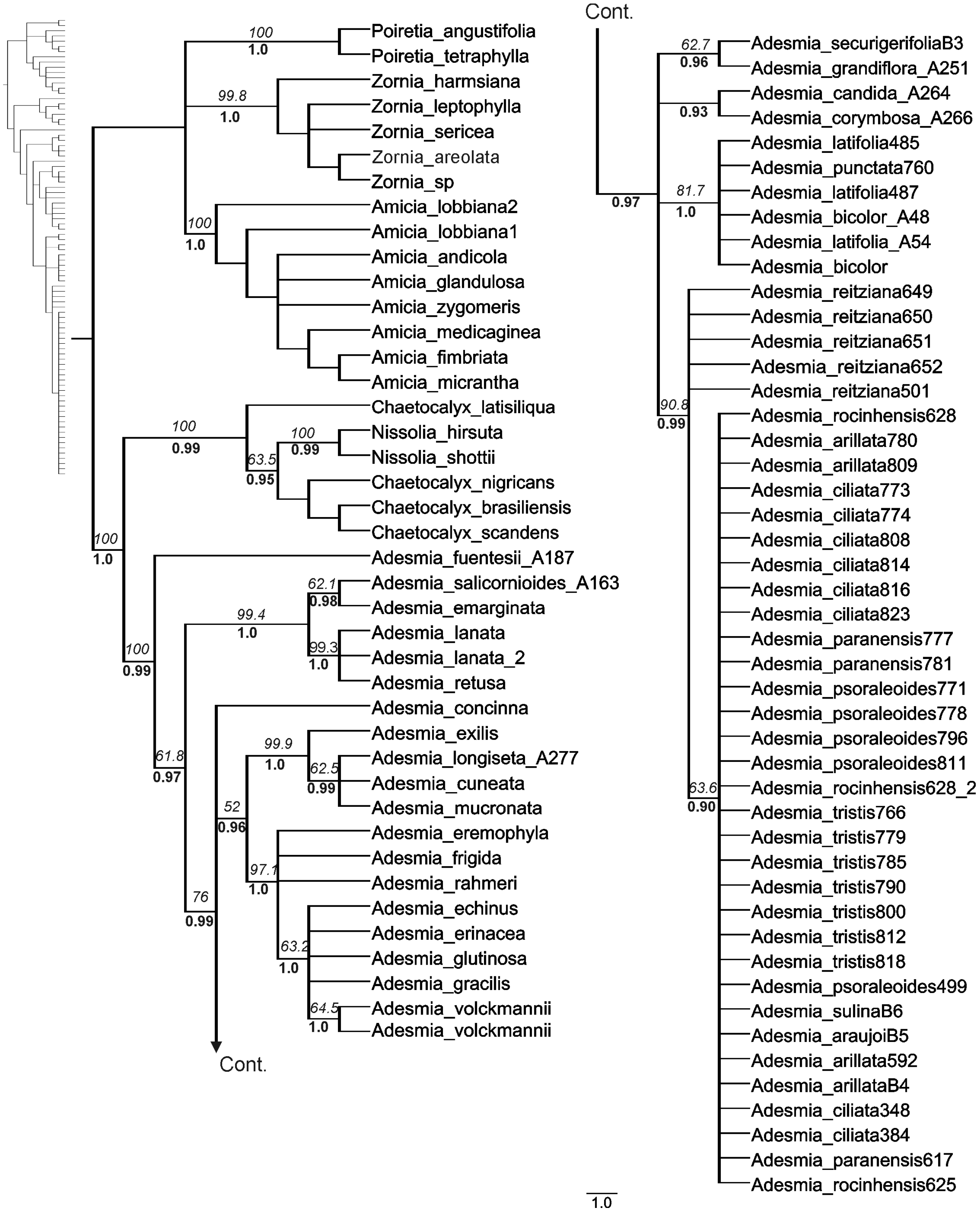

Figure 5. Phylogeny of *Adesmia* ser. *Psoraleoides* Burkart based on DNA sequences of the *matK*. Strict consensus tree of the 10000 most parsimonious trees produced in parsimony analysis. Numbers above and below nodes are Bootstrap percentages and posterior probabilities from parsimony and Bayesian analysis respectively.

