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Universidade Federal de Alfenas / UNIFAL-MG
Programa de Pós-graduação – Ciências Ambientais
Rua Gabriel Monteiro da Silva, 714. Alfenas - MG CEP 37130-000
Fone: (35) 3697-4729(Coordenação) / (35) 3701-9268 (Secretaria)
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Ana Carolina Granero e Silva

The effectiveness of Conservation Units in the conservation of vascular epiphytes endemic to the Atlantic Forest

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Dissertation presented as part of the requirements for obtaining the title of Master in Environmental Sciences by the Federal University of Alfenas.

Advisors: Dr. Flavio Nunes Ramos
Dra. Glenda Mendieta Leiva

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ANA CAROLINA GRANERO E SILVA

"A efetividades da Unidades de Conservação na conservação de epífitas vasculares endêmicas da Mata Atlântica"

A Banca examinadora abaixo-assinada aprova a Dissertação apresentada como parte dos requisitos para a obtenção do título de Mestre em Ciências Ambientais pela Universidade Federal de Alfenas. Área de concentração: Ciências Ambientais.

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Prof. Dr. Flavio Nunes Ramos

Instituição: Universidade Federal de Alfenas

Prof. Dr. Marcelo Leandro Bueno

Instituição: Universidade Estadual do Mato Grosso do Sul

Dr. Adriano Costa Quaresma

Instituição: Instituto Nacional de Pesquisa da Amazônia

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Resumo

As atividades antrópicas são responsáveis por grande parte das alterações ambientais, como fragmentação e perda de habitats, extinção de espécies e mudanças climáticas. Como resultado, sérias consequências são geradas para a conservação da diversidade nos biomas. Em consequência dessas ameaças faz-se necessário a existência de ferramentas que auxiliem na conservação da fauna e flora dos biomas ao redor do mundo e uma dessas ferramentas é criação de unidades de conservação (UC) *in situ*. As UCs possuem a função de conservar habitats naturais de espécies, assegurando a manutenção de serviços ecossistêmicos relevantes que podem amenizar parte das mudanças climáticas. Epífitas vasculares são parte expressiva da flora global, com 10% de toda a riqueza de plantas vasculares, podendo chegar a até 50% em determinadas regiões (e.g., Mata Atlântica), além de muitas espécies serem bioindicadoras da qualidade do clima. O objetivo do trabalho foi verificar se as UCs presentes na Mata Atlântica estão sendo efetivas na conservação de epífitas vasculares. Utilizamos o dataset "ATLANTIC EPIPHYTES: a data set of vascular and non‐vascular epiphyte plants and lichens from the Atlantic Forest", de onde foram extraídas os dados de epífitas vasculares endêmicas. Esses dados foram relacionados com as variáveis climáticas: faixa diurna da temperatura média, isotermalidade, sazonalidade de temperatura, precipitação do mês mais seco, sazonalidade de precipitação, elevação, cobertura média de nuvens e aridez. E fizemos análises com os dados de ocorrência de todas as espécies e com a probabilidade de ocorrência de algumas espécies (>10 registros) pela modelagem de distribuição de espécies (SDM). Analisando todas as espécies só com o ocorrência, encontramos que das 842 UCs, apenas 85 (10%) possuem ocorrências das epífitas endêmicas. Por sua vez, das 992 espécies, 557 (56%) ocorrem dentro e fora das UCs, 95 (10%) espécies ocorrem apenas dentro e 340 (34%) ocorrem apenas fora das UCs. Das 212 espécies estudadas com SDM, apenas 52 (25%) delas possuem probabilidade de ocorrência dentro das UCs e atestamos que apenas 24 (11%) dessas espécies possuem a probabilidade de ocorrerem de forma simultânea nas UCs, ou seja, juntas. Já após a modelagem, analisamos a adequabilidade das espécies nas UCs e concluímos que as UCs presentes na Mata Atlântica não estão sendo efetivas na conservação das epífitas endêmicas.

Palavras-chaves: Baixa efetividades, Unidades de Conservação (UCs), Mata Atlântica, Epífitas vasculares, conservação.

Abstract

Anthropogenic activities are responsible for a large part of environmental changes, such as fragmentation and loss of habitats, species extinction and climate change. As a result, serious consequences are generated for the conservation of diversity in biomes. As a result of these threats, it is necessary to have tools to help conserve the fauna and flora of biomes around the world, and one of these tools is the creation of conservation units (UC) in situ. The UCs have the function of conserving natural habitats of species, ensuring the maintenance of relevant ecosystem services that can mitigate part of climate change. Vascular epiphytes are an expressive part of the global flora, with 10% of all vascular plant richness, reaching up to 50% in certain regions (e.g., Atlantic Forest), and many species are bioindicators of climate quality. The objective of this work was to verify if the UCs present in the Atlantic Forest are being effective in the conservation of vascular epiphytes. We used the dataset "ATLANTIC EPIPHYTES: the dataset of vascular and non-vascular epiphyte plants and lichens from the Atlantic Forest", from which data on endemic vascular epiphytes were extracted. These data were related to the climatic variables: diurnal mean temperature range, isothermality, temperature seasonality, driest month precipitation, precipitation seasonality, elevation, average cloud cover and aridity. And we did analysis with occurrence data for all species and with probability of occurrence of some species (>10 records) by species distribution modeling (SDM). Analyzing all species with only the occurrence, we found that of the 842 UCs, only 85 (10%) have occurrences of endemic epiphytes. In turn, of the 992 species, 557 (56%) occur inside and outside PAs, 95 (10%) species occur only inside PAs and 340 (34%) occur only outside PAs. Of the 212 species studied with SDM, only 52 (25%) of them are likely to occur within the CUs and we attest that only 24 (11%) of these species are likely to occur simultaneously in the CUs, that is, together. After modeling, we analyzed the suitability of species in the CUs and concluded that the CUs present in the Atlantic Forest are not being effective in the conservation of endemic epiphytes.

Keywords: Low effectiveness, Conservation Units (CUs), Atlantic Forest, Vascular epiphytes, conservation.

Sumário

1. Introdução geral

1.1. Unidades de Conservação

A Convenção sobre Diversidade Biológica (CDB) é um tratado da Organização das Nações Unidas que foi estabelecido na ECO-92, a Conferência das Nações Unidas sobre Meio Ambiente e Desenvolvimento (CNUMAD). Possui como princípios a conservação da biodiversidade biológica, o uso sustentável da biodiversidade e a repartição justa e equitativa dos benefícios provenientes da utilização dos recursos genéticos, englobando assim assuntos referentes diretamente ou indiretamente com a biodiversidade (MMA, 2018). A CDB visa auxiliar na conservação *in situ* e *ex situ*, pesquisa, treinamento, educação e conscientização pública, minimização dos impactos negativos como uso descontrolado dos recursos naturais, desmatamento, sobrepesca, poluição e degradação ambiental (CDB, 2018), estabelecendo um acordo internacional direcionado para a conservação biológica *in situ*, voltado para as Unidades de Conservação. Os objetivos da CDB são de "conservação da diversidade biológica, a utilização sustentável de seus componentes e a repartição justa e equitativa dos benefícios derivados da utilização dos recursos genéticos, mediante, inclusive, o acesso adequado aos recursos genéticos e transferência adequada de tecnologias pertinentes levando em conta todos os direitos sobre tais recursos e tecnologias, e mediante financiamento adequado" (MMA, 1994). A partir da décima primeira Conferência das Partes (COP - 11) da Convenção sobre Diversidade Biológica (CBD), foram definidas as "Metas Aichi", as quais integram o Plano de Estratégia de Biodiversidade de 2011 a 2020. As Metas de Aichi, referentes à conservação da diversidade, são a base para a implementação da conservação biológica (ONU, 2014).

Dentre as metas presentes no plano de estratégias, a meta 11 em especial assegura a cobertura das Unidades de Conservação. Pela Meta 11, em 2020, pelo menos 17% das zonas terrestres devem estar conservadas de forma eficaz e justa, sendo ecologicamente bem representadas e com um amplo sistema de Unidades de Conservação conectadas (ONU, 2014). Às Unidades de Conservação são ferramentas importantes para o processo de conservação das espécies endêmicas, porém é de suma importância que elas estejam exercendo o seu papel de conservação.

As Unidades de Conservação (UCs) são uma ferramenta importante para a conservação das espécies, evitando a perda da diversidade biológica a partir de mudanças climáticas e uso do solo(KHAROUBA; KERR, 2010). As Unidades de Conservação são

reconhecidas pelo seu papel de conservação *in situ* (CHAPE *et al.*, 2005), que é a conservação de habitats naturais de espécies e populações, assegurando a manutenção de serviços ecossistêmicos (BRASIL, 2011a). Auxiliam na proteção das espécies das ações antrópicas, diretas ou indiretas como processos de fragmentação e perda de habitats (RIBEIRO, BRUNO R. *et al.*, 2016). Além da conservação, essas áreas minimizam as alterações climáticas em seu interior, devido a sua heterogeneidade de habitats e diferentes condições microclimáticas (LOVEJOY, 2006a; SUNDAY *et al.*, 2014).

No Brasil as unidades de conservação (UCs) fazem parte do Sistema Nacional de Unidades de Conservação (SNUC), que foi implementada a partir da Lei nº 9.985 de 2000. As UCs são divididas em 12 categorias, que são distribuídas aos dois tipos de UCs. As unidades de conservação podem ser: I) Proteção Integral, que engloba as categorias de Estações Ecológicas, Reservas Biológicas (REBIO), Parque Nacional (PARNA), Monumentos Naturais e Refúgios da Vida Silvestre; II) Uso Sustentável, que engloba as categorias de Unidades de Conservação Ambiental (APA), Áreas de Relevantes Interesse Ecológico (ARIE), Floresta Nacional (FLONA), Reservas Extrativistas (RESEX), Reserva de Fauna (REFAU), Reserva de Desenvolvimento Sustentável (RDS), Reserva Particular de Patrimônio Natural (RPPN) (BRASIL, 2011b). As Unidades de Conservação Integral possuem como objetivo principal a conservação da natureza, tendo regras mais restritas ao uso dos recursos nelas presentes; Unidades de Uso Sustentável possuem o objetivo de aliar o uso sustentável dos recursos naturais com a sua conservação, ocorrendo o uso direto dos recursos (MMA-SNUC-PNAP, 2006). Sendo uma ferramenta indispensável na manutenção do equilíbrio das atividades e sistemas.

A superfície terrestre e a maior parte dos ecossistemas da Terra sofreram alterações diretas e indiretas por parte das ações antrópicas (remodelados, reestruturados e reorganizados pelo homem) e em grande parte resultaram em degradação do meio ambiente (GASTON *et al.*, 2008; IPBES, 2016). Atividades antrópicas como mineração, superexploração de espécies economicamente interessantes, expansão de espécies invasoras e mudanças climáticas (MARTINELLI, MORAES, 2013; HERINGER *et al.*, 2019) têm transformado florestas contínuas em remanescentes florestais cercados por paisagens antrópicas, como pastagem, agricultura e mesmo cidades (TABARELLI *et al.*, 2012). Os avanços dessas atividades são responsáveis pela degradação de mais de 60% do meio ambiente que auxilia na preservação de recursos, florestas e rios, e, por consequência, acarretam em alterações climáticas e desastres naturais (CAO; PENG; LIU, 2015). As alterações nas paisagens naturais apresentam séria ameaça para a conservação da biodiversidade das florestas, visto que pequenos

fragmentos não possuem a capacidade de conservação das espécies e de manutenção dos serviços ecossistêmicos essenciais para a vida humana (TABARELLI *et al.*, 2012).

Devido a essas mudanças, a taxa de extinção aumentou drasticamente e aproximadamente 60% dos serviços ecossistêmicos estão sendo insustentáveis e constantemente destruídos, criando uma situação grave para a proteção ecológica (MEA, 2005; CAO; PENG; LIU, 2015). Além disso, o cenário global (extinção, declínio da abundância de espécies, perda de habitat, mudanças na distribuição, etc.) indica que a biodiversidade continuará em declínio ao longo do século 21 (PEREIRA *et al.*, 2010).

Devido a essas ameaças, são necessárias ferramentas que auxiliem a conservação da flora e da fauna dos biomas ao redor do globo terrestre, como as Unidades de Conservação (UCs). Unidades de Conservação permitem a conservação *in situ*, que é a conservação das espécies e populações em seu habitat natural, garantindo a manutenção dos serviços ecossistêmicos relevantes para a população humana (BRASIL, 2011a). Os serviços relevantes para a sobrevivência do homem são a garantia da produção alimentar, madeira, bioenergia e água limpa; além de o papel regulador que o meio ambiente exerce, como manutenção do clima, fluxo e qualidade da água, qualidade do solo, polinização, pestes e doenças (IPBES, 2016), a boa conservação do meio ambiente e de seus serviços garantem ao homem uma boa qualidade de vida. No entanto, a criação das Unidades de Conservação nem sempre foram voltadas para a preservação da biodiversidade (LOUCKS *et al.*, 2008), grande parte delas foram criadas em áreas com baixa produtividade ou em áreas próximas de atividades antrópicas (PRESSEY *et al.*, 2002), que abrigam diversidade e serviços ambientais reduzidos.

Unidades de Conservação ajudam na proteção de espécies e na mitigação dos efeitos causados por distúrbios antrópicos, como perda de habitat, fragmentação e alterações climáticas (RIBEIRO, BRUNO R. *et al.*, 2016). Devido às mudanças climáticas, diversas espécies podem ser expostas a condições climáticas que excedam a tolerância fisiológica, levando-as ao estresse (RIBEIRO, BRUNO R. *et al.*, 2016), resultando na redução da população e até mesmo na extinção (HUEY *et al.*, 2012). Além disso, devido à heterogeneidade de habitats e às diversas condições microclimáticas nas UCs, elas são protegidas dos efeitos das mudanças climáticas (LOVEJOY, 2006a; SUNDAY *et al.*, 2014). No entanto, as mudanças climáticas podem causar diversas implicações ao longo do tempo para as espécies nas UCs, uma vez que cada espécie responde de formas distintas às mudanças (LOVEJOY, 2006b), resultando na diminuição e até na extinção das espécies mais sensíveis. Nem todas as UCs possuem eficácia na conservação das espécies. Se as unidades de conservação não conseguem manter as espécies com populações viáveis para o futuro, a crise

da biodiversidade pode atingir níveis sem precedentes (LOYOLA, RAFAEL D *et al.*, 2012). Esta é a razão pela qual existem maiores preocupações em relação à eficácia das UCs e respostas em relação às mudanças climáticas.

O Brasil possui um dos maiores sistemas de Unidades de Conservação, porém não há uma homogeneidade na distribuição dessas áreas pelos biomas (PACHECO; NEVES; FERNANDES, 2018), acarretando na falta de conectividade entre elas. Na teoria, as UCs são indicadores válidos para definir a diminuição da perda da biodiversidade e o progresso da conservação, porém elas indicam apenas um compromisso político superficial para com a conservação da biodiversidade (CHAPE *et al.*, 2005). Visto que há uma preocupação científica de que as UCs existentes não sejam capazes de garantir a preservação a longo prazo das espécies existentes nelas (SCOTT *et al.*, 2001; AITKEN *et al.*, 2008), devido alterações climáticas e nos usos do solo, levando a necessidade de avaliar a efetividade das áreas e o que pode ser feito para melhorar essa capacidade.

1.2. Efetividade das Unidades de Conservação

Com essa mesma preocupação, a comunidade científica está trabalhando para avaliar a efetividade das UCs e as alterações que podem ocorrer ao longo do tempo. Existem trabalhos que mediram a efetividade das UCs através de processos de desmatamento (RIBEIRO, BRUNO R. *et al.*, 2016), uso do solo (FIGUEROA; SÁNCHEZ-CORDERO, 2008) e subsistência antrópica ao redor (COAD *et al.*, 2008), assim como através da riqueza das espécies, como de: (i) plantas, como espécies vasculares endémicas (SALINAS-RODRÍGUEZ *et al.*, 2018), samambaias e licófitas (HERINGER *et al.*, 2020), espécies de plantas ameaçadas (RIBEIRO, BRUNO R. *et al.*, 2018) ou (ii) animais, como borboletas (KHAROUBA; KERR, 2010) mariposas (FERRO *et al.*, 2014), vertebrados em geral (RIGGIO *et al.*, 2019), anfíbios (LEMES; MELO; LOYOLA, 2014), répteis (NORI *et al.*, 2018) aves (BARNES *et al.*, 2015), e grande carnívoros (TERRAUBE *et al.*, 2020), e vertebrados em geral (RIGGIO *et al.*, 2019).

Existem 15 artigos publicados que mediram as efetividades das UCs através da riqueza das espécies: três estudaram em âmbito global (RODRIGUES *et al.* 2004, GRAY *et al.*, 2016; NORI *et al.*, 2015), um no continente Africano (RIGGIO *et al.*, 2019)e os demais foram em diferentes países: a) nas Américas (Brasil, Canadá e México), b) Europa (Finlândia), e c) Oceania (Austrália). Todos eles utilizaram grids ou polígonos em suas análises e compararam o número de espécies dentro e fora das Unidades de Conservação (LEMES; MELO; LOYOLA, 2014, COAD *et al.*, 2008, FIGUEROA;

SÁNCHEZ-CORDERO, 2008, KHAROUBA; KERR, 2010, BARNES *et al.*, 2015, FERRO *et al.*, 2014, RIBEIRO *et al.*, 2018, RIGGIO *et al.*, 2019, TERRAUBE *et al.*, 2020, HERINGER *et al.*, 2020). Cada trabalho fez uso de modelos de distribuição de espécies (SDM) com espécies de grupos taxonômicos diferentes e variáveis ambientais tanto do presente quanto do futuro, assim como métodos distintos para auxiliar na compreensão das efetividades das Unidades de Conservação.

Coad *et al.* (2008), visa avaliar as consequência de atividades de subsistência nas redes de unidades de conservação, a fim de informar a redução das emissões CO2 através do desmatamento e degradação ambiental (REED). É possível vermos os conflitos existentes entre as comunidades residentes e os gestores dessas áreas, devido às categorias dessas unidades e a desigualdades na divisão dos recursos naturais. Foi possível avaliar que, em unidades de uso sustentável, esses conflitos são menores, porém depende da gestão presente nelas. A alternativa para que essas situações diminuam e com o tempo desapareçam, seria o envolvimento das comunidades locais no planejamento e implementação das REED, e garantir que os benefícios, financeiros ou não, sejam compartilhados. O maior envolvimento das comunidades pode resultar em um processo de soluções sustentáveis maior, no processo de desmatamento.

Figueroa; Sanchez-Cordeiro (2008), avaliou a efetividade das unidades de proteção no México para mudanças como o uso / cobertura da terra, consideradas como uma das causas da degradação ambiental. Desenvolveram um índice de eficácia, no qual incluía a porcentagem de NPA (Áreas Naturais Protegidas). As NPAs são áreas que foram transformadas de alguma forma, como: agricultura, vegetação induzida (pastagem), plantações florestais e assentamentos humanos. Foram avaliadas mudanças ao longo do tempo dentro das NPA, ao redor delas e entre elas, ao longo de 9 anos (1993 à 2002). Foi avaliado que mais de 54% dos NAPs foram eficazes na proteção. Eles foram distribuídos de forma heterogênea por categorias de manejo, sendo: 65% das Reservas da Biosfera, 53% das Unidades de Conservação da Flora e Fauna e 45% dos Parques Nacionais. Dentre os 46% dos NAPs restantes, 23% foram considerados fracamente eficazes e os 23% restantes como não eficazes. Os autores reconheceram a importância das NAPs no processo de conservação, pois tiveram um papel significativo para evitar a perda de vegetação natural.

Kharouba and Kerr (2010) mediram a riqueza das espécies de borboletas no Canadá, tanto em UCs quanto em áreas não protegidas, ecologicamente semelhantes utilizando o método de modelagem Maxent em duas épocas diferentes, entre 1900 e 1930 e entre 1960 e 1990. Os autores avaliaram que as alterações de riqueza e composição de espécies foram

semelhantes nas áreas protegidas e não protegidas. Concluíram que as Unidades de Conservação no Canadá fornecem pouca proteção para os impactos das mudanças climáticas na riqueza de espécies de borboletas. As Unidades de Conservação são indispensáveis para a conservação da biodiversidade biológica, porém elas se mostraram incapazes de manter o habitat para evitar que as mudanças climáticas afetassem as espécies de forma extrema.

Ferro *et al.* (2014) modelaram a riqueza de Mariposas nas UCs presentes na Mata Atlântica Brasileira para 2080, de acordo com o cenário das mudanças climáticas. Eles utilizaram modelos apenas de presença (Euclidianas e Gower, Análise de Fator de Nicho Ecológica (ENFA), Entropia Máxima (MaxEnt), Algoritmo Genético para Produção de Conjunto de Regras (GARP) e Redes Neurais Artificiais (ANN)), através de grids (10kmx10 km resolução espacial). Foram considerados para o estudo aqueles grids que possuem mais de cinco ocorrências da espécie. Os modelos indicaram que no presente e futuro as áreas com maior riqueza da espécie são o centro e sul da Mata Atlântica. Porém, é estimado que em 2080, essas áreas serão inadequadas climaticamente, acarretando na diminuição da distribuição das espécies.

Nori *et al.* (2015) mensuraram a efetividade das UCs no Mundo para os anfíbios, sobrepondo os polígonos dos modelos de distribuição (SDM) de espécies e das UCs. Utilizaram ferramentas de seleção por localização no ArcGis 10.2, para analisar as espécies que possuíam a sua distribuição sobreposta às UCs e também analisar as consequências de alterações antrópicas em áreas de distribuição das espécies que não eram protegidas. Revelaram que aproximadamente 25% das espécies de anfíbios permanecem desprotegidos fora de UCs. Alguns continentes com espécies de lacunas, ou seja, aquelas com distribuição totalmente fora de UCs como América Latina, Ásia e África, estão sofrendo com os impactos das atividades humanas. Ressaltando que modificações contínuas das paisagens pelo homem podem afetar negativamente e serem irreversíveis.

Barnes *et al.* (2014) mediram a efetividade das UCs na conservação de espécies de aves endêmicas na Austrália. Para avaliar os impactos e as tendências de prevalência das espécies utilizaram a Análise de Comprimento de Lista (LLA), a regressão logística Bayesiana e a amostragem de Monte Carlo da cadeia de Markov (MCMC) para estimar a probabilidade de uma espécie ocorrer em uma lista em função do comprimento da lista e do ano de levantamento. Concluíram que as unidades de conservação presentes nos trópicos úmidos apresentam melhores condições para a sobrevivência das espécies. Porém, ao longo do tempo as aves presentes nas unidades de conservação não estarão em melhor condição que

as aves presentes nas áreas não protegidas, contanto que que as florestas ao redor sejam mantidas intactas.

Gray *et al.* (2016) calcularam a razão entre a riqueza dentro e fora das UCs e a influência dos diferentes tipos de uso do solo através do modelo linear generalizado de efeito misto (GLMM), através de um banco de dados da biodiversidade global. Avaliaram que a riqueza e abundância de espécies globais são maiores em unidades de conservação do que nas não protegidas, reforçando a importância global das UCs. Porém elas não beneficiam espécies com pequenas extensões ou aumentam a variedades dos nichos ecológicos.

Ribeiro *et al.* (2018), mediram a eficiência das unidades de conservação (UCs) e territórios indígenas (TIs) na proteção de espécies de plantas em risco de extinção no Brasil. Os autores fizeram polígonos de cada espécie de plantas com risco de extinção e através da sobreposição desses polígonos e das UCs e TIs eles consideraram efetivas as áreas que apresentaram registros das espécies ou quaisquer extensão dos polígonos sobre as áreas de UCs ou TIs. Avaliaram que 33% das espécies ameaçadas de plantas conhecidas estão presentes fora de Unidades de Conservação.

Salinas-Rodrigues *et al.* (2018), para mensurar a efetividades das UCs para as plantas endêmicas vasculares da Sierra Madre Oriental (SMOr) no México utilizaram as recomendações da União Internacional para a Conservação da Natureza e a Estratégia Global de Conservação de Plantas 2011-2020 (SHARROCK *et al.* 2014), que considera eficaz as UCs que possuem pelo menos 10% de cada espécies endêmica dentro das UCs. Foram identificados os hotspots através dos padrões de distribuição da modelagem Maxent, e utilizaram o Marxan para reconstrução de um mapa para propor novas Unidades de Conservação que abrange um maior número de espécies endêmicas. Concluíram que ao considerar 10% da distribuição geográfica de cada espécie endêmica estudada, 66% das espécies endêmicas estão presentes nas unidades de conservação. É uma porcentagem aceitável, mas exclui um número considerável de espécies, portanto o trabalho sugere o reconhecimento de mais dez áreas que possam ser promissoras na conservação desse grupo de 34% restantes de espécies endêmicas a serem conservadas.

Riggio *et al.* (2019), mediram as representatividades de espécies de vertebrados endêmicos nos UCs da África Ocidental. Para isso modelaram a distribuição de cada uma das espécies para gerar um mapa de riqueza. Mediram a eficiência das UCs a partir da quantidades de terras que foram convertidas em usos antrópicos a partir de grids de 0,01º x 0,01º. Concluíram que as unidades de conservação protegem cerca de 10% das espécies endêmicas de vertebrados terrestres, porém 37% das áreas de distribuição dessas espécies não

possui 10% de cobertura por UCs e apenas 26% das espécies endêmicas têm pelo menos metade de sua distribuição coberta por UCs. Avaliaram que apenas 6,8% das áreas protegidas da África Oriental foram convertidas para a agricultura ou outro uso humano desde a desclassificação. Apenas 1,6% das Unidades de Conservação integral foram convertidas, fornecendo evidências muito fortes de que a proteção integral é a forma mais duradoura de salvaguardar o habitat.

Heringer *et al.* (2020) mediram a efetividade das UCs para conservação de samambaias e licófitas em Minas Gerais, no Brasil. Para isso compararam a quantidade de espécies que foram estimadas a partir de dados do herbário e coletas pelo autor, que haviam exclusivamente dentro e fora das UCs e em ambos, sendo consideradas efetivas quando há maior número de espécies dentro das UCs. Avaliaram que o número de espécies é maior dentro das unidades de conservação, e esse número é maior quando consideraram apenas as espécies ameaçadas. A partir da curva de rarefação, obtiveram que nas Unidades de Conservação há uma maior riqueza de espécies, inclusive das ameaçadas.

Terraube *et al.* (2020) mediram os impactos gerados pelas UCs em espécies de grandes carnívoros silvestres na Finlândia. Selecionaram 1220 áreas sendo 610 protegidas e 610 não protegidas para testar a efetividade na proteção de grandes carnívoros. Para isso utilizaram um buffer de 1km, onde o centróide foi fixado no centro das UCs. Consideraram UCs protegidas, as áreas que o buffer de 1km cruzassem com polígono que representa as UCs. O GLMMadaptive foi utilizado para gerar modelos para avaliação dos impactos ao redor das UCs que afetam a riqueza das espécies de carnívoros. Foram revelados uma baixa diferença na densidade de carnívoros em áreas protegidas e não protegidas na Finlândia. Esse resultado revela padrões complexos de interação entre lacunas na aplicação da lei, pressão de caça e disponibilidade de presas.

A efetividade das UCs não pode ser avaliada apenas através do seu número e de suas dimensões, são necessários outros parâmetros para essa medição como riqueza de espécies, permanência de espécies e presença de recursos. Visto que ao longo das mudanças climáticas grande parte das UCs irão se tornar climaticamente inadequadas, acarretando na diminuição de espécies nelas presentes (FERRO *et al.*, 2014). São necessários estudos, para melhor compreensão dessa ferramenta e as respostas das espécies nelas presentes. As plantas são um grupo vasto nessas áreas, sendo um alvo importante para serem utilizados nas análises para melhor compreensão dessas Unidades de Conservação Ambiental.

1.3. Mata Atlântica

O bioma da Mata Atlântica nos anos de 1500 cobria aproximadamente 15% do território brasileiro, e é considerado um Patrimônio Nacional pela Constituição Federal e que abrange 17 Estados brasileiros e mais de 3 mil municípios total e parcialmente (APREMAVI, 2021), além de parte dos territórios da Argentina, Paraguai e Uruguai. A Mata Atlântica, também abrange bacias hidrográficas dos rios Paraná, Uruguai, Paraíba do Sul, Doce, Jequitinhonha e São Francisco (WWF, 2021), é também dentre os biomas brasileiros, o único que não possui maior parte da sua cobertura natural, e abriga cerca de 49,3% das áreas urbanas nacionais (IBGE, 2020) abriga aproximadamente 72% da população brasileira e possui cerca de 12,4% da sua floresta original, sendo que 80% dessas remanescentes são em áreas privadas (SOS & INPE, 2019). O bioma possui uma grande heterogeneidade em sua composição abrangendo diferentes zonas climáticas e composições florestais (TABARELLI *et al.*, 2006), e possui uma alta riqueza de biodiversidade, sendo apontado como um dos hotspots do mundo (MITTERMEIER *et al.*, 2011), e está presente em grande parte do litoral brasileiro.

A Mata Atlântica é a segunda maior floresta pluvial tropical presente no continente americano, que originalmente cobria de forma contínua a costa brasileira (TABARELLI *et al.*, 2006). Noventa e cinco por cento do bioma ocorre no Brasil, mas ele também ocorre na Argentina, Paraguai e Uruguai (RIBEIRO *et al.*, 2009). Sua área original correspondia a aproximadamente 1,300.000km², constituída por florestas, restingas, manguezais e campos de altitude (ICMBIO, 2019). A Mata Atlântica abrange uma vasta variedade de zonas climáticas e fitofisionomias (TABARELLI *et al.*, 2006), como Floresta Ombrófila Densa, Floresta Ombrófila Mista, Floresta Ombrófila Aberta, Floresta Estacional Semidecidual, e Floresta Estacional Decidual. As altitudes ao longo desse Bioma variam do nível do mar até acima de 2800m (RIZZINI, 1979; MANTOVANI, 2003) e as áreas mais elevadas e costeiras podem chegar a 4000 mm de precipitação média anual em alguns trechos.

1.4. Epífitas

As epífitas funcionam como um fonte de nutrientes para a fauna arbórea e para a vegetação, possuem um papel importante na produtividade primária e na ciclagem de nutrientes dos ecossistemas (PETEAN *et al.*, 2018), além de influenciar no microclima dos dossiês e na dinâmica da água (NADKARNI, 1984). As epífitas desempenham um papel fundamental nas interações ecossistêmicas nas florestas tropicais úmidas, principalmente em processos que afetam o balanço da água e a ciclagem de nutrientes da floresta (COXSON; NADKARNI, 1995). Elas são as maiores fontes de comida e hábitats para UCs, mamíferos,

anfíbios, invertebrados e microorganismos (REMSEN; PARKER, 1984; NADKARNI; MATELSON, 1989) e auxiliam na diversidade dos ecossistemas por meio de suas interações com outra biota (YANOVIAK; NADKARNI; SOLANO, 2007). E no ecossistema, elas podem fornecer abrigo e materiais de nidificação para algumas espécies de insetos e pássaros, além de serem fontes de alimento para vários animais forrageiros (COXSON; NADKARNI, 1995; STUNTZ *et al.*, 2002).

As epífitas representam 10% de toda a flora vascular do mundo (ZOTZ, GERHARD *et al.*, 2021), e aproximadamente 78% das espécies de epífitas vasculares são endêmicas da Mata Atlântica (FREITAS *et al.*, 2016), sendo uma espécie de alta representatividade neste bioma.Visando compreender a efetividade das Unidades de Conservação presentes na Floresta da Mata Atlântica para a conservação das espécies de epífitas endêmicas e as alterações geradas a partir das mudanças climáticas, o principal objetivo deste trabalho foi: I) Avaliar a efetividades das Unidades de Conservação (UCs) implantadas na Mata Atlântica na conservação de epífitas endêmicas.

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Chapter 1

1. The effectiveness of Conservation Units in the conservation of vascular epiphytes endemic to the Atlantic Forest

Conservation Units (CUs) were defined by the International Union for the Conservation of Nature (IUCN) as established geographic spaces that are recognized and governed by laws or documents. They have important natural, cultural or ecological value to be preserved and were identified by the IUCN based on their main goals and management methods (JAMES; KEVIN; BALMFORD, 1999). The CUs have the objective of in situ conservation (CHAPE *et al.*, 2005), that is, protection of the fauna and flora present in the biomes that they occur naturally. They provide protection for the conservation and maintenance of species, populations, habitats and ecosystem services against anthropic actions (BRASIL, 2011; RIBEIRO, *et al.*, 2016). In Brazil, PAs are part of the National System of Conservation Units (SNUC) divided into two types, which are: Integral Protection Areas and Sustainable Use Areas. They are heterogeneously distributed throughout the biome (PACHECO; NEVES; FERNANDES, 2018) and vary in size and shape. They are an indispensable tool in the conservation of diversity hotspots and forest remnants, being indispensable in the process of maintenance and conservation of the world's fauna and flora.

Studies to assess the effectiveness of CUs in the conservation of species are extremely important, but more studies are needed to better understand the CUs and the biodiversity present in them. Existing studies assess the effectiveness of CUs against changes in land use and land cover (FIGUEROA; SÁNCHEZ-CORDERO, 2008) and in maintaining the richness of some groups of: (i) plants, such as endemic vascular species (SALINAS-RODRÍGUEZ *et al.*, 2018), ferns and lycophytes (HERINGER *et al.*, 2020), endangered plant species (RIBEIRO, BRUNO R. *et al.*, 2018) or (ii) animals such as butterflies (KHAROUBA; KERR, 2010), moths (FERRO *et al.*, 2014), amphibians (LEMES; MELO; LOYOLA, 2014), reptiles (NORI *et al.*, 2018), birds (BARNES *et al.*, 2015), large carnivores (TERRAUBE *et al.*, 2020), and vertebrates in general (RIGGIO *et al.*, 2019). Some of these studies indicate that CUs are essential areas for the conservation and maintenance of species, (FIGUEROA; SÁNCHEZ-CORDERO, 2008; GRAY et al., 2016; RIBEIRO et al., 2018; RIGGIO et al., 2019; SALINAS- RODRÍGUEZ et al., 2018; TERRAUBE et al., 2020; HERINGER et al., 2020), but if human activities do not decrease, the effectiveness of these areas may be compromised (BARNES et al., 2015; NORI et al., 2015). On the other hand, some studies showed that some CUs are not efficient in the protection and conservation of species and

habitats of some groups of plants and animals (KHAROUBA; KERR, 2010; FERRO et al., 2014).

A biome that has been degraded for generations and needs its CUs to be efficiently protected is the Atlantic Forest (Figure 1), due to the process of disorderly destruction and territorial occupation, in addition to the unrestrained exploitation of natural resources (PINTO *et al.,* 2004). This biome is among the 34 global hotspots, with high biodiversity and endemism rate (MITTERMEIER *et al.*, 2011; OLIVEIRA *et al.*, 2017). It currently has only about 12.4% of its original vegetation cover (INPE, 2019), a consequence of a continuous degradation process. These changes in the biome lead to changes in the dynamics of fauna and flora communities (MORELLATO; HADDAD, 2000), requiring more and more a greater structuring and awareness of the importance of their CUs. There are currently 2446 Conservation Units in Brazil, discontinuous and fragmented, in the Municipal, State and Federal spheres (MMA, 2019). The Atlantic Forest biome has about 842 UCs (https://mUCs.csr.ufmg.br/) (Figure 2). Therefore, the objective of this work is to evaluate the effectiveness of the Atlantic Forest Conservation Units for the conservation of endemic vascular epiphyte species.

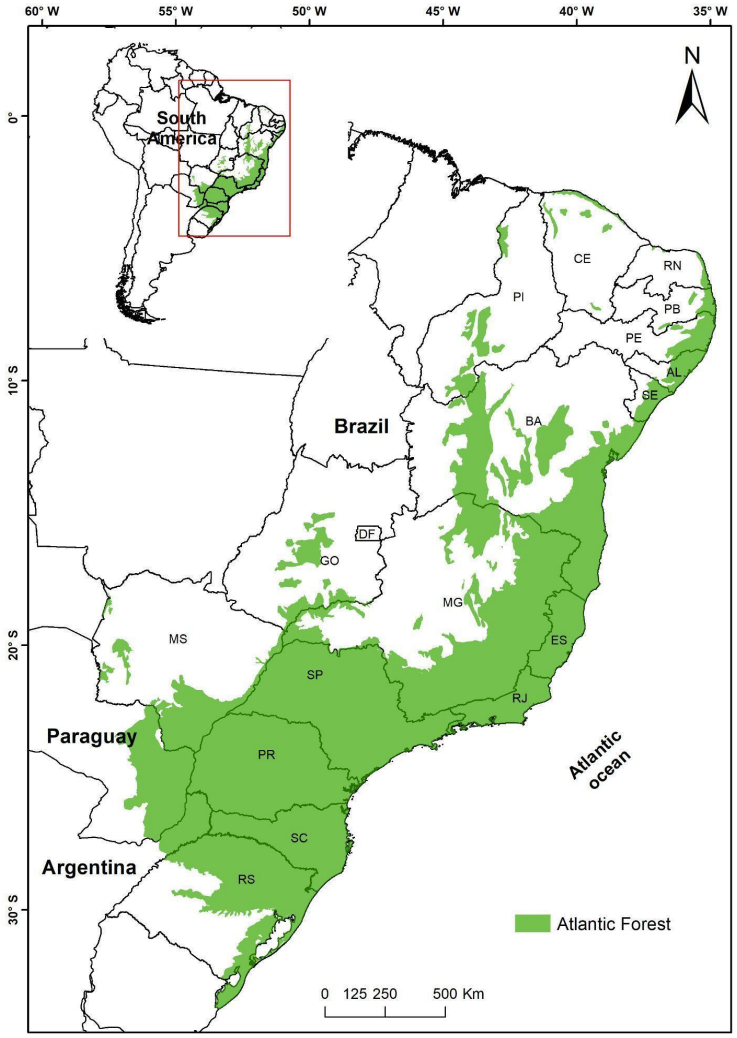

Figure 1 – Map of South America showing the distribution of the Atlantic Forest biome in Paraguay, Argentina and the States of Brazil.

Vascular epiphytes are represented by 31,311 species, from 79 families, characterizing 10% of the worldwide vascular flora (ZOTZ, GERHARD *et al.*, 2021). In the Atlantic Forest there are about 2200 species, of which about 78% are endemic (FREITAS *et al.*, 2016). In addition to being highly representative, epiphytes provide resources for other species (BARTELS; CHEN, 2012), serve as reproductive refuges (BENZING, 1986) and some species are considered bioindicators of ecosystem quality and productivity (JOVAN; MCCUNE, 2006; MCCUNE, 2000), since they are dependent on good environmental conditions such as shade, humidity and substrate (AMPARO *et al.*, 2003). Due to these characteristics, they are an important group for studies on the ecology and conservation of ecosystems (ZOTZ, GERHARD, 2013). Thus, the present work aims to quantify the degree of

effectiveness of conservation of protected areas to protect species of vascular epiphytes endemic to the Atlantic Forest.

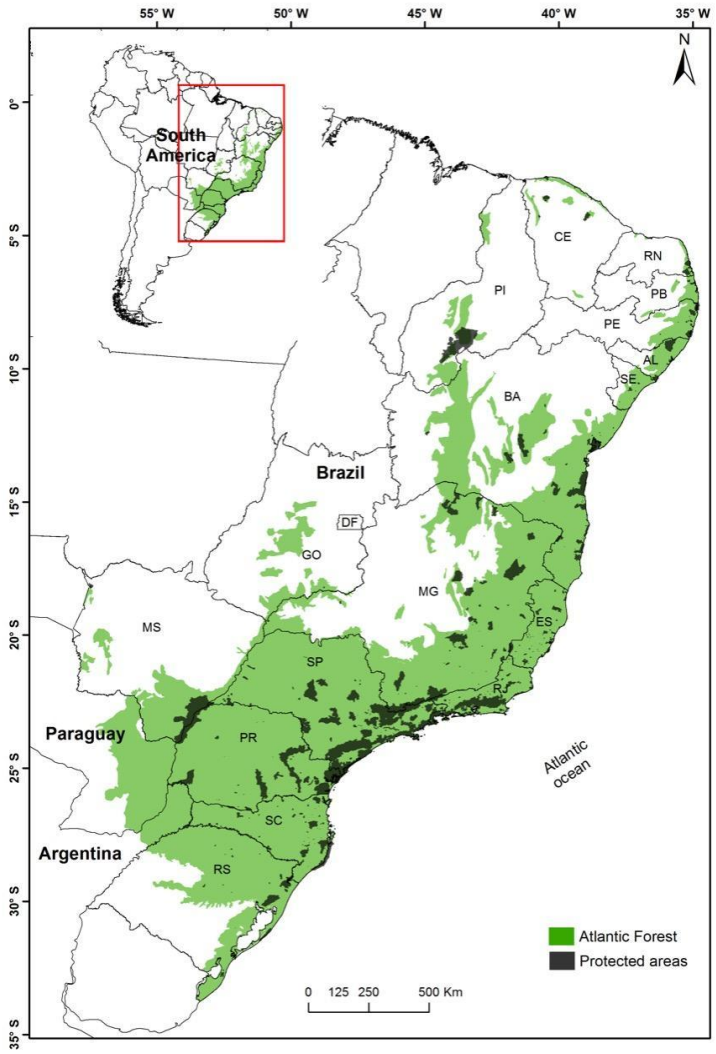

Figure 2 – Map of South America showing the Atlantic Forest biome and the distribution of Conservation Units analyzed in this study.

2. Materials and methods

a. Study area

The study area corresponds to the Atlantic Forest, which fully or partially covers 17 Brazilian states, from Piauí to Rio Grande do Sul (FERREIRO, 2017) and also covers parts of the territories of Argentina, Paraguay and Uruguay (RIBEIRO *et al.*, 2009). The Atlantic Forest covers a wide variety of climatic zones and phytophysiognomies (TABARELLI *et al.*, 2006), such as Dense Ombrophilous Forest, Mixed Ombrophilous Forest, Open Ombrophilous Forest, Seasonal Semideciduous Forest, and Seasonal Deciduous Forest. The

altitudes along this Biome vary from sea level to above 2800m (RIZZINI, 1979; MANTOVANI, 2003) and the highest and coastal areas can reach 4000 mm of average annual precipitation in some stretches. The Atlantic Forest is the second largest tropical rainforest present on the American continent, which originally covered the Brazilian coast continuously (TABARELLI et al., 2006). Ninety-five percent of the biome occurs in Brazil, with the remainder of the percentage distributed in other Latin American countries (RIBEIRO et al., 2009) mentioned above. Its original area corresponded to approximately 1,300,000km², consisting of forests, sandbanks, mangroves and high altitude fields (ICMBIO, 2019). Compared to Brazilian biomes, the Atlantic Forest is the one with the lowest percentage of its original cover (IBGE, 2020), with the conservation of vegetation cover being approximately 12.4% of its original forest (SOS & INPE, 2019).

In Brazil, Conservation Units are part of the National System of Conservation Units (SNUC), which was regulated in July 2000 by Federal Law Nº. 9985 and is divided into two categories being Integral Protection (IUCN categories I, II and II), where there is no direct anthropic action and its main objective is the conservation of biodiversity; and Sustainable Use (IUCN categories IV, V and VI), in which natural resources are exploited in a controlled manner and biodiversity conservation is secondary (RYLANDS; BRANDON, 2005). Present in the Atlantic Forest biome, there are 842 Conservation Units. We used the categories of Integral Protection, Sustainable Use and Indigenous Lands, aiming to analyze the conservation of these CUs present in the biome, and their role in the conservation of endemic vascular epiphytes. Data from the CUs were obtained from the website of the Federal University of Minas Gerais (https://mUCs.csr.ufmg.br/). And to quantify the effectiveness of these Conservation Units, we overlay the suitability maps obtained from the Species Modeling and Distribution (SDM) analysis with the limits of Conservation Units and extract this suitability of the species within the limits.

b. Sampling and Statistical Analysis

i. Data on Endemic Vascular Epiphytes

Data from the Atlantic Forest epiphytes were obtained from the database of RAMOS et al. (2019). This database consists of both previously published data (comprising peer-reviewed articles, books, and theses) and unpublished data. Epiphyte records are: (i) random or non-systematic (herbarium) collection (presence-only: 78%) and (ii) inventories

(presence-absence and abundance: 22%). For the analysis of this dissertation, the database with 2,095 species, with 89,270 holo/hemiepiphytes original records was filtered in four steps: 1) we removed the duplicate records; 2) we restricted collection records from the year 1980 (majority), to avoid temporal bias; 3) we removed the species of vascular epiphytes not endemic to the Atlantic Forest, according to FREITAS et al., (2016) leaving 992 species with 8,813 records (Figure 3) and for the SDM analysis there was 4) we removed the species with less of 10 records within the cells, to increase the reliability of the model, thus leaving 212 species and 2,857 records (Figure 4). In a brief evaluation of the data, we obtained that the occurrence of species are mostly close to the coast.

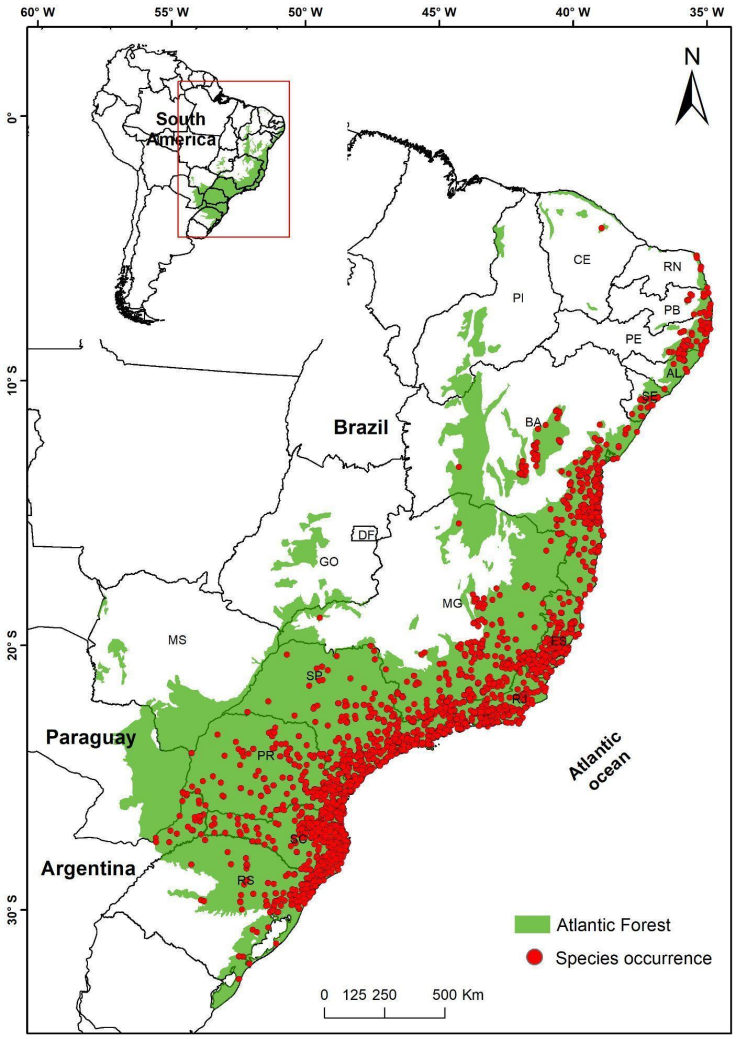

Figure 3 – Map of South America showing the Atlantic Forest biome and the distribution of 992 species of endemic vascular epiphytes with 8,813 records.