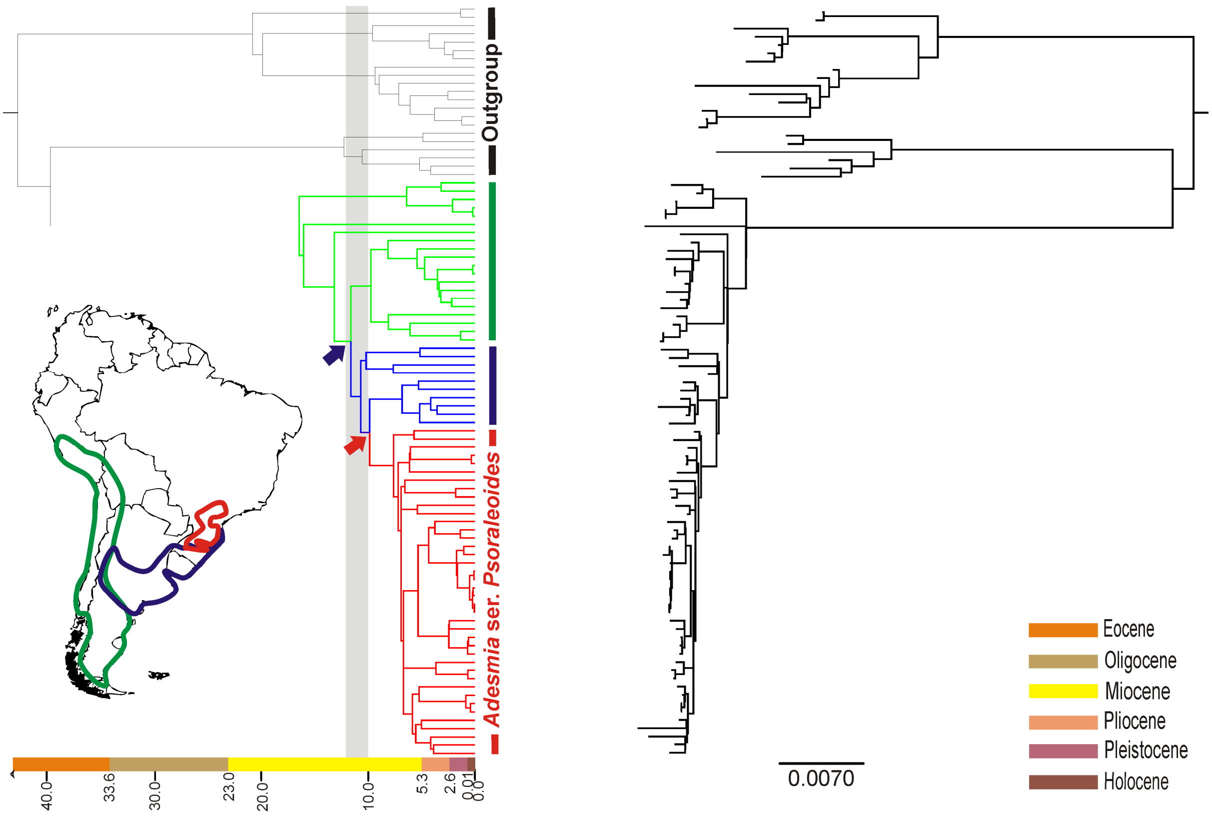

Figure 6. Chronogram based on *matK'* Bayesian dating analysis using an uncorrelated relaxed molecular clock (left), and the correspondent phylogram (right). The grey strip represents the major marine transgression event recorded to southern South America (~12-10 Mya), and the arrows indicates the main diversification events in agreement with this period. Colors in clades represent the geographic distribution of taxa, according to the map. See Suplementary Information (SI2) for details on ancestral distribution methods, and Fig. 5 for details on the *matK'* phylogenetic tree and support indices.

Supplementary Information

Iganci et al. “Diversification history of *Adesmia* ser. *Psoraleoides*”

Contents

SI1. Individual results for cpDNA regions analyzed in the combined dataset.

SI2. Supplementary method - Patterns of geographical distribution within *Adesmia.*

SI1. Individual results for cpDNA regions analyzed in the combined dataset.

The analysis of *matK* (*trnK* intron, including *matK*) was proceeded with 29 terminal taxa, including 2664 molecular characters, of which 63 (2.3 %) of substitutions were parsimony-informative. The parsimony analysis yielded 3869 equally most parsimonious trees of 261 steps, CI = 0.73 and RI = 0.47. The results are summarized on Table 1. The analysis based on *rbcL* included 29 terminal taxa, and 639 characters of which 79 (12.3 %) were potentially phylogenetic informative. The parsimony analysis produced 3781 equally most parsimonious trees of 298 steps, CI = 0.67 and RI = 0.15 (Tab. 1). For the *rps16*, 29 terminal taxa were analyzed, and the aligned matrix presented 421 bp of which 20 (4.6 %) were potentially phylogenetic informative. The parsimony analysis yielded 3975 equally most parsimonious trees of 64 steps, CI = 0.50 and RI = 0.21 (Tab. 1). Individual results for each plastid region are given in Table 1 (individual trees not shown).

Supplementary Information

Iganci et al. “Diversification history of *Adesmia* ser. *Psoraleoides*”

SI2. Supplementary method - Patterns of geographical distribution within *Adesmia.*

Patterns of geographical distribution within *Adesmia*, were inferred using the phylogenetic trees produced by *matK* analysis for the Adesmia clade. The analysis considered three main geographic areas, as character states, which represents the whole distribution of the genus. The consensus tree produced by *matK* analysis was used for character optimization with MP implemented in MESQUITE 2.74 (Maddison and Maddison, 2010), where character states were treated as unordered, allowing any transition among states.

Considerações finais

CONSIDERAÇÕES FINAIS

O conhecimento sobre a biodiversidade da flora do sul do Brasil necessita ser destacado para auxiliar no direcionamento de políticas públicas que visem a sua conservação. Apesar de existirem diversos estudos taxonômicos voltados para a flora desta região, sua diversidade vegetal é muitas vezes subestimada quando comparada à dos principais biomas que compõe a flora brasileira. Entretanto, o presente estudo sobre a diversidade de endemismos no sul do Brasil destaca a grande contribuição de sua flora para a composição da vegetação do País. Da mesma forma, a flora endêmica dos Campos de Cima da Serra, principal foco do estudo, é representada por 25% de endemismos que a diferenciam das demais formações campestres das regiões Sul e Sudeste do Brasil.

Até a data da publicação do trabalho sobre endemismos em plantas no sul do Brasil (Iganci et al., 2011), foram registrados 1020 táxons endêmicos de angiospermas, distribuídos em nove biomas. Dezenas de espécies novas para a Ciência foram descritas após a publicação deste trabalho e contribuem para a composição da diversidade vegetal do sul do Brasil como conhecida hoje. Isto ressalta o caráter efêmero de listagens taxonômicas, assim como já evidenciado no método apresentado no artigo sobre endemismos, onde são confrontadas duas listagens contemporâneas e, ao mesmo tempo, discrepantes, que tratam sobre a flora do sul do Brasil. Desta forma, as transformações no conhecimento científico estão diretamente refletidas no trabalho do taxonomista.

Apesar de a maior parte das espécies de plantas endêmicas do sul do Brasil ser restrita a cada bioma, análises de similaridade corroboram as classificações biogeográficas vigentes. As formações florestais são agrupadas às formações campestres tropicais e subtropicais, todas pertencentes ao domínio Atlântico, e distintas das formações campestres e savânicas que compõem o domínio do Pampa, no extremo sul do Brasil, e da savana tropical (Cerrado), no norte do estado do Paraná.

Assim, o alto número de táxons endêmicos nos Campos de Cima da Serra e a complexidade da história evolutiva dos táxons que compõem esta vegetação sugerem que esta formação campestre foi estabelecida há um longo tempo e não representa simplesmente um estágio sucessional de uma floresta perturbada, como sugerido em estudos recentes (Alves & Kolbek, 2010).

Neste contexto se insere o estudo de *Adesmia* ser. *Psoraleoides*, um grupo restrito aos Campos de Cima da Serra, no sul do Brasil, que compreende onze espécies, em sua maioria endêmicas deste bioma (Iganci et al., 2011; Iganci & Miotto, 2011). Dentre estas está a espécie *Adesmia sessilifolia* Iganci & Miotto, nova para a Ciência e descrita como parte do presente estudo. Esta espécie ocorre em uma área restrita que representa conexões geomorfológicas relictuais com as formações basálticas que formam a Serra Geral.

A maior parte das espécies de *Adesmia* ser. *Psoraleoides* é endêmica dos Campos de Cima da Serra e teve uma diversificação relativamente recente neste bioma. Estes resultados estão de acordo com a unidade e a delimitação dos Campos de Cima da Serra. *Adesmia* ser. *Psoraleoides* apresenta um padrão de distribuição semelhante ao encontrado em outras linhagens que ocorrem nesta área. Conforme Donato et al. (2003), a distribuição atual da biota do sul da América do Sul representa uma história complexa composta por eventos de extinção, dispersão e vicariância, o que poderia estar ligado a grandes eventos históricos na evolução geobiótica da América do Sul. Considerando os acontecimentos históricos ocorridos no sul da América do Sul durante o Mioceno e o

Plioceno, transgressões marinhas e variações climáticas poderiam ser apontadas como possíveis eventos que promoveram o isolamento entre linhagens do leste da América do Sul e dos Andes.