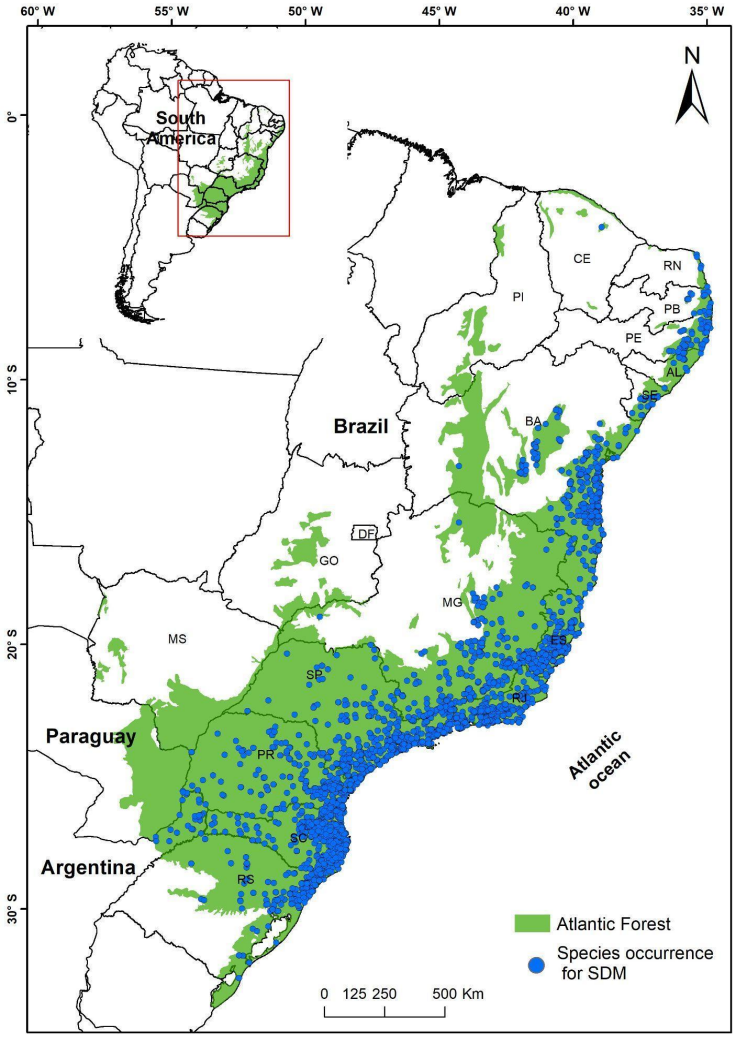

Figure 4 – Map of South America showing the Atlantic Forest biome and the distribution of the 212 species of endemic vascular epiphytes with 2,857 records that were filtered for the Species Modeling and Distribution analysis.

ii. Species Modeling and Distribution

1. Climate Variables

To select the set of climatic variables that would be used in the models, we used as a basis (i) the variables present in CHELSA (KARGER *et al.*, 2017), (ii) elevation of the relief due to the greater presence of epiphytes in mountainous reliefs (BOTANICAL; PRESS; GARDEN, 1987; KREFT *et al.*, 2004; KÜPER *et al.*, 2004; DING *et al.*, 2016;

HSU; WOLF; TAMIS, 2014), (iii) annual average cloud cover (WILSON; JETZ, 2016) and (iv) aridity (ZOMER *et al.*, 2008). We made a Pearson correlation matrix between this initial set of variables, and those that presented a correlation index ≥0.7 were eliminated. The variables that showed correlation were prioritized those that are important in the survival of epiphytes in the literature. The variables that were selected to proceed with the modeling were: diurnal range of mean temperature, isothermality, temperature seasonality, driest month precipitation, precipitation seasonality, elevation, average cloud cover and aridity.

2. Selection of Species Distribution Models

We used Species Modeling and Distribution (SDM) to test the effectiveness of PAs in the conservation of endemic epiphytes. The models were generated using the packages "kernlab", "psych", "maptools", "dismo", "raster", "rgeos", "randomForest", "sp", "rgdal", "dismo", "rJava", "gam", in the R software, version 3.5.3 (LIAW, WIENER, 2002; KARATZOGLOU et al., 2004; PEBESMA, BIVAND, 2005; BIVAND, PEBESMA, GOMEZ-RUBIO, 2013; HIJMANS et al., 2017; BIVAND, LEWIN-KOH, 2019; BIVAND, KEITT, ROWLINGSON, 2019; HASTIE, 2019; R Core Team, 2019; BIVAND, RUNDEL, 2020; URBANEK, 2020; REVELLE, 2020; HIJMANS, 2020). The algorithms used to generate the species distribution models were selected from the presence data and we used a background to calculate the pseudo-absences. To evaluate the performance of the models, we compared the SDM outputs using the Area Under the Curve (AUC) threshold of ≥0.7 to select the best models (HANLEY; MCNEIL, 1982). We use five algorithms: generalized linear models (GLM), generalized additive models (GAM), Random Forest (RF), Maxent and Support Vector Machine (SVM).

iii. Statistical analysis

1. Effectiveness of UCs by records

To measure the effectiveness of the PAs present in the Atlantic Forest, we used the records of the species present in the dataset (RAMOS *et al.*, 2019) and the limits of the PAs (https://mUCs.csr.ufmg.br/). The records were overlaid on the boundaries of the CUs and we got which records are in and out, just in and just outside the boundaries of the CUs. For this analysis we did not use the filter of 10 records or more per cell and we did not use cells either, thus totaling 992 species with 8,813 records (Figure 5). As only 10% (Supplementary Material 1) of the CUs had records, we thought it was important to model the species distribution to get a sense of the probability of occurrence of epiphytes in all of them.

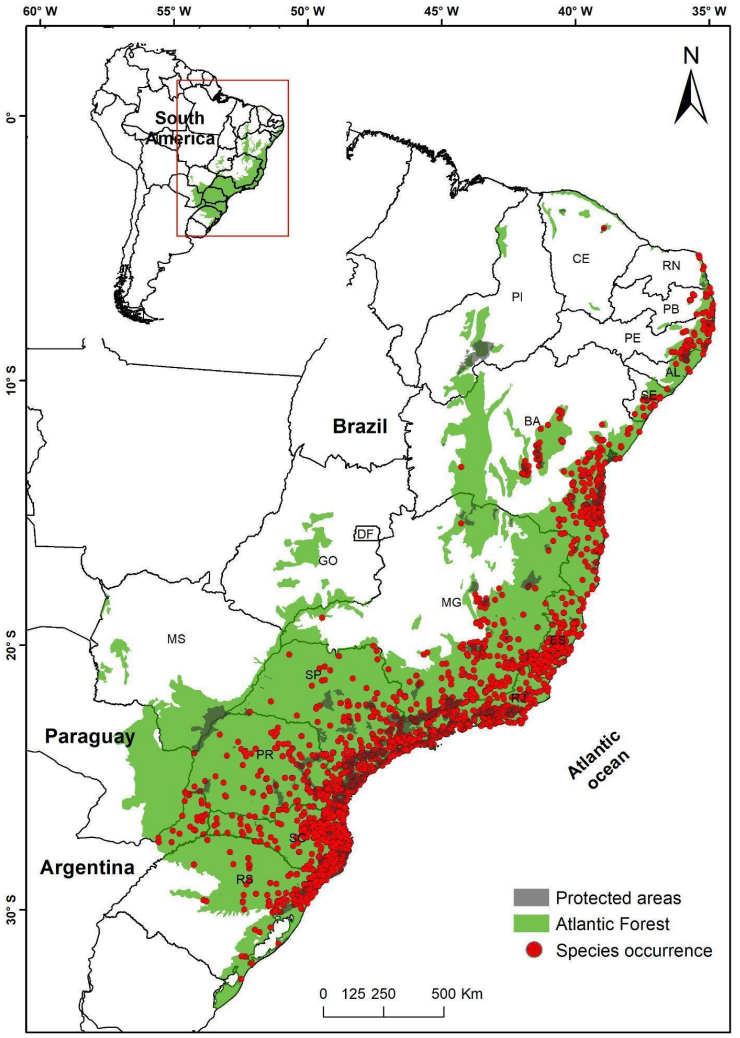

Figure 5 – Map of South America showing the Atlantic Forest biome and the distribution of 992 species of endemic vascular epiphytes and the boundaries of Protected Areas.

2. Species Modeling and Distribution

We used the occurrence data of the species and the variables selected by Pearson's correlation for the modeling. Pseudo-absence data were also used, as no absence data were recorded. Pseudo-absences are necessary, as the GLM, GAM, RF and SVM models use this information to differentiate habitats into suitable or unsuitable. To obtain the pseudo-absences, 1000 random points were assigned within the cells not occupied by the species distribution. Maxent is a model that does not use pseudo-absence data, distinguishing between the presence and random points of a background area through a probability distribution (PHILLIPS *et al.*, 2006). For comparability between models, we make the background area for Maxent equal to the cells of the other models, of which pseudo-absences were used.

We consider the three classes of CUs, federal, state and municipal, which include Protected Areas of strict protection, sustainable use and indigenous lands. The Atlantic Forest biome was divided into cells of 30 arc-sec (~1 km²), the same resolution as the environmental variables, in order to better analyze the occurrence of endemic species. We used an occurrence filter in which we selected only the species that had a presence above 10 individuals in different cells, in order to achieve a reliable response from the models. From this filtering, we obtained a total of 212 species of epiphytes endemic to the Atlantic Forest. To assess the effectiveness of the UCs, we used the maps generated by modeling and species distribution, in which species suitability maps were generated for each algorithm, and in the end resulted in a single map per species showing the ensemble (Supplementary Material 2) of these models for each of them. Our ensemble was the result of overlaying the five maps generated by the algorithms.

To assess the effectiveness of the Environmental Conservation Units, we overlay the species distribution data on maps with the limits of the Conservation Units present in the biome. We consider that the epiphyte species was present in a CUs when there is any cell with AUC >0.7. After calculating the presence inside and outside the PAs for all 212 species, we calculated the degree of effectiveness of these PAs based on the percentage of species occurring in them (Figure 6).

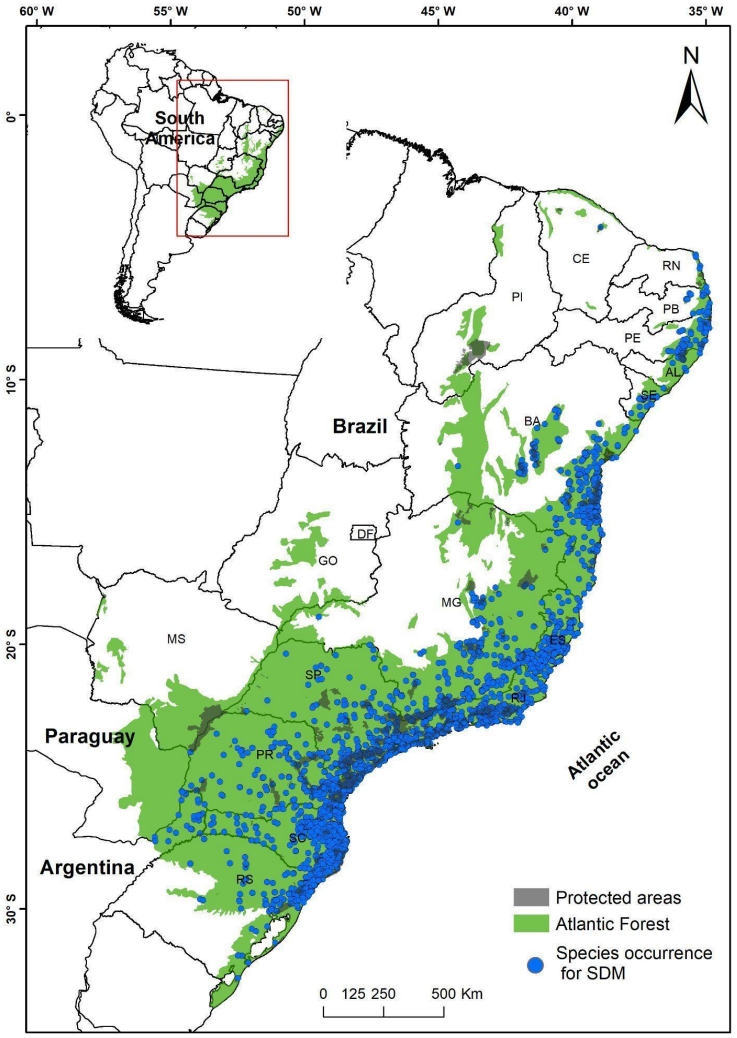

Figure 6 – Map of South America showing the Atlantic Forest biome and the distribution of the 212 species of endemic vascular epiphytes and the boundaries of the Conservation Units present in the biome.

Results

a) No modeling

We found that of the 992 species in the study, 557 (56%) are within the limits of some CU, while 340 (34%) are not protected (Supplementary Material 1). Among the species protected in CUs, only 95 (~10%) species occur only inside (Supplementary Material 3), while 557 (56%) occur both inside and outside the boundaries of the CUs present in the Atlantic Forest (Supplementary Material). 4). The families with the highest number of species occurring inside and outside the CUs are Orchidaceae (272 species) and Bromeliaceae (249 species). The species with occurrences only within the CUs are mostly Orchidaceae (39 species) and Bromeliaceae (30 species) and the species with occurrences only outside the

boundaries of the CUs are Orchidaceae (171 species) and Bromeliaceae (137 species, Supplementary material 5). Of the 842 Conservation Units present in the biome, only 85 (10%) of them obtained records of epiphytes within their limits (Supplementary Material 6), 37 (44%) of them being of Sustainable Use (Environmental Protection Area (31), Private Natural Heritage Reserve (1), Sustainable Development Reserve (2) , Area of relevant Ecological Interest (1), National Forest (1) and 48 (56%) of Integral Protection (National Park (36), Ecological Station (5), Biological Reserve (4), Wildlife Refuge (2), Strict Nature Reserve (1)). Of the UCs with epiphyte records are mostly in the Southeast of Brazil, with 54% (46) of them distributed in the states of São Paulo (20), Rio de Janeiro (14), Espírito Santo (8) and Minas Gerais (4). The Conservation Units with the highest number of records were Guaraqueçaba Environmental Protection Area (PR) with 264 records, Costa de Itacari/Serra Grande Environmental Protection Area (BA) with 172 records, Piraquara State Environmental Protection Area (PR) with 169 records, Carlos Botelho State Park (SP) with 155 records, Serra do Itajaí National Park (SC) with 151 records, Petrópolis Environmental Protection Area (RJ) with 149 records, Guaratuba State Environmental Protection Area (PR) with 136 records, Serra dos Orgãos National Park (RJ) with 124 and Serra de Itabaiana National Park (SE) with 117 records (Figure 7).

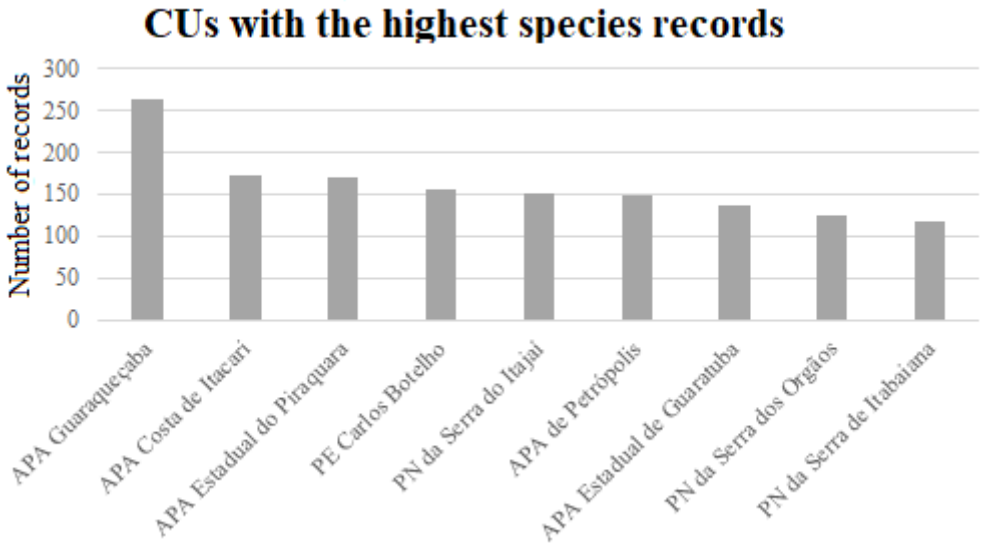

Figure 7 - The Conservation Units with the highest number of records were Guaraqueçaba Environmental Protection Area (PR), Costa de Itacari/Serra Grande Environmental Protection Area (BA), Piraquara State Environmental Protection Area (PR), Carlos Botelho State Park (SP), Serra do Itajaí National Park (SC), Petrópolis Environmental Protection Area (RJ), Guaratuba State Environmental Protection Area (PR), Serra dos Órgãos National Park (RJ), Serra de National Park Itabaiana (SE).

b) With modeling

For modeling, after filtering species with at least 10 individuals, we used 212 (21%) species for this analysis (Supplementary Material 7). Of these 212, only 54 (25%) (Supplementary Material 8) presented a probability of occurrence in any of the UCs. While of the 842 Conservation Units present in the Atlantic Forest, 452 (54%) did not present any probability of occurrence for any of the 212 species. Only 390 (46%) of them have probability of occurrence of at least one of the studied endemic species (Supplementary Material 9). Of the UCs with Probability of occurrence of endemic species, 126 (32%) are Integral Protection (Park (94), Biological Reserve (16), Ecological Station (11) and Natural Monument (5)) and 264 (67%) are Sustainable Use (Natural Heritage Reserve (181), Environmental Protection Area (66), Forest (12), Sustainable Development Reserve (4) and Extractive Reserve (1). The maximum value of species suitability, likely to occur in a CUs, was 24 species occurring together. However, the majority (51%) of CUs with occurrence of epiphytes only present the probability of occurrence of only one species (Figure 8). The Conservation Units that showed suitability for the species (Supplementary Material 9) had between 24 and 1 simultaneous occurrence of species. The CUs that showed occurrence of species between 24 and 19 were mostly National Parks, State and Biological Reserves.

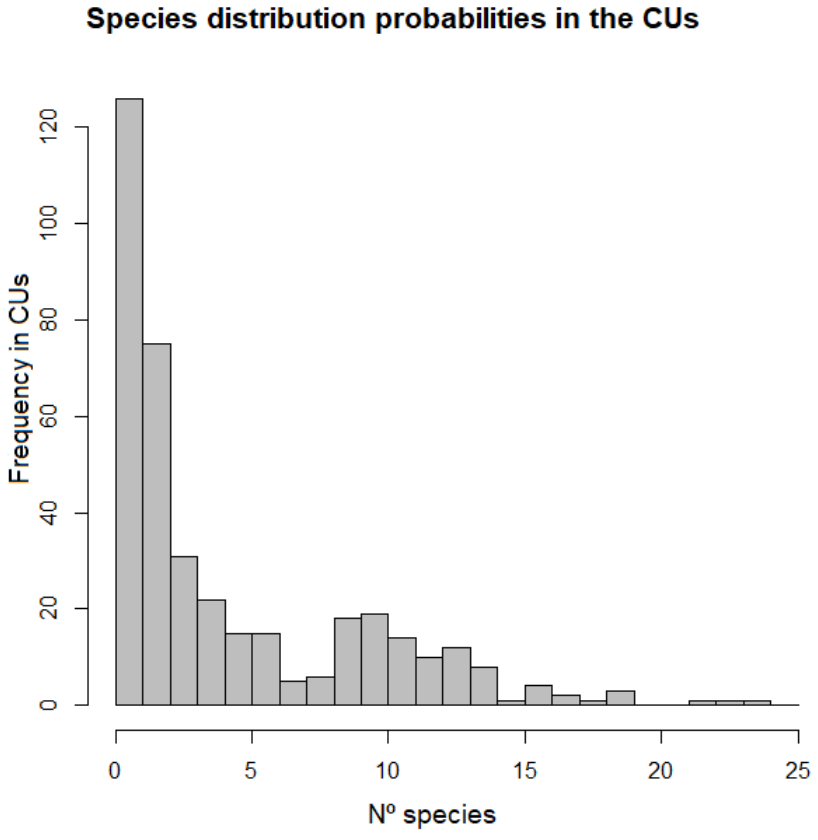

Figure 8 – Histogram with the frequency of 52 (25%) endemic epiphyte species that occurred in Conservation Units (CUs).

Discussion

We found that there is very little record of vascular epiphytes within the Atlantic Forest Conservation Units, only 10% of the 842 Conservation Units had a record. However, the few records and the probability of occurrence of the species indicate that the PAs have low effectiveness in their preservation, since about a third of the species (34%) only have records outside them. Even after using the species distribution modeling, because of the few records within the Conservation Units, only 25% of the species were likely to occur within the Conservation Units.

The Conservation Units present in the Atlantic Forest have low records of endemic vascular epiphyte species, indicating a concern regarding the conservation status of these areas. The UCs that presented registrations were mostly fully protected. Integral protection areas have stricter rules, where environmental protection is the main objective, and natural resources can only be used indirectly, such as through ecological tourism or scientific research (Brasil 2011b). They are areas that present a greater conservation of species due to all the restrictions in their delimitations, thus being one of the hypotheses for being areas with the greatest number of records, it is because they are areas without any anthropogenic alteration. But we also have the problem of sampling, since the CUs are not so well sampled (SALINAS-RODRÍGUEZ *et al.*, 2018), thus generating this low representation of the species within them. Another important point to be said is the greater amount of records present outside the CUs. This situation may be directly linked to the fact that these areas outside the CUs have adequate habitats for the survival of endemic epiphyte species. Since the initial CUs were mostly implemented randomly, without many area studies, only in regions that could not be used economically (PRESSEY *et al.*, 2002; LOUCKS *et al.*, 2008). It was found that the Atlantic Forest is undersampled for epiphytes, that is, they have a low sampling of these species (ARAUJO; RAMOS, 2021). We found that CUs have low sampling for endemic vascular epiphyte species, thus pointing to an even greater sampling gap in areas that are not protected. According to Araújo and Ramos (2021), the areas with the greatest sampling effort are mostly close to Conservation Units and areas with greater vegetation coverage. In our results, we found that these areas have low sampling, resulting in a lack of knowledge of the diversity of these environments, since these areas are under-sampled.

In the Species Modeling and Distribution (SDM), we obtained a greater number of CUs with probabilities of occurrence of the species than the one visualized by the records: 25% with and 10% without SDM. However, it is still a very low number. Since the models are generated from the environmental variables that best house the species, the models show us the regions that are suitable for the species. Even though we have low records of species for our analysis, the application of the models was advantageous to show the areas in which the species has adequate climatic variables. Thus, an analysis that enables the identification of areas with possible occurrences, but which are not found within the CUs. In both analyzes we obtained some CUs that have records or possible occurrences of the species. The strict protection CUs had the highest number among the registered CUs, whereas the Sustainable Use CUs had a higher number of records of endemic epiphyte species. And in the modeling analysis, the Sustainable Use Conservation Units had a higher probability of occurrence of the species than the strict protection ones.

In the literature, there are some studies that also found low effectiveness of CUs in the conservation of some species from several different groups. Kharouba and Kerr (2010) found low effectiveness of CUs in Canada in the conservation of butterfly species and Ferro et al. (2014) found this low effectiveness of CUs for moths in the Atlantic Forest, especially in climate change scenarios. Riggio et al., (2019) observed the low effectiveness of CUs for the conservation of endemic vertebrate species, from forests present in East Africa (Burundi, Kenya, Rwanda, Tanzania and Uganda), due to constant anthropic actions in and around areas from them. In turn, Terraube et al. (2020) found no difference in the diversity of species of large carnivores within the UCs, in Finland, compared to unprotected areas, pointing to the low effectiveness of protected areas. However, some other studies found results different from ours. Salinas-Rodrigues et al. (2018), showed that endemic vascular plants had 66% of their species conserved in CUs in the state of Minas Gerais in Brazil, but pointing to a concern with species that are found outside these areas. Ribeiro et al. (2018) observed that species of plants threatened with extinction in Brazil have 33% of their occurrence outside CUs, even so, pointing to the non-effectiveness of CUs in the integral conservation of these species.

The non-effectiveness of Conservation Units is directly linked to the fact that epiphytes are species with high sensitivity to environmental changes, mainly caused by anthropic actions, which can cause limitations in growth and survival for the species (KÖSTER *et al.*, 2009). This suggests that these PAs are not acting as a buffer for changes around them, maintaining the diversity of species since epiphytes are indicators of forest conservation status (ZOTZ, GERHARD; BADER, 2011). Of the 85 CUs that have records of

epiphytes, 54% (46) of them are located in the Southeast region, distributed in the states of São Paulo (20), Rio de Janeiro (14), Espírito Santo (8) and Minas Gerais (4). According to IBGE data, the Southeast region has the largest investments in environmental agencies by its States (IBGE, 2013). It should also be noted that the absence of collections in other regions may lead to a sampling bias.

Lima and Ramos (2021) showed that the collection of vascular epiphytes along the Atlantic Forest presents a low sampling effort, with many gaps and biases, and that it is necessary to increase and redirect the next inventories. Greater data collection provides the identification of priority sites for species conservation (ZOTZ; BADER, 2011), so it is extremely important to collect more data on species, especially in CUs. Also, the scarcity of knowledge on biodiversity present within the CUs in Brazil (OLIVEIRA *et al.*, 2017), can lead to divergent results on the effectiveness of these areas. A large part of the endemic species in the biomes are found outside conservation-oriented areas (OLIVEIRA et al., 2017), pointing to the need for more studies aimed at better knowledge of the biodiversity of existing CUs and for the implementation of new CUs in areas with large diversity. There is a great need for actions aimed at the preservation and management of CUs, to better serve in situ conservation. A better listing of biodiversity is needed, especially in CUs that have a low sampling (SOBRAL; STEHMANN, 2009; MARTINS; LOYOLA; MARTINELLI, 2017; OLIVEIRA *et al.*, 2017; LOYOLA *et al.*, 2018).

In addition to the Atlantic Forest biome, there are other biomes that have the problem with low sampling, such as the Amazon Forest. The low documentation of species present in the biome results in very little or no knowledge of species that occurred in the biome prior to deforestation (STROPP et al., 2020). And the Conservation Units present in this biome also suffer from the lack of knowledge about the distribution of the diversity of species present in them (MILLIKEN et al., 2010). And in order to reduce uncertainties in species distribution models, it is necessary to improve the quality of data on species occurrences (STROPP et al., 2020) in Conservation Units and outside them as well.

Vascular species are sensitive to environmental changes, especially in forest areas with a high edge effect (ZOTZ; BADER, 2008), and we have seen that the CUs present in the biome are of small sizes, possibly presenting a large edge effect. This can cause a decrease in the number of individuals of these species, due to the deforestation processes that occur around these areas. Therefore, we can conclude that the low percentage of occurrence within the Conservation Units present in the Atlantic Forest indicate the low effectiveness in the conservation of vascular epiphyte species endemic to the Atlantic Forest biome. In addition, it

is necessary to encourage the collection of vascular epiphytes within the 842 Conservation Units, since only 10% of the Conservation Units had records.

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Supplementary Materials

Supplementary Material 1 - To the 340 species of the 992 that are registered only outside the limits of the Conservation Units.

Family	Species	Dataset Records
Amaryllidaceae	*Hippeastrum calyptratum*	1
Araceae	*Anthurium angustifolium*	2
Araceae	*Anthurium ianthinopodum*	7
Araceae	*Anthurium leonii*	2
Araceae	*Anthurium santaritense*	1
Araceae	*Philodendron longilaminatum*	1
Aspleniaceae	*Asplenium truncorum*	2
Begoniaceae	*Begonia lanceolata*	1
Bromeliaceae	*Aechmea apocalyptica*	2
Bromeliaceae	*Aechmea araneosa*	5
Bromeliaceae	*Aechmea azurea*	3
Bromeliaceae	*Aechmea bambusoides*	4
Bromeliaceae	*Aechmea bocainensis*	2
Bromeliaceae	*Aechmea cariocae*	1
Bromeliaceae	*Aechmea catendensis*	1

Bromeliaceae	*Aechmea cephaloides*	1
Bromeliaceae	*Aechmea chrysocoma*	1
Bromeliaceae	*Aechmea comata*	6
Bromeliaceae	*Aechmea curranii*	4
Bromeliaceae	*Aechmea dealbata*	1
Bromeliaceae	*Aechmea flavorosea*	1
Bromeliaceae	*Aechmea fosteriana*	1
Bromeliaceae	*Aechmea grazielae*	1
Bromeliaceae	*Aechmea gurkeniana*	1
Bromeliaceae	*Aechmea hostilis*	3
Bromeliaceae	*Aechmea kleinii*	3
Bromeliaceae	*Aechmea maasii*	8
Bromeliaceae	*Aechmea paradoxa*	1
Bromeliaceae	*Aechmea pimenti-velosoi*	1
Bromeliaceae	*Aechmea rubrolilacina*	1
Bromeliaceae	*Aechmea serragrandensis*	1
Bromeliaceae	*Aechmea squarrosa*	1
Bromeliaceae	*Aechmea triticina*	2

Bromeliaceae	*Aechmea victoriana*	1
Bromeliaceae	*Aechmea warasii*	3
Bromeliaceae	*Aechmea winkleri*	2
Bromeliaceae	*Araeococcus sessiliflorus*	1
Bromeliaceae	*Billbergia alfonsijoannis*	5
Bromeliaceae	*Billbergia chlorantha*	1
Bromeliaceae	*Billbergia kautskyana*	1
Bromeliaceae	*Billbergia laxiflora*	3
Bromeliaceae	*Billbergia leptopoda*	4
Bromeliaceae	*Billbergia lymanii*	6
Bromeliaceae	*Billbergia minarum*	2
Bromeliaceae	*Billbergia reichardtii*	1
Bromeliaceae	*Billbergia tweedieana*	6
Bromeliaceae	*Canistropsis simulans*	1
Bromeliaceae	*Canistrum alagoanum*	1
Bromeliaceae	*Canistrum fosterianum*	1
Bromeliaceae	*Canistrum guzmanioides*	1
Bromeliaceae	*Canistrum pickelii*	3

Bromeliaceae	*Canistrum triangulare*	3
Bromeliaceae	*Fernseea bocainensis*	1
Bromeliaceae	*Hohenbergia membranostrobilus*	1
Bromeliaceae	*Lymania alvimii*	4
Bromeliaceae	*Lymania brachycaulis*	1
Bromeliaceae	*Lymania marantoides*	3
Bromeliaceae	*Lymania spiculata*	1
Bromeliaceae	*Neoregelia abendrothae*	1
Bromeliaceae	*Neoregelia ampullacea*	6
Bromeliaceae	*Neoregelia angustifolia*	1
Bromeliaceae	*Neoregelia azevedoi*	1
Bromeliaceae	*Neoregelia binotii*	1
Bromeliaceae	*Neoregelia carcharodon*	2
Bromeliaceae	*Neoregelia coimbrae*	2
Bromeliaceae	*Neoregelia coriacea*	1
Bromeliaceae	*Neoregelia gigas*	2
Bromeliaceae	*Neoregelia ibitipocensis*	3
Bromeliaceae	*Neoregelia indecora*	1

Bromeliaceae	*Neoregelia kautskyi*	1
Bromeliaceae	*Neoregelia kerryi*	2
Bromeliaceae	*Neoregelia leprosa*	1
Bromeliaceae	*Neoregelia lymaniana*	1
Bromeliaceae	*Neoregelia maculata*	1
Bromeliaceae	*Neoregelia marmorata*	2
Bromeliaceae	*Neoregelia nevaresii*	1
Bromeliaceae	*Neoregelia oligantha*	1
Bromeliaceae	*Neoregelia pernambucana*	1
Bromeliaceae	*Neoregelia petropolitana*	1
Bromeliaceae	*Neoregelia princeps*	1
Bromeliaceae	*Neoregelia rubrifolia*	1
Bromeliaceae	*Neoregelia sanguinea*	1
Bromeliaceae	*Neoregelia sarmentosa*	4
Bromeliaceae	*Neoregelia seideliana*	1
Bromeliaceae	*Neoregelia spectabilis*	1
Bromeliaceae	*Neoregelia tigrina*	1
Bromeliaceae	*Nidularium albiflorum*	1

Bromeliaceae	*Nidularium angustifolium*	2
Bromeliaceae	*Nidularium apiculatum*	1
Bromeliaceae	*Nidularium espiritosantense*	3
Bromeliaceae	*Nidularium mangaratibense*	1
Bromeliaceae	*Nidularium picinguabense*	2
Bromeliaceae	*Nidularium purpureum*	2
Bromeliaceae	*Nidularium viridipetalum*	1
Bromeliaceae	*Portea filifera*	2
Bromeliaceae	*Portea fosteriana*	2
Bromeliaceae	*Portea nana*	2
Bromeliaceae	*Quesnelia alborosea*	1
Bromeliaceae	*Ronnbergia silvana*	1
Bromeliaceae	*Tillandsia montana*	2
Bromeliaceae	*Tillandsia roseiflora*	3
Bromeliaceae	*Tillandsia seideliana*	1
Bromeliaceae	*Vriesea amethystina*	1
Bromeliaceae	*Vriesea barilletii*	1
Bromeliaceae	*Vriesea biguassuensis*	2

Bromeliaceae	*Vriesea blackburniana*	1
Bromeliaceae	*Vriesea brusquensis*	6
Bromeliaceae	*Vriesea calimaniana*	1
Bromeliaceae	*Vriesea colnagoi*	2
Bromeliaceae	*Vriesea correia-araujoi*	1
Bromeliaceae	*Vriesea declinata*	1
Bromeliaceae	*Vriesea eltoniana*	4
Bromeliaceae	*Vriesea fidelensis*	1
Bromeliaceae	*Vriesea fradensis*	1
Bromeliaceae	*Vriesea garlippiana*	1
Bromeliaceae	*Vriesea gracilior*	7
Bromeliaceae	*Vriesea grandiflora*	1
Bromeliaceae	*Vriesea hoehneana*	5
Bromeliaceae	*Vriesea interrogatoria*	7
Bromeliaceae	*Vriesea jonesiana*	2
Bromeliaceae	*Vriesea kautskyana*	2
Bromeliaceae	*Vriesea leptantha*	2
Bromeliaceae	*Vriesea lidicensis*	2

Bromeliaceae	*Vriesea linharesiae*	1
Bromeliaceae	*Vriesea minutiflora*	1
Bromeliaceae	*Vriesea modesta*	6
Bromeliaceae	*Vriesea monacorum*	2
Bromeliaceae	*Vriesea muelleri*	4
Bromeliaceae	*Vriesea parviflora*	3
Bromeliaceae	*Vriesea pauciflora*	1
Bromeliaceae	*Vriesea pulchra*	1
Bromeliaceae	*Vriesea punctulata*	2
Bromeliaceae	*Vriesea racinae*	3
Bromeliaceae	*Vriesea rastrensis*	3
Bromeliaceae	*Vriesea roberto-seidelii*	1
Bromeliaceae	*Vriesea rubens*	3
Bromeliaceae	*Vriesea rubyae*	1
Bromeliaceae	*Vriesea schunkii*	1
Bromeliaceae	*Vriesea schwackeana*	2
Bromeliaceae	*Vriesea secundiflora*	2
Bromeliaceae	*Vriesea seideliana*	5

Bromeliaceae	*Vriesea sparsiflora*	3
Bromeliaceae	*Vriesea vellozicola*	7
Bromeliaceae	*Vriesea weberi*	1
Bromeliaceae	*Wittrockia paulistana*	1
Cactaceae	*Rhipsalis agudoensis*	2
Dryopteridaceae	*Elaphoglossum amorimii*	2
Dryopteridaceae	*Elaphoglossum brevipetiolatum*	1
Dryopteridaceae	*Elaphoglossum gardnerianum*	1
Gesneriaceae	*Codonanthe serrulata*	2
Gesneriaceae	*Nematanthus mirabilis*	2
Gesneriaceae	*Nematanthus punctatus*	1
Gesneriaceae	*Nematanthus serpens*	2
Gesneriaceae	*Nematanthus teixeiranus*	4
Hymenophyllaceae	*Hymenophyllum vestitum*	1
Melastomataceae	*Pleiochiton longipetiolatum*	1
Oleandraceae	*Oleandra brasiliana*	1
Orchidaceae	*Acianthera binotii*	4
Orchidaceae	*Acianthera brachiloba*	1

Orchidaceae	*Acianthera caldensis*	1
Orchidaceae	*Acianthera cristata*	1
Orchidaceae	*Acianthera cryptophoranthoides*	1
Orchidaceae	*Acianthera duartei*	1
Orchidaceae	*Acianthera fenestrata*	3
Orchidaceae	*Acianthera freyi*	1
Orchidaceae	*Acianthera gracilisepala*	1
Orchidaceae	*Acianthera heliconiscapa*	1
Orchidaceae	*Acianthera hoffmannseggiana*	1
Orchidaceae	*Acianthera jordanensis*	2
Orchidaceae	*Acianthera klotzschiana*	3
Orchidaceae	*Acianthera langeana*	3
Orchidaceae	*Acianthera magalhanesii*	1
Orchidaceae	*Acianthera malachantha*	1
Orchidaceae	*Acianthera montana*	1
Orchidaceae	*Acianthera murexoidea*	1
Orchidaceae	*Acianthera panduripetala*	3
Orchidaceae	*Acianthera papillosa*	2

Orchidaceae	*Acianthera pardipes*	2
Orchidaceae	*Acianthera ramosa*	3
Orchidaceae	*Acianthera spilantha*	1
Orchidaceae	*Acianthera violaceomaculata*	4
Orchidaceae	*Anathallis bleyensis*	2
Orchidaceae	*Anathallis corticicola*	2
Orchidaceae	*Anathallis gehrtii*	1
Orchidaceae	*Anathallis laciniata*	1
Orchidaceae	*Anathallis lichenophila*	1
Orchidaceae	*Anathallis lobiserrata*	1
Orchidaceae	*Anathallis marginata*	2
Orchidaceae	*Anathallis montipelladensis*	2
Orchidaceae	*Anathallis nectarifera*	1
Orchidaceae	*Anathallis pabstii*	1
Orchidaceae	*Anathallis paranaensis*	3
Orchidaceae	*Anathallis recurvipetala*	2
Orchidaceae	*Anathallis rudolfii*	1
Orchidaceae	*Anathallis tigridens*	1

Orchidaceae	*Anathallis velvetina*	1
Orchidaceae	*Anathallis ypirangae*	1
Orchidaceae	*Barbosella crassifolia*	3
Orchidaceae	*Barbosella spiritu-sanctensis*	2
Orchidaceae	*Bifrenaria stefanae*	2
Orchidaceae	*Brasiliorchis consanguinea*	9
Orchidaceae	*Brasiliorchis kautskyi*	2
Orchidaceae	*Brasiliorchis porphyrostele*	7
Orchidaceae	*Brasiliorchis schunkeana*	1
Orchidaceae	*Brassavola flagellaris*	3
Orchidaceae	*Brassia arachnoidea*	2
Orchidaceae	*Bulbophyllum boudetianum*	1
Orchidaceae	*Bulbophyllum calimanianum*	1
Orchidaceae	*Bulbophyllum cantagallense*	4
Orchidaceae	*Bulbophyllum chloroglossum*	7
Orchidaceae	*Bulbophyllum kautskyi*	2
Orchidaceae	*Bulbophyllum macroceras*	1
Orchidaceae	*Bulbophyllum malachadenia*	1

Orchidaceae	*Bulbophyllum teimosense*	1
Orchidaceae	*Campylocentrum brachycarpum*	5
Orchidaceae	*Campylocentrum organense*	1
Orchidaceae	*Campylocentrum spannagelii*	2
Orchidaceae	*Campyloneurum centrobrasilianum*	2
Orchidaceae	*Campyloneurum fallax*	2
Orchidaceae	*Capanemia adelaidae*	5
Orchidaceae	*Catasetum globiflorum*	1
Orchidaceae	*Catasetum labiatum*	1
Orchidaceae	*Catasetum mattosianum*	2
Orchidaceae	*Catasetum purum*	4
Orchidaceae	*Catasetum triodon*	1
Orchidaceae	*Cattleya aclandiae*	2
Orchidaceae	*Cattleya alaorii*	1
Orchidaceae	*Cattleya amethystoglossa*	4
Orchidaceae	*Cattleya bicolor*	5
Orchidaceae	*Cattleya labiata*	4

Orchidaceae	*Cattleya lundii*	5
Orchidaceae	*Cattleya perrinii*	4
Orchidaceae	*Cattleya porphyroglossa*	1
Orchidaceae	*Cattleya pumila*	4
Orchidaceae	*Cattleya purpurata*	5
Orchidaceae	*Cattleya schilleriana*	2
Orchidaceae	*Cattleya tenebrosa*	2
Orchidaceae	*Cattleya tigrina*	5
Orchidaceae	*Cattleya velutina*	1
Orchidaceae	*Cattleya virens*	2
Orchidaceae	*Cattleya xanthina*	7
Orchidaceae	*Centroglossa tripollinica*	1
Orchidaceae	*Christensonella echinophyta*	1
Orchidaceae	*Chytroglossa aurata*	1
Orchidaceae	*Chytroglossa marileoniae*	1
Orchidaceae	*Cirrhaea fuscolutea*	4
Orchidaceae	*Cirrhaea loddigesii*	1
Orchidaceae	*Cirrhaea longiracemosa*	2

Orchidaceae	*Cirrhaea silvana*	1
Orchidaceae	*Encyclia bohnkiana*	1
Orchidaceae	*Encyclia bragancae*	1
Orchidaceae	*Encyclia gallopavina*	3
Orchidaceae	*Encyclia pauciflora*	1
Orchidaceae	*Encyclia unaensis*	1
Orchidaceae	*Epidendrum ammophilum*	1
Orchidaceae	*Epidendrum garciae*	2
Orchidaceae	*Epidendrum parahybunense*	3
Orchidaceae	*Epidendrum zappii*	1
Orchidaceae	*Eurystyles cogniauxii*	3
Orchidaceae	*Eurystyles lorenzii*	5
Orchidaceae	*Gomesa curta*	1
Orchidaceae	*Gomesa damacenoi*	1
Orchidaceae	*Gomesa echinata*	2
Orchidaceae	*Gomesa silvana*	1
Orchidaceae	*Gomesa uhlii*	1
Orchidaceae	*Gongora meneziana*	1

Orchidaceae	*Gongora nigrita*	1
Orchidaceae	*Grandiphyllum edwallii*	3
Orchidaceae	*Grobya fascifera*	3
Orchidaceae	*Hoehneella heloisae*	1
Orchidaceae	*Leptotes bohnkiana*	1
Orchidaceae	*Lockhartia ludibunda*	2
Orchidaceae	*Masdevallia curtipes*	2
Orchidaceae	*Masdevallia discoidea*	1
Orchidaceae	*Maxillaria milenae*	1
Orchidaceae	*Maxillaria robusta*	4
Orchidaceae	*Maxillaria rodriguesii*	2
Orchidaceae	*Myoxanthus pulvinatus*	2
Orchidaceae	*Myoxanthus ruschii*	1
Orchidaceae	*Myoxanthus seidelii*	1
Orchidaceae	*Notylia nemorosa*	1
Orchidaceae	*Notylia pubescens*	7
Orchidaceae	*Octomeria alexandri*	1
Orchidaceae	*Octomeria linearifolia*	1

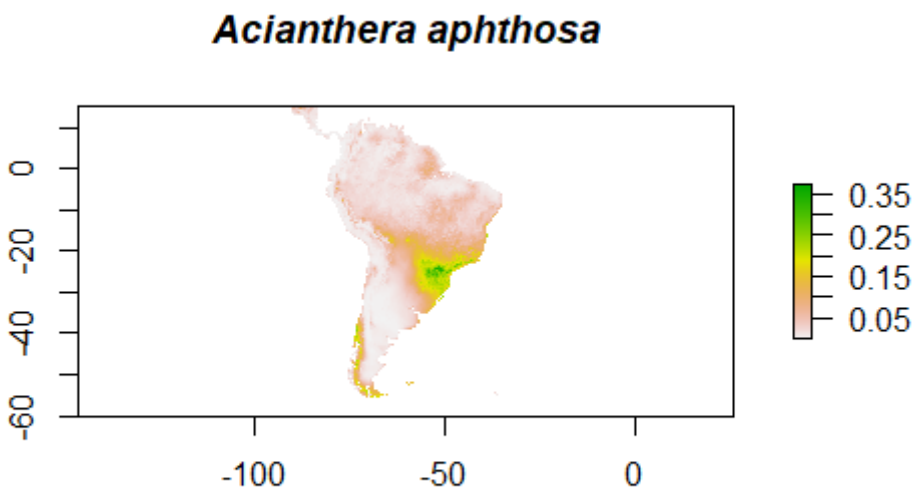
Orchidaceae	*Octomeria rotundiglossa*	1
Orchidaceae	*Octomeria rubrifolia*	1
Orchidaceae	*Octomeria tricolor*	1
Orchidaceae	*Pabstia viridis*	1
Orchidaceae	*Pabstiella carinifera*	1
Orchidaceae	*Pabstiella carrisii*	1
Orchidaceae	*Pabstiella cordilabia*	1
Orchidaceae	*Pabstiella ephemera*	3
Orchidaceae	*Pabstiella granulosa*	2
Orchidaceae	*Pabstiella imbeana*	1
Orchidaceae	*Pabstiella lingua*	3
Orchidaceae	*Pabstiella pandurifera*	1
Orchidaceae	*Pabstiella pellifeloidis*	3
Orchidaceae	*Pabstiella podoglossa*	2
Orchidaceae	*Pabstiella rubrolineata*	1
Orchidaceae	*Pabstiella ruschii*	1
Orchidaceae	*Phymatidium mellobarretoi*	2
Orchidaceae	*Phymatidium microphyllum*	5

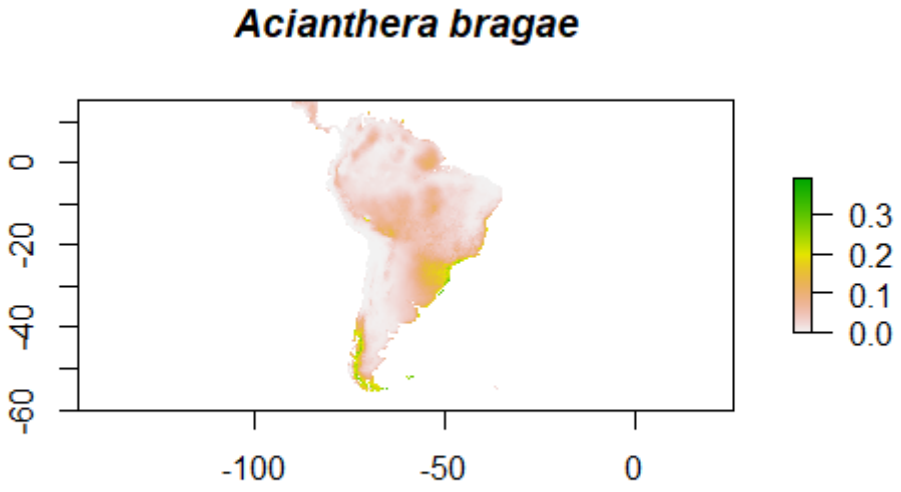
Orchidaceae	*Pleurothallis ipyrangana*	1
Orchidaceae	*Promenaea rollissonii*	2
Orchidaceae	*Prosthechea alagoensis*	1
Orchidaceae	*Prosthechea kautskyi*	1
Orchidaceae	*Prosthechea punctifera*	3
Orchidaceae	*Prosthechea regnelliana*	1
Orchidaceae	*Rodriguezia bahiensis*	4
Orchidaceae	*Rodriguezia limae*	1
Orchidaceae	*Rodriguezia obtusifolia*	6
Orchidaceae	*Rodriguezia rigida*	1
Orchidaceae	*Rodriguezia sucrei*	1
Orchidaceae	*Sansonia bradei*	1
Orchidaceae	*Scaphyglottis brasiliensis*	2
Orchidaceae	*Scuticaria novaesii*	1
Orchidaceae	*Specklinia gomesferreirae*	1
Orchidaceae	*Stanhopea guttulata*	2
Orchidaceae	*Stelis caespitosa*	1
Orchidaceae	*Stelis catharinensis*	2

Orchidaceae	*Stelis modesta*	1
Orchidaceae	*Stenia bohnkiana*	1
Orchidaceae	*Thysanoglossa organensis*	1
Orchidaceae	*Trigonidium macranthum*	2
Orchidaceae	*Warczewiczella candida*	1
Orchidaceae	*Zygostates bradei*	2
Orchidaceae	*Zygostates multiflora*	3
Orchidaceae	*Zygostates ovatipetala*	1
Piperaceae	*Peperomia castelosensis*	5
Piperaceae	*Peperomia pseudobcordata*	1
Piperaceae	*Peperomia regelii*	1
Piperaceae	*Peperomia stenocarpa*	2
Piperaceae	*Peperomia stroemfeltii*	3
Piperaceae	*Peperomia subopposititifolia*	1
Piperaceae	*Peperomia subpilosa*	1
Piperaceae	*Peperomia subrubricaulis*	1
Polypodiaceae	*Lellingeria depressa*	1
Polypodiaceae	*Lellingeria suspensa*	1

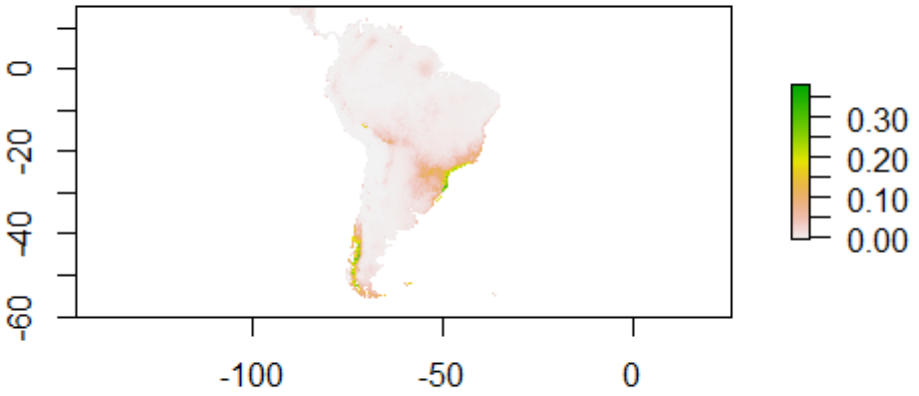
Polypodiaceae	*Pleopeltis monoides*	1
Polypodiaceae	*Terpsichore chrysleri*	1

Supplementary Material 2 - Ensembles maps of the 212 species of endemic vascular epiphytes in the Atlantic Forest with SDM analysis. Each map demonstrates the probability of occurrence of species based on climatic variables.

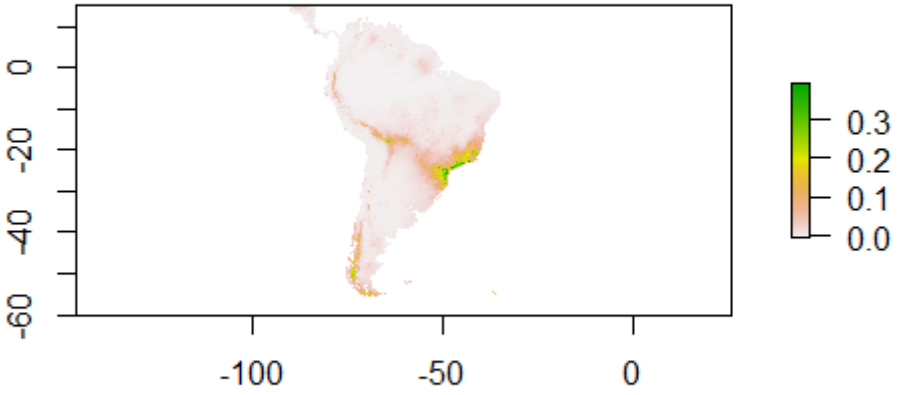




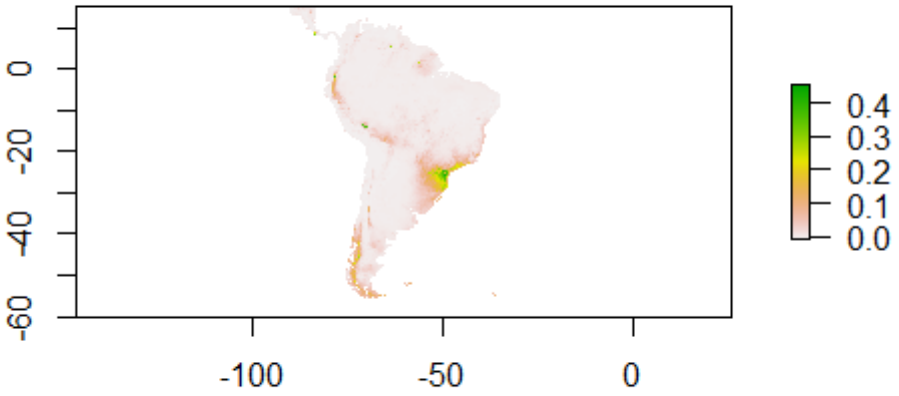
Acianthera glanduligera



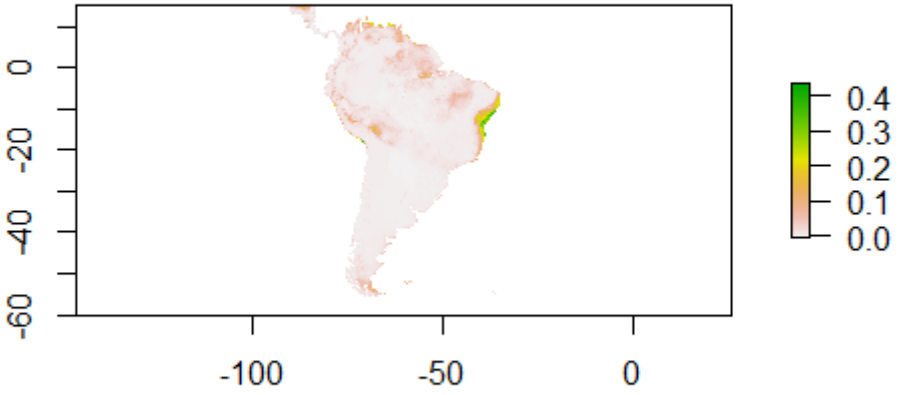
Acianthera saurocephala



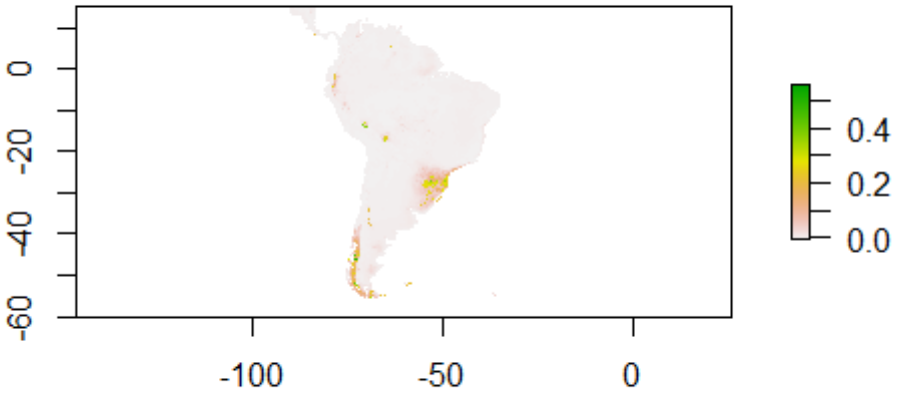
Acianthera sonderiana



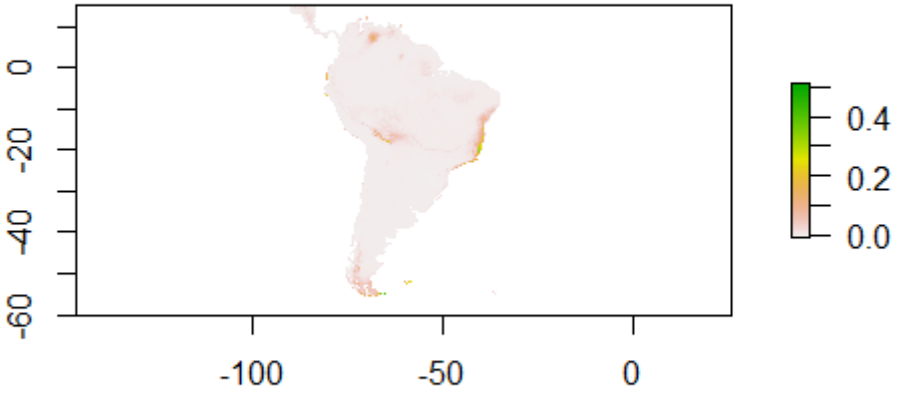
Aechmea aquilega



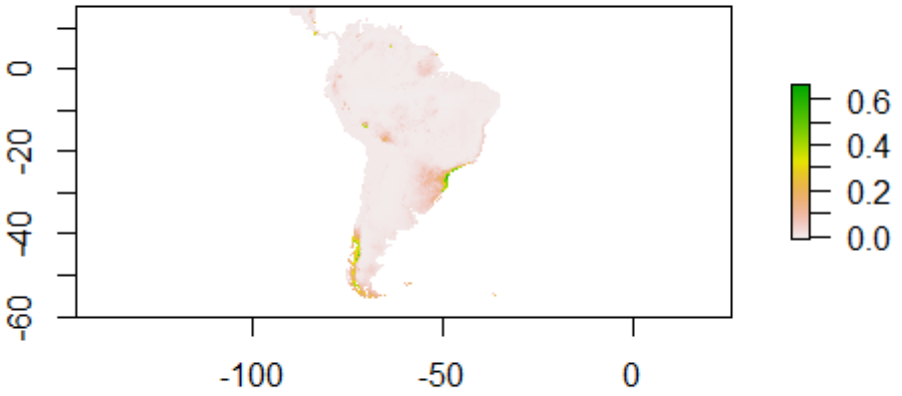
Aechmea blumenavii



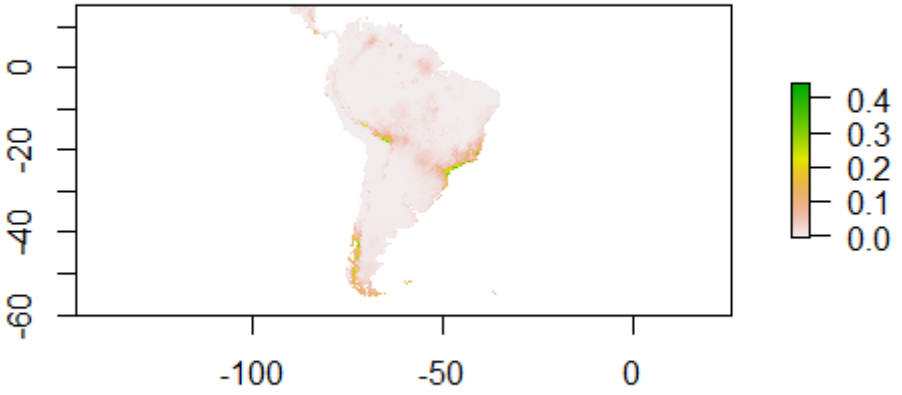
Aechmea capixabae



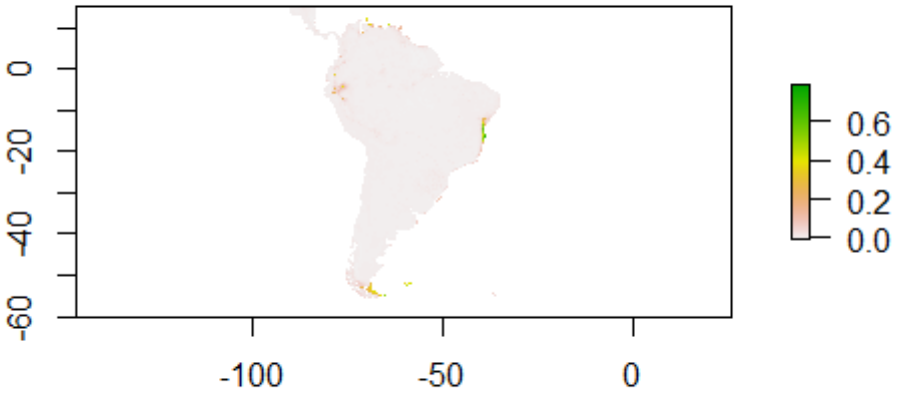
Aechmea caudata



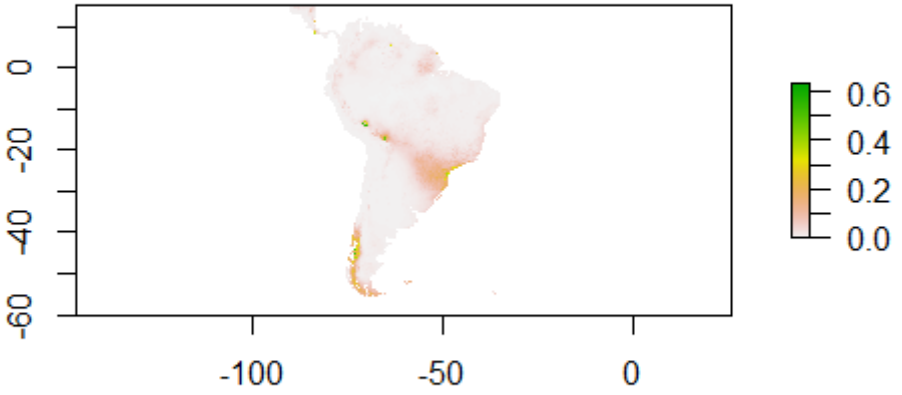
Aechmea coelestis



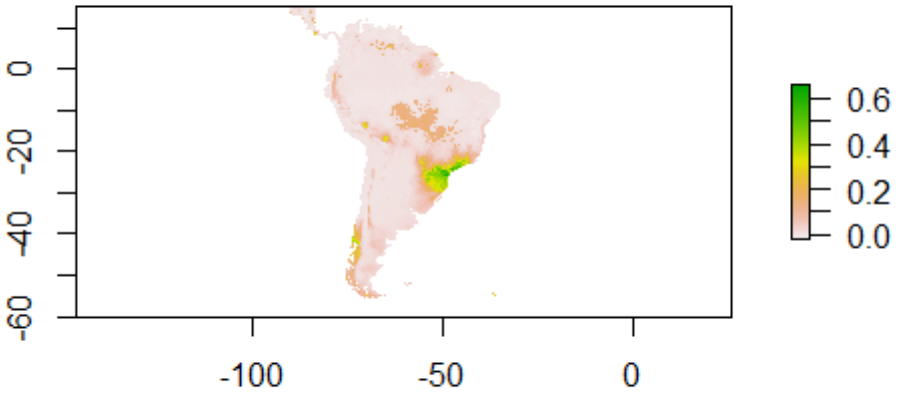
Aechmea conifera



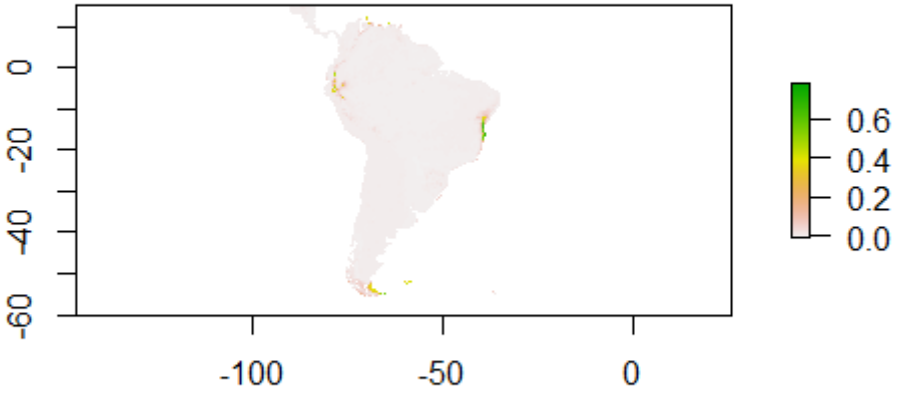
Aechmea cylindrata



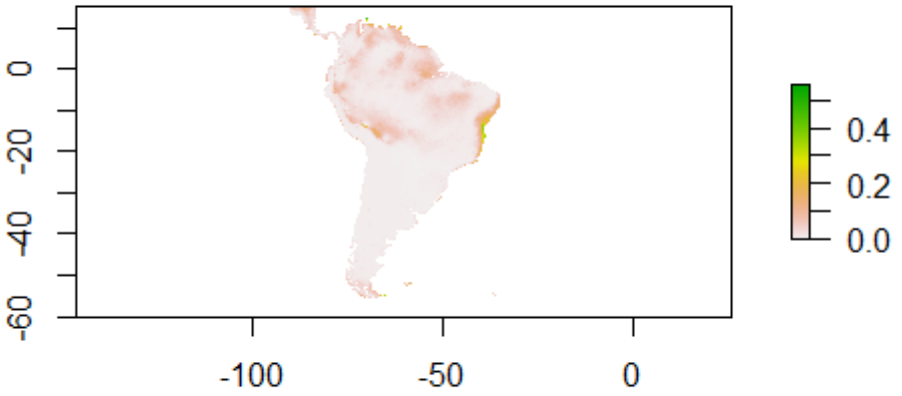
Aechmea distichantha



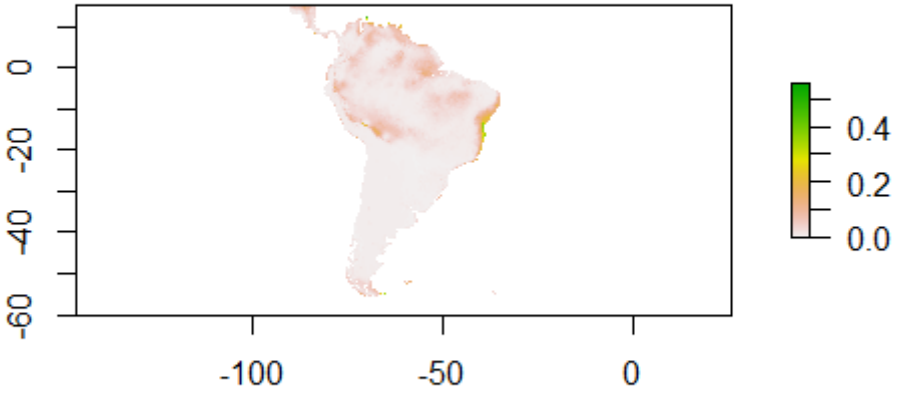
Aechmea fasciata



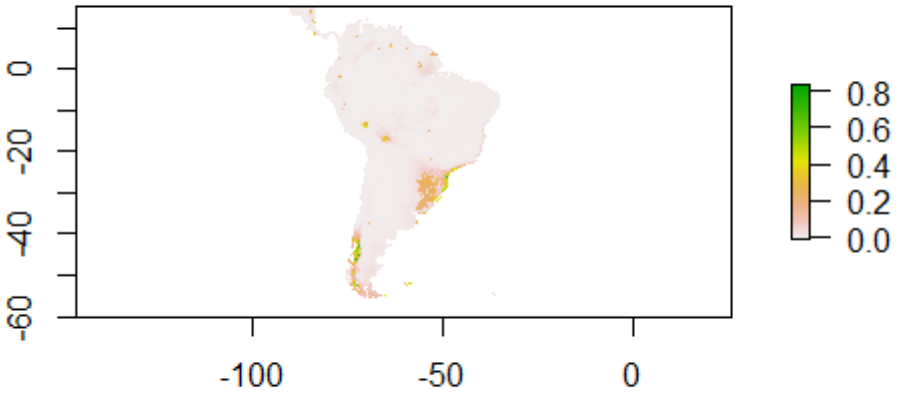
Aechmea froesii



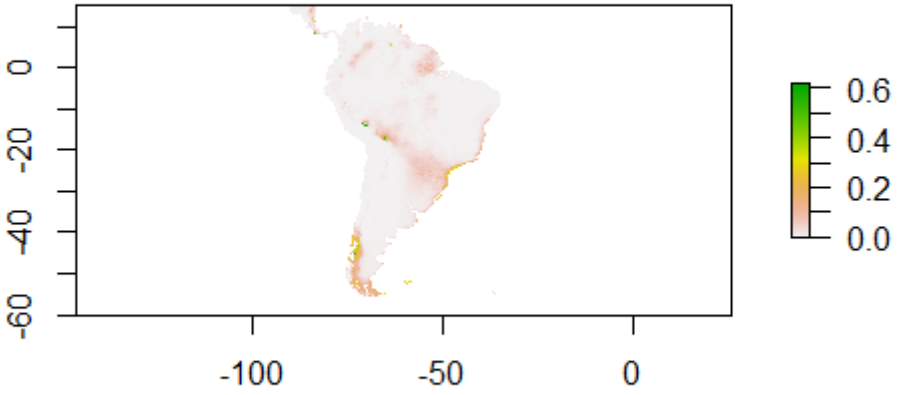
Aechmea fulgens



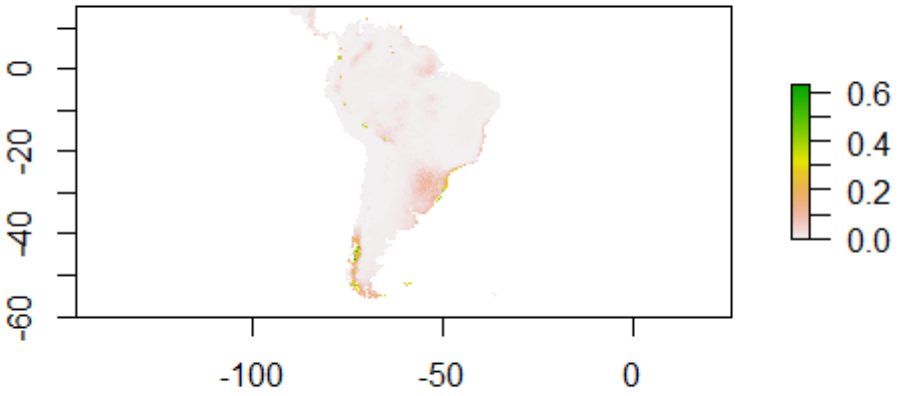
Aechmea gamosepala



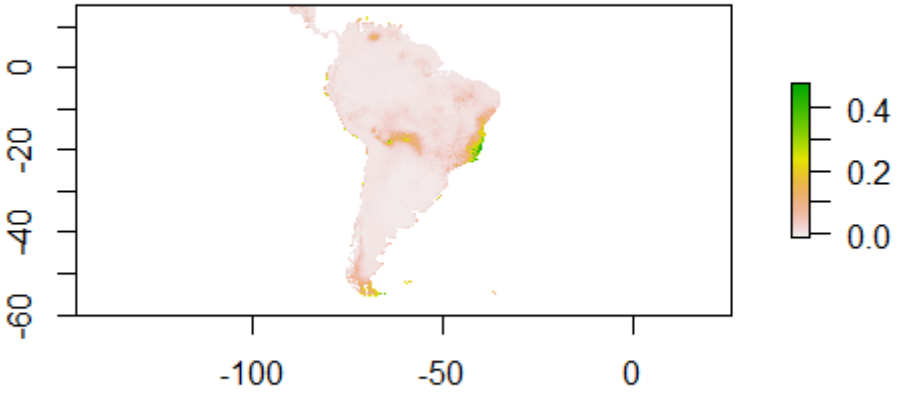
Aechmea gracilis



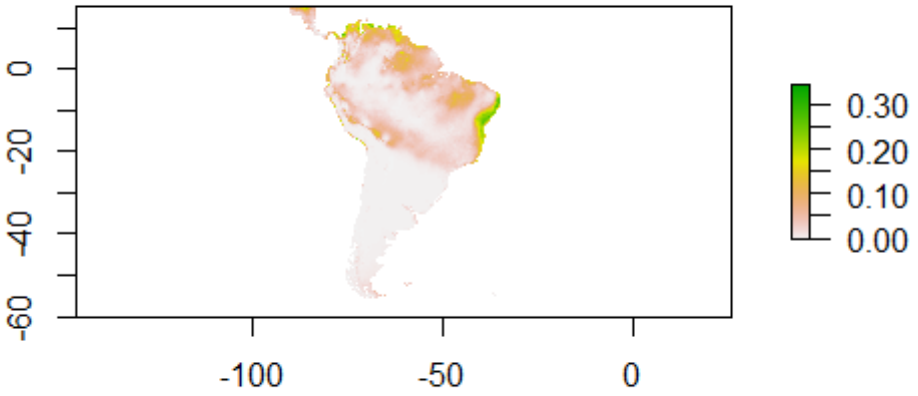
Aechmea kertesziae



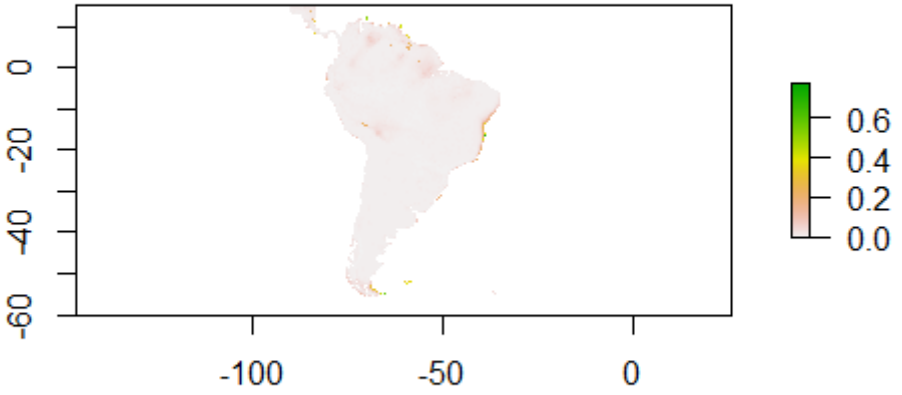
Aechmea lamarchei



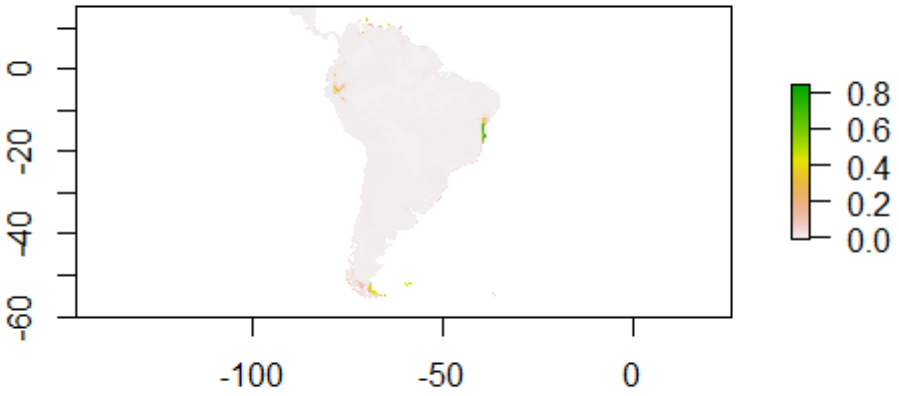
Aechmea leptantha



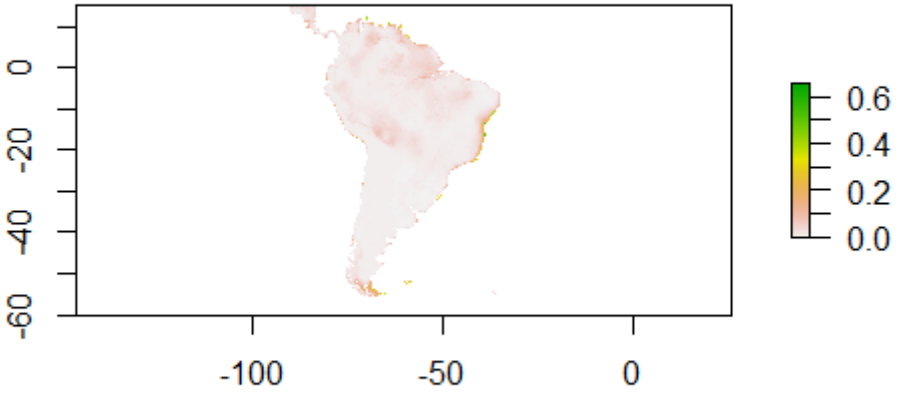
Aechmea marauensis



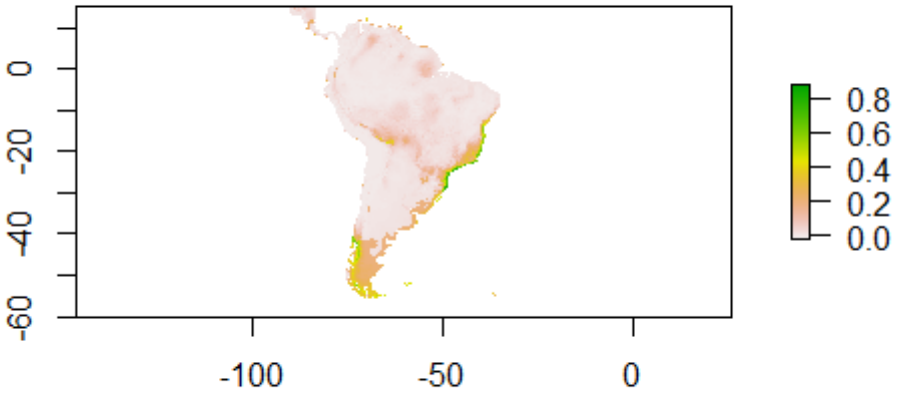
Aechmea miniata



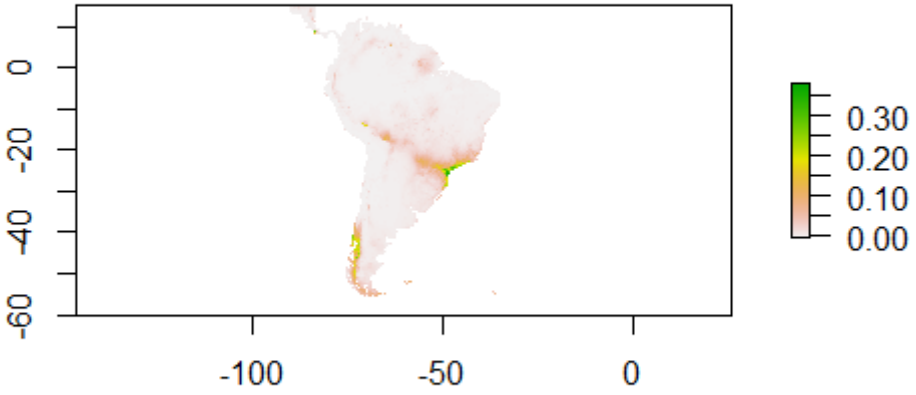
Aechmea multiflora



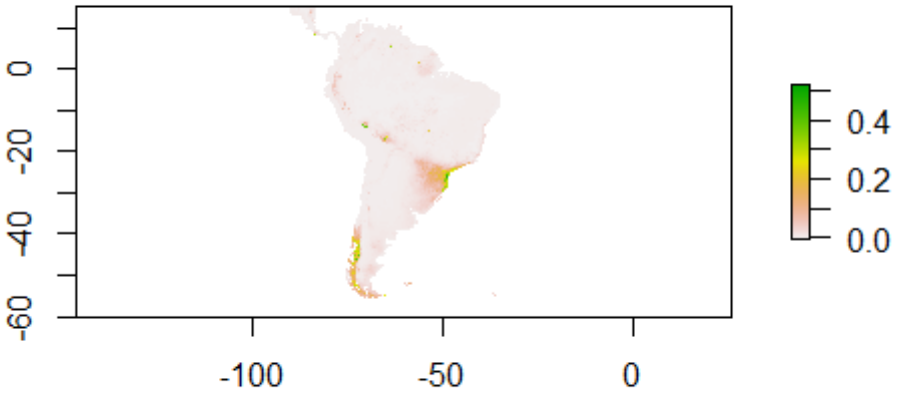
Aechmea nudicaulis



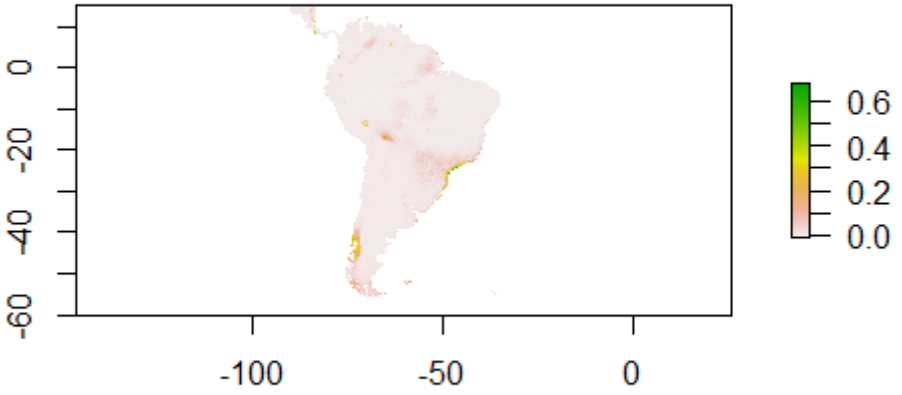
Aechmea organensis

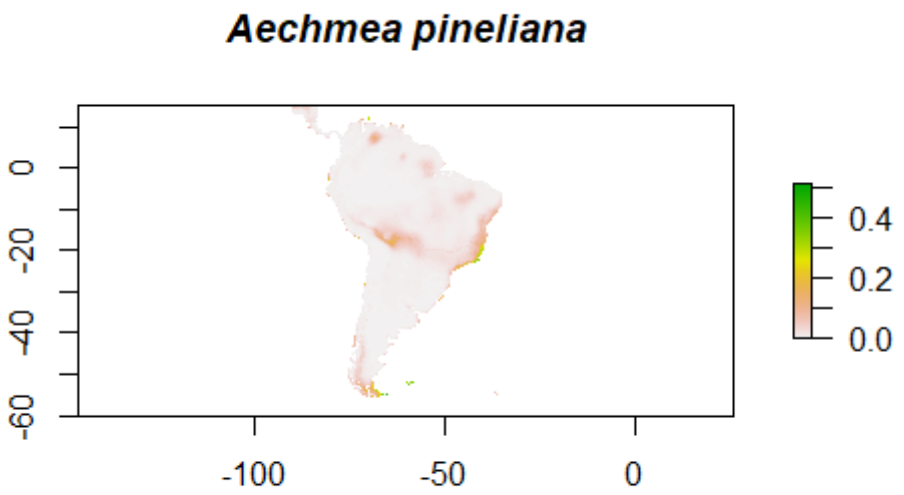


Aechmea ornata



Aechmea pectinata

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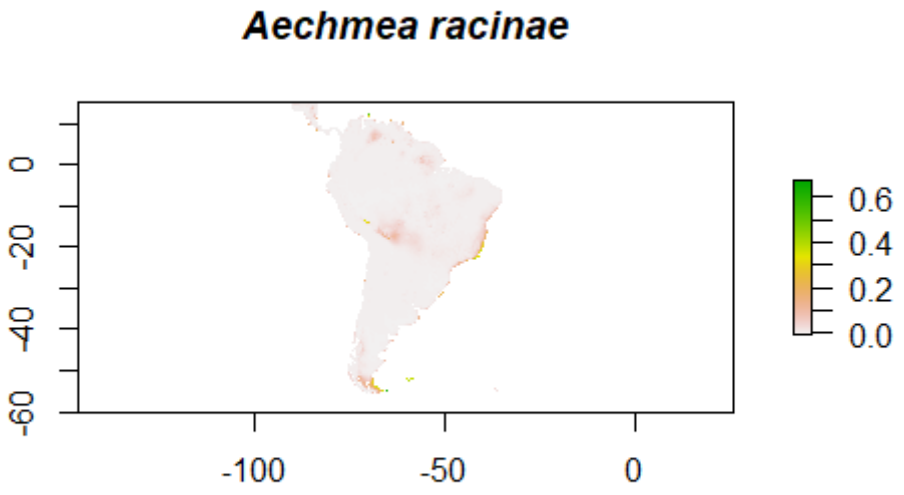
0.2
0.0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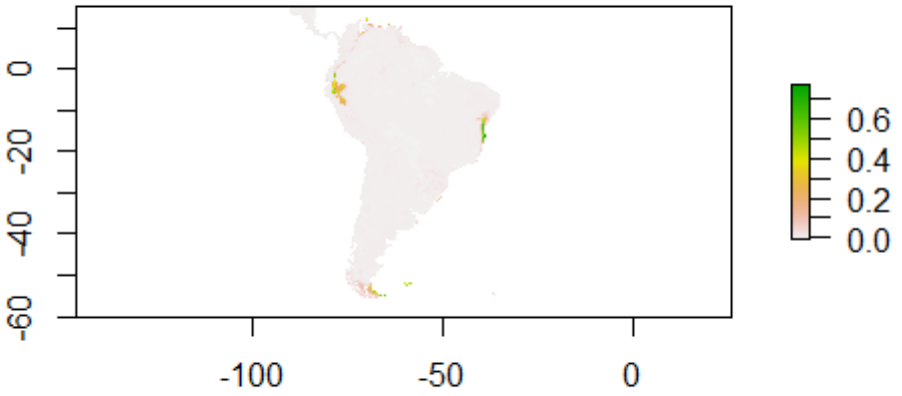
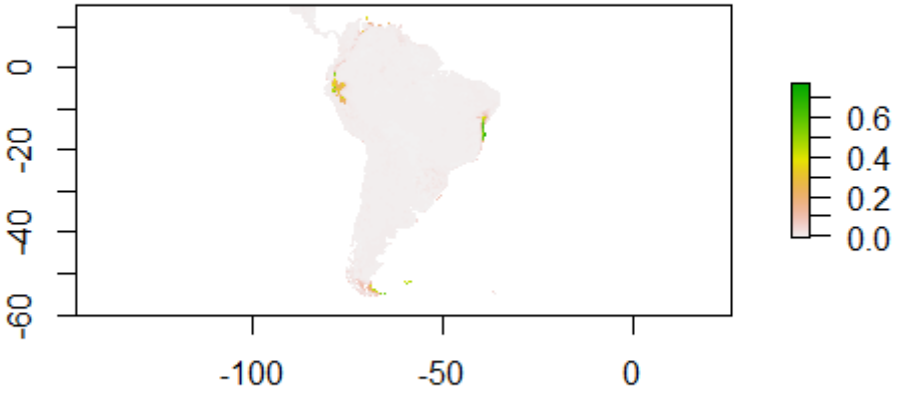
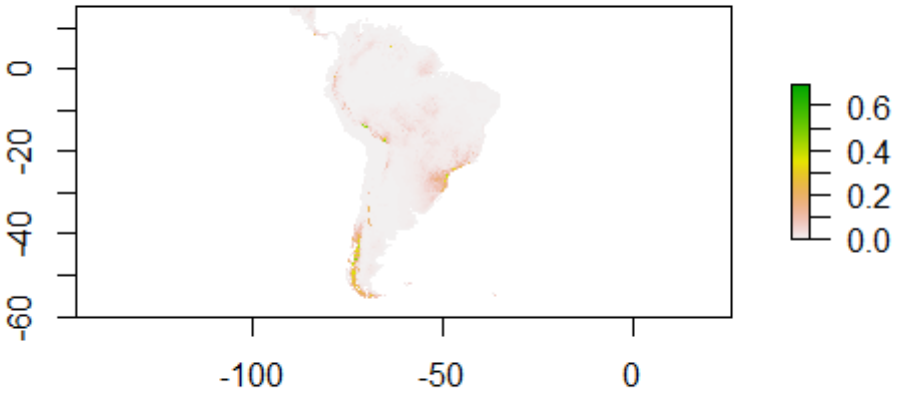
Aechmea ramosa



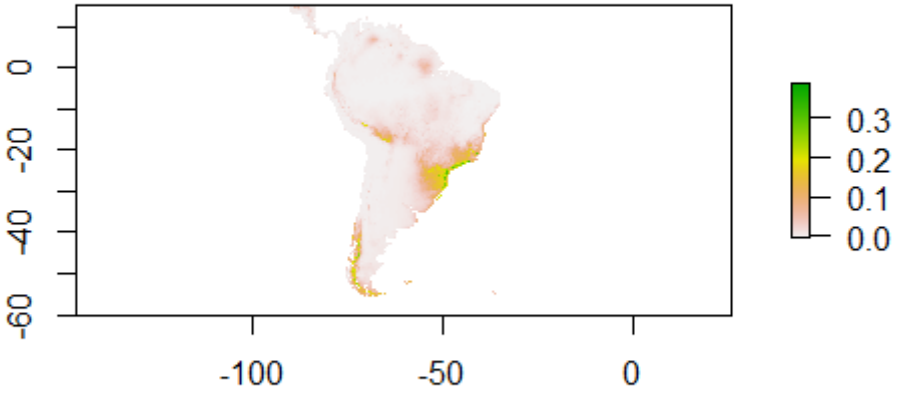
Aechmea turbinocalyx



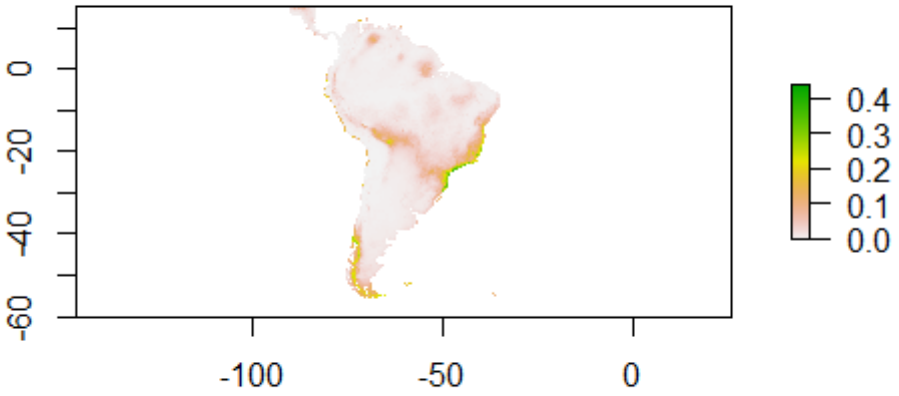
Alansmia reclinata



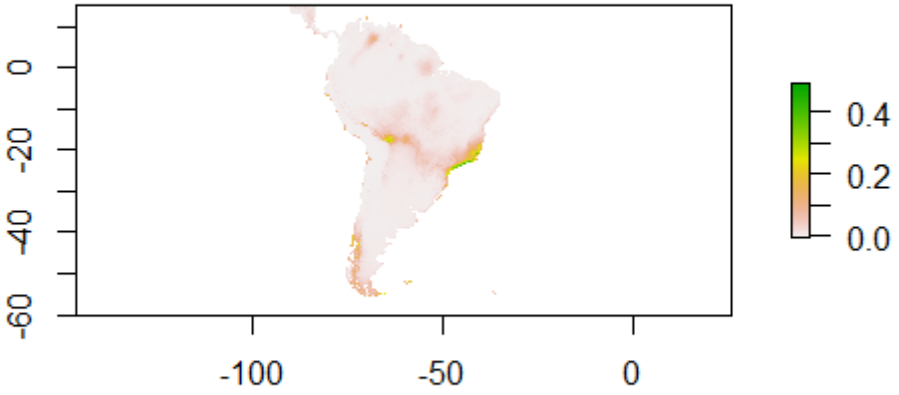
Anathallis adenochila



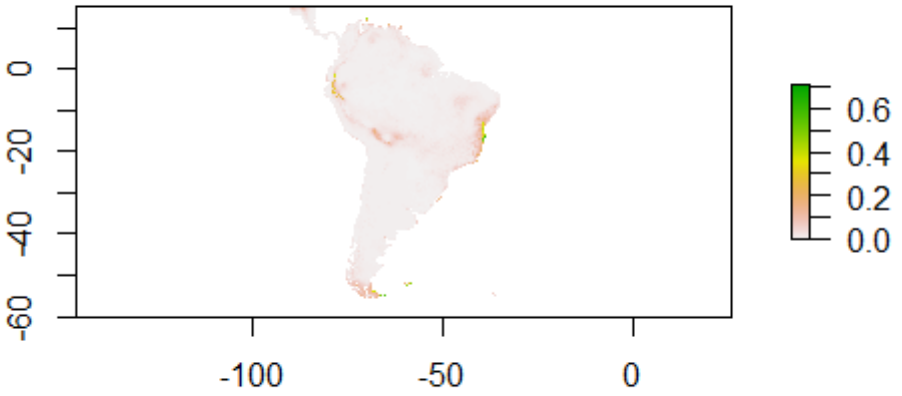
Anathallis sclerophylla



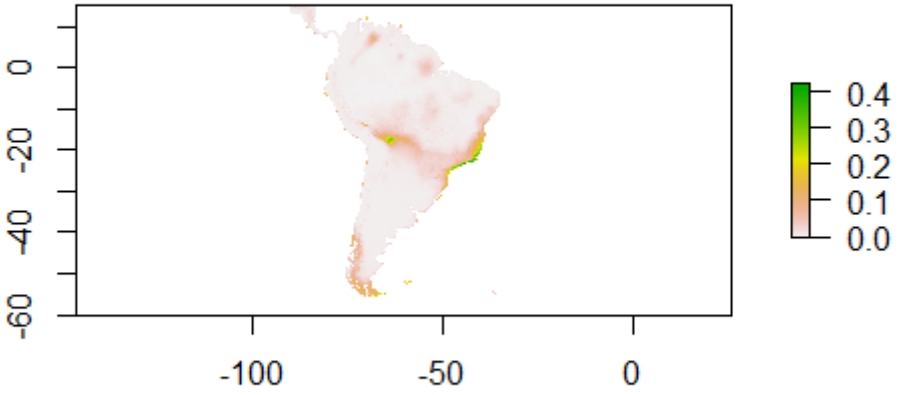
Anthurium comtum



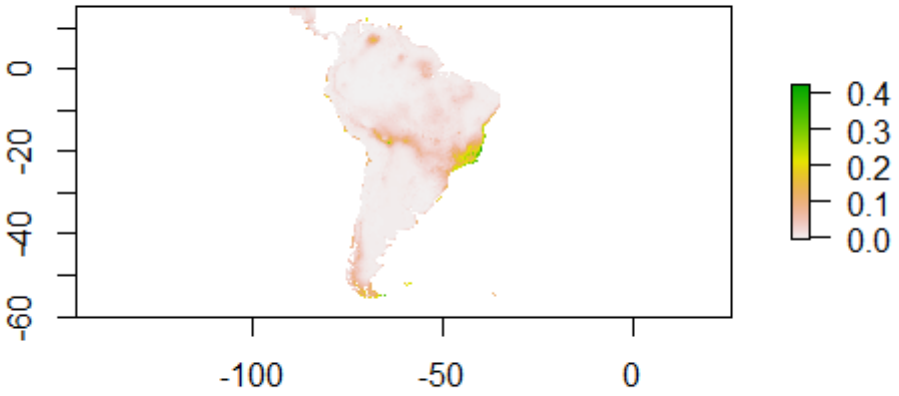
Anthurium jilekii



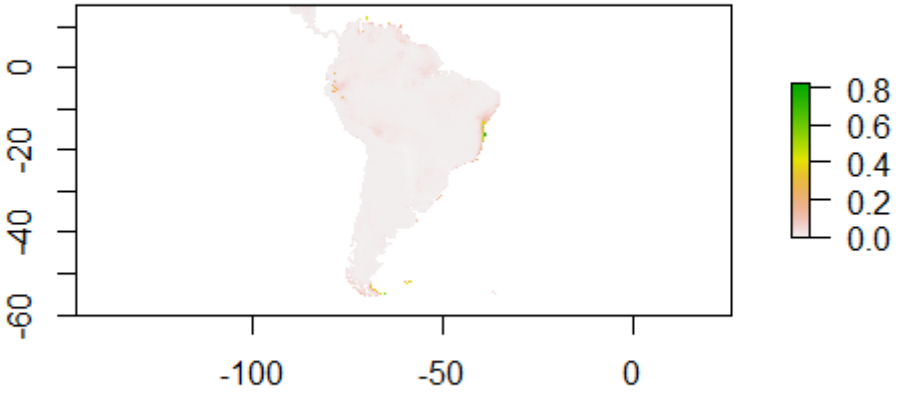
Anthurium longifolium



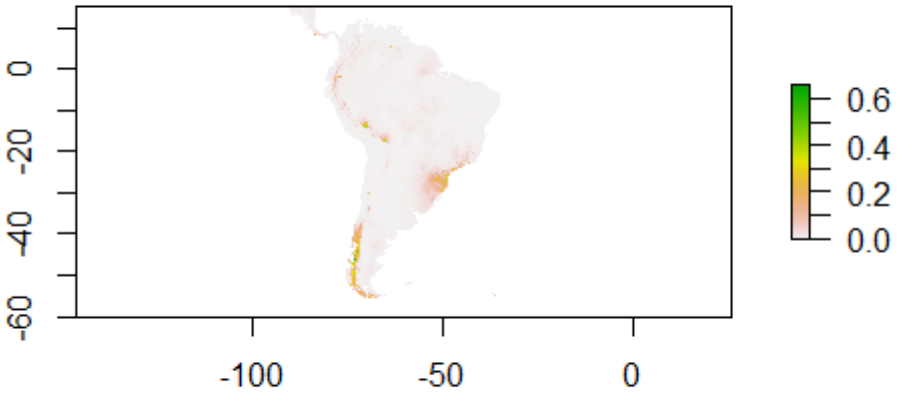
Anthurium solitarium



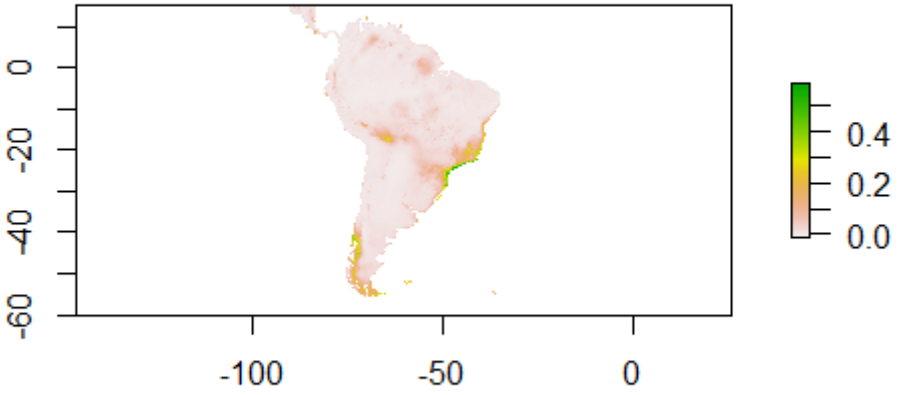
Araeococcus parviflorus



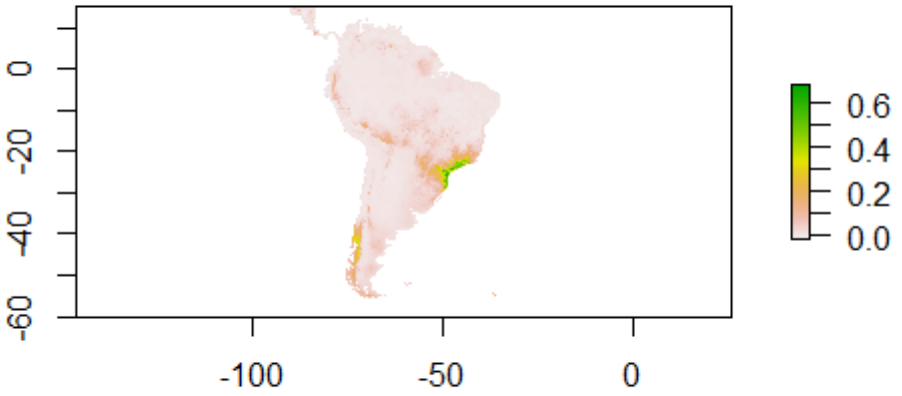
Asplenium incurvatum



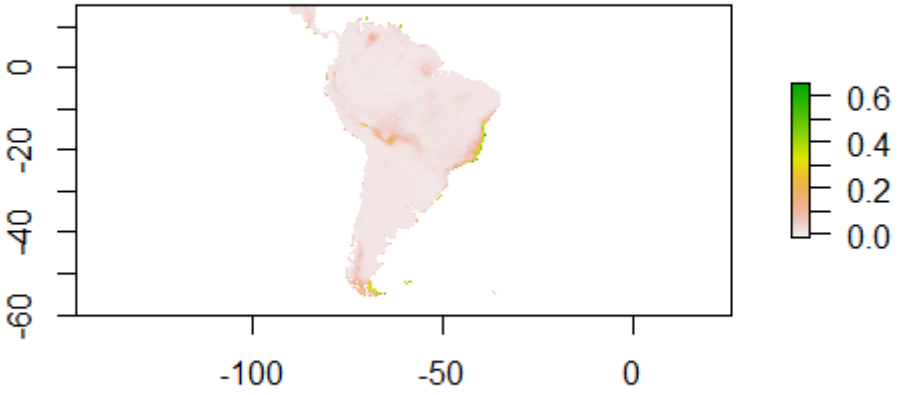
Billbergia amoena



Billbergia distachia



Billbergia euphemiae



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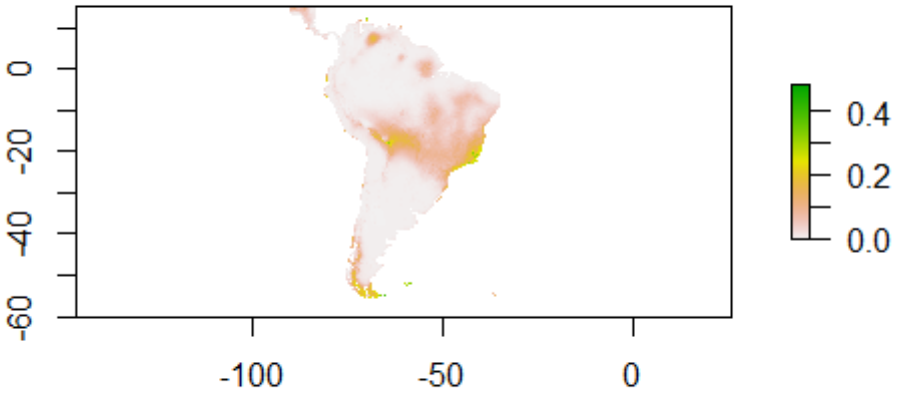