Durante o Mioceno Médio, o gênero *Adesmia* provavelmente teve a sua radiação e os principais eventos de dispersão guiados por modificações geológicas e pelo clima favorável que contribuiu para a colonização de áreas ao nordeste da distribuição original. Esta distribuição contínua pode ter sido fragmentada por transgressões marinhas ocorridas durante o Mioceno Tardio e o Plioceno Inicial, fragmentando as linhagens e conservando as populações localizadas em regiões de maior altitude. Estas linhagens isoladas, como por exemplo *Adesmia* ser. *Psoraleoides*, permaneceram nestas áreas mais altas durante os períodos interglaciais e diversificaram localmente em períodos glaciais/interglaciais posteriores. Estes eventos podem ter originado linhagens restritas ou endêmicas naquelas áreas isoladas, em ambientes muito específicos, como no caso dos Campos de Cima da Serra. A maior elevação altitudinal dos Campos de Cima da Serra proporciona o ambiente frio e seco, com um nicho semelhante àquele ocupado pelo gênero *Adesmia* e por outras linhagens de clima temperado do sul no Brasil. A radiação secundária de alguns clados promoveu o posterior contato entre espécies de *Adesmia* ser. *Bicolores*, que são encontradas em maior abundância nos campos do Pampa, e as espécies de *Adesmia* ser. *Psoraleoides* nos Campos de Cima da Serra, o que pode ser interpretado como resultado de eventos de dispersão recente. Os remanescentes campestres mais ricos em número de espécies de *Adesmia* ser. *Psoraleoides* são encontrados na região noroeste do estado de Santa Catarina e sudoeste do estado do Paraná, nas localidades conhecidas como campos de Palmas e de Água Doce, bem como na borda oriental da Serra Geral, no nordeste do Rio Grande do Sul e no sudeste de Santa Catarina. Estas áreas estão ameaçadas pelo uso da terra e são carentes de áreas protegidas para garantir a conservação de linhagens raras e exclusivas desta região. Os esforços de conservação devem ser dirigidos para proteger a biodiversidade ao longo dos Campos de Cima da Serra, que representam os remanescentes de conexões florísticas passadas entre os campos do sul e do sudeste da América do Sul. Como por exemplo, cita-se a espécie *Adesmia rocinhensis* que representa um claro exemplo de fragmentação de hábitat, sendo encontrada em populações restritas e isoladas nos Campos de Cima da Serra, nos três Estados do sul do Brasil. Esta espécie provavelmente apresentou uma distribuição mais ampla no passado, em relação a sua distribuição atual, tendo suas subpopulações sido isoladas tanto pelo avanço natural das florestas sobre os campos, como também pela fragmentação do hábitat devido a atividades antrópicas. Ao contrário do exemplo citado, outras espécies de *Adesmia* ser. *Psoraleoides* são amplamente distribuídas através dos campos, apresentando alta plasticidade morfológica e capacidade de adaptação para ocupar diferentes micro-hábitats.

A análise filogenética baseada em sequências de DNA da região *matK* mostra uma diversificação geograficamente estruturada do gênero *Adesmia*. As linhagens mais antigas do gênero são encontradas em formações áridas e semi-áridas dos Andes na Bolívia, no Chile e na Patagônia argentina. A vegetação campestre do sul do Brasil foi objeto de estudo essencialmente descritivo por Rambo (1953), que considerou as formações campestres das terras altas e suas espécies exclusivas, como *Adesmia* ser. *Psoraleoides*, as linhagens de plantas mais antigas que colonizaram esse ambiente, durante as primeiras glaciações do Cretáceo e do Cenozóico (Miotto & Waechter, 1996). A estimativa de idades de diversificação para as principais linhagens dentro de *Adesmia* mostra que *Adesmia* ser. *Psoraleoides* é muito mais recente do que a origem da vegetação dos Campos de Cima da Serra como sugerido por Rambo (1953), e a maioria das espécies atuais se diversificou entre o Mioceno Tardio e o Plioceno Inicial, em torno de 6-5 Mya.

Rambo (1953) destacou o caráter insular dos campos subtropicais e temperados do sul do Brasil e do norte do Uruguai. Estas formações compreendem tanto linhagens andinas como brasileiras (Iganci et al., 2011). Rambo (1953) refere-se ao isolamento físico, devido às transgressões marinhas, quando ele discute sobre o isolamento da flora. A história evolutiva dessas linhagens foi possivelmente um processo complexo e gradual, em uma escala de tempo diferente daquela sugerida por Rambo (1953) e por Smith (1962).

Durante a execução das atividades relacionadas à tese de doutorado, foram realizadas dezesseis excursões para coleta de material botânico, abrangendo toda a área de estudo, no período compreendido entre outubro de 2008 e novembro de 2011. Neste período foram coletados cerca de 500 exemplares principalmente provenientes da flora do sul do Brasil, dentre os quais a maior parte é composta por representantes da família Leguminosae.

Perspectivas

Cerca de um terço dos gêneros encontrados na flora do sul do Brasil são relacionados a linhagens temperadas austral-antárticas e andinas (Rambo, 1951; 1953; 1956; Smith, 1962; Safford, 1999; 2007; Waechter, 2002; Iganci et al., 2011). Estes grupos constituem focos de radiação secundária de táxons andinos e austral-antárticos no leste da América do Sul (Rambo, 1953; Safford, 1999; 2007; Waechter, 2002).

Embora seja encontrada uma alta diversidade de espécies campestres no sul do Brasil, as condições climáticas atuais não são propícias para a manutenção desta diversidade. A flora campestre está ameaçada pela fragmentação e perda de seu hábitat natural. Além disso, as condições atuais de temperatura e de precipitação no sul do Brasil são propícias para o desenvolvimento de florestas, em detrimento dos campos. Desta forma, o avanço das florestas ombrófilas densa e mista em direção aos campos é claramente visível (Duarte et al., 2006; Behling & Pillar, 2007) e espécies tropicais de ampla dispersão avançam rapidamente em direção aos ambientes não florestais (Koehler-Santos et al., 2006).

Os biomas podem ser unidades efêmeras ao longo do tempo geológico, frutos do acaso e do instante no tempo, guiados por condições bióticas e abióticas que moldam a paisagem como a vemos neste instante. É sabido que muitas linhagens conservam o nicho, mas este nicho pode ser móvel ao longo do tempo, pode surgir ou desaparecer de acordo com as condições favoráveis ou não para determinados táxons. No momento em que o bioma é extinto, outro ocupa seu lugar e este pode ser formado por espécies muito distintas, adaptadas ao novo ambiente, ou que apresentam maior capacidade de se adaptar devido à grande plasticidade fenotípica, como no caso de espécies generalistas.

Pesquisas futuras serão direcionadas para o estudo da história da diversificação de outras linhagens de plantas que apresentam padrões de distribuição semelhantes ao observado em *Adesmia*. O conhecimento mais amplo sobre os táxons diversificados nos campos do sul do Brasil permitirá compreender os processos históricos que levaram à formação dos biomas atuais. A análise destes processos será importante também para auxiliar na tomada de decisões de caráter conservacionista, sobre a melhor forma de preservar as linhagens relictuais que compõe a paisagem atual do sul do Brasil.

Estas análises serão direcionadas para compilar os dados sobre os principais eventos históricos geológicos e climáticos que levaram às conexões florísticas entre as formações campestres do sul da América do Sul, preenchendo as lacunas no conhecimento sobre a descontinuidade entre as formações vegetacionais atuais. O estudo buscará evidências sobre ambas as linhagens vegetais e animais que apresentam padrões de diversificação e distribuição geográfica similares aos destacados no presente trabalho, permitindo inferir sobre as influências das alterações climáticas como principal hipótese para explicar eventos de dispersão e de vicariância que promoveram a diversificação da biota ao longo do tempo.