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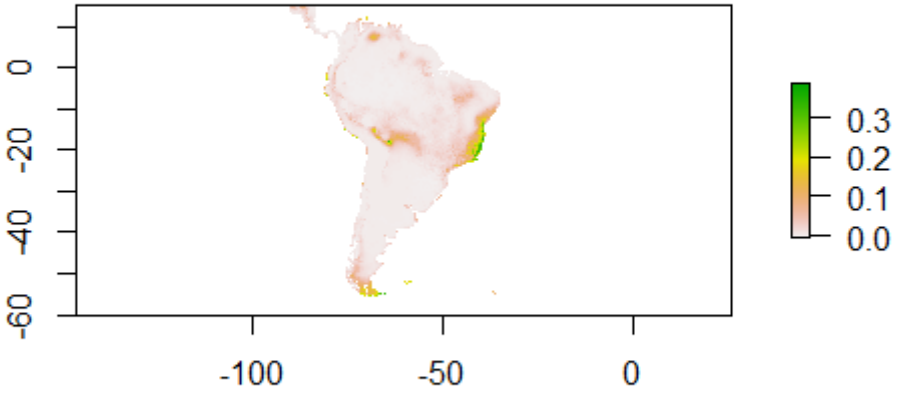
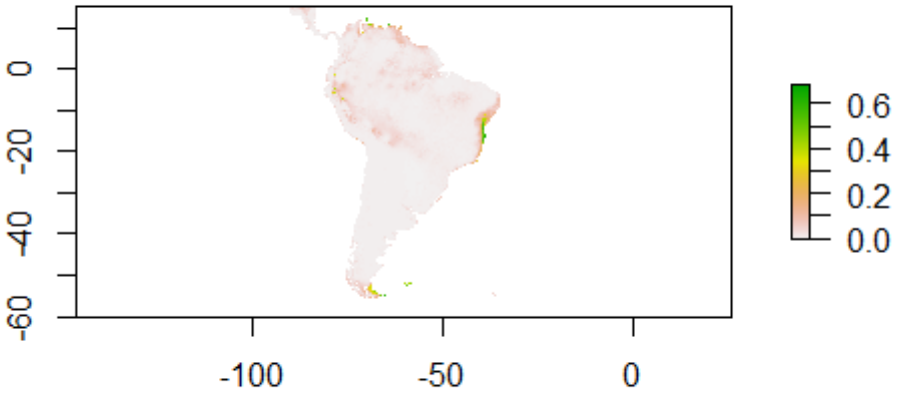


Billbergia morelii



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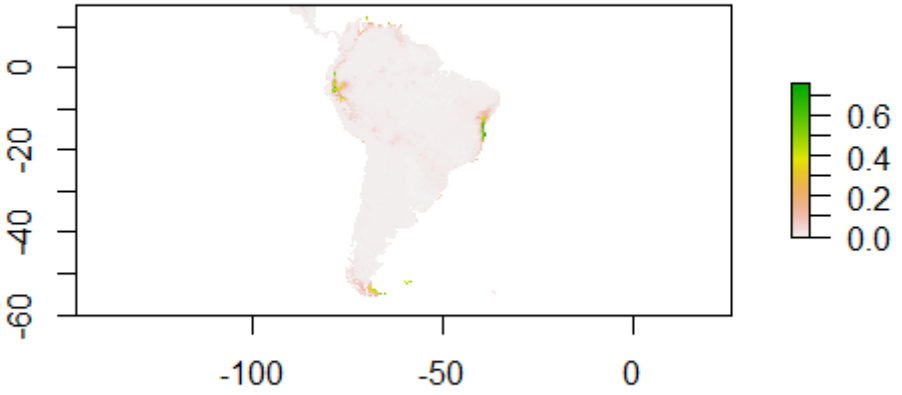
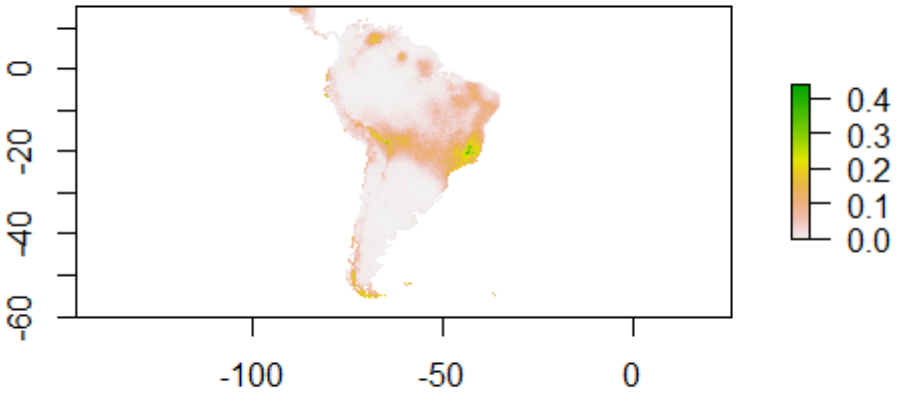
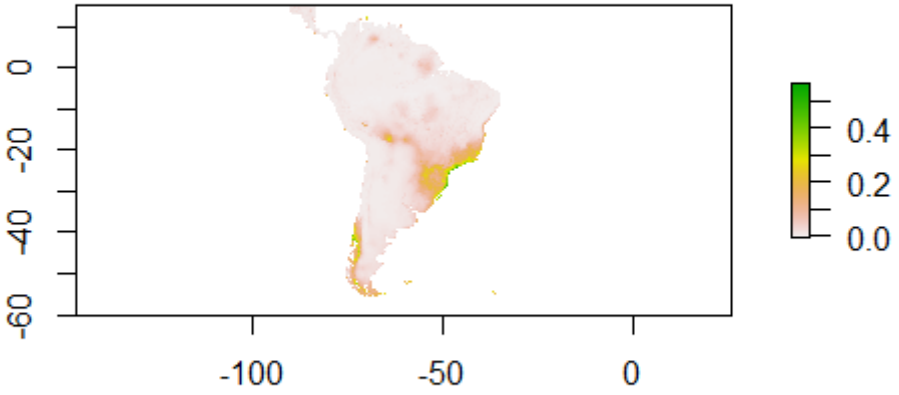


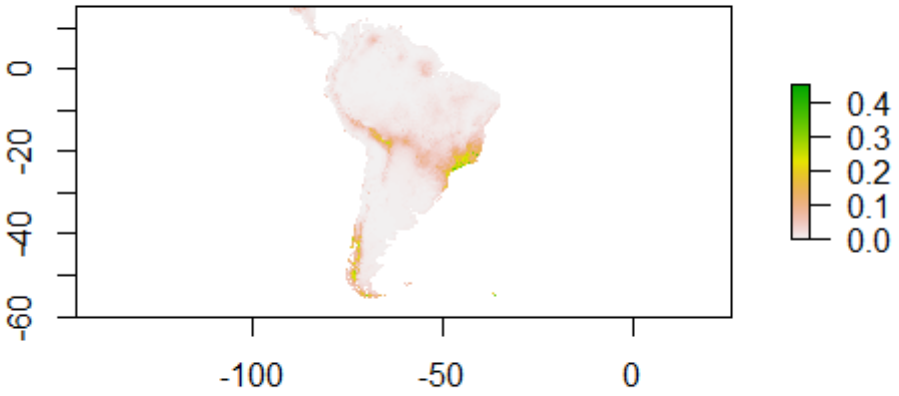
Billbergia vittata



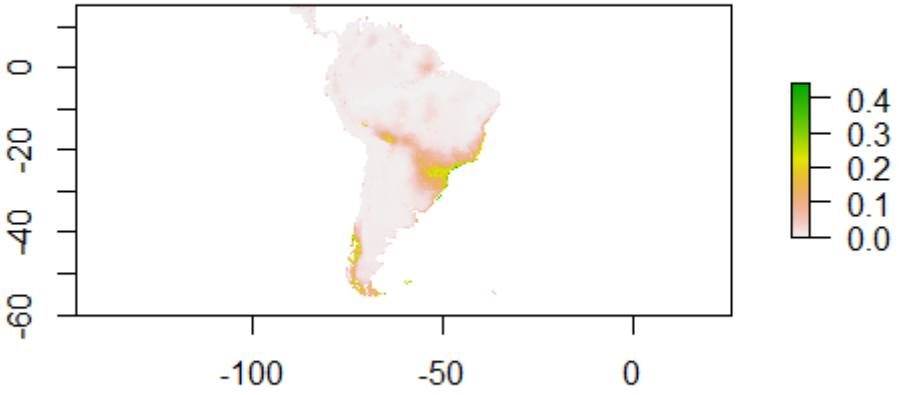
Billbergia zebrina



Brasiliorchis gracilis



Brasiliorchis marginata



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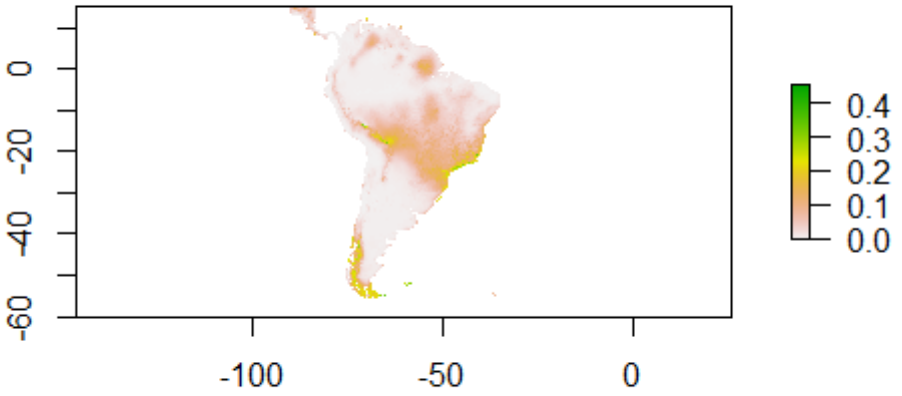
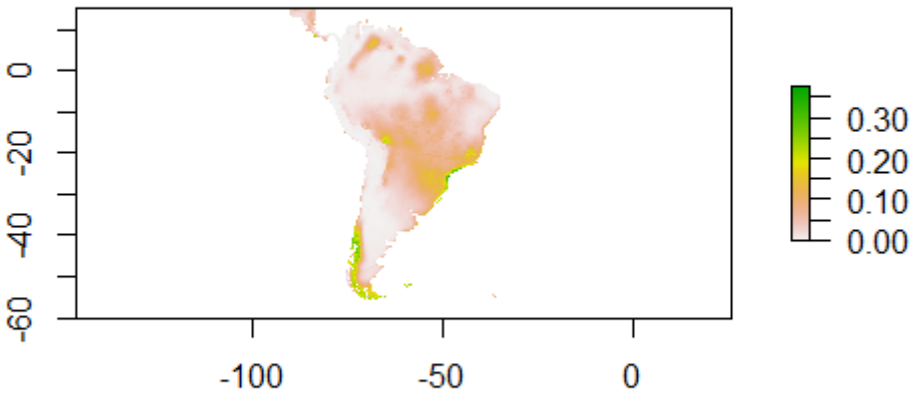
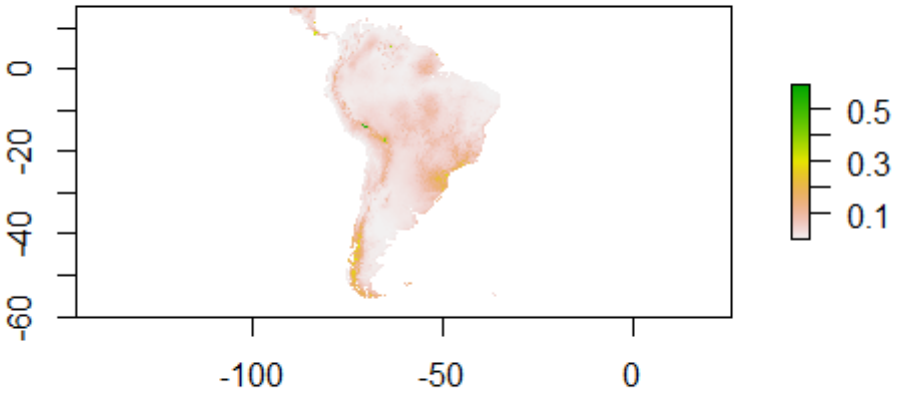


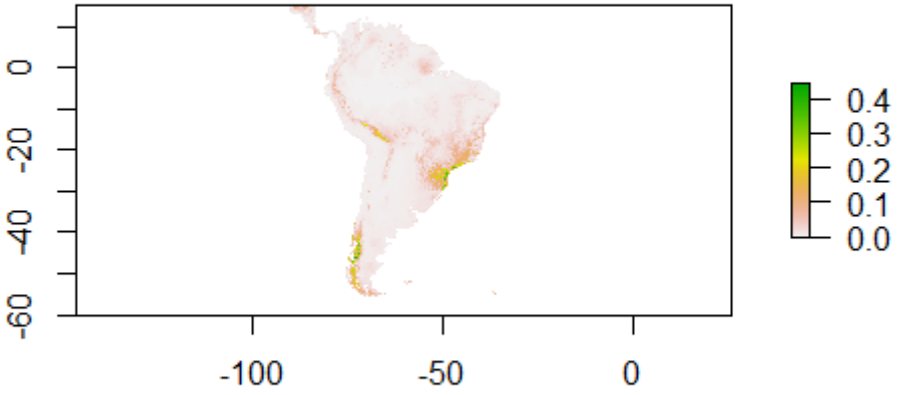
Bulbophyllum glutinosum



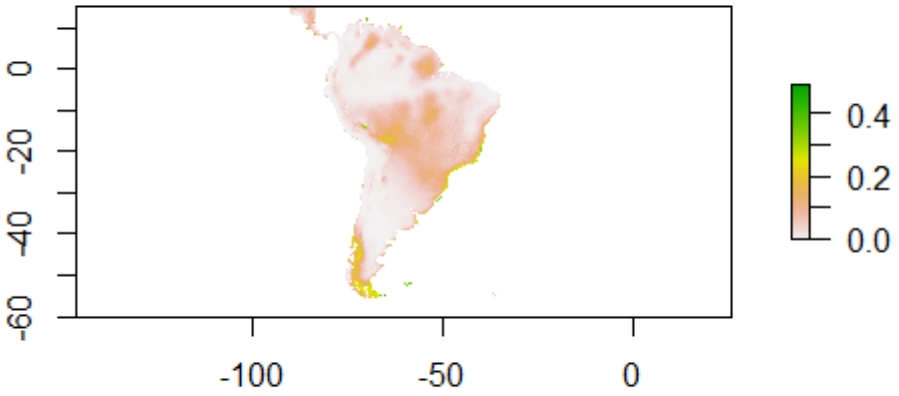
Bulbophyllum granulosum



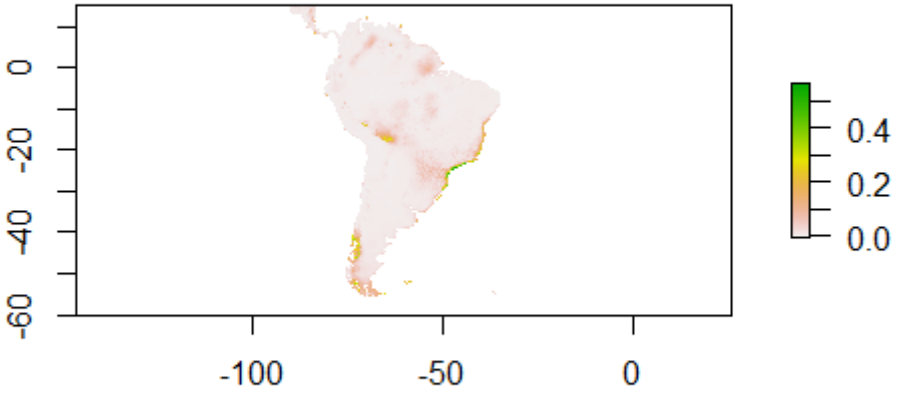
Bulbophyllum napellii



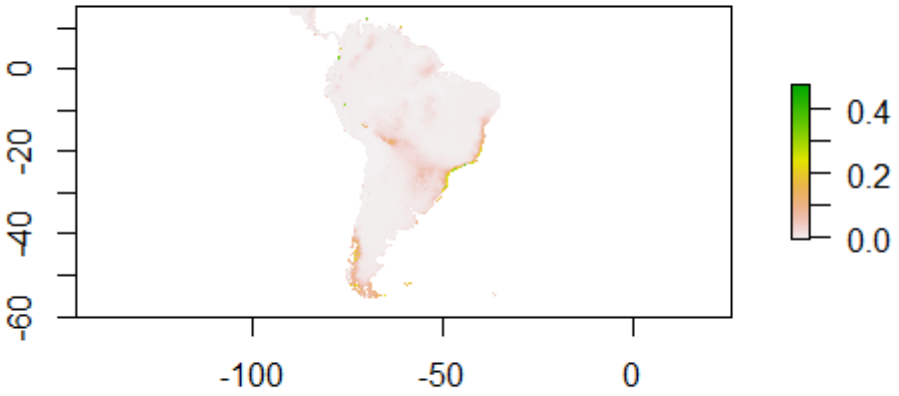
Campylocentrum sellowii



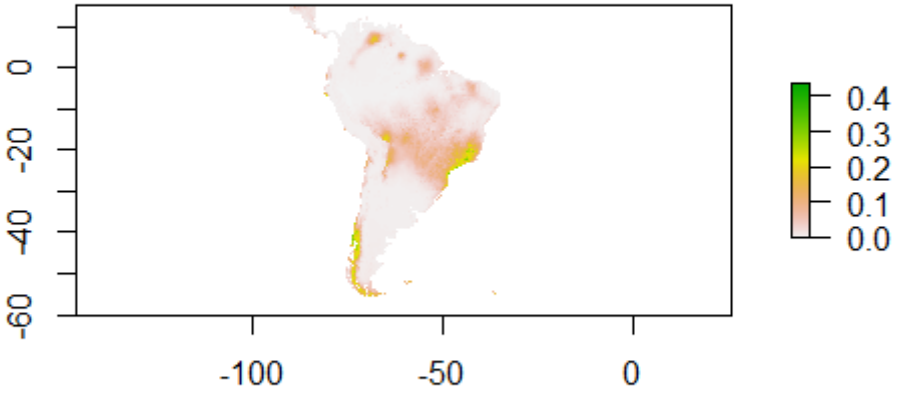
Canistropsis billbergioides



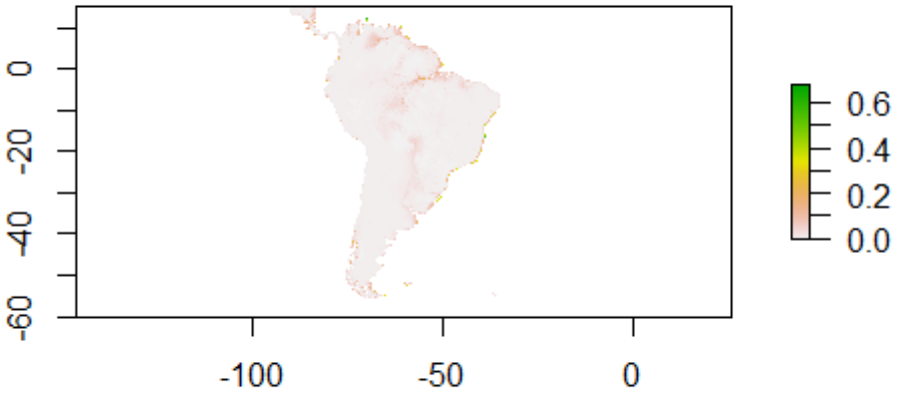
Canistropsis microps



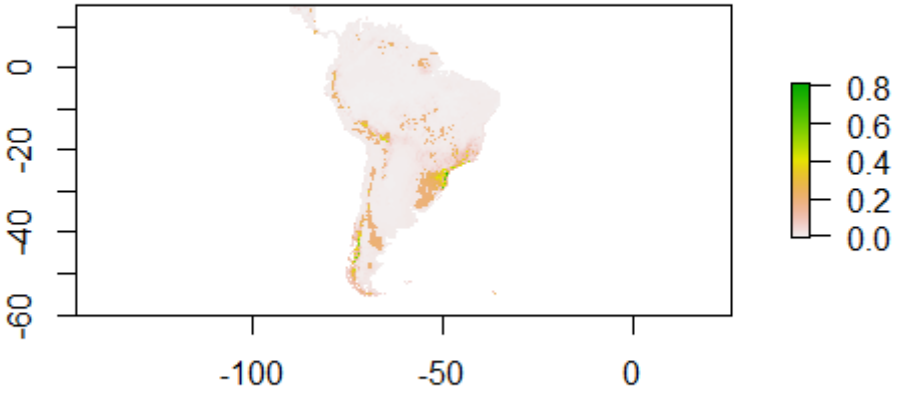
Catasetum cernuum



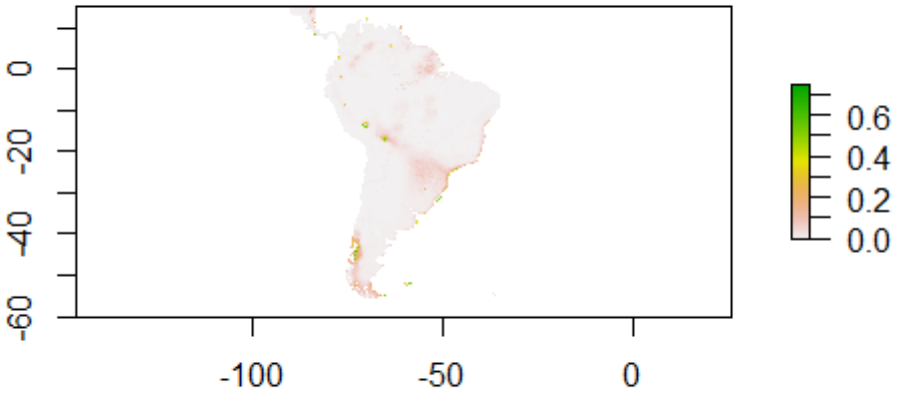
Catopsis berteroniana



Cattleya coccinea



Cattleya forbesii



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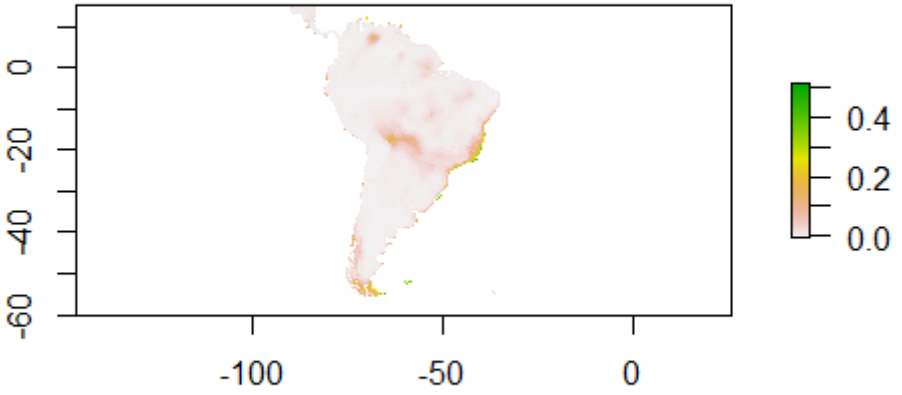
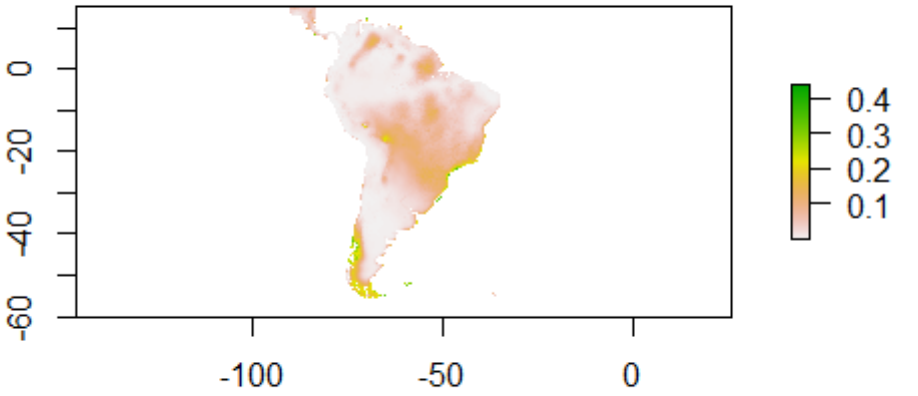
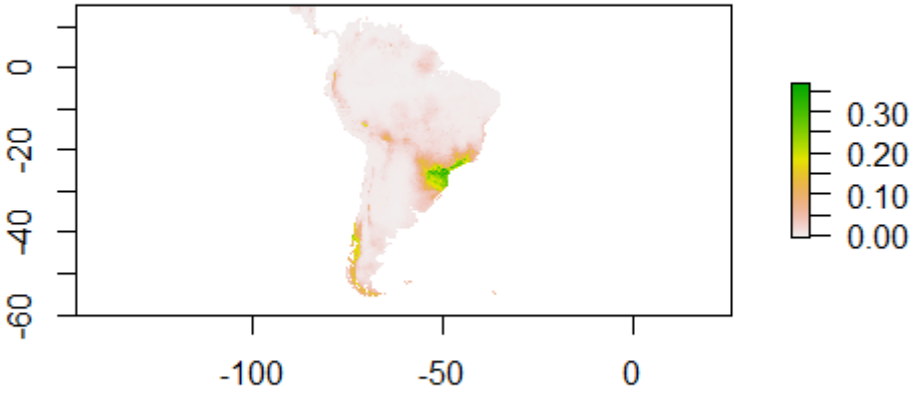


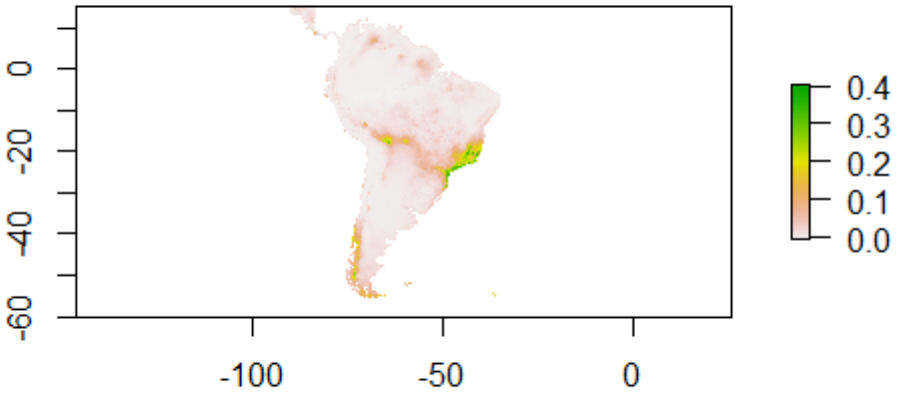
Christensonella ferdinandiana



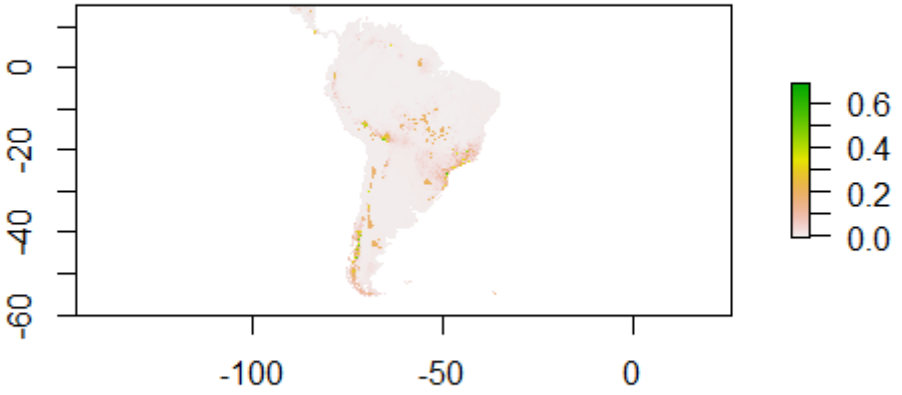
Christensonella neowiedii



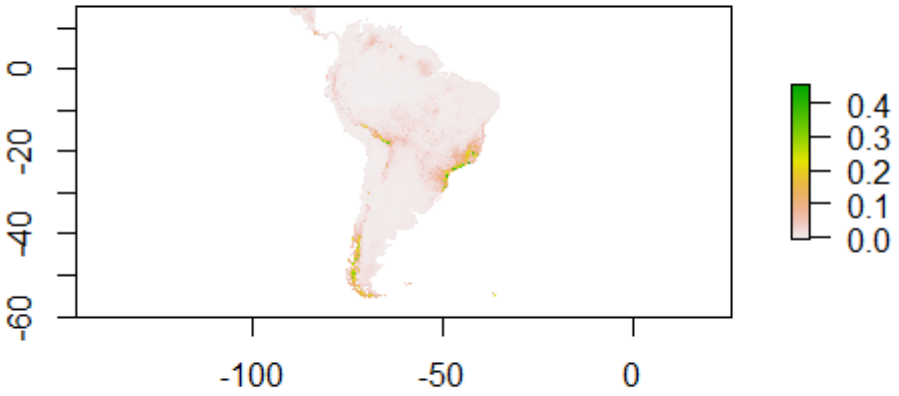
Christensonella subulata



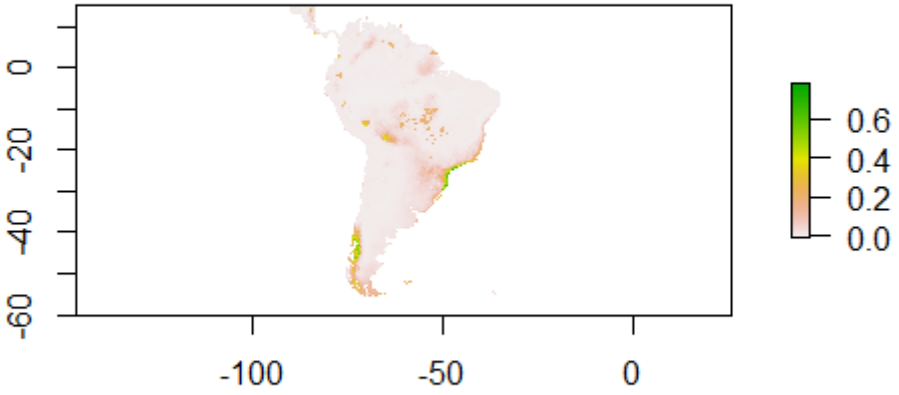
Cochlidium punctatum



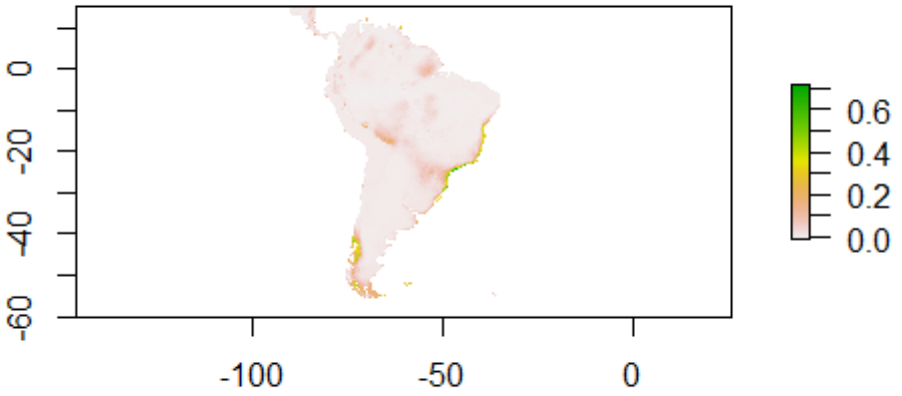
Codonanthe cordifolia



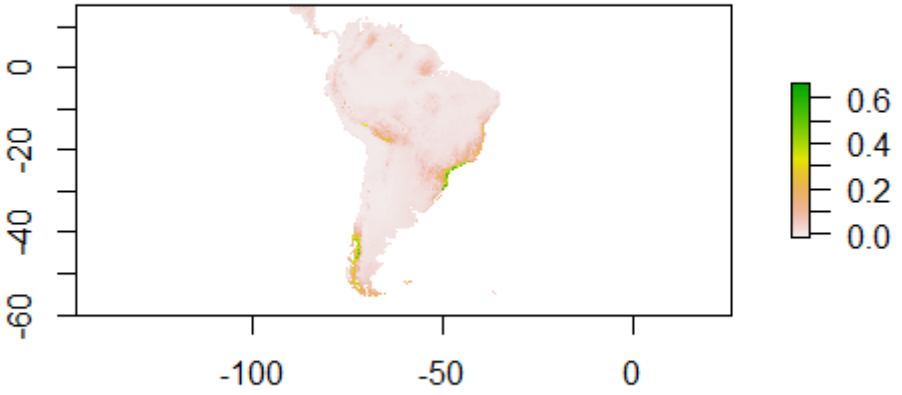
Codonanthe devosiana



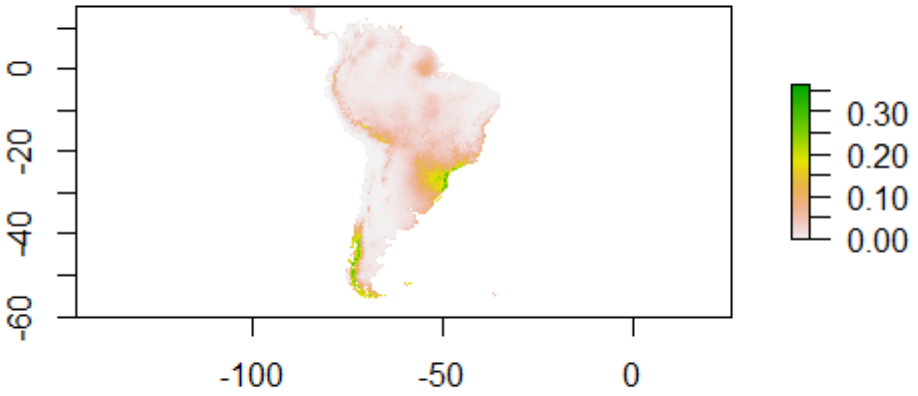
Codonanthe gracilis



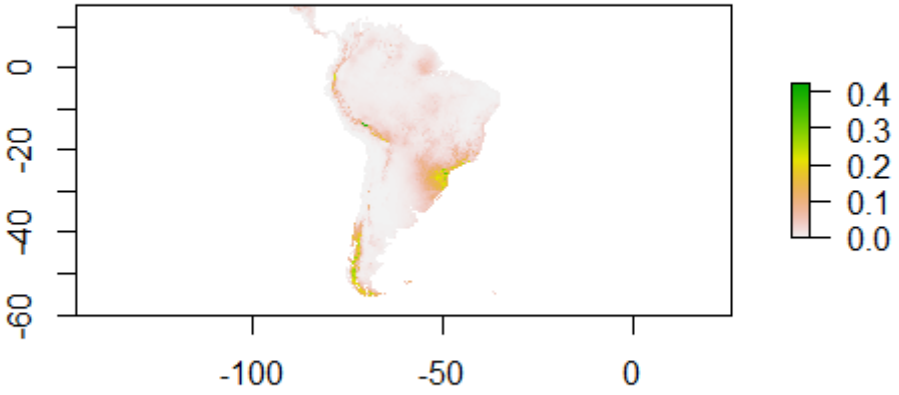
Dichaea cogniauxiana



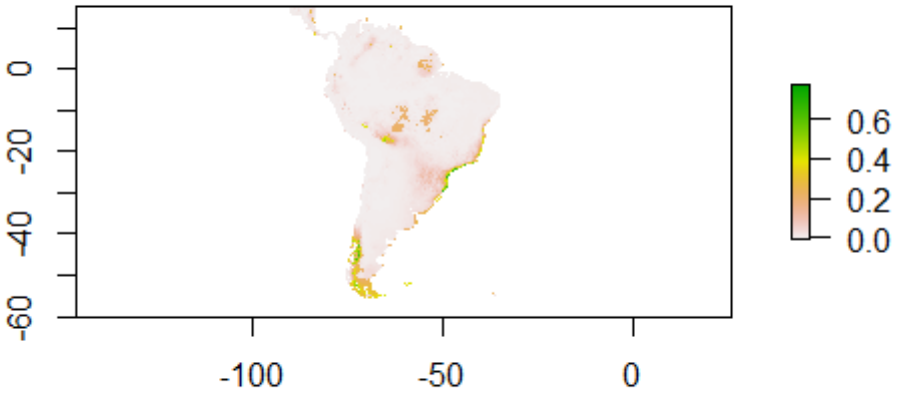
Dryadella edwallii



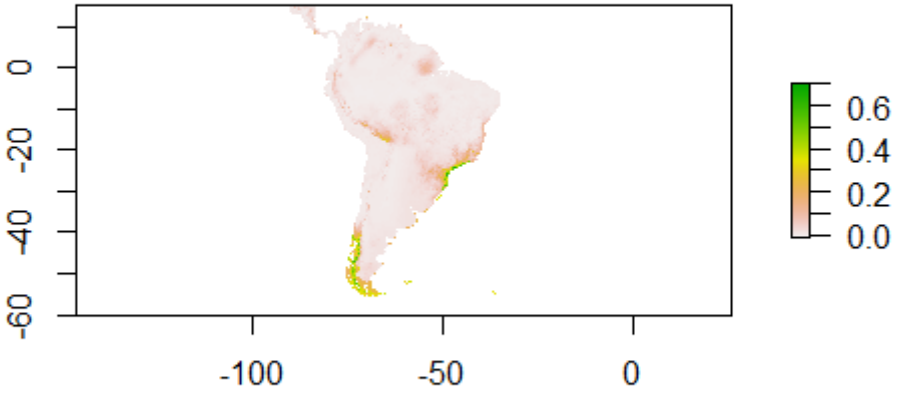
Dryadella lilliputiana



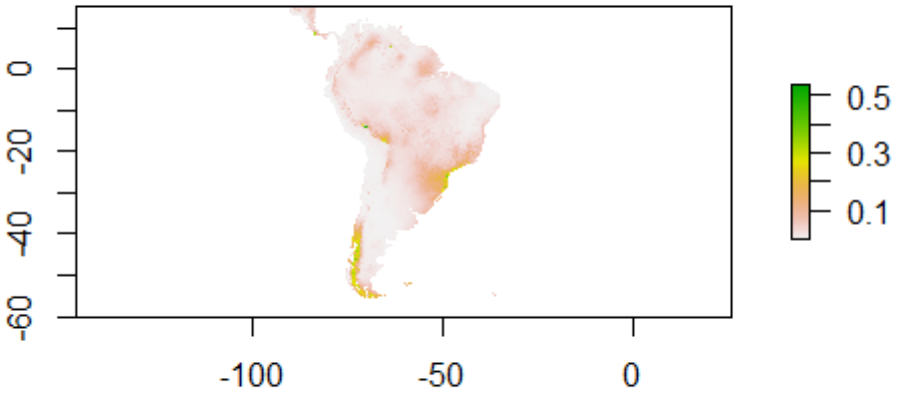
Edmundoa lindenii



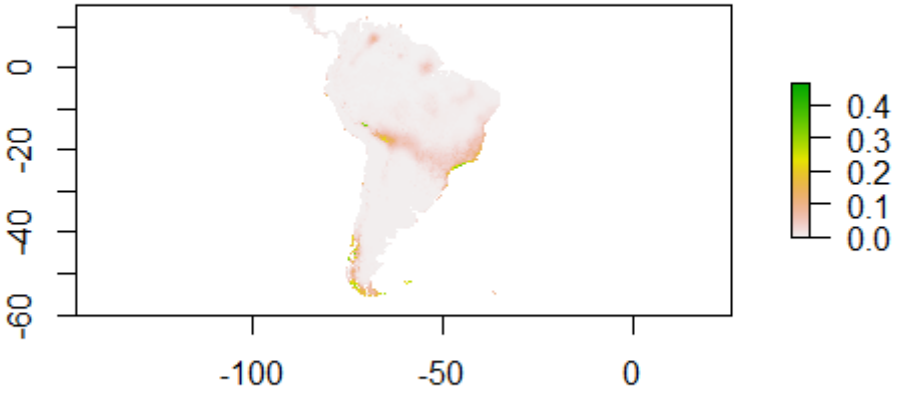
Elaphoglossum glaziovii



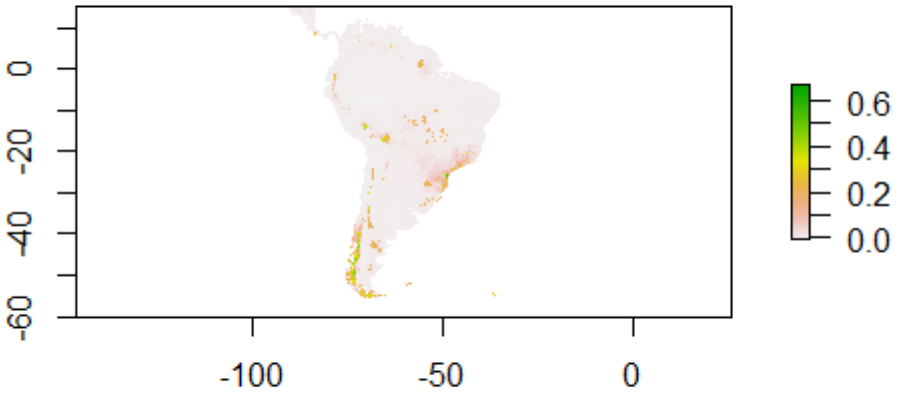
Elaphoglossum lingua



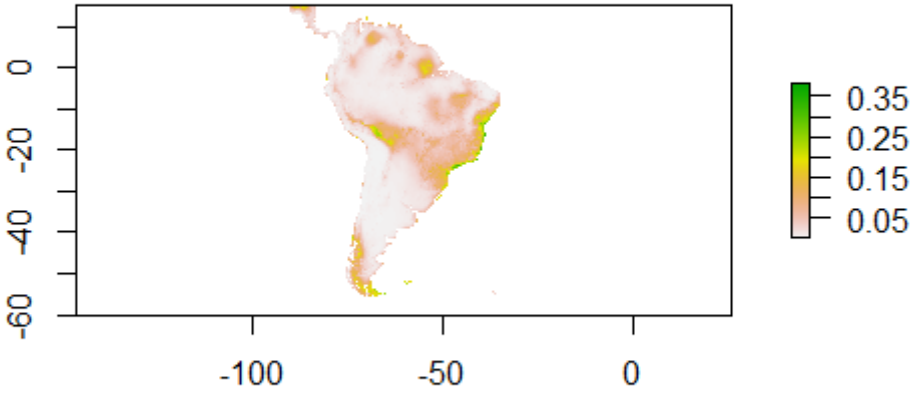
Elaphoglossum scolopendrifolium

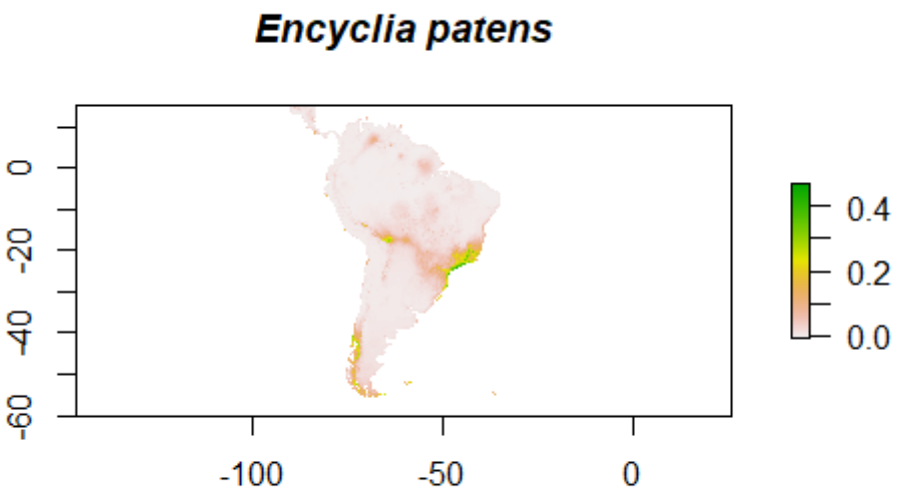


Elaphoglossum vagans



Encyclia oncidioides

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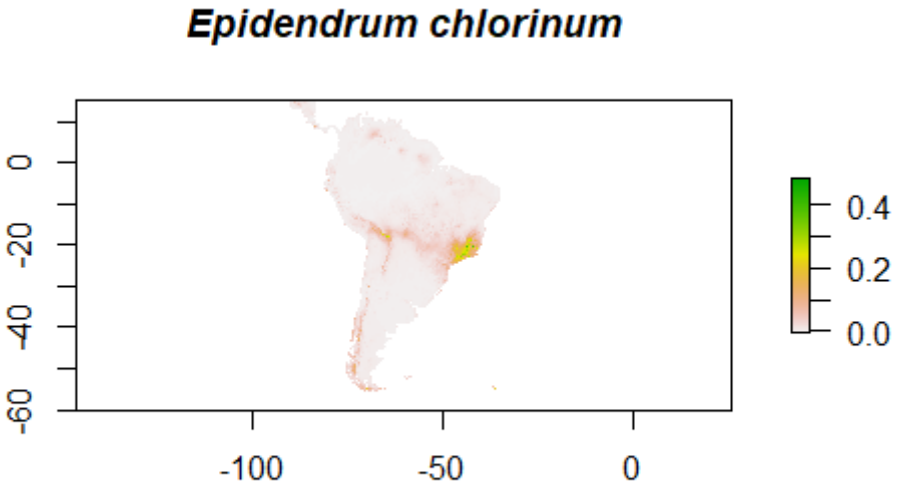
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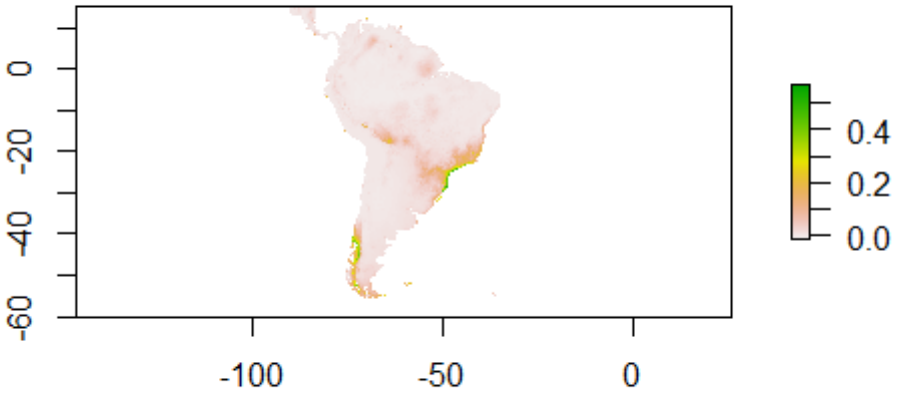
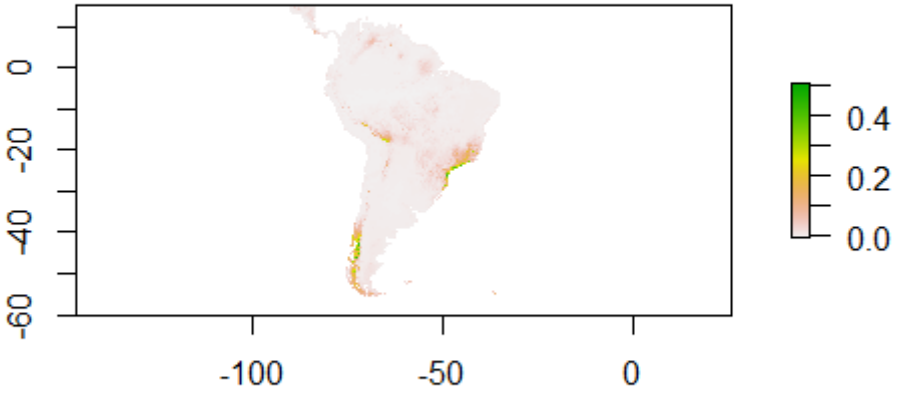
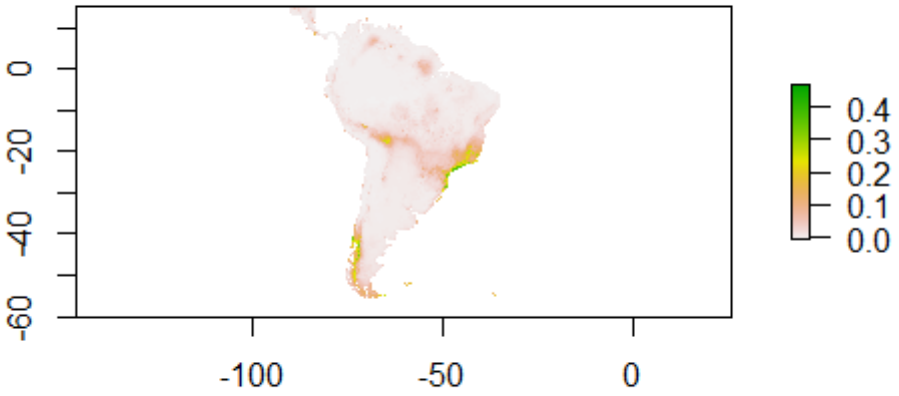


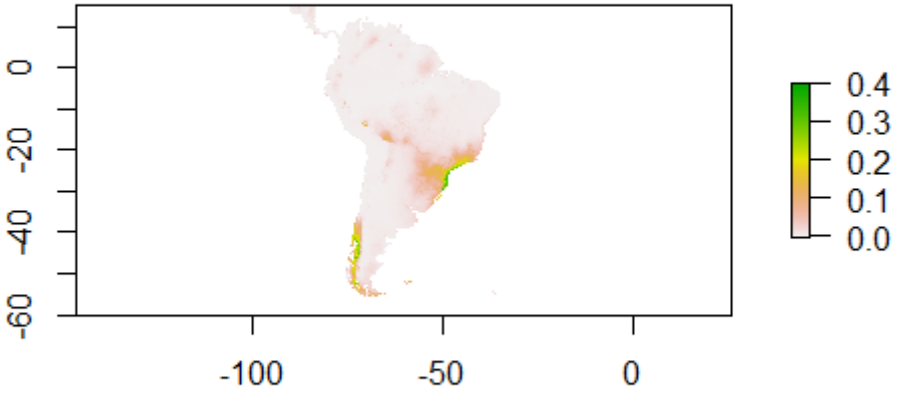
Epidendrum paranaense



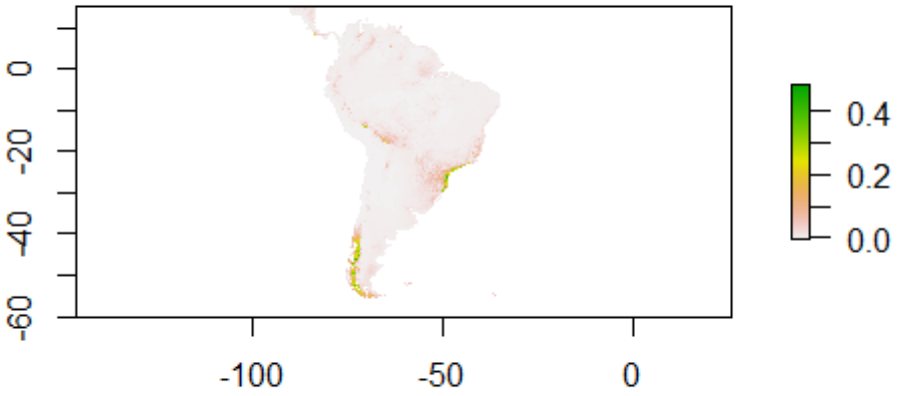
Epidendrum proligerum



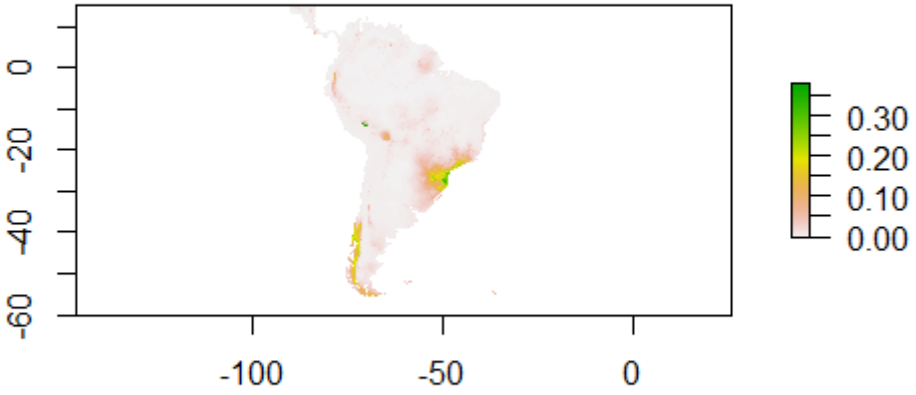
Epidendrum pseudodifforme



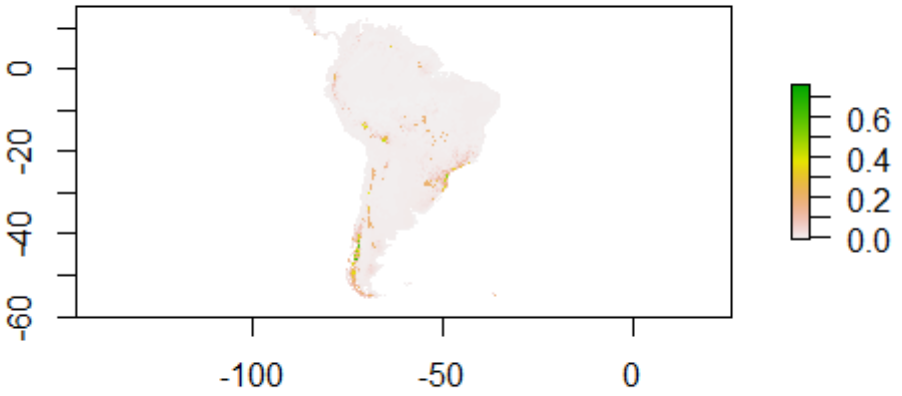
Epidendrum vesicatum



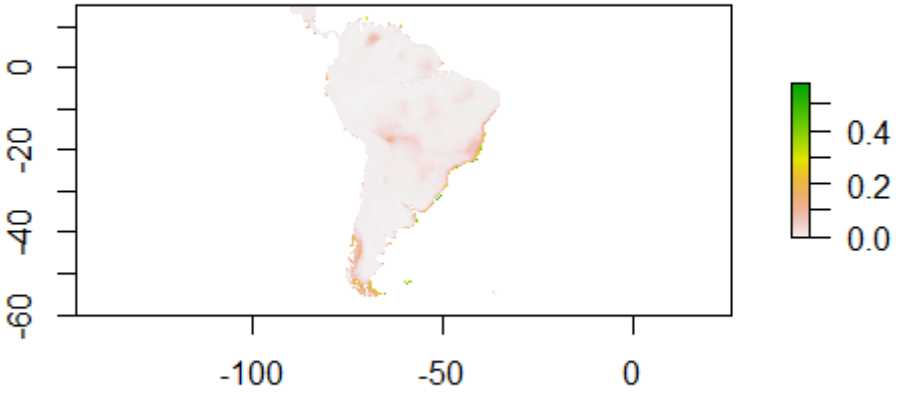
Eurystyles cotyledon

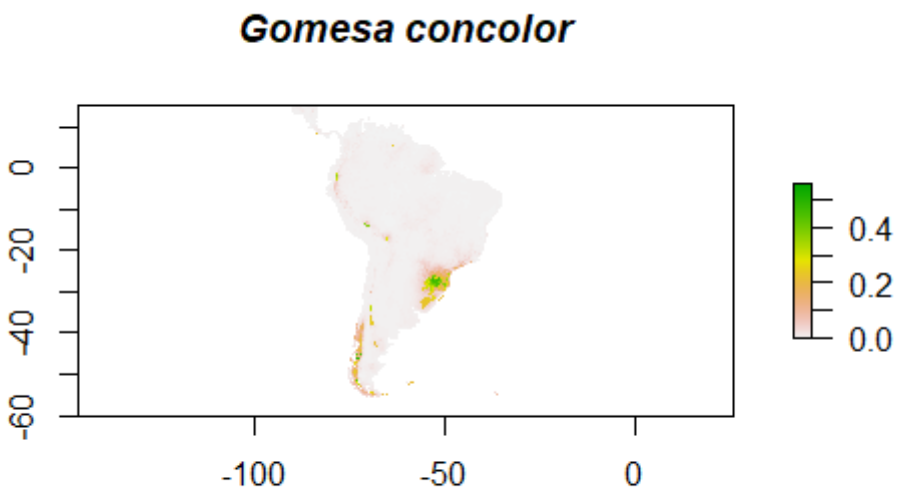


Fuchsia regia



Gomesa ciliata

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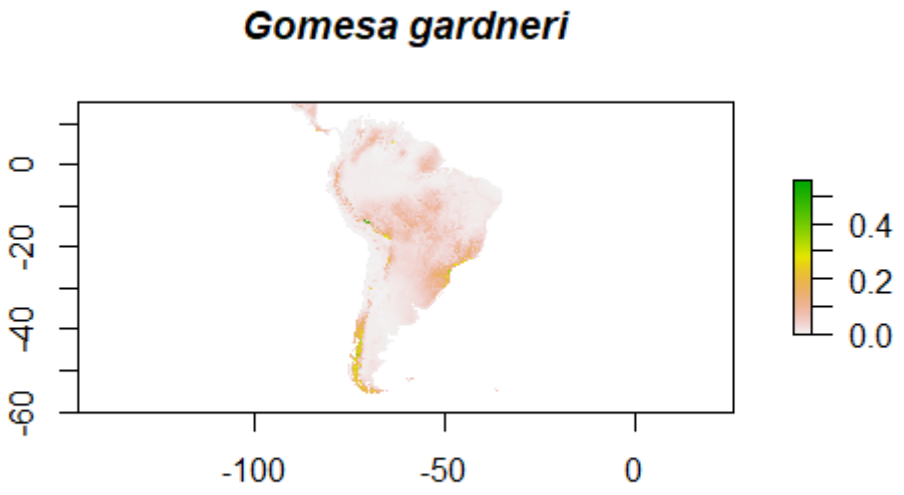
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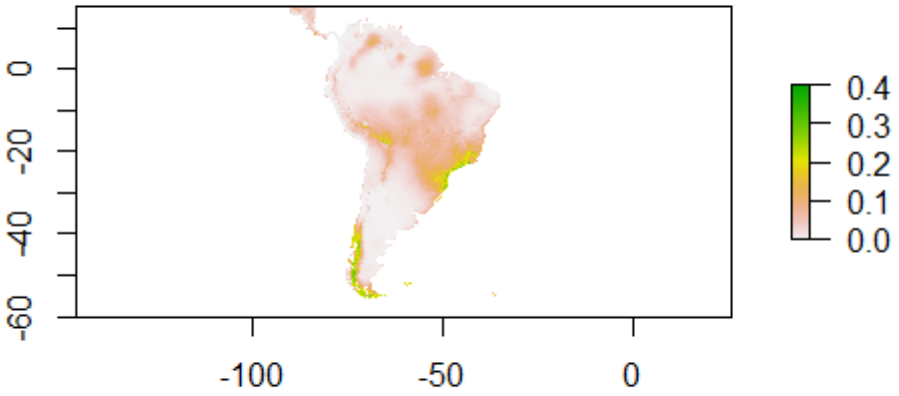
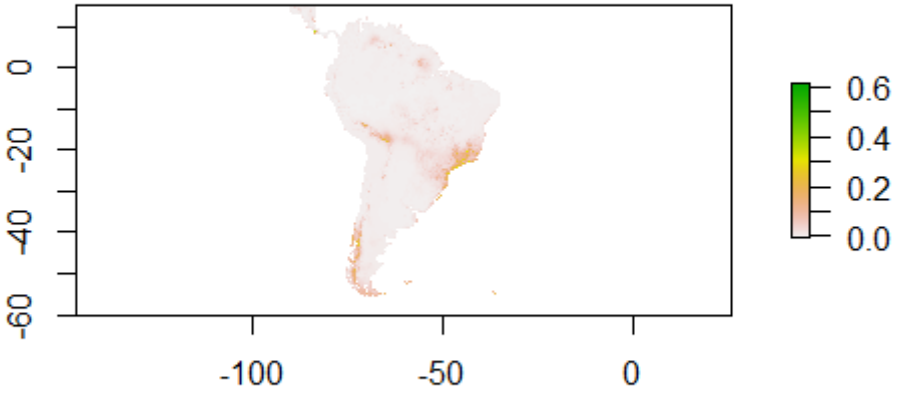
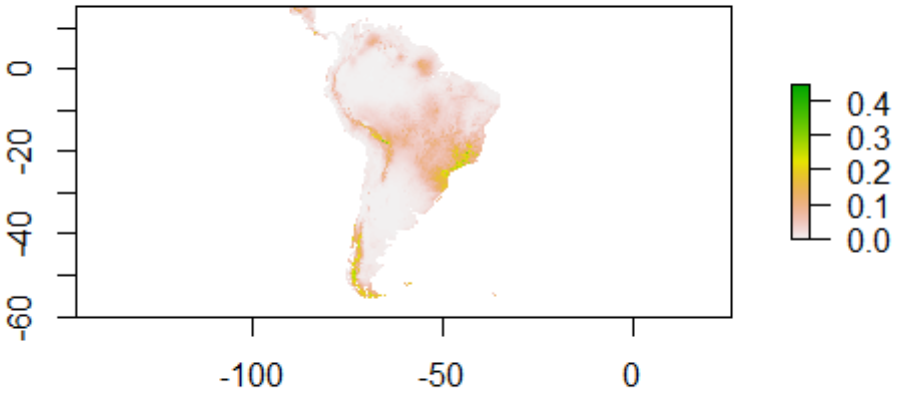
Gomesa glaziovii



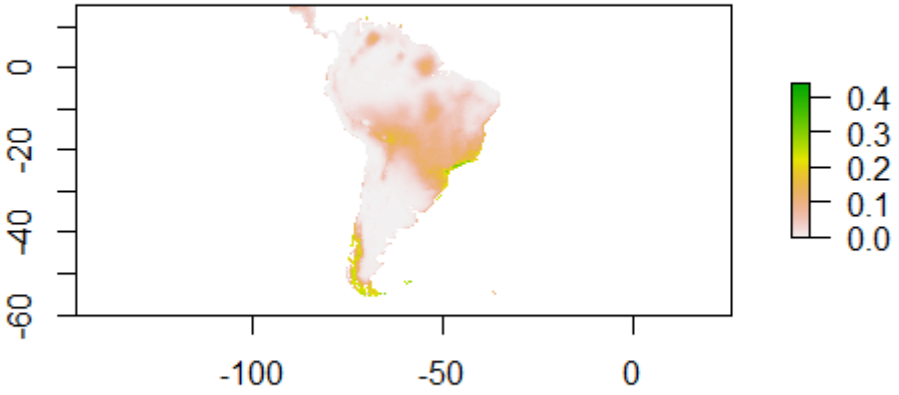
Gomesa gomezoides

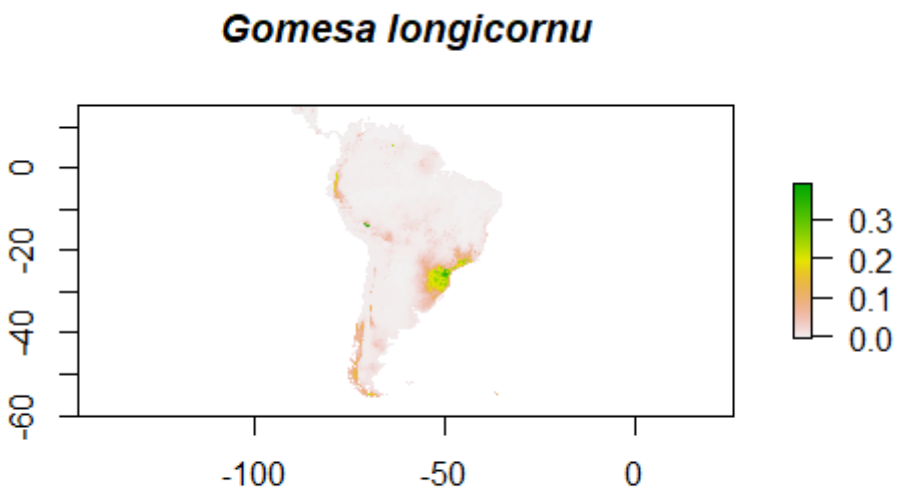


Gomesa imperatoris-maximiliani



Gomesa laxiflora

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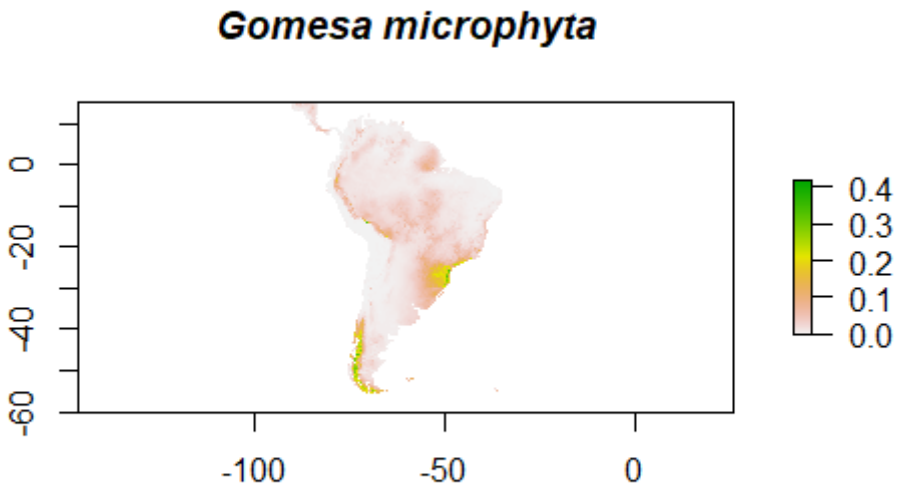
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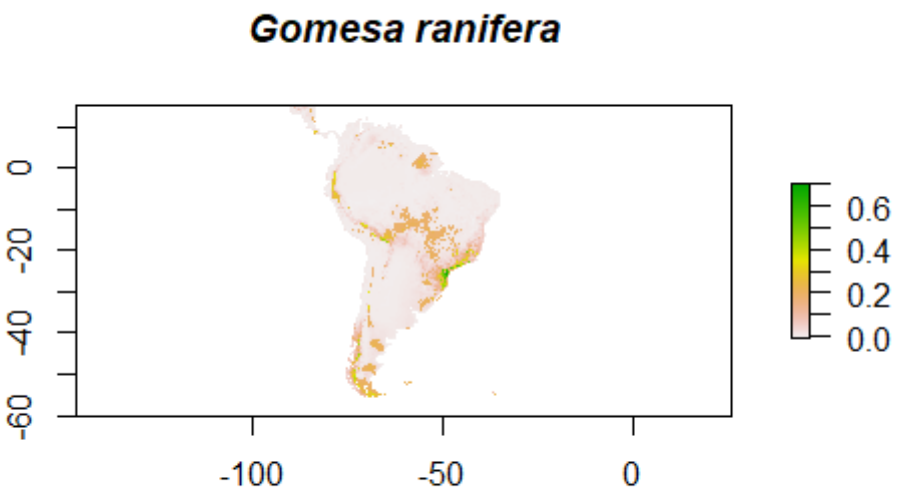
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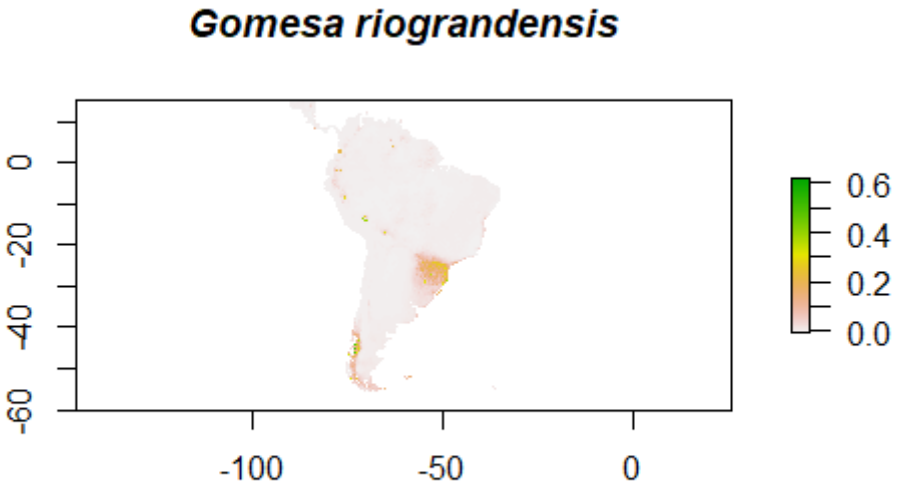
Gomesa riograndensis
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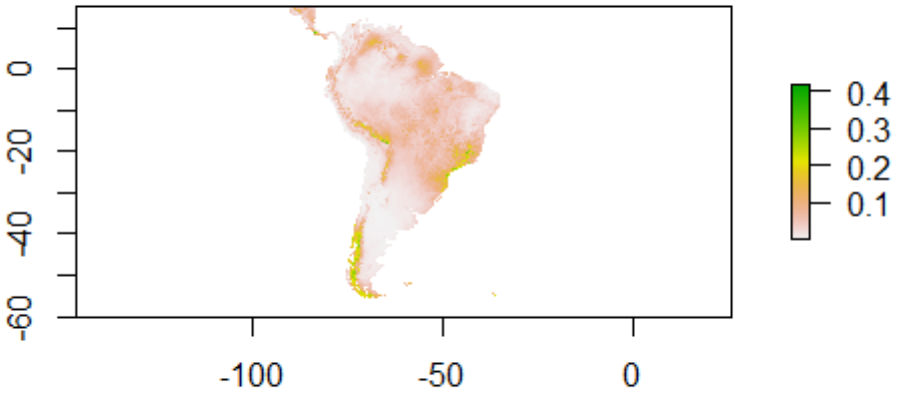
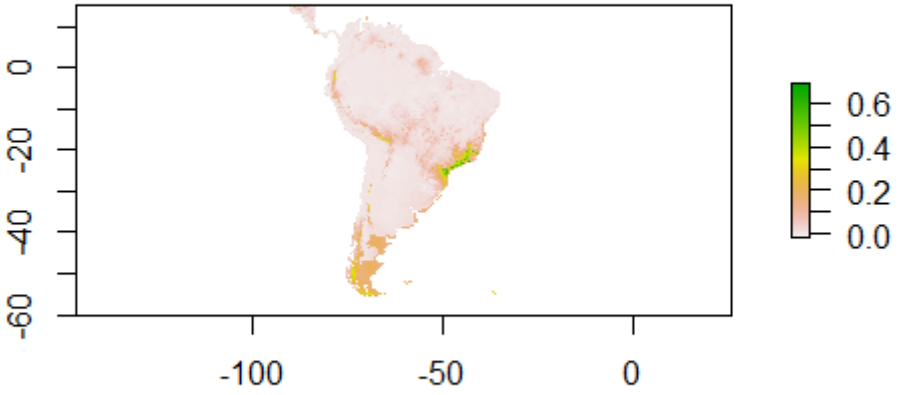
0.0

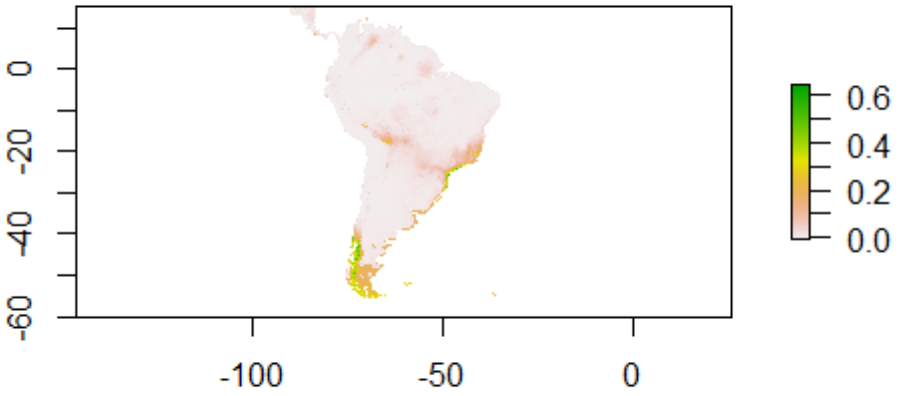
Grobya amherstiae



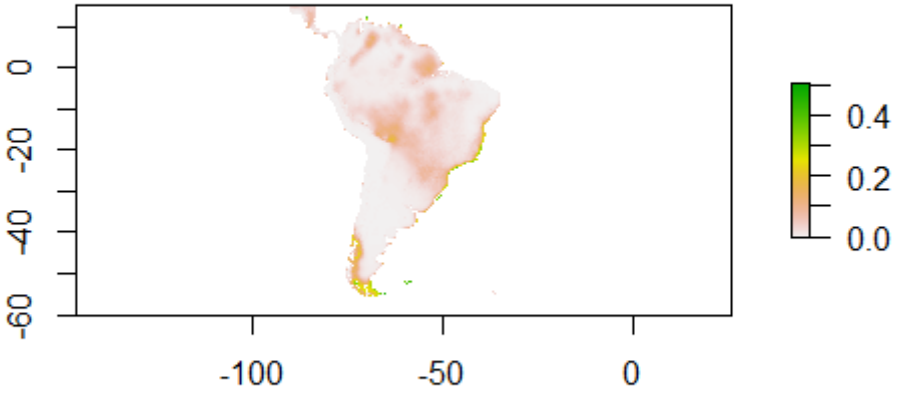
Hatiora salicornioides



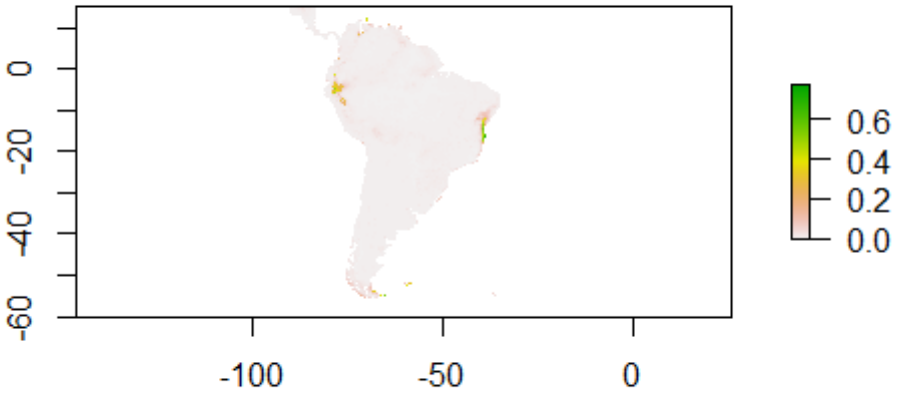
Heterotaxis brasiliensis



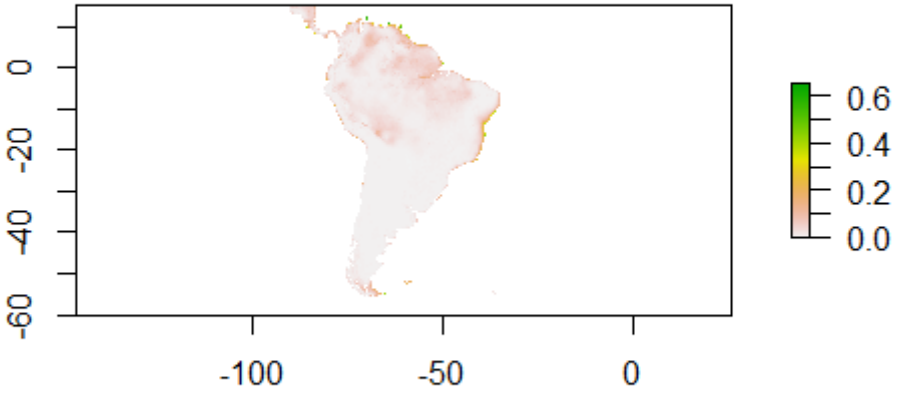
Hohenbergia augusta



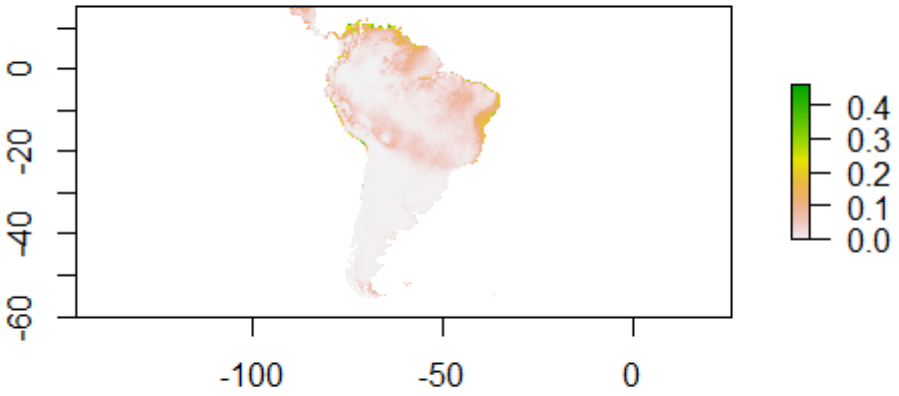
Hohenbergia belemii



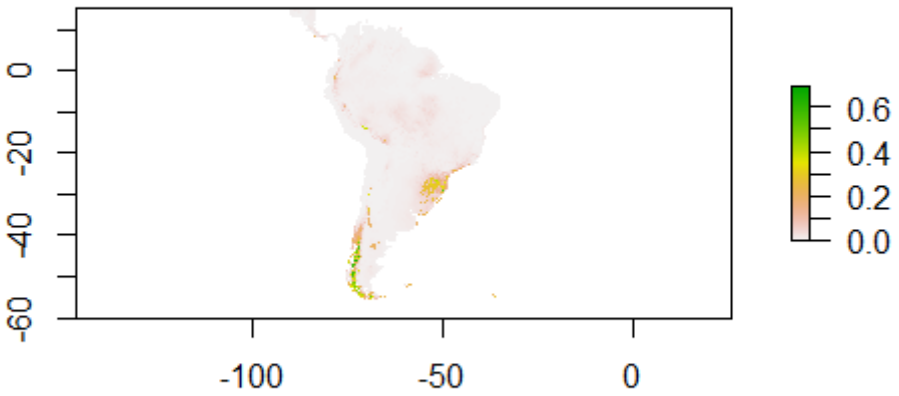
Hohenbergia ramageana



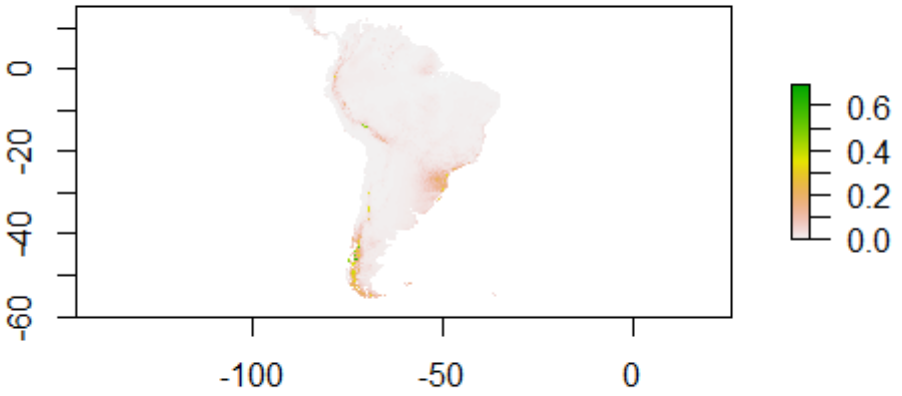
Hohenbergia ridleyi



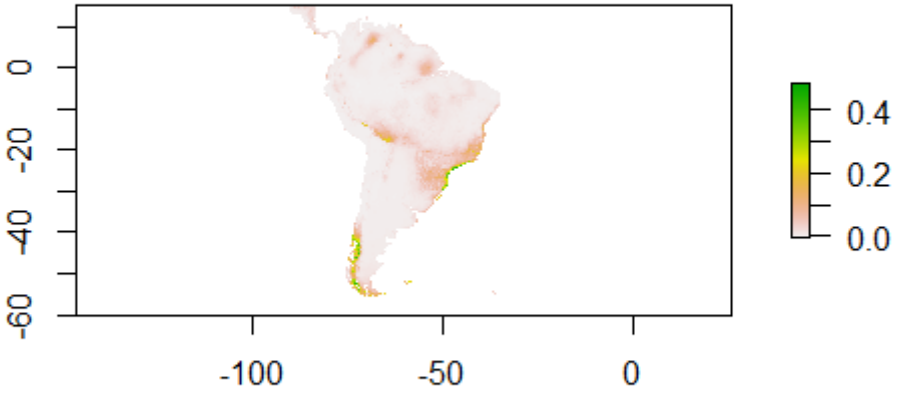
Hymenophyllum rufum



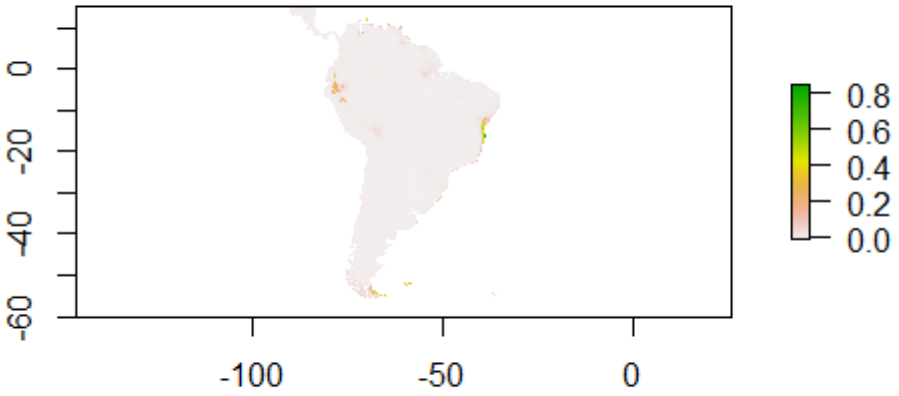
Leucotrichum organense



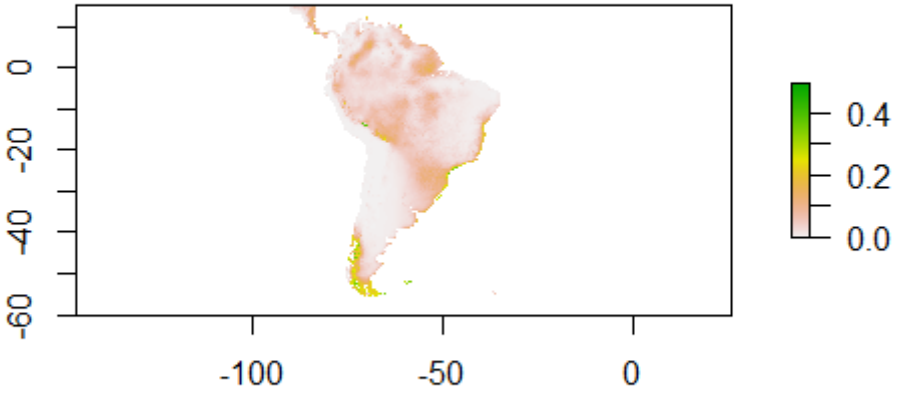
Lockhartia lunifera



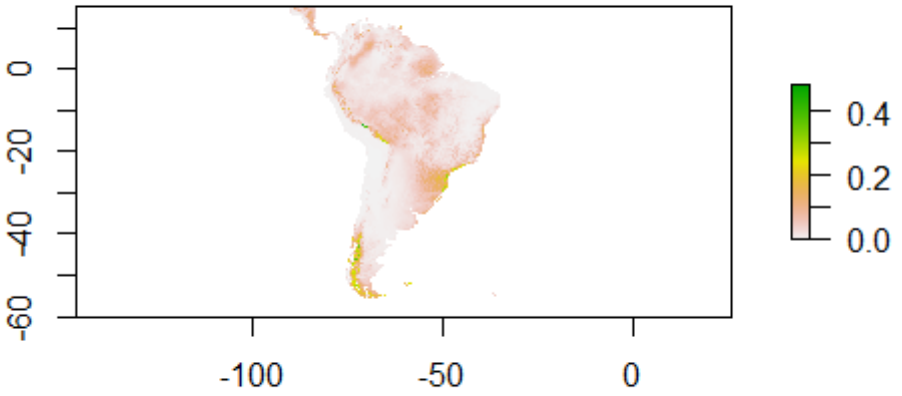
Lymania smithii



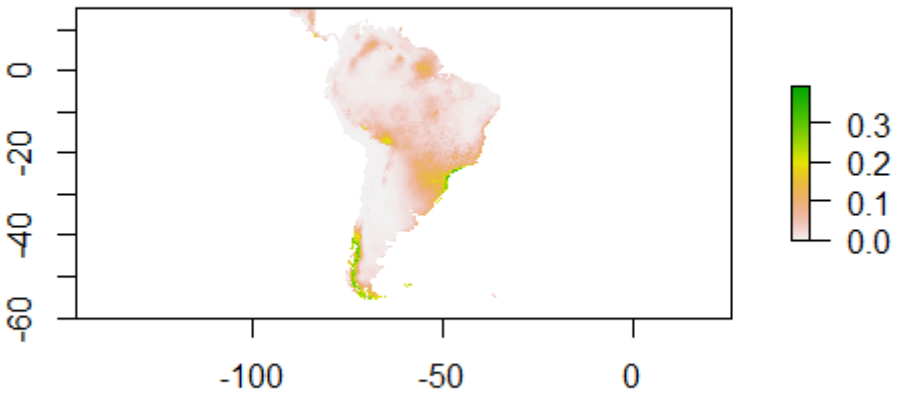
Maxillaria leucaimata

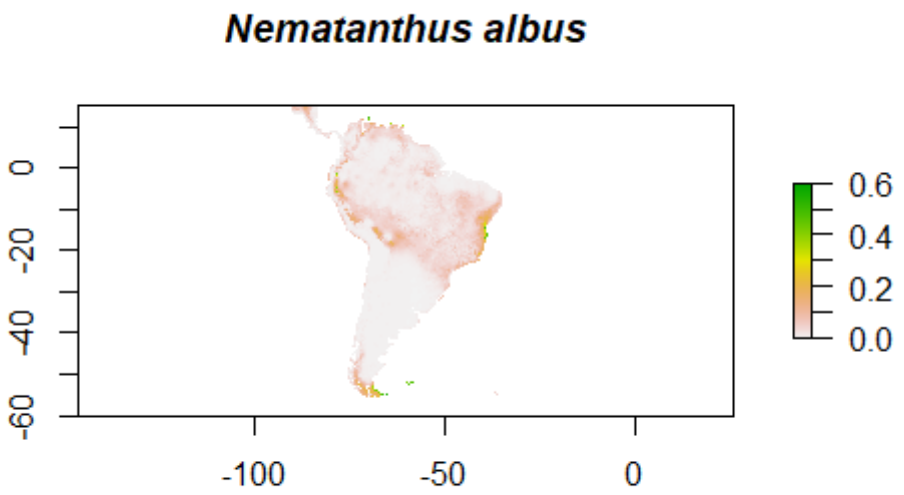


Microgramma tecta



Miltonia regnellii




Nematanthus albus
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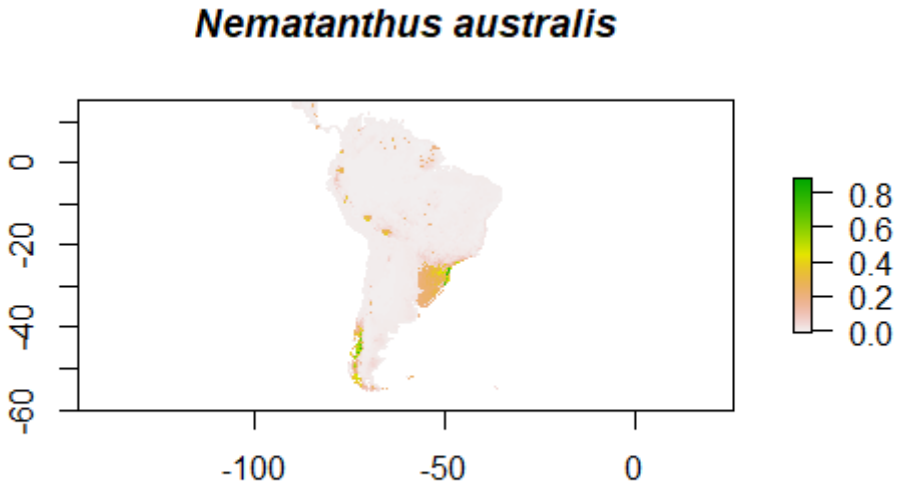
0.0


Nematanthus australis
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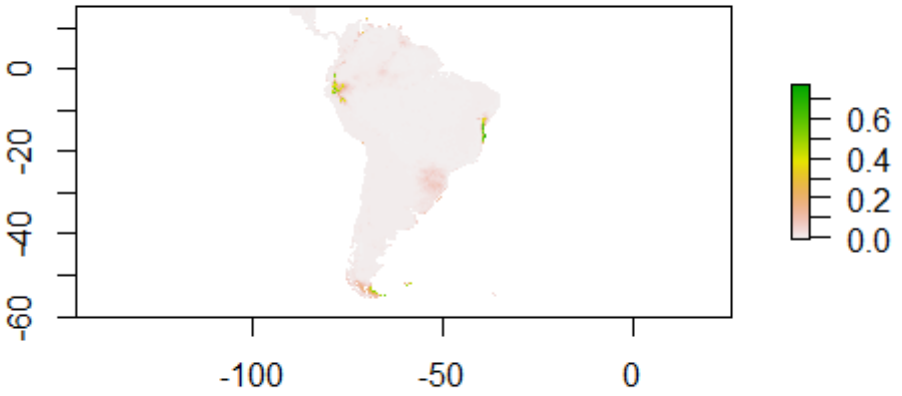
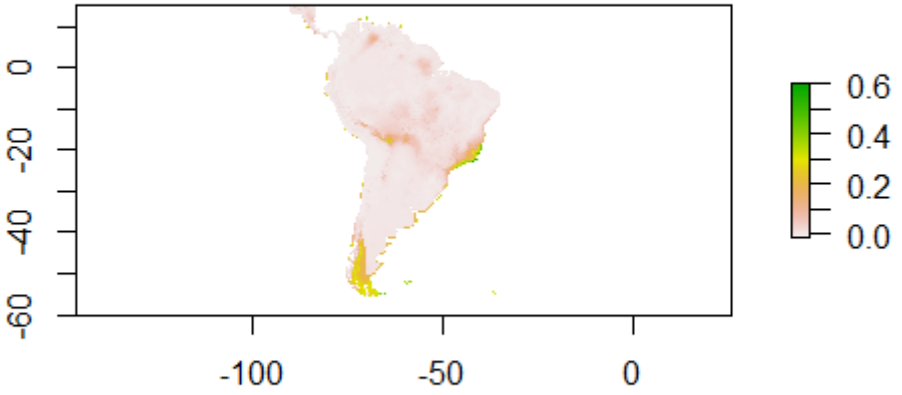
0.4
0.2
0.0