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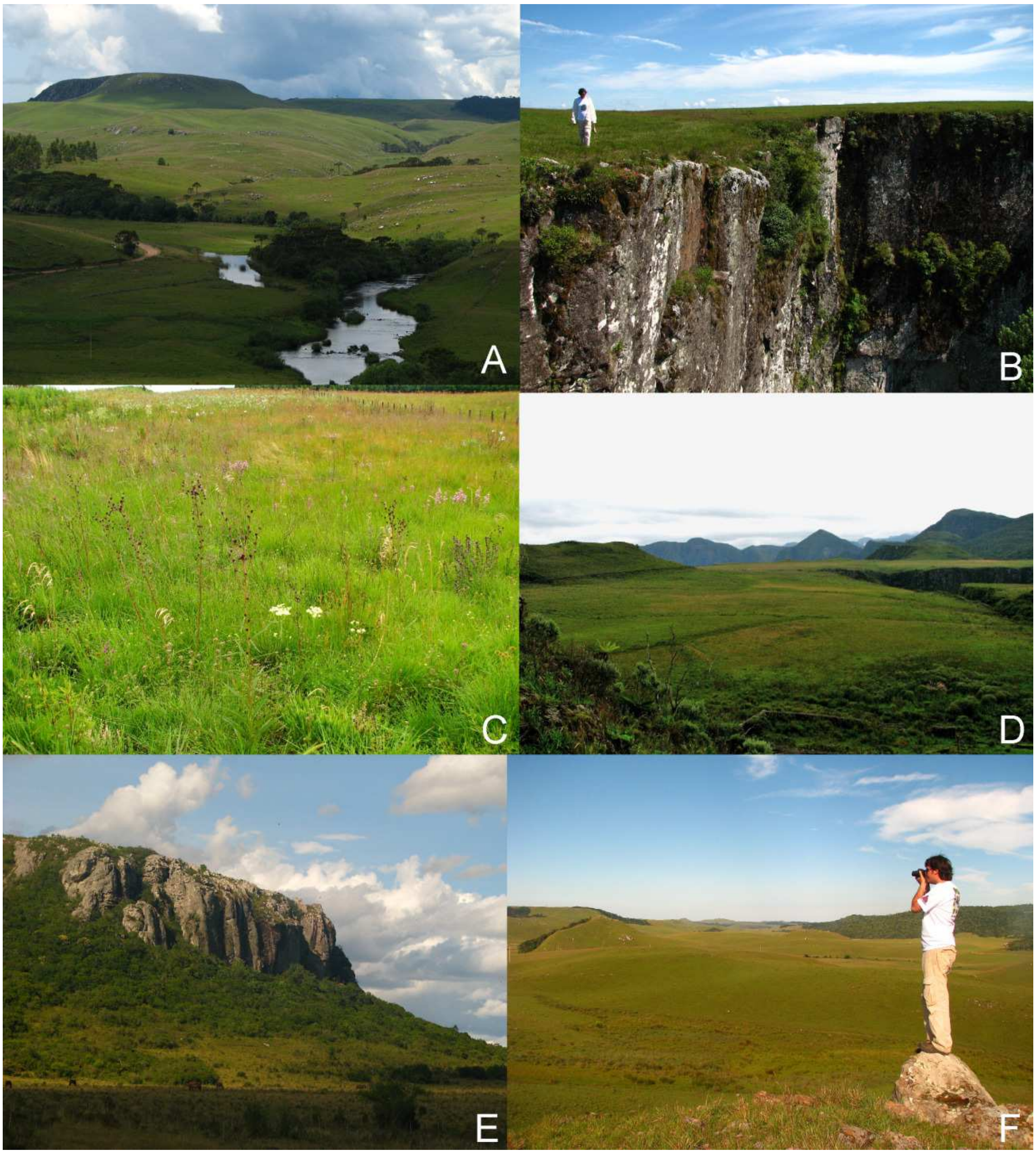
Anexos

Anexo 1. Alguns exemplares de *Adesmia* ser. *Psoraleoides* Burkart. A. *Adesmia paranensis* Burkart; B. *Adesmia rocinhensis* Burkart; C. *Adesmia psoraleoides* Burkart; D. hemicraspédios de *Adesmia ciliata* Vogel; E. *Adesmia latifolia* (Spreng.) Vogel; F. *Adesmia tristis* Vogel, com destaque para os frutos eretos; G. *Adesmia ciliata* Vogel.



Anexo 2. Formações campestres ocorrentes na área de estudo. A. São José dos Ausentes, Rio Grande do Sul; B. Cânion Monte Negro, Rio Grande do Sul (Foto: G. Heiden); D. Campos de Água Doce, Santa Catarina; D. Serra do Corvo Branco, Santa Catarina; E. Minas, Departamento de Lavalleja, Uruguai; F. São José dos Ausentes, Rio Grande do Sul (Foto: G. Heiden).

Anexo 3. Área de estudo. A. Bagé, Rio Grande do Sul; B. Urubici, Santa Catarina; C. Bom Jardim da Serra, Santa Catarina (Foto: G. Heiden); D. Coleta de *Adesmia rocinhensis*, Cambará do Sul, Rio Grande do Sul (Foto: C. Siniscalchi); E. Araranguá, Santa Catariana.