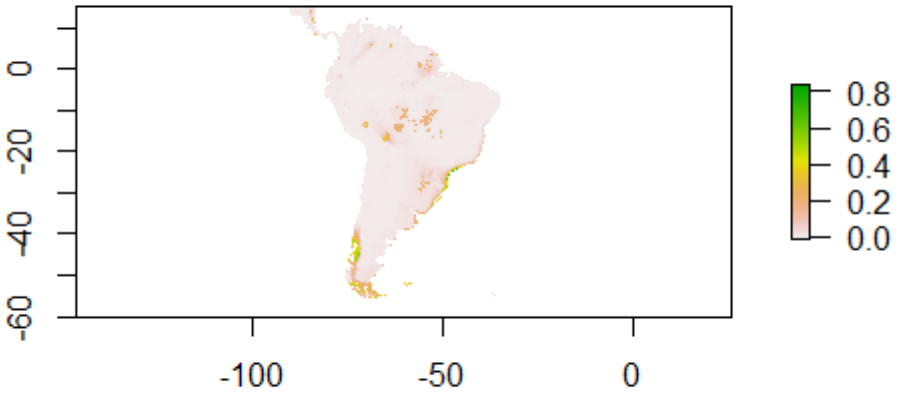
Nematanthus corticola



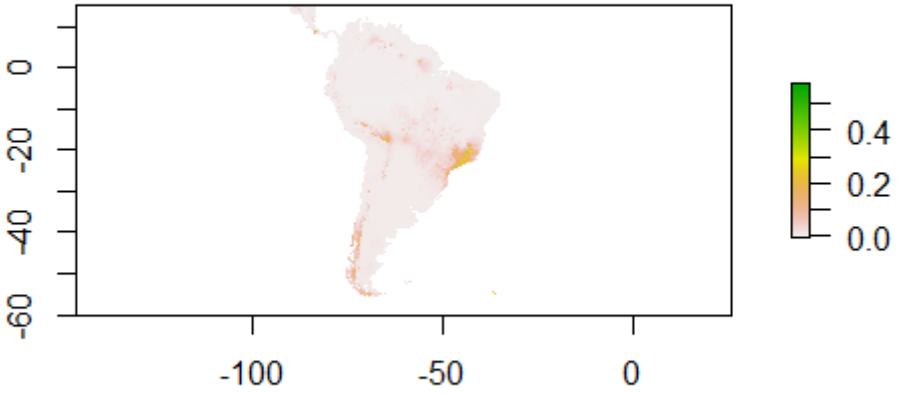
Nematanthus crassifolius



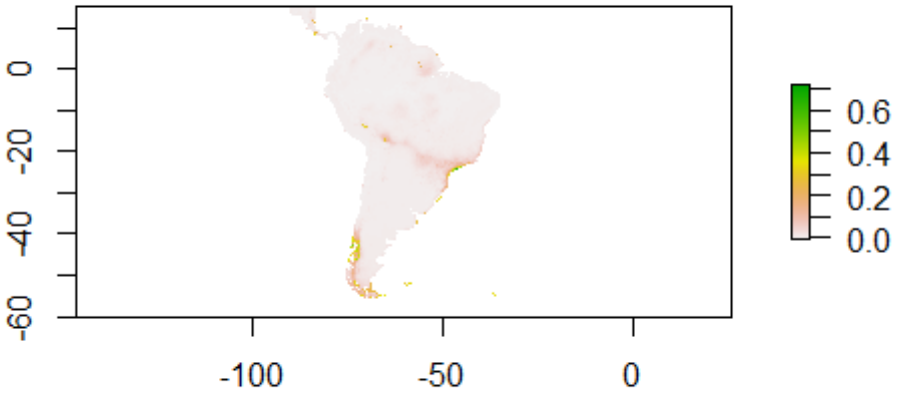
Nematanthus fissus



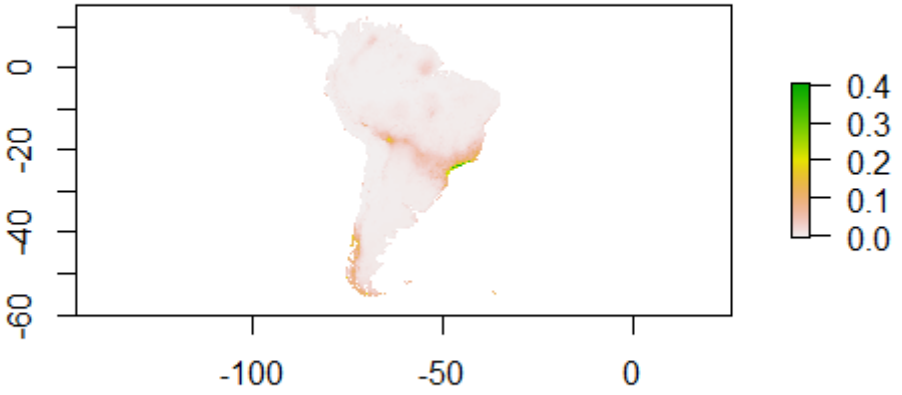
Nematanthus fornix



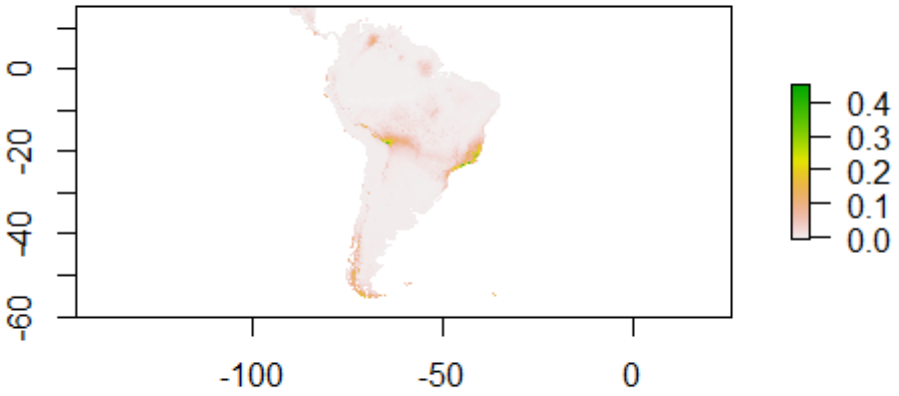
Nematanthus fritschii



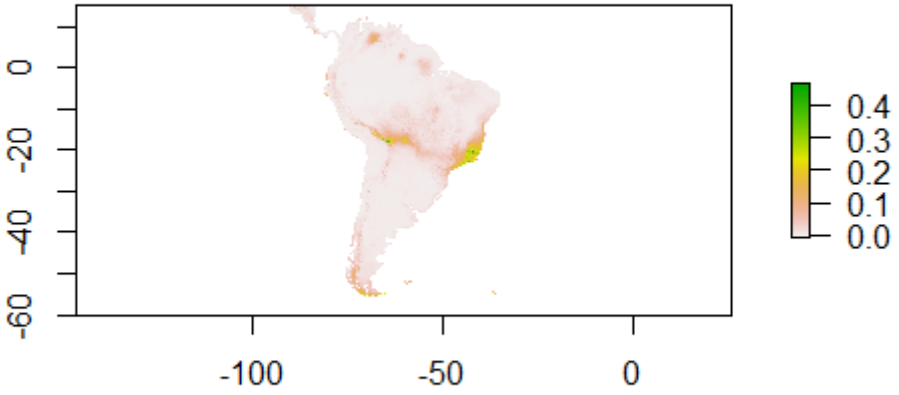
Nematanthus gregarius



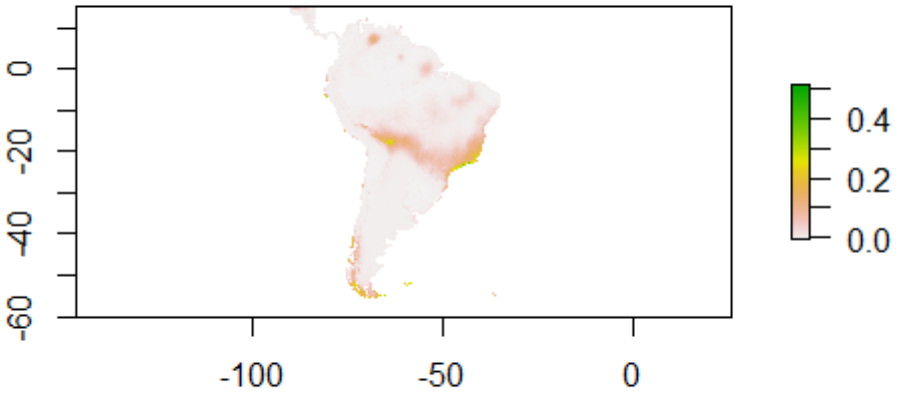
Nematanthus hirtellus



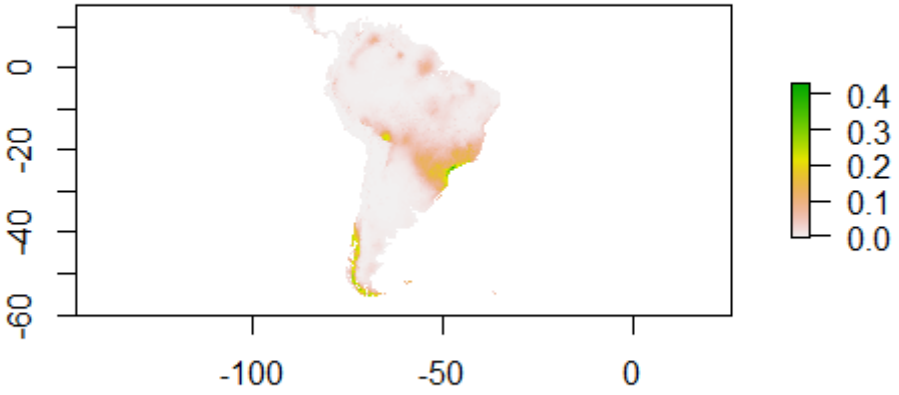
Nematanthus lanceolatus



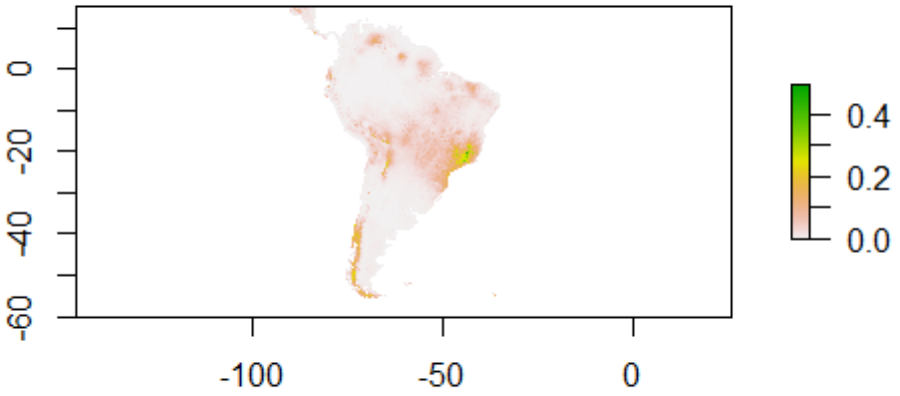
Nematanthus sericeus



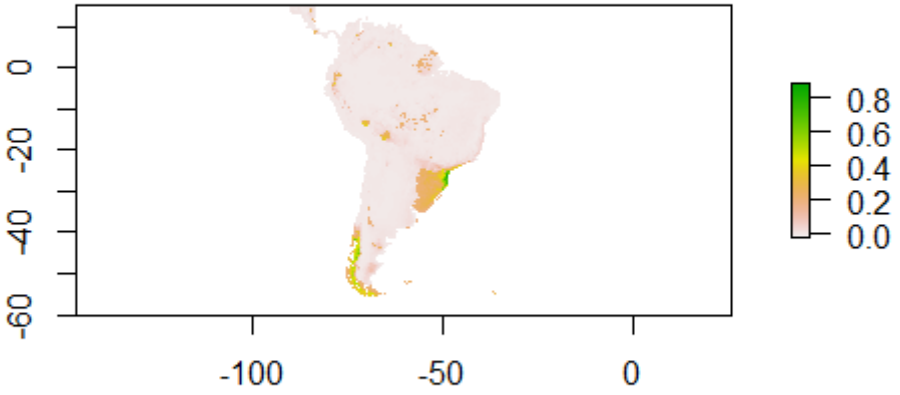
Nematanthus striatus



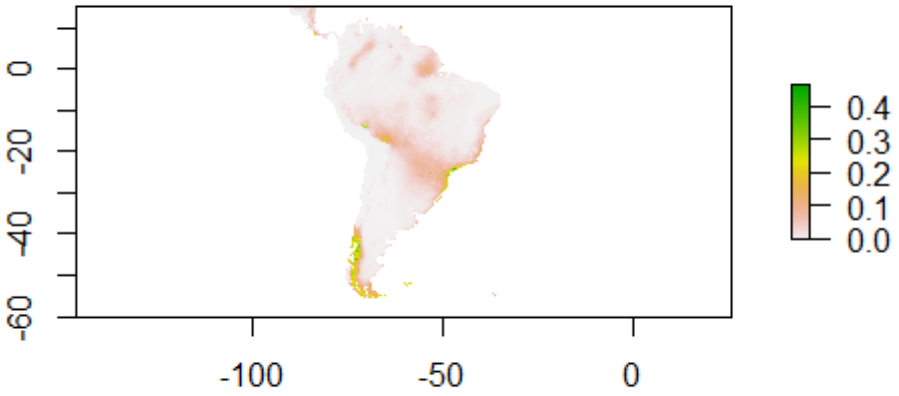
Nematanthus strigillosus



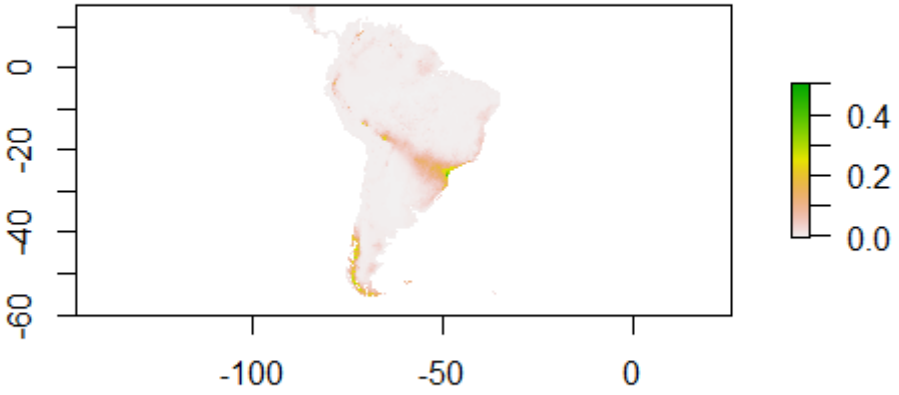
Nematanthus tessmannii



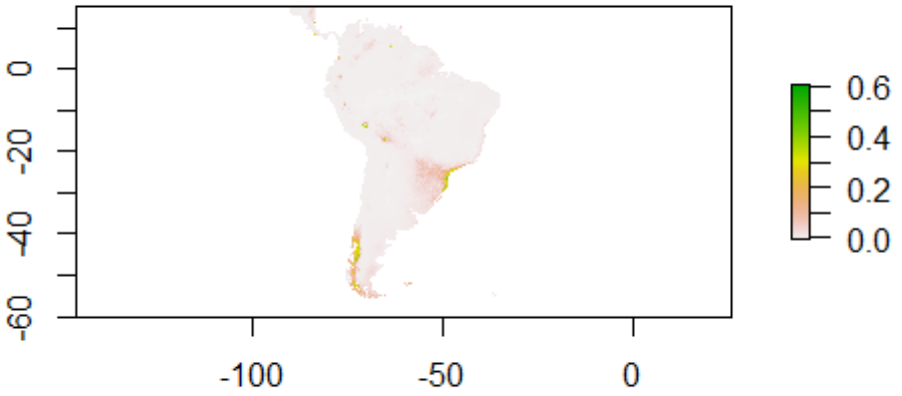
Nematanthus villosus



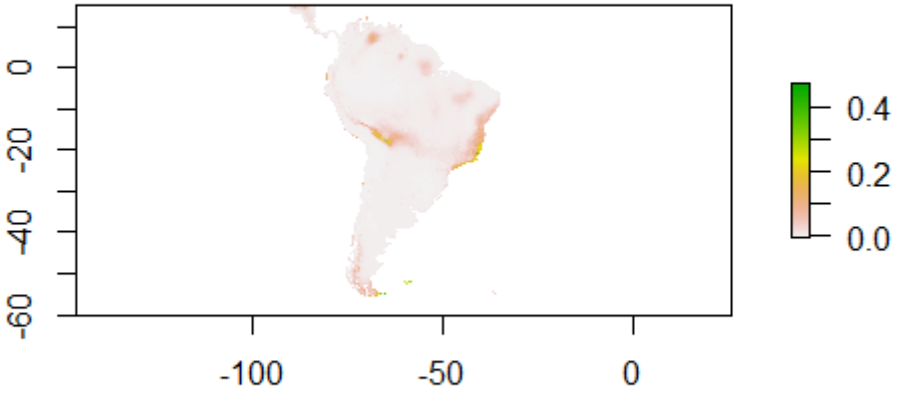
Nematanthus wettsteinii



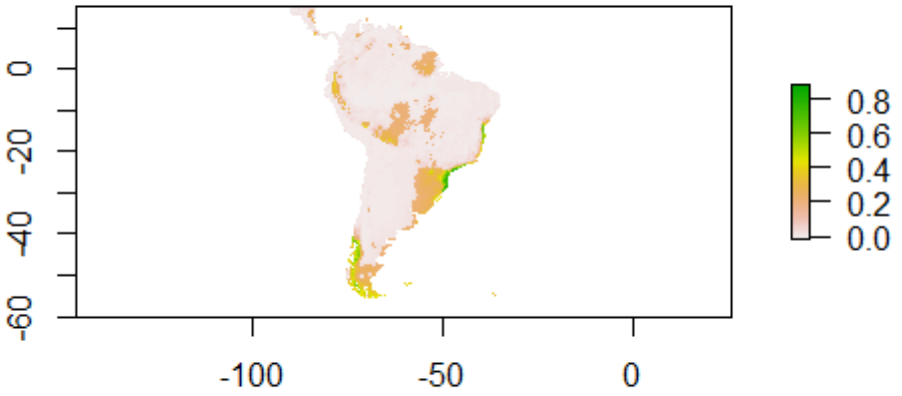
Nidularium amazonicum



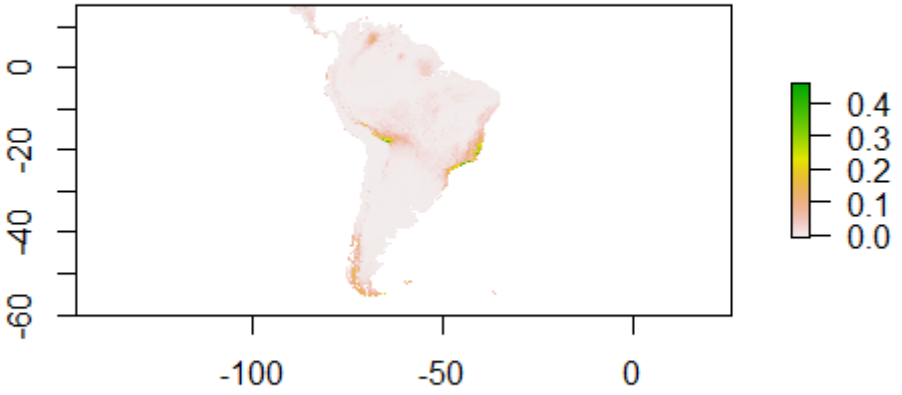
Nidularium cariacicaense



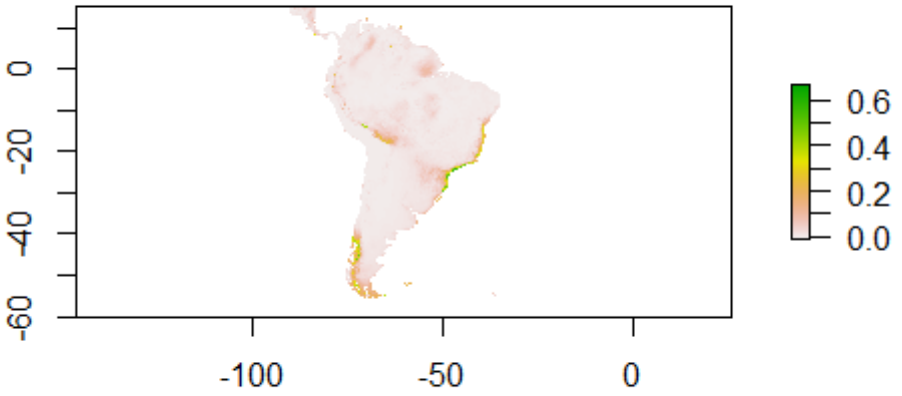
Nidularium innocentii



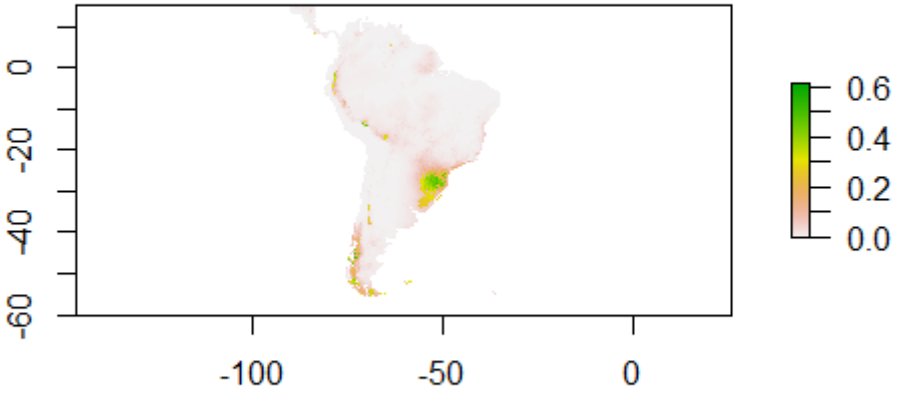
Nidularium longiflorum



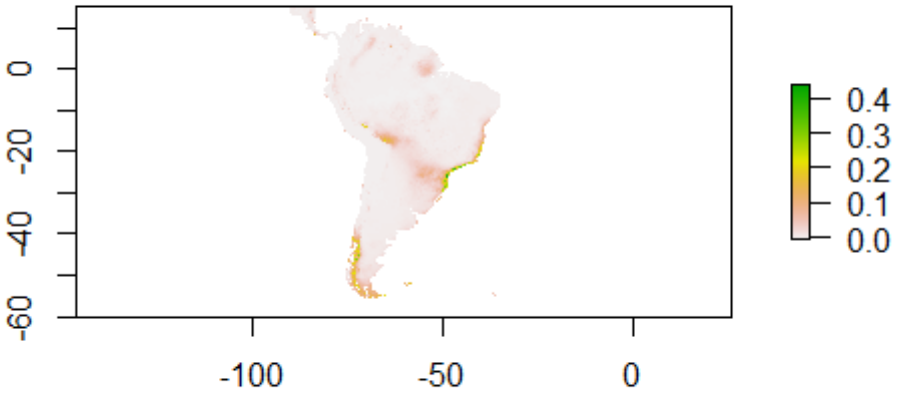
Nidularium procerum



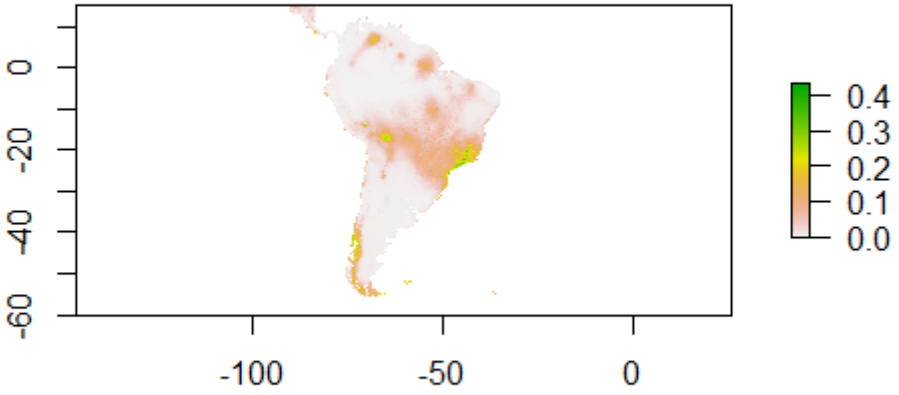
Pabstiella matinhensis



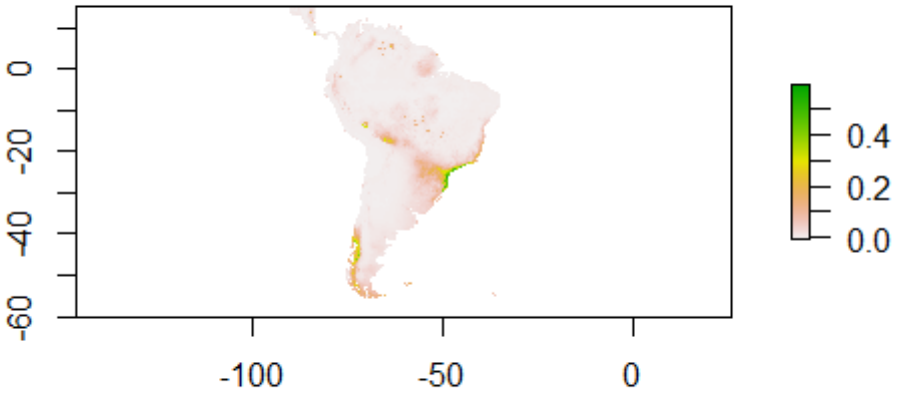
Pabstiella trifida



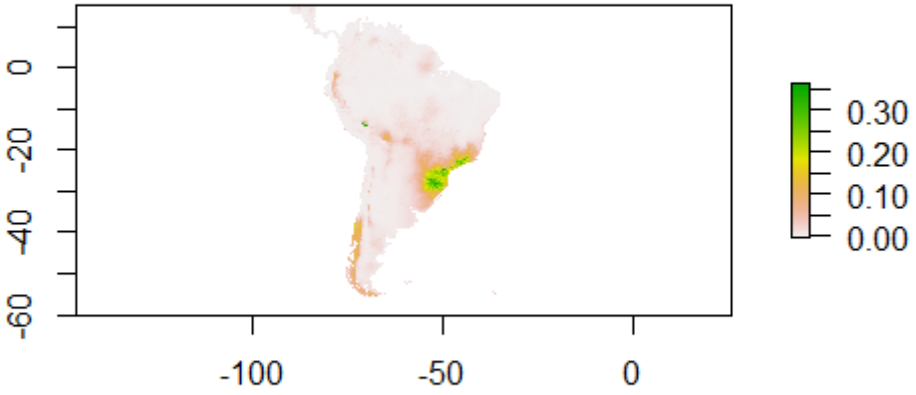
Peperomia crinicaulis



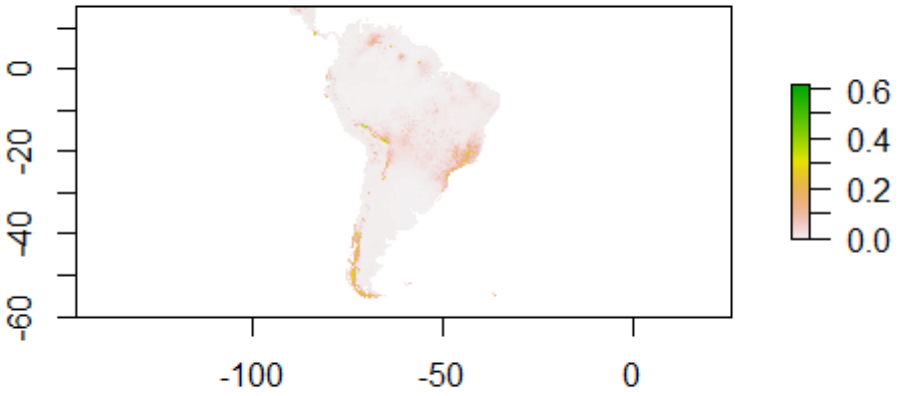
Peperomia glazioui



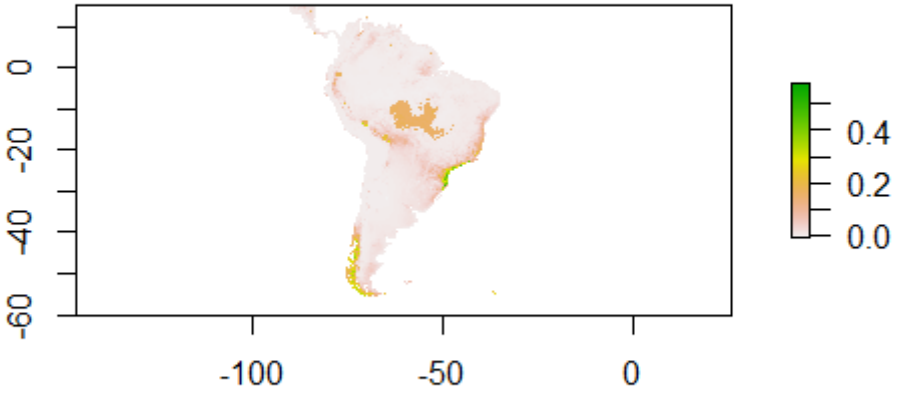
Peperomia hilariana



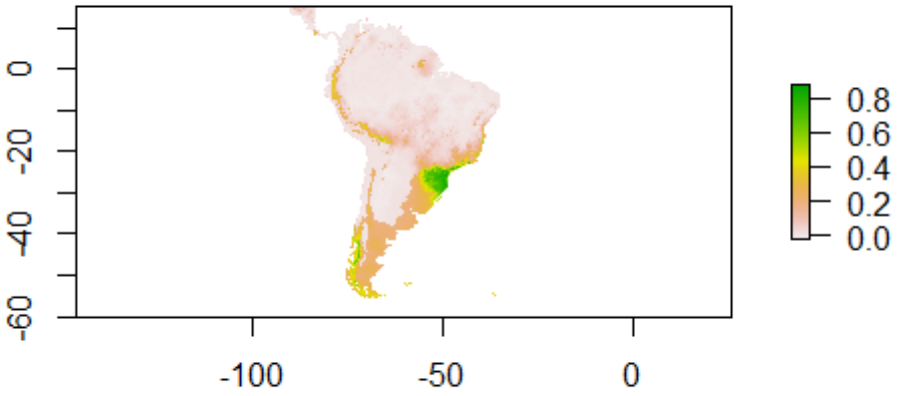
Peperomia mandioccana



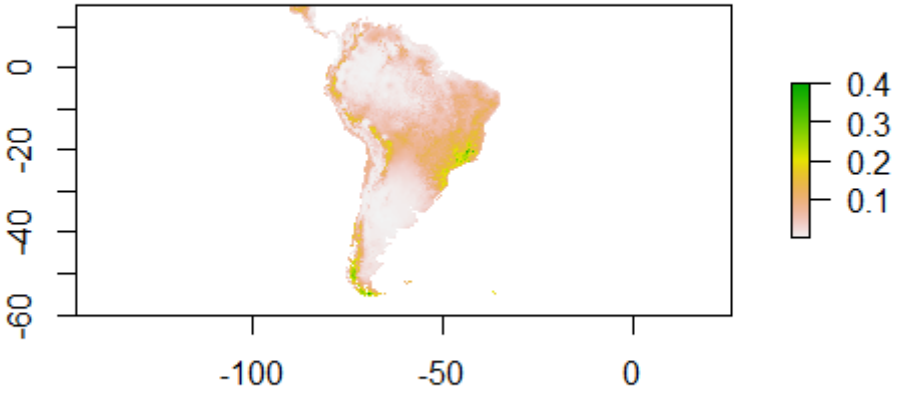
Peperomia pseudoestrellensis



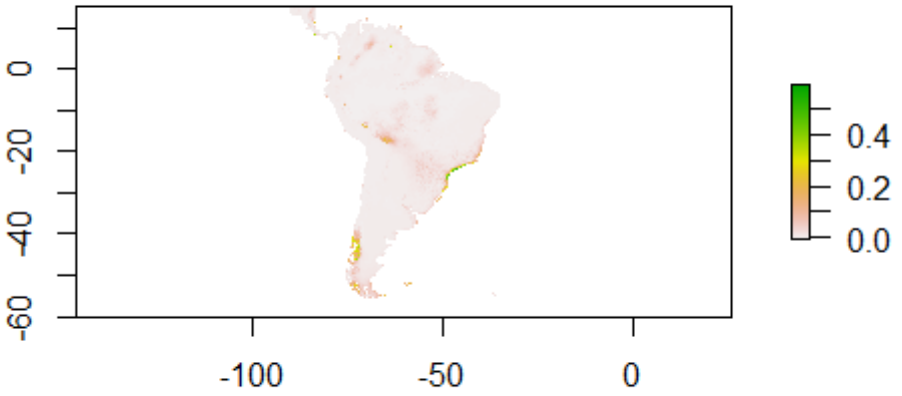
Peperomia tetraphylla



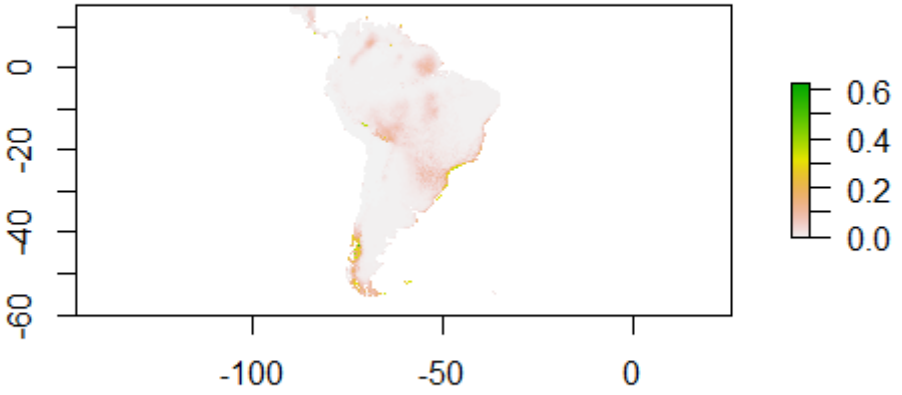
Peperomia velloziana



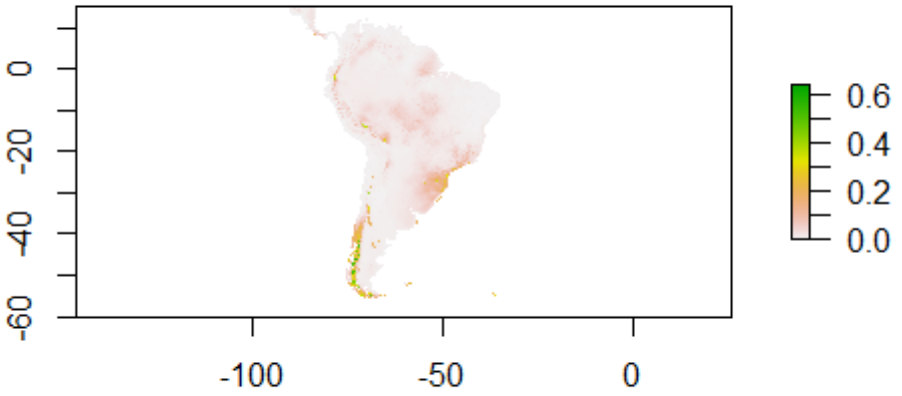
Philodendron crassinervium



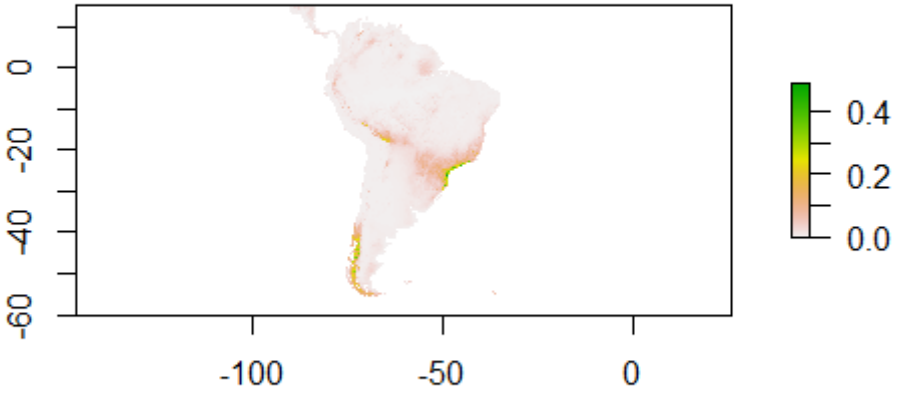
Philodendron martianum



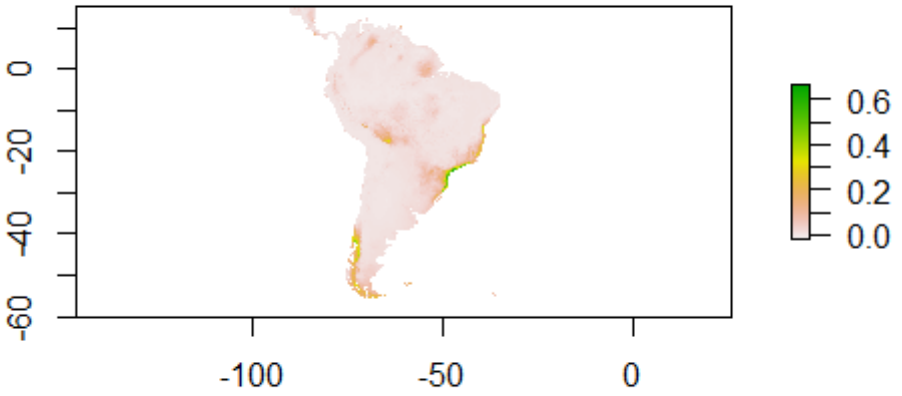
Phlegmariurus quadrifariatus



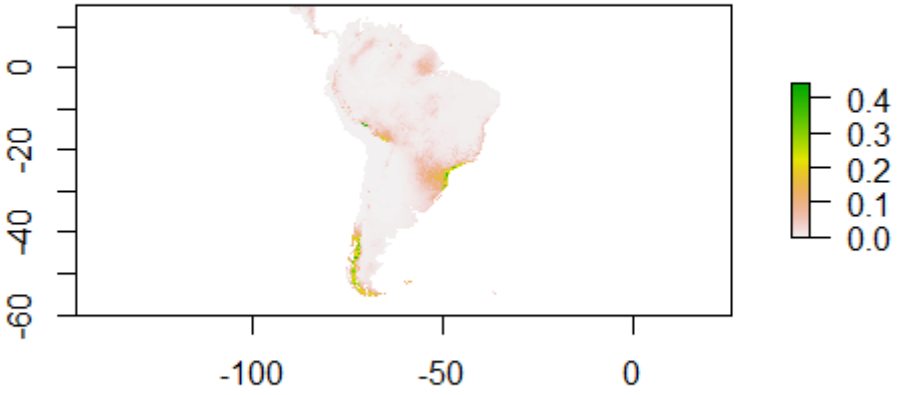
Phymatidium falcifolium



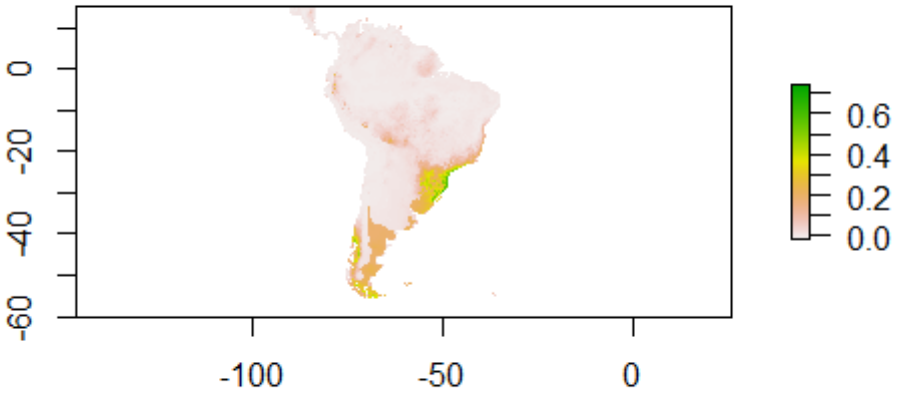
Pleiochiton blepharodes



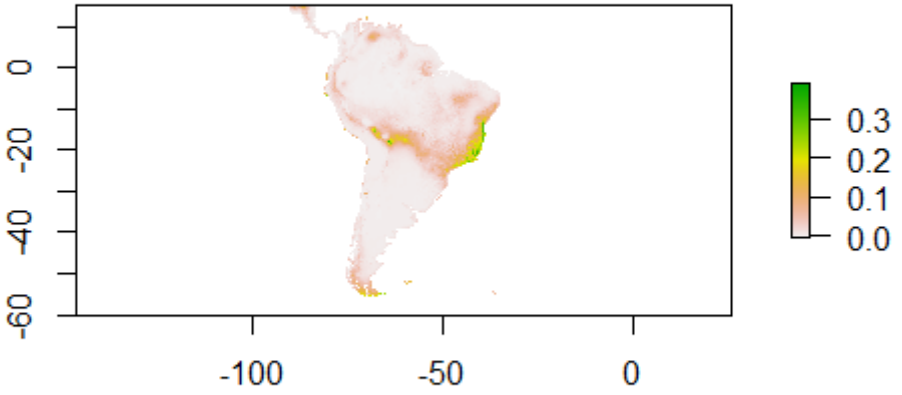
Pleiochiton ebracteatum



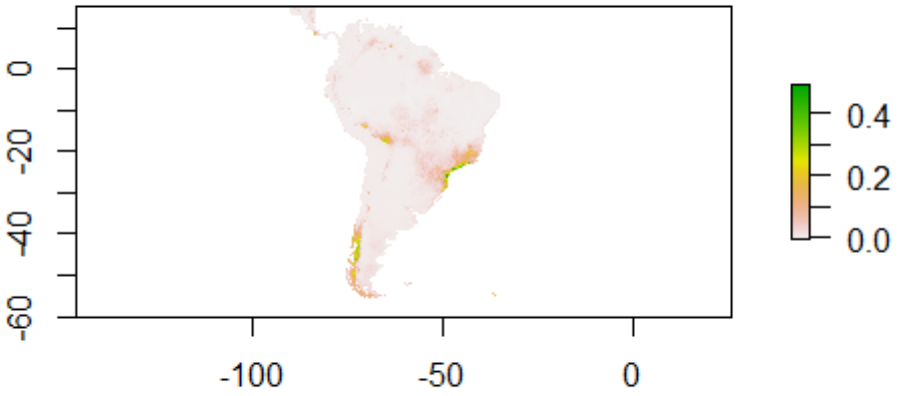
Pleopeltis pleopeltifolia



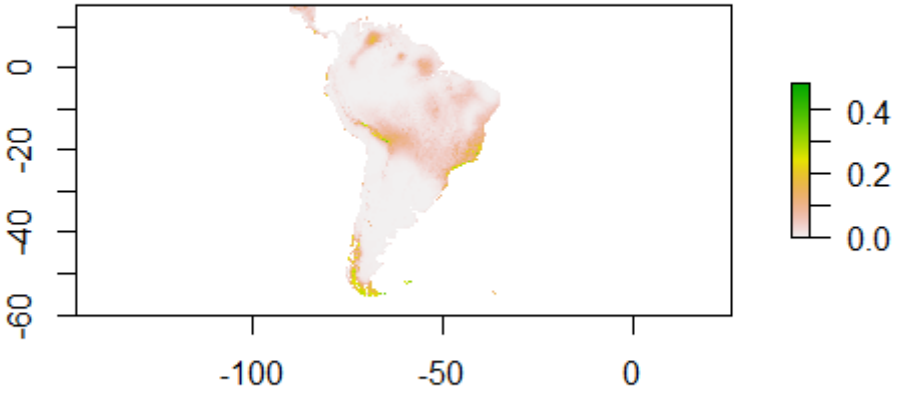
Portea petropolitana



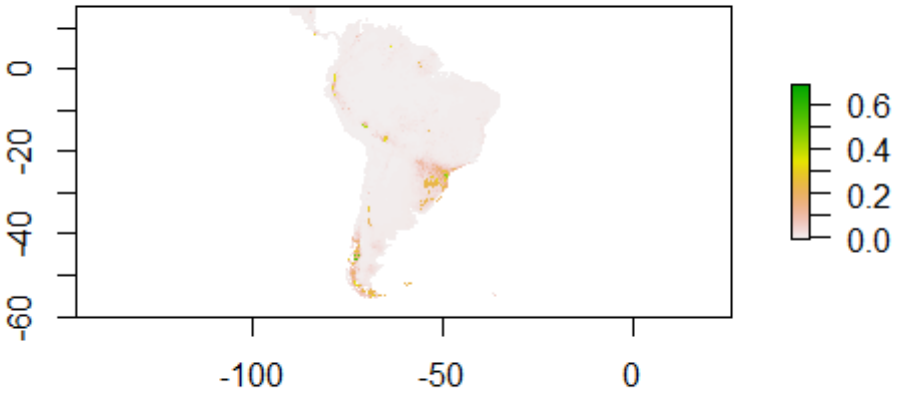
Promenaea xanthina



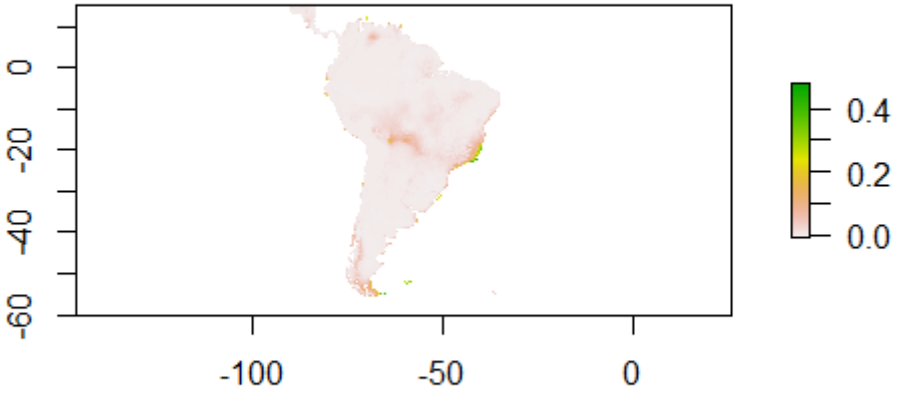
Prosthechea calamaria



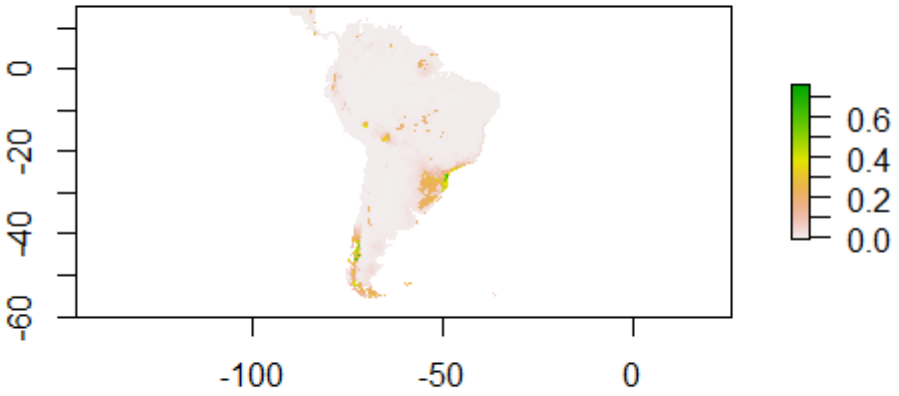
Prosthechea fausta



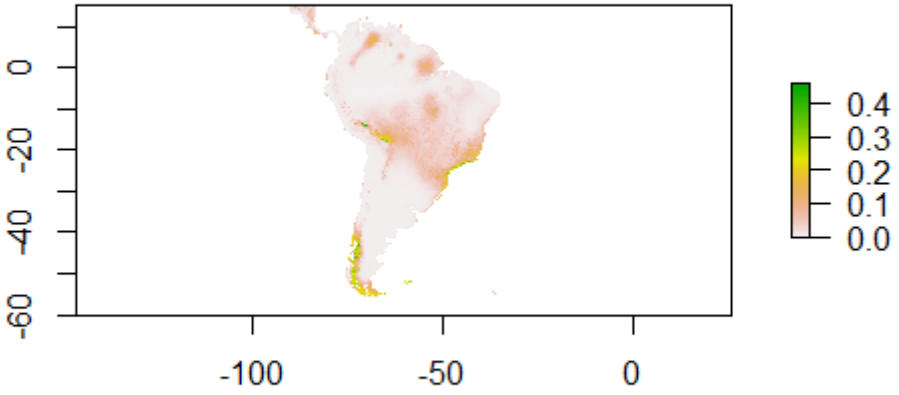
Quesnelia quesneliana



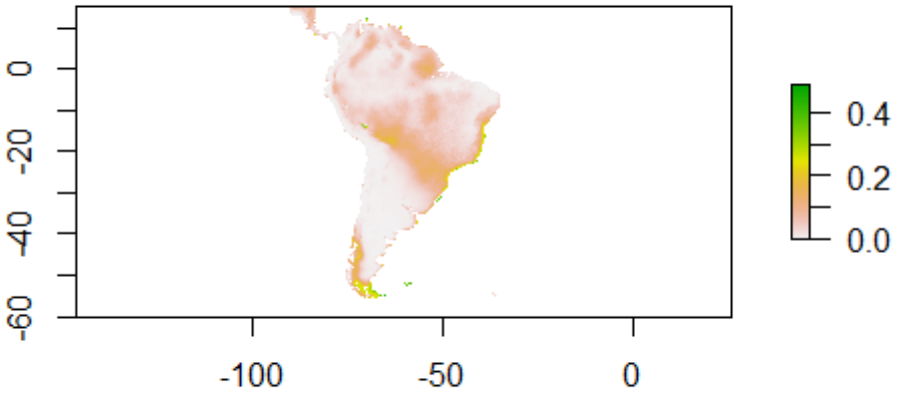
Rhipsalis campos-portoana



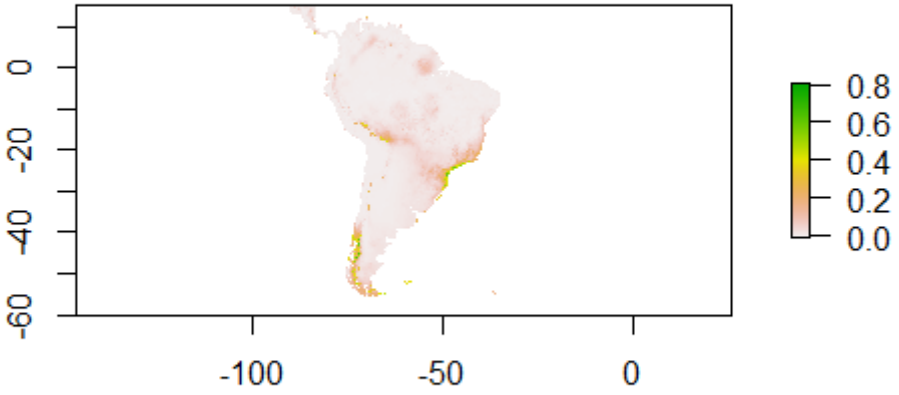
Rhipsalis clavata



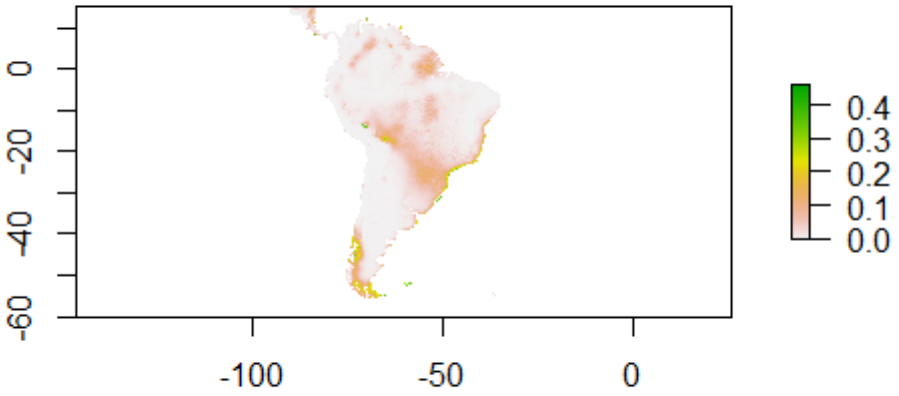
Rhipsalis crispata



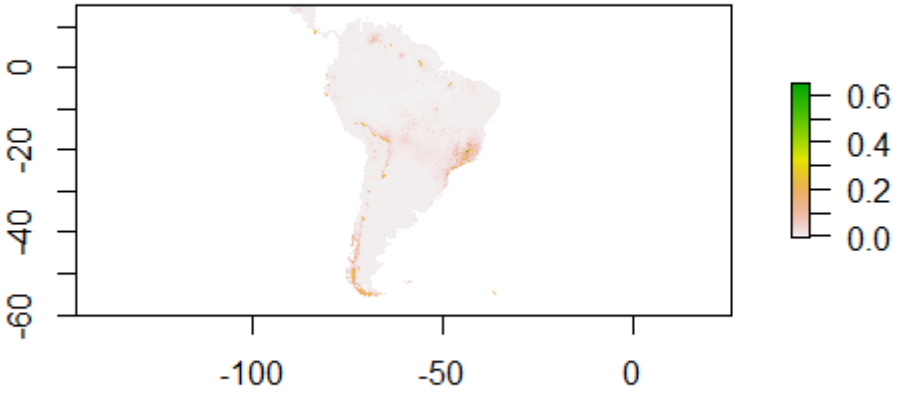
Rhipsalis elliptica



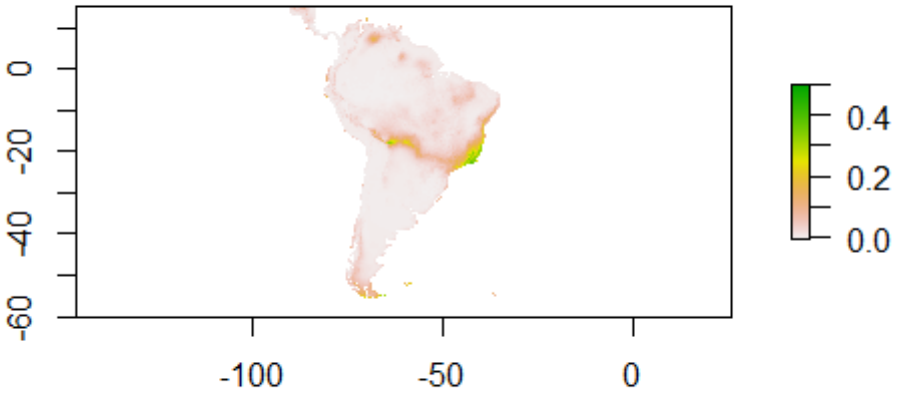
Rhipsalis grandiflora



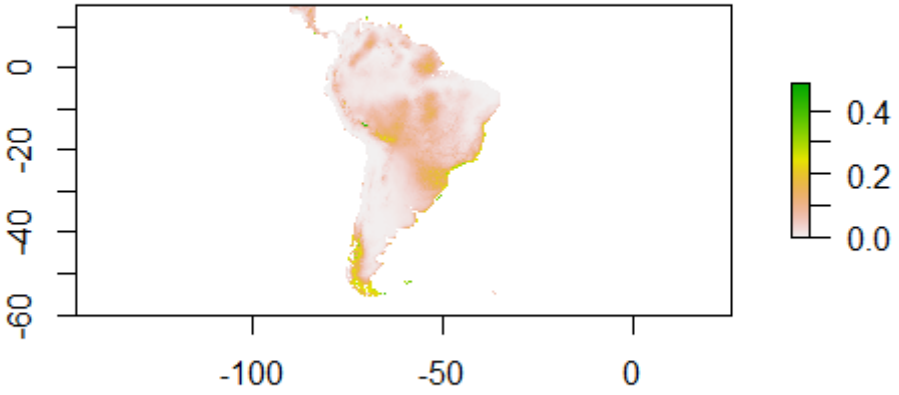
Rhipsalis juengeri



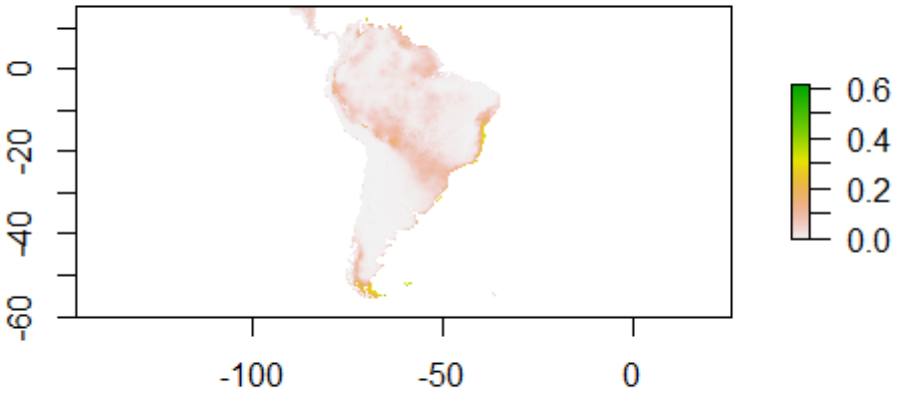
Rhipsalis lindbergiana



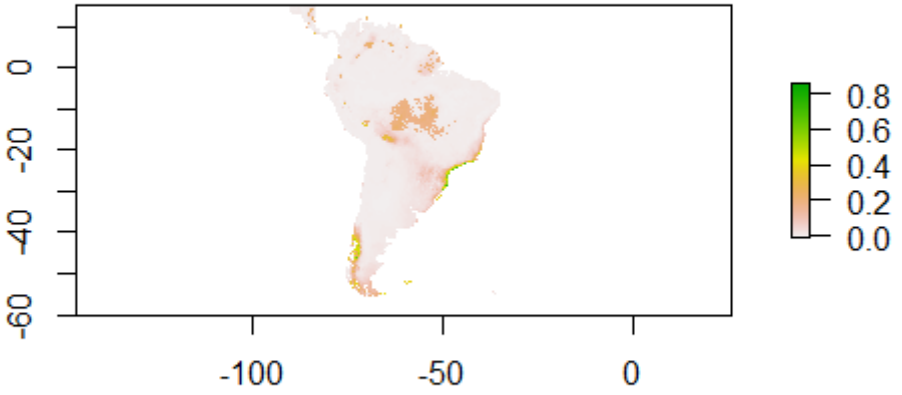
Rhipsalis neves-armondii



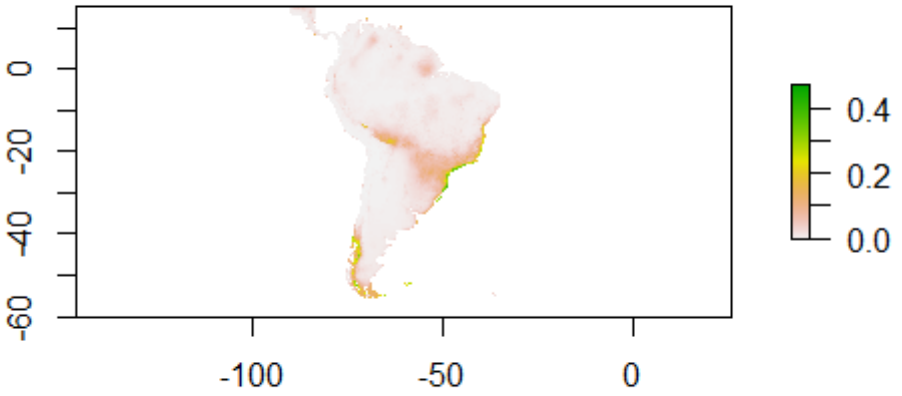
Rhipsalis oblonga



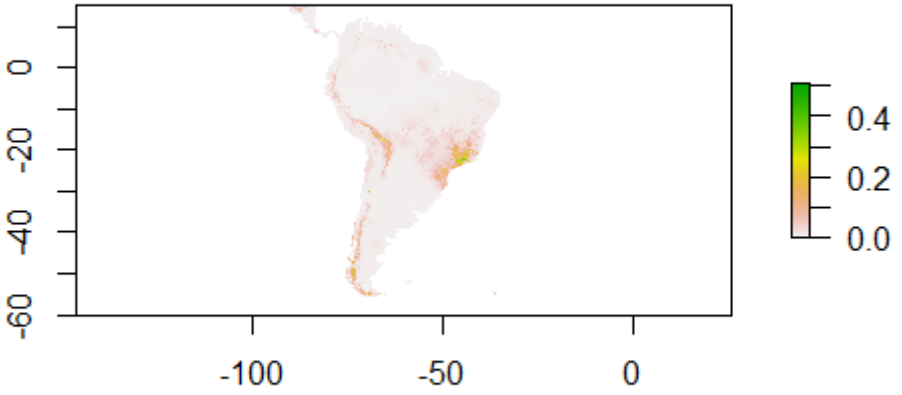
Rhipsalis pachyptera



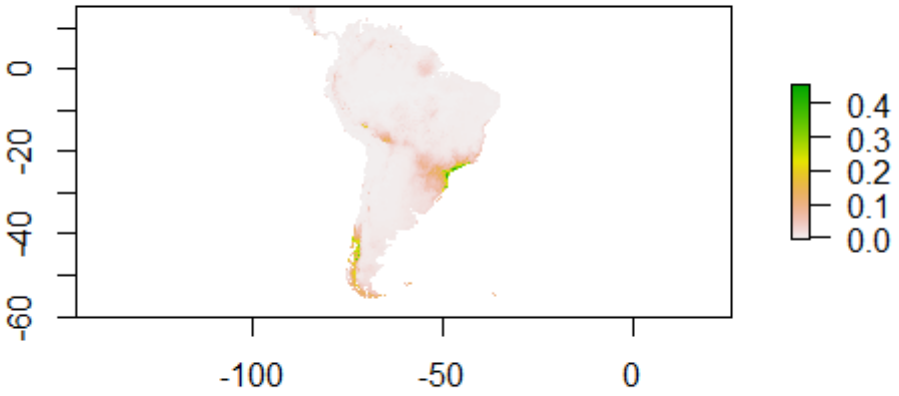
Rhipsalis paradoxa



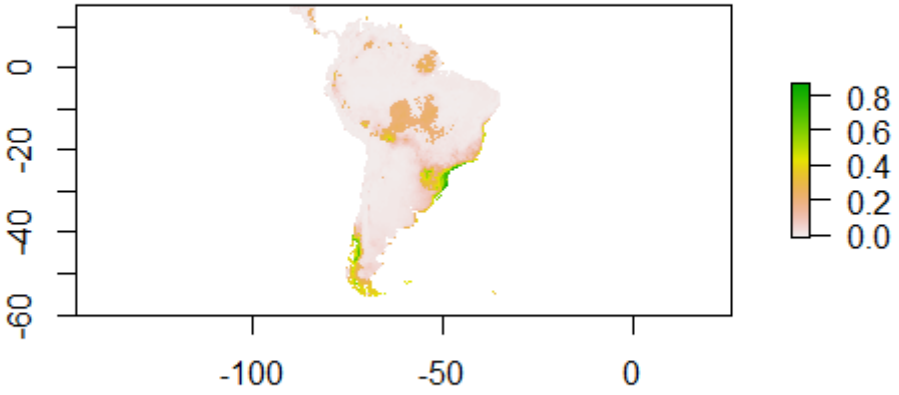
Rhipsalis pulchra



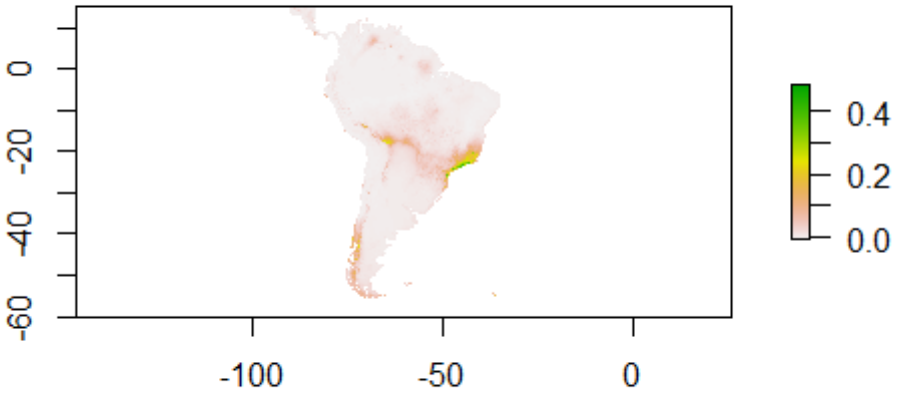
Rhipsalis puniceodiscus



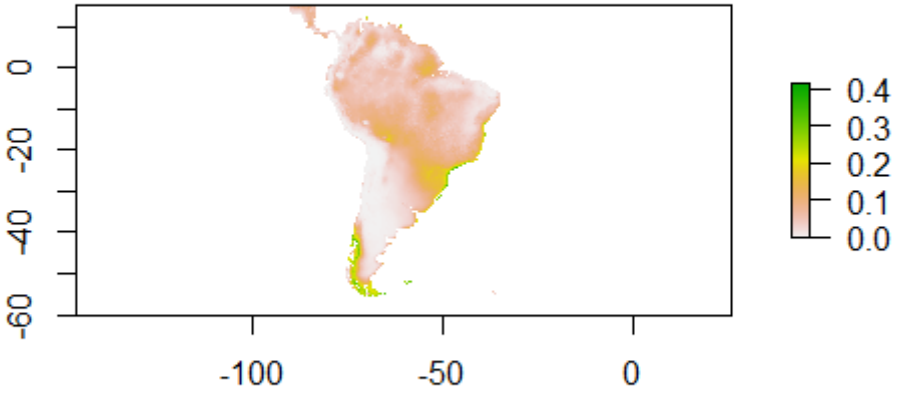
Rhipsalis teres



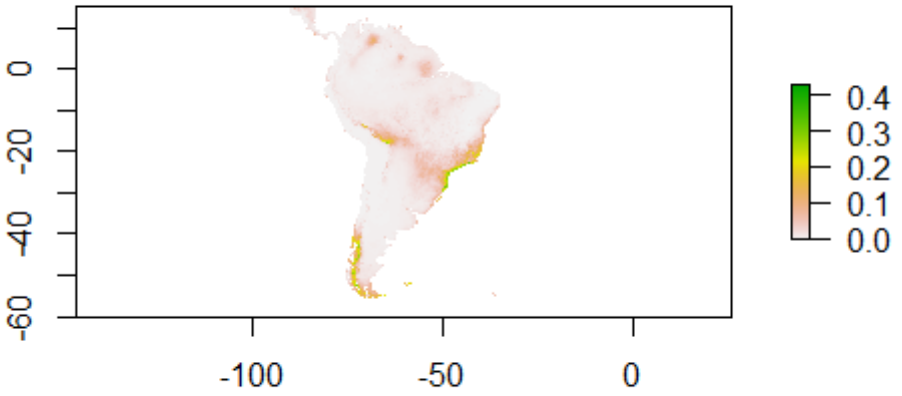
Sinningia cooperi



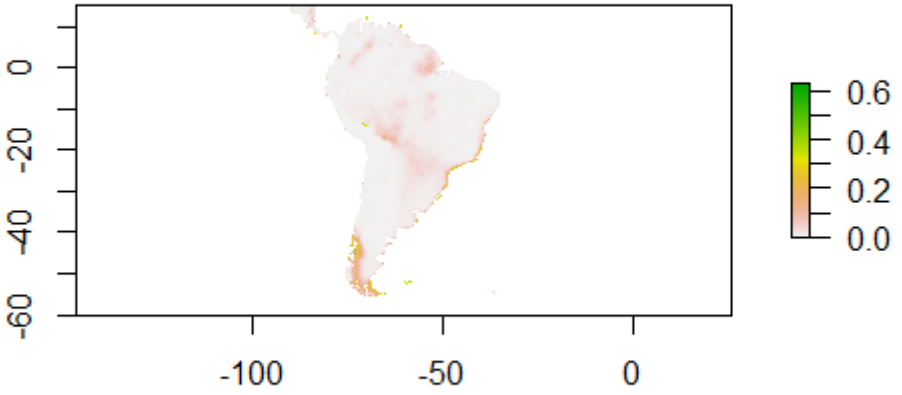
Stelis deregularis



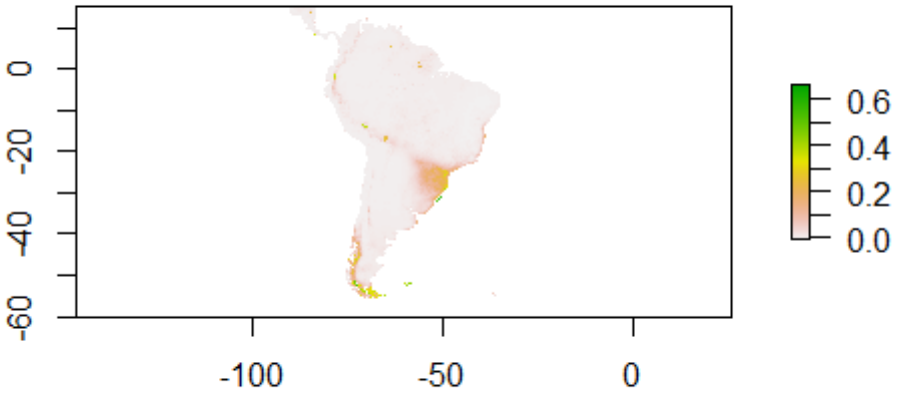
Stelis megantha



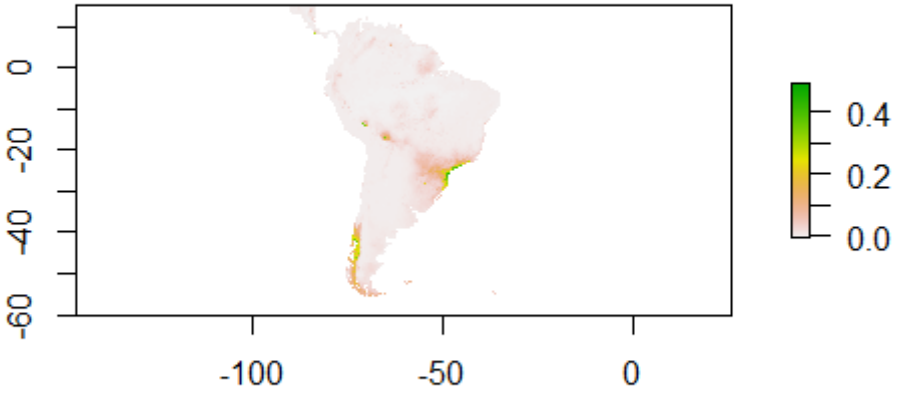
Tillandsia dura



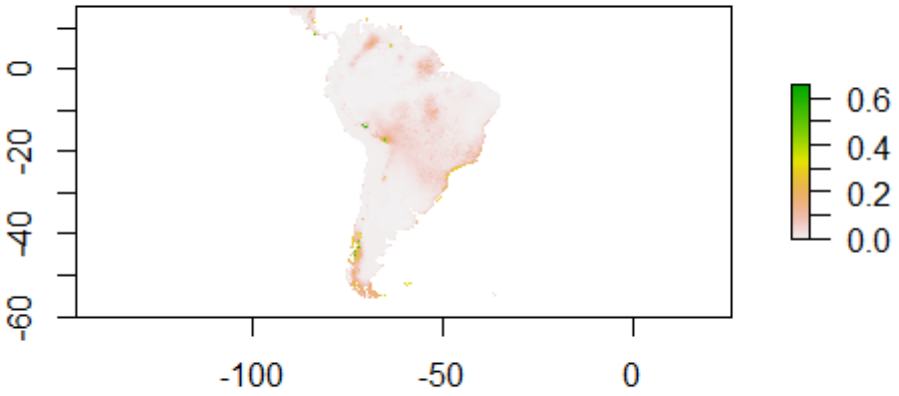
Tillandsia mallemontii



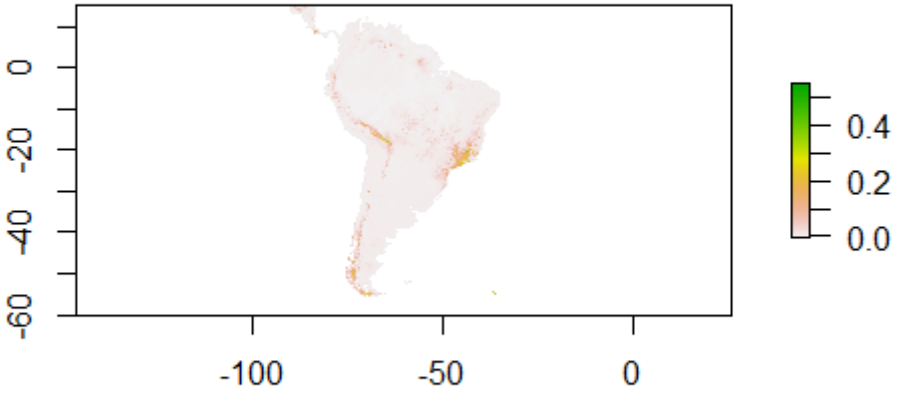
Vriesea altodaserrae



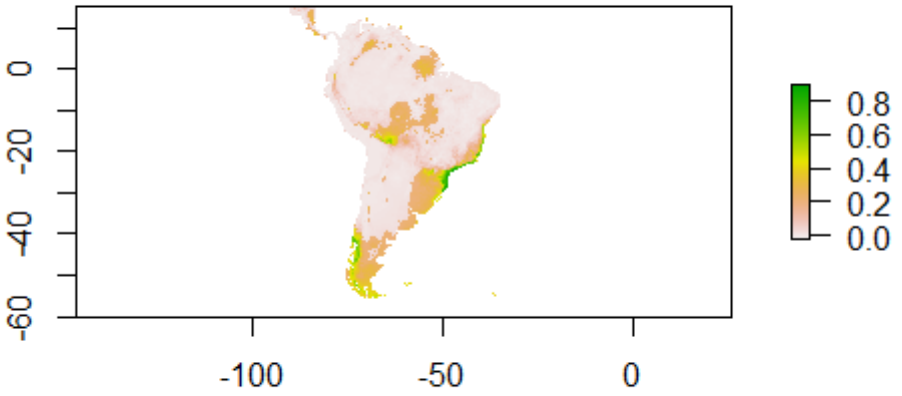
Vriesea atra



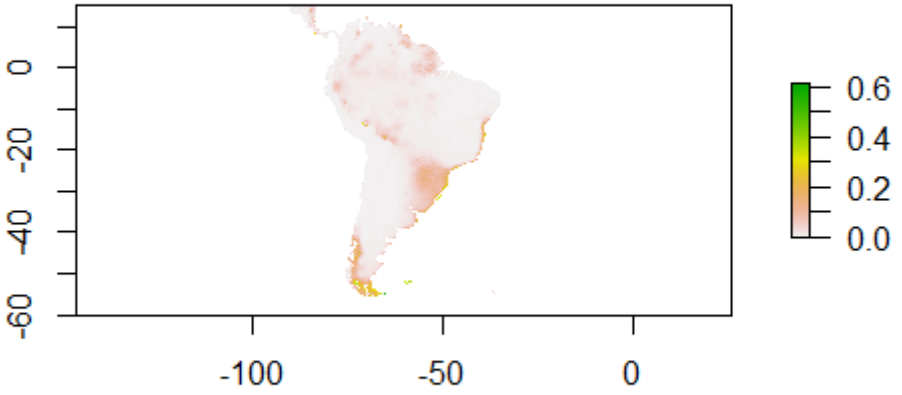
Vriesea bituminosa



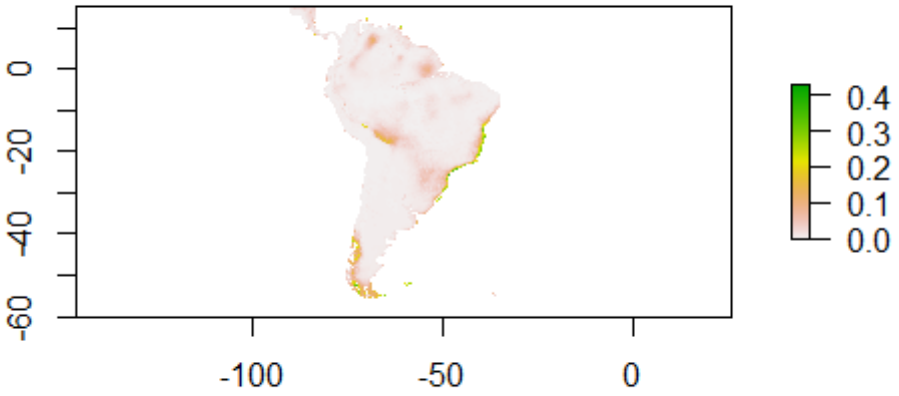
Vriesea carinata



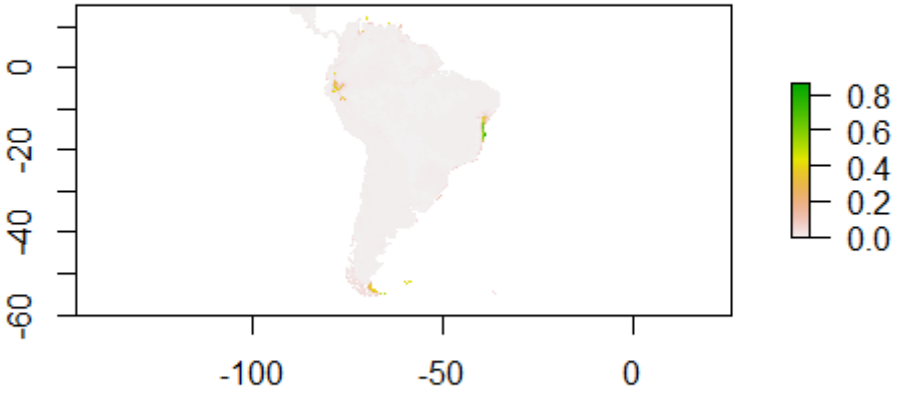
Vriesea corcovadensis



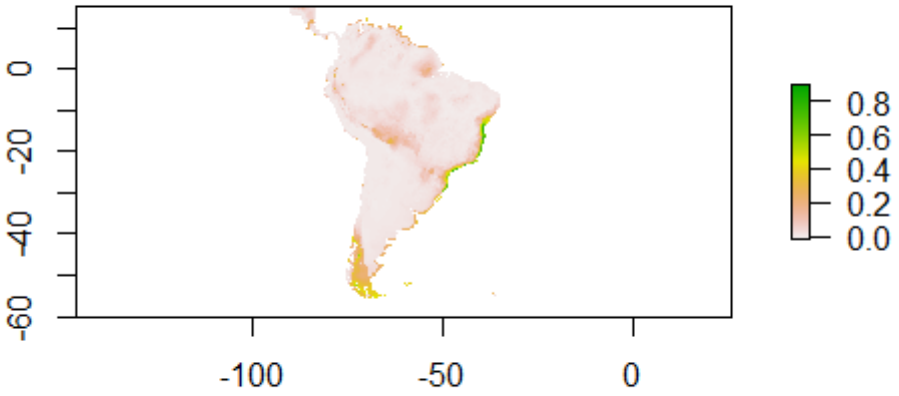
Vriesea drepanocarpa



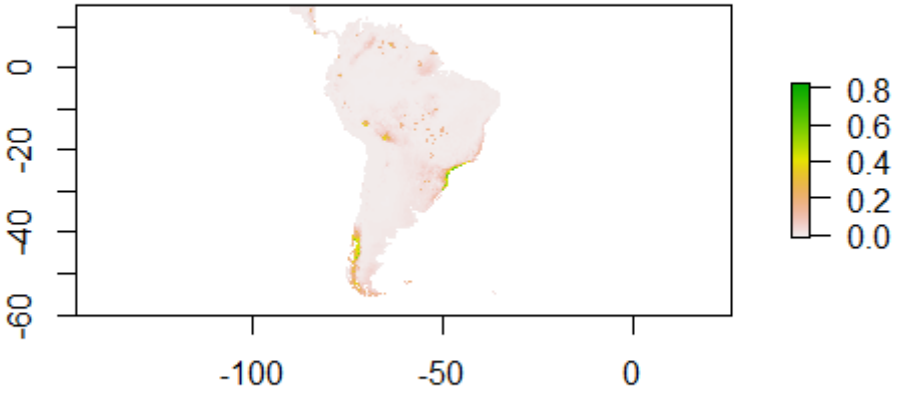
Vriesea duvaliana



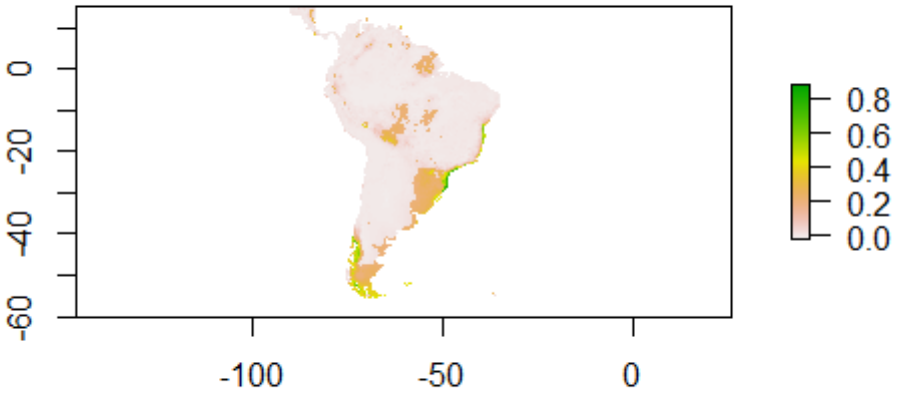
Vriesea ensiformis



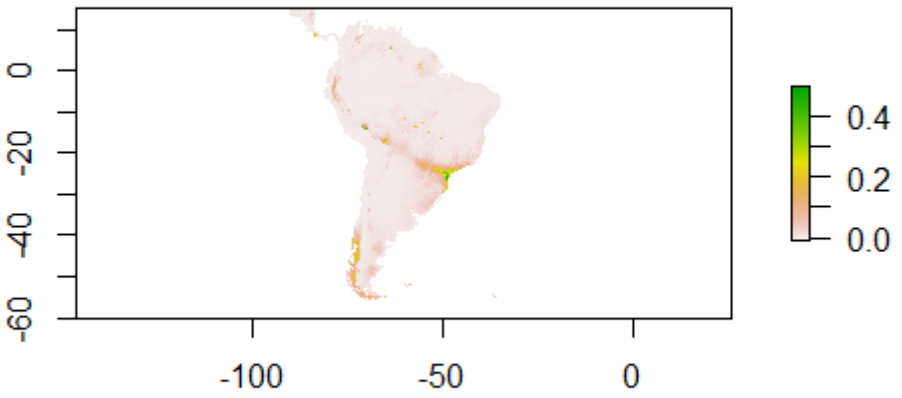
Vriesea erythrodactylon



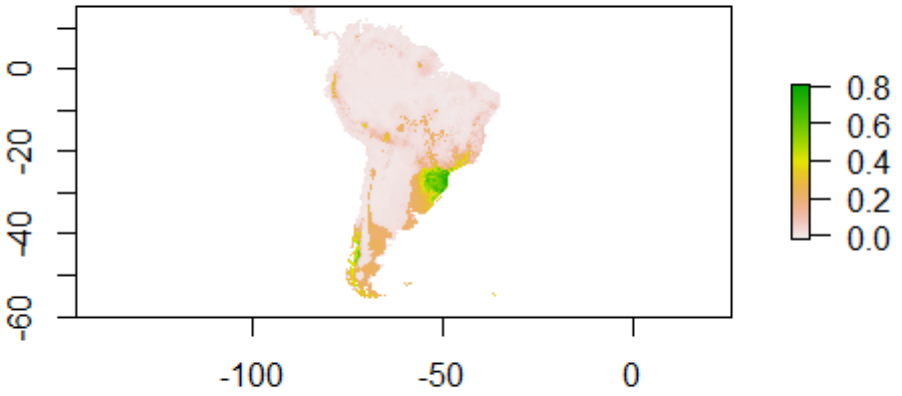
Vriesea flammea



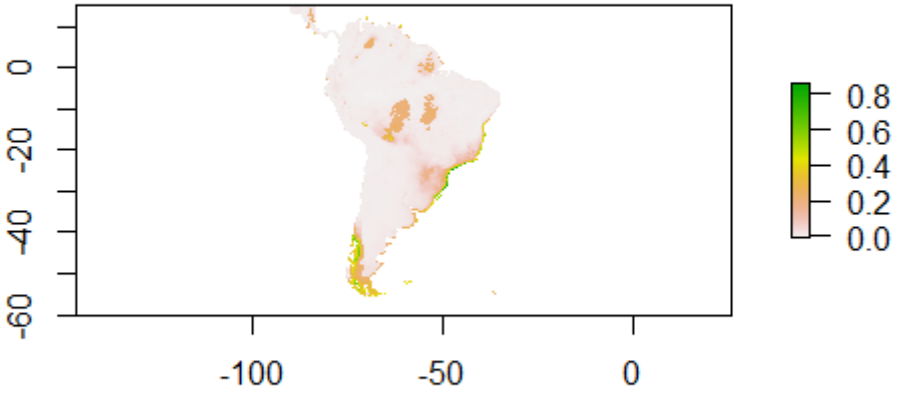
Vriesea flava



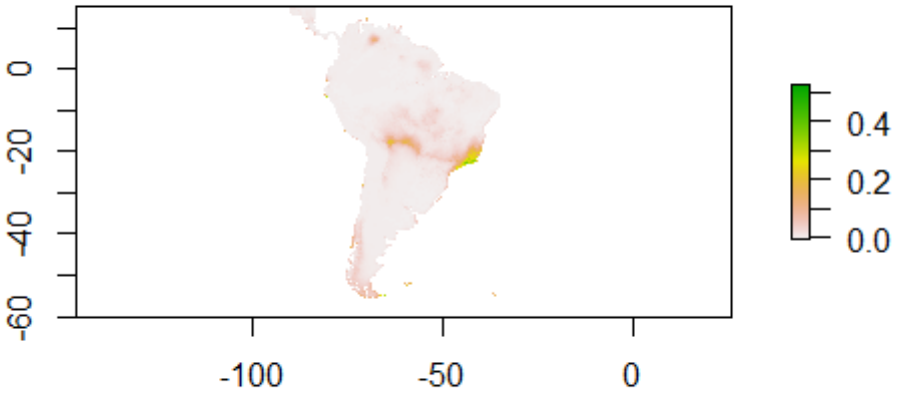
Vriesea friburgensis



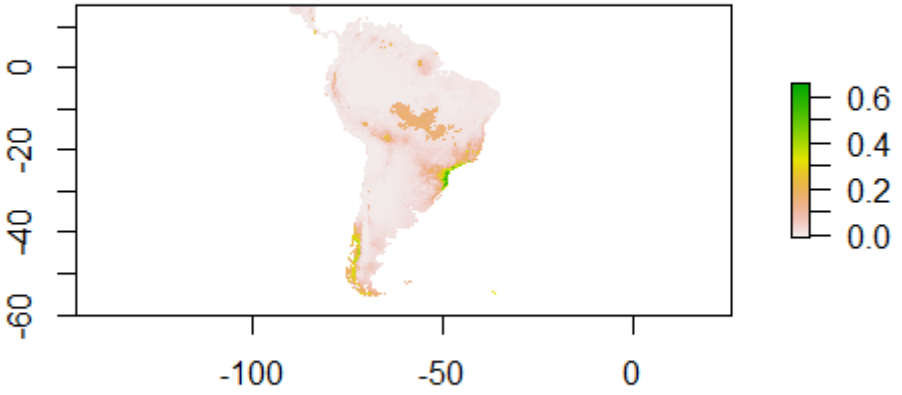
Vriesea gigantea



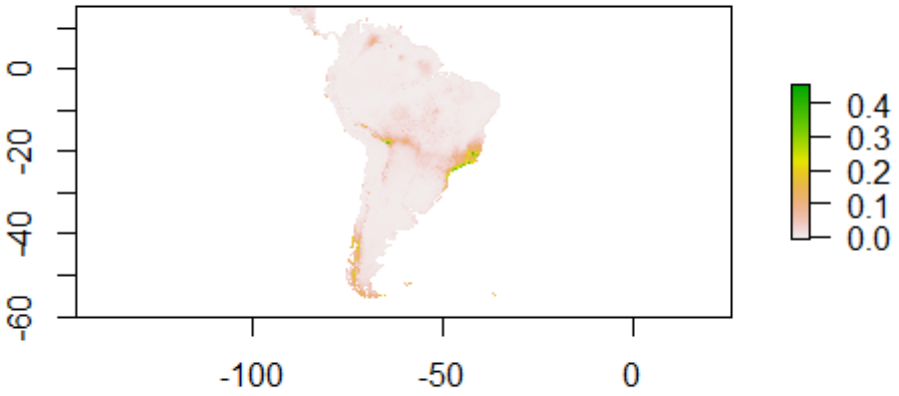
Vriesea gradata



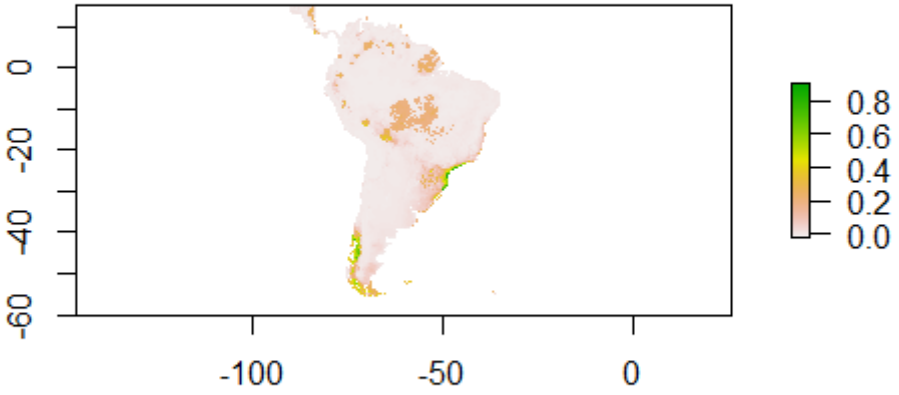
Vriesea guttata



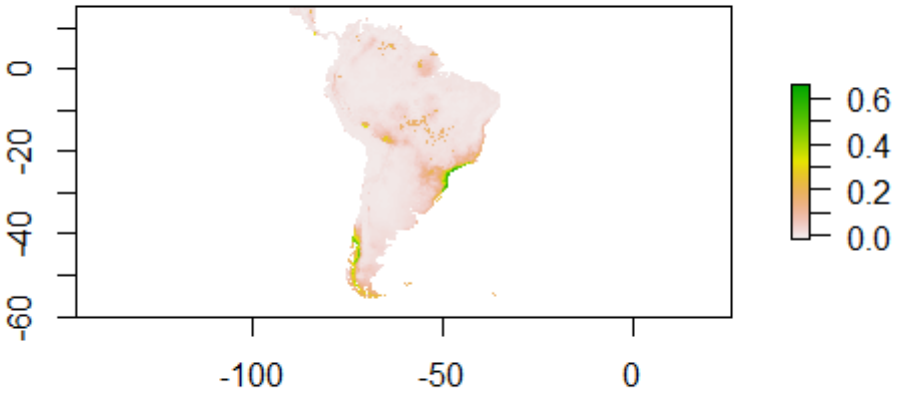
Vriesea heterostachys



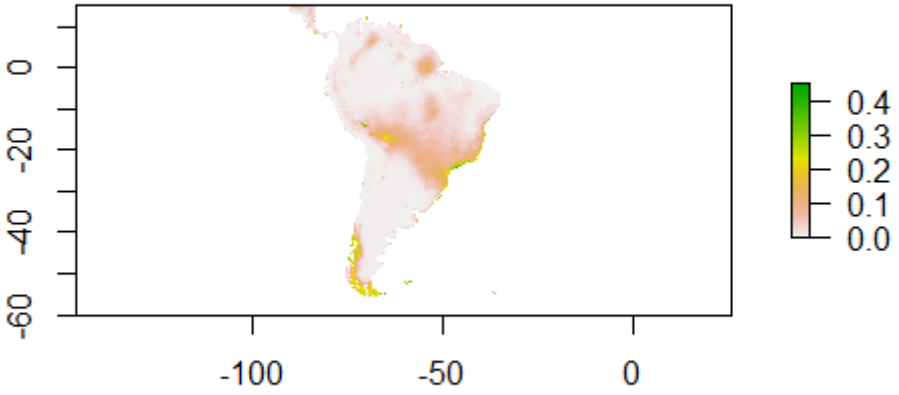
Vriesea incurvata



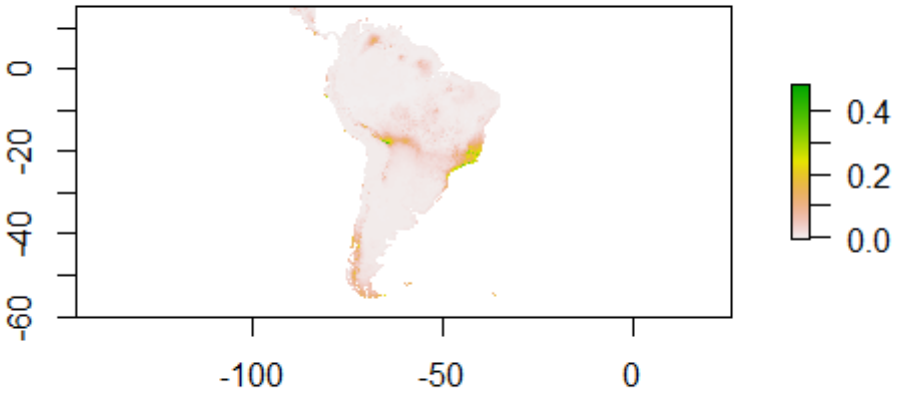
Vriesea inflata



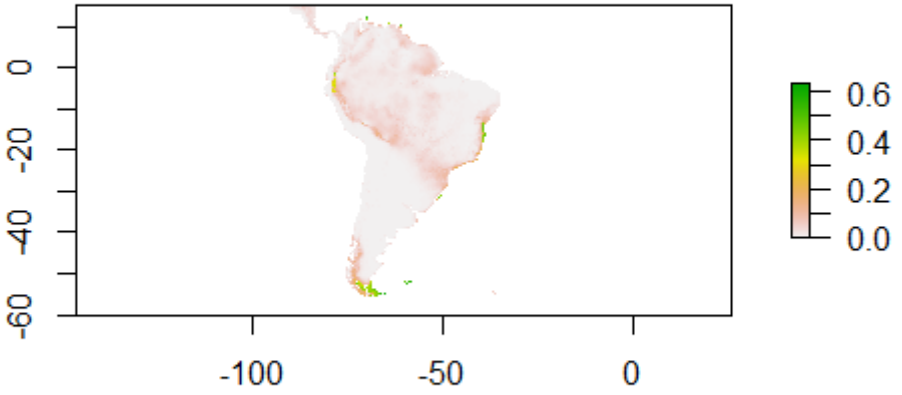
Vriesea jonghei



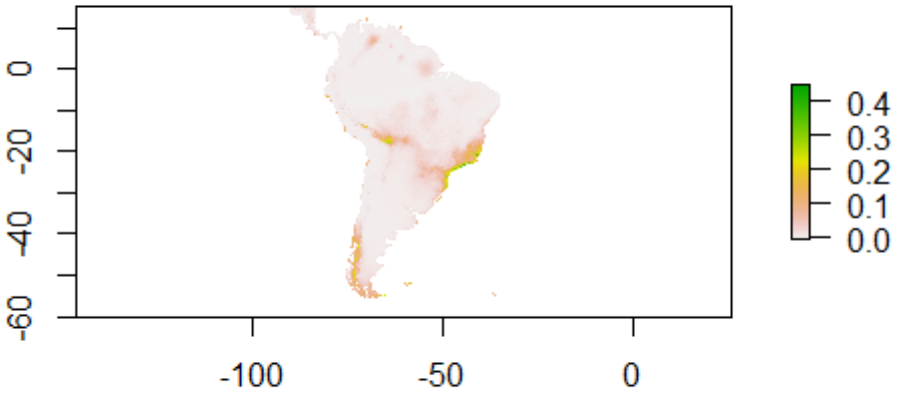
Vriesea longicaulis



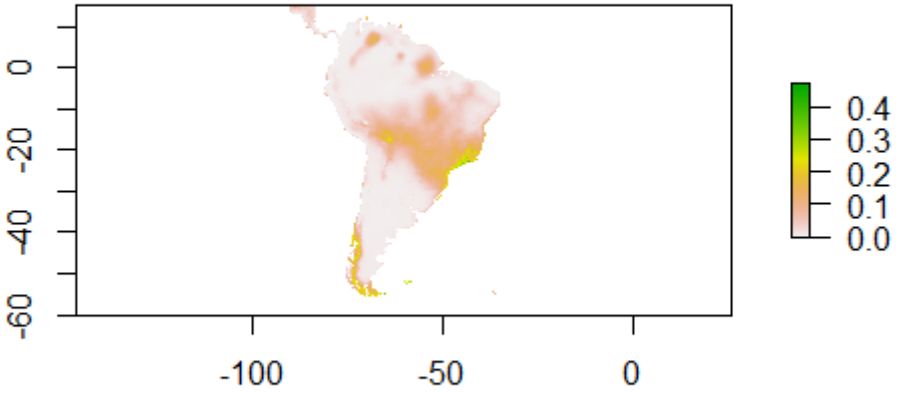
Vriesea longiscapa



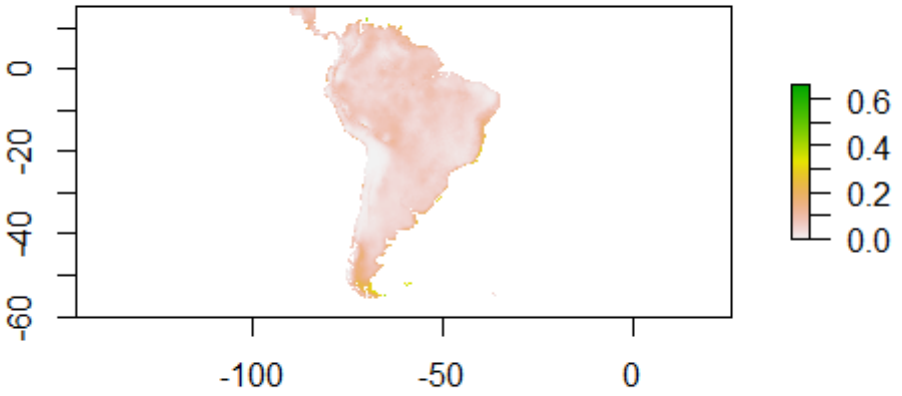
Vriesea lubbersii



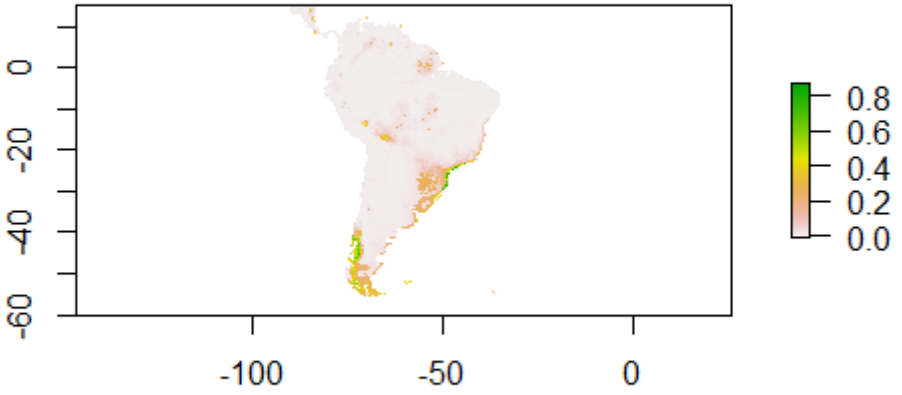
Vriesea paraibica



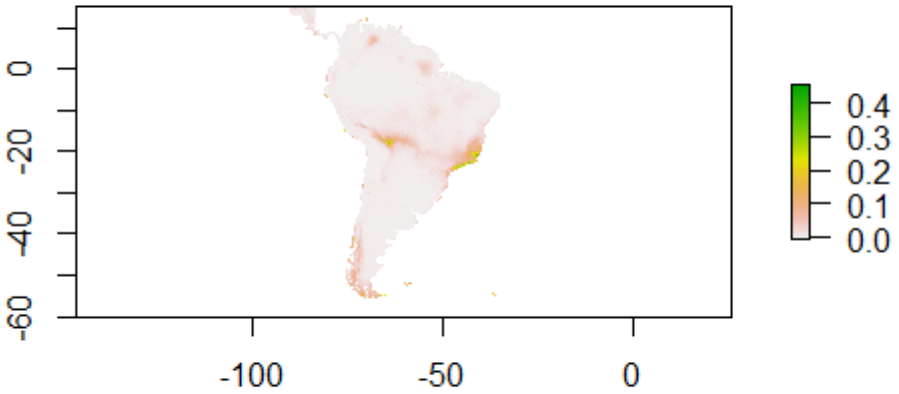
Vriesea pauperrima



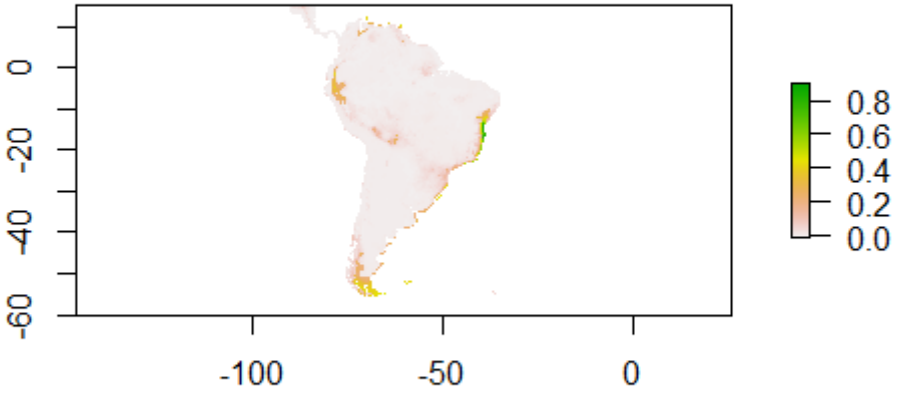
Vriesea philippocoburgii



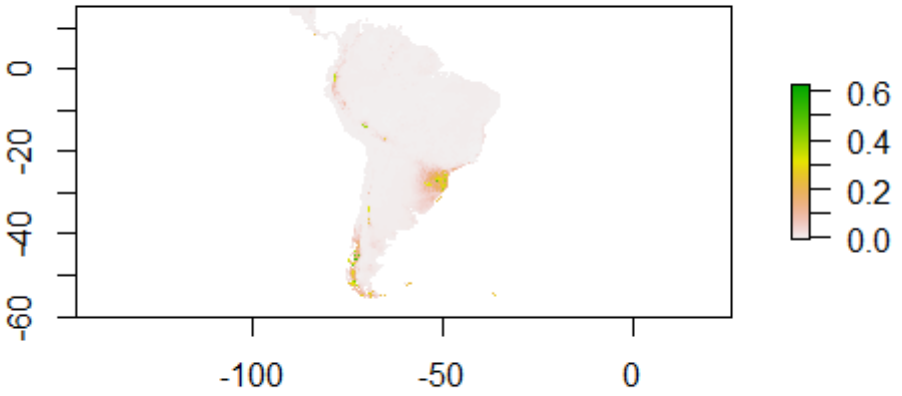
Vriesea poenulata



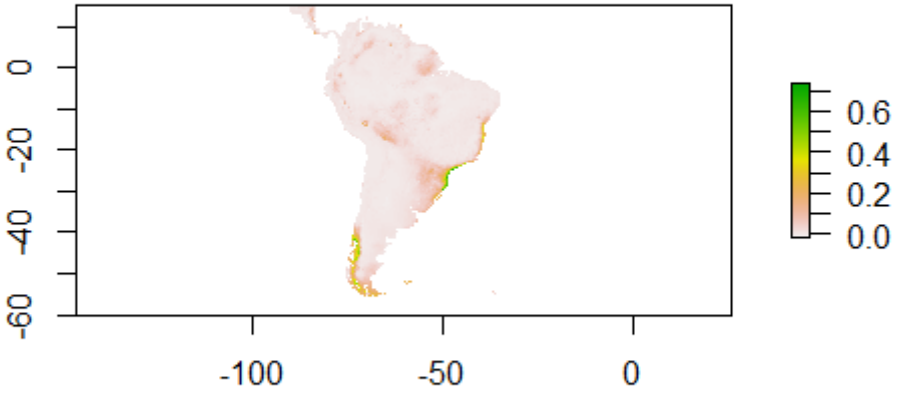
Vriesea psittacina



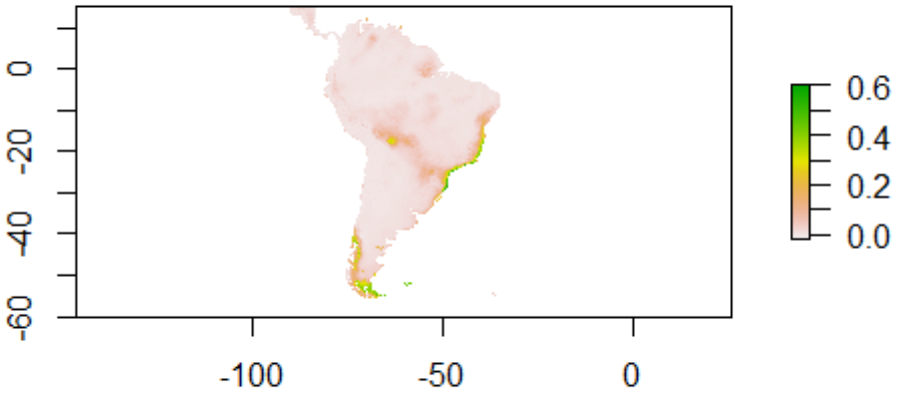
Vriesea reitzii



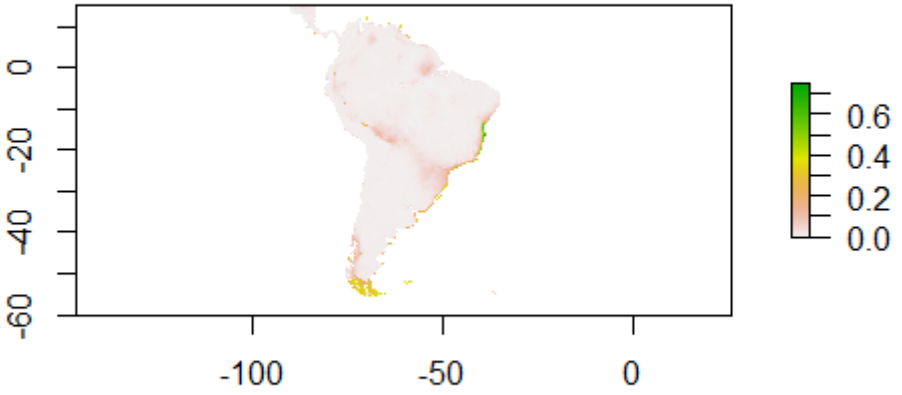
Vriesea rodigasiana



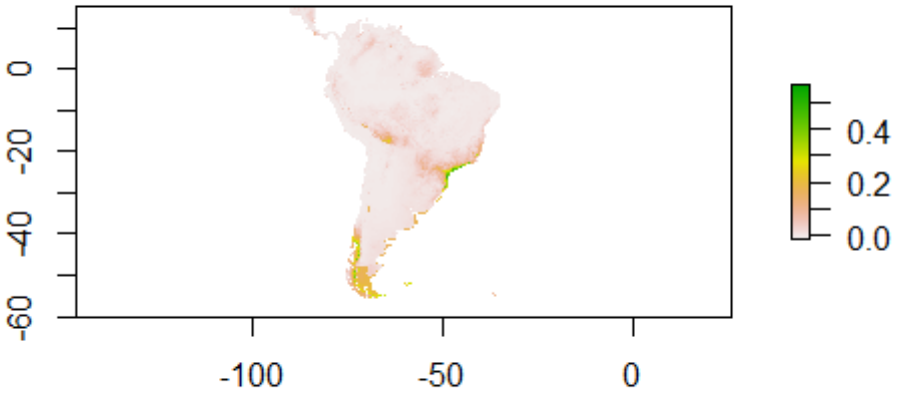
Vriesea scalaris



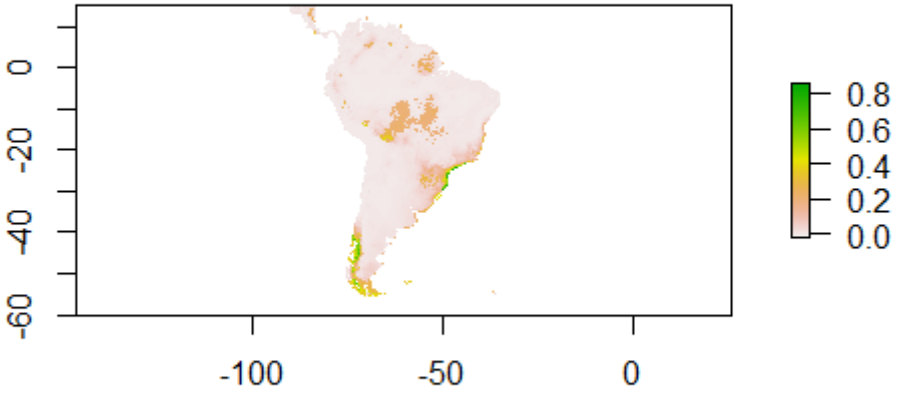
Vriesea tijucana



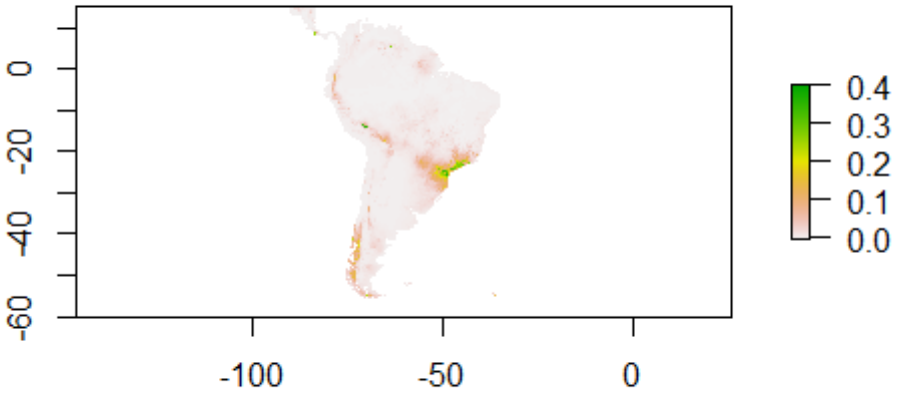
Vriesea unilateralis



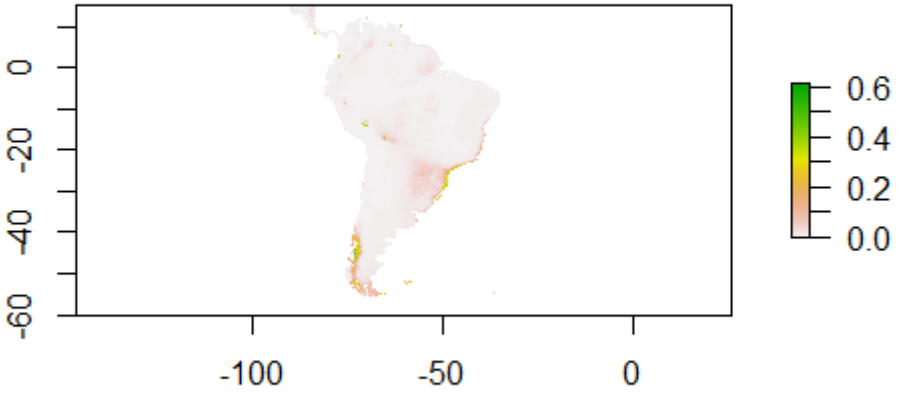
Vriesea vagans

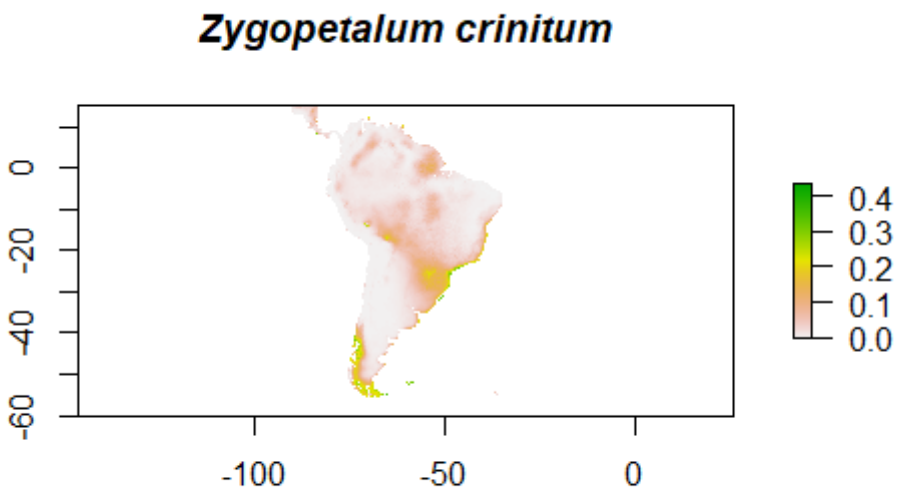


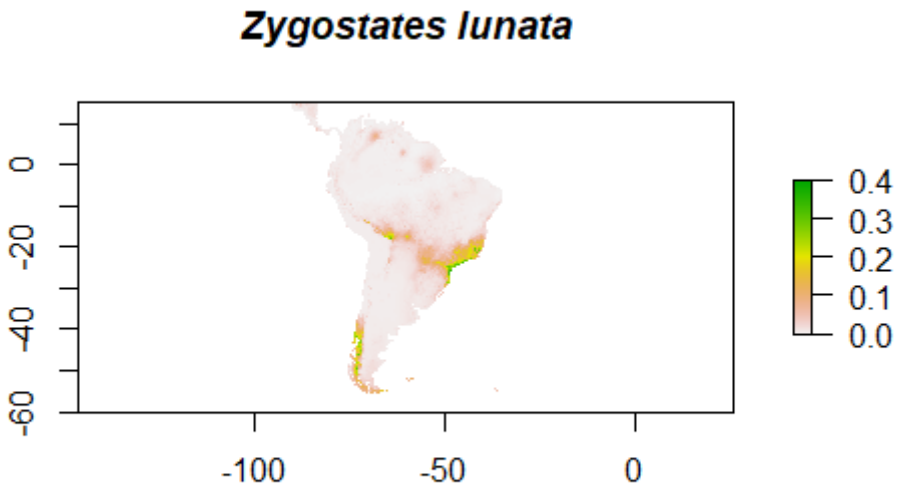
Wittrockia cyathiformis



Wittrockia superba







Supplementary Material 3 - To the 95 species that have records only within the limits of the Conservation Units.

Family	Species	Occurrence in CUs	Dataset Records
Bromeliaceae	*Aechmea aiuruocensis*	2	2
Bromeliaceae	*Aechmea andersoniana*	1	1
Bromeliaceae	*Aechmea canaliculata*	2	2

Bromeliaceae	*Aechmea farinosa*	1	1
Bromeliaceae	*Aechmea lactifera*	1	1
Bromeliaceae	*Araeococcus chlorocarpus*	5	5
Bromeliaceae	*Billbergia pohliana*	1	1
Bromeliaceae	*Canistropsis marceloi*	2	2
Bromeliaceae	*Canistrum auratum*	1	1
Bromeliaceae	*Edmundoa ambigua*	1	1
Bromeliaceae	*Guzmania monostachia*	1	1
Bromeliaceae	*Neoregelia doeringiana*	1	1
Bromeliaceae	*Neoregelia dungsiana*	1	1
Bromeliaceae	*Neoregelia guttata*	1	1
Bromeliaceae	*Neoregelia hoehneana*	2	2
Bromeliaceae	*Neoregelia lactea*	1	1
Bromeliaceae	*Neoregelia leucophoea*	1	1
Bromeliaceae	*Neoregelia macahensis*	1	1
Bromeliaceae	*Neoregelia ruschii*	1	1
Bromeliaceae	*Nidularium amorimii*	2	2
Bromeliaceae	*Nidularium corallinum*	1	1
Bromeliaceae	*Nidularium itatiaiae*	2	2
Bromeliaceae	*Nidularium marigoi*	5	5
Bromeliaceae	*Quesnelia clavata*	2	2
Bromeliaceae	*Vriesea dictyographa*	1	1
Bromeliaceae	*Vriesea fontourae*	1	1
Bromeliaceae	*Vriesea rafaelii*	1	1
Bromeliaceae	*Vriesea regnellii*	2	2
Bromeliaceae	*Vriesea serrana*	2	2

Bromeliaceae	*Vriesea teresopolitana*	1	1
Cactaceae	*Hatiora cylindrica*	2	2
Cactaceae	*Hatiora herminiae*	1	1
Cactaceae	*Hohenbergia mutabilis*	1	1
Cactaceae	*Rhipsalis hoelleri*	1	1
Cactaceae	*Rhipsalis ormindoi*	1	1
Cactaceae	*Schlumbergera kautskyi*	2	2
Dryopteridaceae	*Elaphoglossum paulistanum*	2	2
Dryopteridaceae	*Elaphoglossum prestonii*	1	1
Dryopteridaceae	*Elaphoglossum rigidum*	1	1
Gesneriaceae	*Codonanthe venosa*	3	3
Gesneriaceae	*Nematanthus bradei*	6	6
Lycopodiaceae	*Phlegmariurus loefgrenianus*	1	1
Lycopodiaceae	*Phlegmariurus quadrifariatus*	11	11
Melastomataceae	*Pleiochiton crassifolium*	1	1
Melastomataceae	*Pleiochiton parasiticum*	1	1
Melastomataceae	*Pleiochiton setulosum*	1	1
Oleandraceae	*Oleandra australis*	1	1
Orchidaceae	*Acianthera gracilis*	1	1
Orchidaceae	*Acianthera guimaraensii*	1	1
Orchidaceae	*Acianthera parva*	1	1
Orchidaceae	*Acianthera pernambucensis*	1	1
Orchidaceae	*Acianthera punctatiflora*	2	2
Orchidaceae	*Barbosella trilobata*	1	1

Orchidaceae	*Bifrenaria tetragona*	1	1
Orchidaceae	*Bulbophyllum perii*	1	1
Orchidaceae	*Campylocentrum hirtellum*	1	1
Orchidaceae	*Cattleya grandis*	1	1
Orchidaceae	*Cattleya kerrii*	2	2
Orchidaceae	*Dichaea bryophyla*	1	1
Orchidaceae	*Dryadella auriculigera*	1	1
Orchidaceae	*Epidendrum bothryanthum*	1	1
Orchidaceae	*Epidendrum cinnabarinum*	1	1
Orchidaceae	*Epidendrum obergii*	1	1
Orchidaceae	*Epidendrum saximontanum*	1	1
Orchidaceae	*Gomesa pectoralis*	1	1
Orchidaceae	*Gomesa welteri*	2	2
Orchidaceae	*Lepanthopsis densiflora*	1	1
Orchidaceae	*Leptotes tenuis*	1	1
Orchidaceae	*Miltonia cuneata*	3	3
Orchidaceae	*Octomeria decumbens*	1	1
Orchidaceae	*Octomeria estrellensis*	1	1
Orchidaceae	*Octomeria fibrifera*	3	3
Orchidaceae	*Octomeria ochroleuca*	1	1
Orchidaceae	*Octomeria octomeriantha*	1	1
Orchidaceae	*Pabstiella curti-bradei*	4	4
Orchidaceae	*Pabstiella miragliae*	1	1
Orchidaceae	*Pabstiella pleurothalloides*	4	4

Orchidaceae	*Pabstiella transparens*	1	1
Orchidaceae	*Pabstiella villosisepala*	1	1
Orchidaceae	*Prosthechea papilio*	1	1
Orchidaceae	*Saundersia mirabilis*	1	1
Orchidaceae	*Stelis loefgrenii*	1	1
Orchidaceae	*Stelis oligantha*	1	1
Orchidaceae	*Stelis parvifolia*	1	1
Orchidaceae	*Trichosalpinx mathildae*	1	1
Orchidaceae	*Zygostates grandiflora*	2	2
Piperaceae	*Peperomia mandioccana*	11	11
Piperaceae	*Peperomia subternifolia*	7	7
Polypodiaceae	*Anathallis crebrifolia*	1	1
Polypodiaceae	*Anathallis jordanensis*	1	1
Polypodiaceae	*Anathallis paranapiacabensis*	1	1
Polypodiaceae	*Anathallis simpliciglossa*	1	1
Polypodiaceae	*Anathallis spannageliana*	1	1
Polypodiaceae	*Ceradenia spixiana*	1	1
Polypodiaceae	*Microgramma geminata*	4	4

Supplementary Material 4 – To 652 of the 992 species that have records inside and outside the Conservation Units.

Family	Epiphyte Species	Occurrences in CUs	Record of Occurrences
Acanthaceae	*Clistax bahiensis*	1	2
Amaryllidaceae	*Hippeastrum aulicum*	2	4
Araceae	*Anthurium comtum*	6	30
Araceae	*Anthurium jilekii*	5	16

Araceae	*Anthurium langsdorffii*	2	3
Araceae	*Anthurium longifolium*	12	21
Araceae	*Anthurium solitarium*	5	26
Araceae	*Philodendron crassinervium*	17	25
Araceae	*Philodendron martianum*	5	13
Araceae	*Philodendron meridionale*	3	9
Aspleniaceae	*Asplenium incurvatum*	11	15
Begoniaceae	*Begonia obdeltata*	2	3
Bromeliaceae	*Aechmea aiuruocensis*	2	2
Bromeliaceae	*Aechmea alba*	2	7
Bromeliaceae	*Aechmea amorimii*	6	5
Bromeliaceae	*Aechmea andersoniana*	1	1
Bromeliaceae	*Aechmea aquilega*	3	24
Bromeliaceae	*Aechmea bicolor*	1	4
Bromeliaceae	*Aechmea blumenavii*	3	16
Bromeliaceae	*Aechmea burle-marxii*	1	3
Bromeliaceae	*Aechmea caesia*	1	4
Bromeliaceae	*Aechmea canaliculata*	2	2
Bromeliaceae	*Aechmea candida*	1	3
Bromeliaceae	*Aechmea capixabae*	1	11
Bromeliaceae	*Aechmea carvalhoi*	1	2
Bromeliaceae	*Aechmea castanea*	1	7
Bromeliaceae	*Aechmea caudata*	14	41
Bromeliaceae	*Aechmea coelestis*	17	27
Bromeliaceae	*Aechmea conifera*	8	12
Bromeliaceae	*Aechmea cylindrata*	4	13
Bromeliaceae	*Aechmea depressa*	1	2
Bromeliaceae	*Aechmea digitata*	1	2
Bromeliaceae	*Aechmea disjuncta*	2	6
Bromeliaceae	*Aechmea distichantha*	23	74
Bromeliaceae	*Aechmea farinosa*	1	1
Bromeliaceae	*Aechmea fasciata*	7	13
Bromeliaceae	*Aechmea floribunda*	4	8
Bromeliaceae	*Aechmea froesii*	9	14
Bromeliaceae	*Aechmea fulgens*	9	14
Bromeliaceae	*Aechmea gamosepala*	15	35
Bromeliaceae	*Aechmea glandulosa*	1	2
Bromeliaceae	*Aechmea gracilis*	6	10
Bromeliaceae	*Aechmea guaratingensis*	1	2
Bromeliaceae	*Aechmea gustavoi*	1	2
Bromeliaceae	*Aechmea kertesziae*	2	12
Bromeliaceae	*Aechmea lactifera*	1	1
Bromeliaceae	*Aechmea lamarchei*	3	36
Bromeliaceae	*Aechmea leonard-kentiana*	2	3

Bromeliaceae	*Aechmea leptantha*	4	12
Bromeliaceae	*Aechmea linharesii*	2	1
Bromeliaceae	*Aechmea macrochlamys*	2	4
Bromeliaceae	*Aechmea marauensis*	12	13
Bromeliaceae	*Aechmea miniata*	7	16
Bromeliaceae	*Aechmea multiflora*	4	13
Bromeliaceae	*Aechmea muricata*	1	6
Bromeliaceae	*Aechmea mutica*	1	4
Bromeliaceae	*Aechmea nudicaulis*	37	116
Bromeliaceae	*Aechmea organensis*	8	18
Bromeliaceae	*Aechmea ornata*	12	26
Bromeliaceae	*Aechmea pectinata*	10	24
Bromeliaceae	*Aechmea perforata*	1	4
Bromeliaceae	*Aechmea pineliana*	2	13
Bromeliaceae	*Aechmea podantha*	1	2
Bromeliaceae	*Aechmea racinae*	2	11
Bromeliaceae	*Aechmea ramosa*	1	26
Bromeliaceae	*Aechmea saxicola*	1	7
Bromeliaceae	*Aechmea subintegerrima*	1	3
Bromeliaceae	*Aechmea sulbahianensis*	3	6
Bromeliaceae	*Aechmea tentaculifera*	1	2
Bromeliaceae	*Aechmea tomentosa*	2	6
Bromeliaceae	*Aechmea triangularis*	1	3
Bromeliaceae	*Aechmea turbinocalyx*	5	11
Bromeliaceae	*Aechmea vanhoutteana*	2	4
Bromeliaceae	*Aechmea viridipetala*	1	2
Bromeliaceae	*Aechmea viridostigma*	1	4
Bromeliaceae	*Aechmea weberi*	4	3
Bromeliaceae	*Aechmea weilbachii*	6	7
Bromeliaceae	*Araeococcus chlorocarpus*	5	5
Bromeliaceae	*Araeococcus nigropurpureus*	3	7
Bromeliaceae	*Araeococcus parviflorus*	6	13
Bromeliaceae	*Billbergia amoena*	16	55
Bromeliaceae	*Billbergia bradeana*	1	3
Bromeliaceae	*Billbergia distachia*	20	65
Bromeliaceae	*Billbergia elegans*	3	6
Bromeliaceae	*Billbergia euphemiae*	8	35
Bromeliaceae	*Billbergia horrida*	3	14
Bromeliaceae	*Billbergia iridifolia*	5	23
Bromeliaceae	*Billbergia morelii*	5	13
Bromeliaceae	*Billbergia pohliana*	1	1
Bromeliaceae	*Billbergia sanderiana*	1	3
Bromeliaceae	*Billbergia saundersii*	4	13
Bromeliaceae	*Billbergia vittata*	3	11

Bromeliaceae	*Billbergia zebrina*	9	46
Bromeliaceae	*Canistropsis albiflora*	1	4
Bromeliaceae	*Canistropsis billbergioides*	11	30
Bromeliaceae	*Canistropsis burchellii*	1	4
Bromeliaceae	*Canistropsis exigua*	1	3
Bromeliaceae	*Canistropsis marceloi*	2	2
Bromeliaceae	*Canistropsis microps*	16	17
Bromeliaceae	*Canistropsis seidelii*	2	4
Bromeliaceae	*Canistrum aurantiacum*	2	4
Bromeliaceae	*Canistrum auratum*	1	1
Bromeliaceae	*Canistrum camacaense*	1	4
Bromeliaceae	*Canistrum montanum*	8	7
Bromeliaceae	*Canistrum seidelianum*	2	4
Bromeliaceae	*Catopsis berteroniana*	3	12
Bromeliaceae	*Edmundoa ambigua*	1	1
Bromeliaceae	*Edmundoa lindenii*	26	48
Bromeliaceae	*Edmundoa perplexa*	1	2
Bromeliaceae	*Guzmania monostachia*	1	1
Bromeliaceae	*Hohenbergia augusta*	1	18
Bromeliaceae	*Hohenbergia belemii*	9	10
Bromeliaceae	*Hohenbergia blanchetii*	4	9
Bromeliaceae	*Hohenbergia brachycephala*	2	5
Bromeliaceae	*Hohenbergia capitata*	2	3
Bromeliaceae	*Hohenbergia hatschbachii*	5	6
Bromeliaceae	*Hohenbergia mutabilis*	1	1
Bromeliaceae	*Hohenbergia ramageana*	5	12
Bromeliaceae	*Hohenbergia ridleyi*	1	12
Bromeliaceae	*Hohenbergia salzmannii*	2	6
Bromeliaceae	*Lymania azurea*	4	6
Bromeliaceae	*Lymania corallina*	3	8
Bromeliaceae	*Lymania globosa*	1	2
Bromeliaceae	*Lymania smithii*	7	15
Bromeliaceae	*Neoregelia carolinae*	3	6
Bromeliaceae	*Neoregelia chlorosticta*	1	3
Bromeliaceae	*Neoregelia compacta*	2	3
Bromeliaceae	*Neoregelia concentrica*	4	13
Bromeliaceae	*Neoregelia doeringiana*	1	1
Bromeliaceae	*Neoregelia dungsiana*	1	1
Bromeliaceae	*Neoregelia farinosa*	1	4
Bromeliaceae	*Neoregelia fosteriana*	1	2
Bromeliaceae	*Neoregelia guttata*	1	1
Bromeliaceae	*Neoregelia hoehneana*	2	2
Bromeliaceae	*Neoregelia johannis*	7	5
Bromeliaceae	*Neoregelia lactea*	1	1

Bromeliaceae	*Neoregelia laevis*	3	9
Bromeliaceae	*Neoregelia leucophoea*	1	1
Bromeliaceae	*Neoregelia longisepala*	2	3
Bromeliaceae	*Neoregelia macahensis*	1	1
Bromeliaceae	*Neoregelia macrosepala*	1	7
Bromeliaceae	*Neoregelia magdalenae*	1	2
Bromeliaceae	*Neoregelia pascoaliana*	1	3
Bromeliaceae	*Neoregelia pauciflora*	1	6
Bromeliaceae	*Neoregelia ruschii*	1	1
Bromeliaceae	*Neoregelia simulans*	1	5
Bromeliaceae	*Neoregelia tristis*	2	3
Bromeliaceae	*Neoregelia wilsoniana*	2	6
Bromeliaceae	*Nidularium altimontanum*	2	1
Bromeliaceae	*Nidularium amazonicum*	13	19
Bromeliaceae	*Nidularium amorimii*	2	2
Bromeliaceae	*Nidularium angustibracteatum*	2	5
Bromeliaceae	*Nidularium antoineanum*	1	3
Bromeliaceae	*Nidularium bicolor*	2	5
Bromeliaceae	*Nidularium campo-alegrense*	2	4
Bromeliaceae	*Nidularium cariacicaense*	1	10
Bromeliaceae	*Nidularium corallinum*	1	1
Bromeliaceae	*Nidularium ferdinandocoburgii*	1	4
Bromeliaceae	*Nidularium fulgens*	4	5
Bromeliaceae	*Nidularium innocentii*	55	116
Bromeliaceae	*Nidularium itatiaiae*	2	2
Bromeliaceae	*Nidularium kautskyanum*	1	2
Bromeliaceae	*Nidularium longiflorum*	8	20
Bromeliaceae	*Nidularium marigoi*	5	5
Bromeliaceae	*Nidularium procerum*	22	53
Bromeliaceae	*Nidularium rutilans*	1	7
Bromeliaceae	*Portea alatisepala*	2	4
Bromeliaceae	*Portea grandiflora*	3	6
Bromeliaceae	*Portea petropolitana*	5	20
Bromeliaceae	*Portea silveirae*	1	4
Bromeliaceae	*Quesnelia arvensis*	2	9
Bromeliaceae	*Quesnelia augusto-coburgii*	1	2
Bromeliaceae	*Quesnelia clavata*	2	2
Bromeliaceae	*Quesnelia edmundoi*	2	15
Bromeliaceae	*Quesnelia humilis*	4	8
Bromeliaceae	*Quesnelia kautskyi*	2	6
Bromeliaceae	*Quesnelia lateralis*	5	6
Bromeliaceae	*Quesnelia liboniana*	5	7
Bromeliaceae	*Quesnelia marmorata*	1	3
Bromeliaceae	*Quesnelia quesneliana*	2	20

Bromeliaceae	*Quesnelia strobilispica*	2	9
Bromeliaceae	*Quesnelia testudo*	2	3
Bromeliaceae	*Quesnelia violacea*	2	3
Bromeliaceae	*Ronnbergia brasiliensis*	2	6
Bromeliaceae	*Tillandsia dura*	6	12
Bromeliaceae	*Tillandsia kautskyi*	1	2
Bromeliaceae	*Tillandsia linearis*	3	8
Bromeliaceae	*Tillandsia mallemontii*	2	25
Bromeliaceae	*Tillandsia sprengeliana*	1	5
Bromeliaceae	*Vriesea agostiniana*	1	3
Bromeliaceae	*Vriesea altodaserrae*	10	27
Bromeliaceae	*Vriesea arachnoidea*	2	4
Bromeliaceae	*Vriesea atra*	8	14
Bromeliaceae	*Vriesea billbergioides*	6	10
Bromeliaceae	*Vriesea bituminosa*	14	18
Bromeliaceae	*Vriesea breviscapa*	4	7
Bromeliaceae	*Vriesea capixabae*	3	8
Bromeliaceae	*Vriesea carinata*	81	239
Bromeliaceae	*Vriesea corcovadensis*	1	12
Bromeliaceae	*Vriesea delicatula*	1	3
Bromeliaceae	*Vriesea dictyographa*	1	1
Bromeliaceae	*Vriesea drepanocarpa*	6	16
Bromeliaceae	*Vriesea duvaliana*	10	17
Bromeliaceae	*Vriesea ensiformis*	33	129
Bromeliaceae	*Vriesea erythrodactylon*	20	43
Bromeliaceae	*Vriesea flammea*	38	108
Bromeliaceae	*Vriesea flava*	10	30
Bromeliaceae	*Vriesea fontourae*	1	1
Bromeliaceae	*Vriesea friburgensis*	12	96
Bromeliaceae	*Vriesea gigantea*	15	82
Bromeliaceae	*Vriesea graciliscapa*	2	3
Bromeliaceae	*Vriesea gradata*	1	28
Bromeliaceae	*Vriesea guttata*	14	65
Bromeliaceae	*Vriesea heterostachys*	7	30
Bromeliaceae	*Vriesea hieroglyphica*	4	7
Bromeliaceae	*Vriesea hydrophora*	1	4
Bromeliaceae	*Vriesea incurvata*	68	125
Bromeliaceae	*Vriesea inflata*	21	68
Bromeliaceae	*Vriesea itatiaiae*	4	6
Bromeliaceae	*Vriesea jonghei*	6	17
Bromeliaceae	*Vriesea languida*	1	5
Bromeliaceae	*Vriesea longicaulis*	13	31
Bromeliaceae	*Vriesea longiscapa*	5	12
Bromeliaceae	*Vriesea lubbersii*	12	37

Bromeliaceae	*Vriesea menescalii*	1	5
Bromeliaceae	*Vriesea minuta*	2	10
Bromeliaceae	*Vriesea morrenii*	3	7
Bromeliaceae	*Vriesea noblickii*	1	2
Bromeliaceae	*Vriesea pabstii*	3	4
Bromeliaceae	*Vriesea paraibica*	7	13
Bromeliaceae	*Vriesea paratiensis*	2	5
Bromeliaceae	*Vriesea pardalina*	5	9
Bromeliaceae	*Vriesea pauperrima*	2	13
Bromeliaceae	*Vriesea penduliflora*	1	6
Bromeliaceae	*Vriesea pereirae*	1	2
Bromeliaceae	*Vriesea philippocoburgii*	30	65
Bromeliaceae	*Vriesea pinottii*	1	2
Bromeliaceae	*Vriesea poenulata*	6	15
Bromeliaceae	*Vriesea psittacina*	27	54
Bromeliaceae	*Vriesea rafaelii*	1	1
Bromeliaceae	*Vriesea recurvata*	3	6
Bromeliaceae	*Vriesea regnellii*	2	2
Bromeliaceae	*Vriesea reitzii*	2	24
Bromeliaceae	*Vriesea revoluta*	1	2
Bromeliaceae	*Vriesea rhodostachys*	3	6
Bromeliaceae	*Vriesea rodigasiana*	28	78
Bromeliaceae	*Vriesea sandrae*	1	3
Bromeliaceae	*Vriesea sazimae*	4	6
Bromeliaceae	*Vriesea scalaris*	11	60
Bromeliaceae	*Vriesea sceptrum*	12	10
Bromeliaceae	*Vriesea serrana*	2	2
Bromeliaceae	*Vriesea taritubensis*	1	4
Bromeliaceae	*Vriesea teresopolitana*	1	1
Bromeliaceae	*Vriesea thyrsoidea*	2	4
Bromeliaceae	*Vriesea tijucana*	13	25
Bromeliaceae	*Vriesea triligulata*	3	4
Bromeliaceae	*Vriesea unilateralis*	14	44
Bromeliaceae	*Vriesea vagans*	38	82
Bromeliaceae	*Wittrockia cyathiformis*	9	18
Bromeliaceae	*Wittrockia gigantea*	3	9
Bromeliaceae	*Wittrockia superba*	8	19
Cactaceae	*Hatiora cylindrica*	2	2
Cactaceae	*Hatiora herminiae*	1	1
Cactaceae	*Hatiora salicornioides*	23	74
Cactaceae	*Rhipsalis burchellii*	1	7
Cactaceae	*Rhipsalis campos-portoana*	16	34
Cactaceae	*Rhipsalis clavata*	15	14
Cactaceae	*Rhipsalis crispata*	5	14

Cactaceae	*Rhipsalis elliptica*	28	60
Cactaceae	*Rhipsalis grandiflora*	4	13
Cactaceae	*Rhipsalis hoelleri*	1	1
Cactaceae	*Rhipsalis juengeri*	5	12
Cactaceae	*Rhipsalis lindbergiana*	6	35
Cactaceae	*Rhipsalis mesembryanthemoides*	1	2
Cactaceae	*Rhipsalis neves-armondii*	5	13
Cactaceae	*Rhipsalis oblonga*	7	11
Cactaceae	*Rhipsalis olivifera*	3	2
Cactaceae	*Rhipsalis ormindoi*	1	1
Cactaceae	*Rhipsalis pachyptera*	26	62
Cactaceae	*Rhipsalis paradoxa*	7	25
Cactaceae	*Rhipsalis pilocarpa*	2	3
Cactaceae	*Rhipsalis pulchra*	6	14
Cactaceae	*Rhipsalis puniceodiscus*	12	24
Cactaceae	*Rhipsalis russellii*	2	6
Cactaceae	*Rhipsalis teres*	43	126
Cactaceae	*Rhipsalis trigona*	3	15
Cactaceae	*Schlumbergera gaertneri*	2	6
Cactaceae	*Schlumbergera kautskyi*	2	2
Cactaceae	*Schlumbergera opuntioides*	5	6
Cactaceae	*Schlumbergera rosea*	2	6
Cactaceae	*Schlumbergera russelliana*	2	1
Cactaceae	*Schlumbergera truncata*	5	8
Dryopteridaceae	*Elaphoglossum crassinerve*	2	4
Dryopteridaceae	*Elaphoglossum glaziovii*	43	71
Dryopteridaceae	*Elaphoglossum iguapense*	1	2
Dryopteridaceae	*Elaphoglossum lingua*	6	13
Dryopteridaceae	*Elaphoglossum macahense*	5	6
Dryopteridaceae	*Elaphoglossum mollissimum*	7	6
Dryopteridaceae	*Elaphoglossum paulistanum*	2	2
Dryopteridaceae	*Elaphoglossum prestonii*	1	1
Dryopteridaceae	*Elaphoglossum rigidum*	1	1
Dryopteridaceae	*Elaphoglossum scolopendrifolium*	8	12
Dryopteridaceae	*Elaphoglossum vagans*	14	16
Gesneriaceae	*Codonanthe carnosa*	2	9
Gesneriaceae	*Codonanthe cordifolia*	11	24
Gesneriaceae	*Codonanthe devosiana*	38	82
Gesneriaceae	*Codonanthe gibbosa*	2	3
Gesneriaceae	*Codonanthe gracilis*	30	53
Gesneriaceae	*Codonanthe mattos-silvae*	2	8
Gesneriaceae	*Codonanthe venosa*	3	3
Gesneriaceae	*Nematanthus albus*	2	10

Gesneriaceae	*Nematanthus australis*	20	44
Gesneriaceae	*Nematanthus bradei*	6	6
Gesneriaceae	*Nematanthus brasiliensis*	2	6
Gesneriaceae	*Nematanthus corticola*	6	11
Gesneriaceae	*Nematanthus crassifolius*	18	57
Gesneriaceae	*Nematanthus fissus*	13	38
Gesneriaceae	*Nematanthus fluminensis*	3	8
Gesneriaceae	*Nematanthus fornix*	14	16
Gesneriaceae	*Nematanthus fritschii*	16	27
Gesneriaceae	*Nematanthus gregarius*	9	18
Gesneriaceae	*Nematanthus hirtellus*	12	17
Gesneriaceae	*Nematanthus jolyanus*	6	4
Gesneriaceae	*Nematanthus kautskyi*	1	7
Gesneriaceae	*Nematanthus lanceolatus*	7	27
Gesneriaceae	*Nematanthus maculatus*	4	6
Gesneriaceae	*Nematanthus monanthos*	3	6
Gesneriaceae	*Nematanthus sericeus*	9	13
Gesneriaceae	*Nematanthus striatus*	9	13
Gesneriaceae	*Nematanthus strigillosus*	1	11
Gesneriaceae	*Nematanthus tessmannii*	29	59
Gesneriaceae	*Nematanthus villosus*	9	11
Gesneriaceae	*Nematanthus wettsteinii*	6	14
Gesneriaceae	*Nematanthus wiehleri*	1	6
Gesneriaceae	*Sinningia cooperi*	11	27
Hymenophyllaceae	*Hymenophyllum rufum*	8	13
Hymenophyllaceae	*Polyphlebium diaphanum*	2	6
Lycopodiaceae	*Phlegmariurus biformis*	2	5
Lycopodiaceae	*Phlegmariurus comans*	4	6
Lycopodiaceae	*Phlegmariurus fontinaloides*	3	6
Lycopodiaceae	*Phlegmariurus hexastichus*	1	2
Lycopodiaceae	*Phlegmariurus loefgrenianus*	1	1
Lycopodiaceae	*Phlegmariurus quadrifariatus*	11	11
Marcgraviaceae	*Marcgraviastrum cuneifolium*	2	1
Melastomataceae	*Pleiochiton blepharodes*	22	52
Melastomataceae	*Pleiochiton crassifolium*	1	1
Melastomataceae	*Pleiochiton ebracteatum*	5	14
Melastomataceae	*Pleiochiton glaziovianum*	3	6
Melastomataceae	*Pleiochiton micranthum*	1	2
Melastomataceae	*Pleiochiton parasiticum*	1	1
Melastomataceae	*Pleiochiton roseum*	2	3
Melastomataceae	*Pleiochiton setulosum*	1	1
Oleandraceae	*Oleandra australis*	1	1
Onagraceae	*Fuchsia regia*	9	22
Orchidaceae	*Acianthera adiri*	1	2

Orchidaceae	*Acianthera aphthosa*	1	14
Orchidaceae	*Acianthera atropurpurea*	1	2
Orchidaceae	*Acianthera bidentula*	1	6
Orchidaceae	*Acianthera bragae*	1	11
Orchidaceae	*Acianthera capanemae*	1	2
Orchidaceae	*Acianthera capillaris*	1	2
Orchidaceae	*Acianthera crepiniana*	2	6
Orchidaceae	*Acianthera cryptantha*	1	5
Orchidaceae	*Acianthera exarticulata*	2	5
Orchidaceae	*Acianthera glanduligera*	7	17
Orchidaceae	*Acianthera glumacea*	2	9
Orchidaceae	*Acianthera gracilis*	1	1
Orchidaceae	*Acianthera guimaraensii*	1	1
Orchidaceae	*Acianthera leptotifolia*	2	6
Orchidaceae	*Acianthera macropoda*	2	5
Orchidaceae	*Acianthera nemorosa*	4	8
Orchidaceae	*Acianthera octophrys*	1	3
Orchidaceae	*Acianthera oligantha*	1	6
Orchidaceae	*Acianthera parva*	1	1
Orchidaceae	*Acianthera pectinata*	1	9
Orchidaceae	*Acianthera pernambucensis*	1	1
Orchidaceae	*Acianthera punctatiflora*	2	2
Orchidaceae	*Acianthera rostellata*	4	2
Orchidaceae	*Acianthera saurocephala*	4	20
Orchidaceae	*Acianthera serpentula*	1	4
Orchidaceae	*Acianthera sonderiana*	6	35
Orchidaceae	*Acianthera strupifolia*	1	5
Orchidaceae	*Acianthera translucida*	1	2
Orchidaceae	*Acianthera wageneriana*	1	2
Orchidaceae	*Anathallis adenochila*	4	15
Orchidaceae	*Anathallis bocainensis*	3	2
Orchidaceae	*Anathallis crebrifolia*	1	1
Orchidaceae	*Anathallis dryadum*	1	7
Orchidaceae	*Anathallis gerthatschbachii*	1	2
Orchidaceae	*Anathallis graveolens*	1	2
Orchidaceae	*Anathallis jordanensis*	1	1
Orchidaceae	*Anathallis liparanges*	2	5
Orchidaceae	*Anathallis malmeana*	3	4
Orchidaceae	*Anathallis microgemma*	3	5
Orchidaceae	*Anathallis paranapiacabensis*	1	1
Orchidaceae	*Anathallis petropolitana*	1	2
Orchidaceae	*Anathallis piratiningana*	1	3
Orchidaceae	*Anathallis radialis*	4	6
Orchidaceae	*Anathallis sclerophylla*	12	29

Orchidaceae	*Anathallis simpliciglossa*	1	1
Orchidaceae	*Anathallis spannageliana*	1	1
Orchidaceae	*Aspasia lunata*	1	8
Orchidaceae	*Barbosella australis*	1	3
Orchidaceae	*Barbosella dusenii*	1	3
Orchidaceae	*Barbosella gardneri*	2	5
Orchidaceae	*Barbosella miersii*	3	9
Orchidaceae	*Barbosella trilobata*	1	1
Orchidaceae	*Bifrenaria aureofulva*	3	6
Orchidaceae	*Bifrenaria harrisoniae*	7	8
Orchidaceae	*Bifrenaria tetragona*	1	1
Orchidaceae	*Bifrenaria vitellina*	4	3
Orchidaceae	*Brachionidium restrepioides*	1	2
Orchidaceae	*Brasiliorchis barbosae*	1	3
Orchidaceae	*Brasiliorchis gracilis*	8	15
Orchidaceae	*Brasiliorchis marginata*	8	21
Orchidaceae	*Brasiliorchis monantha*	2	3
Orchidaceae	*Brasiliorchis phoenicanthera*	2	3
Orchidaceae	*Brasiliorchis ubatubana*	2	14
Orchidaceae	*Bulbophyllum atropurpureum*	3	6
Orchidaceae	*Bulbophyllum campos-portoi*	1	3
Orchidaceae	*Bulbophyllum dusenii*	1	2
Orchidaceae	*Bulbophyllum glutinosum*	2	11
Orchidaceae	*Bulbophyllum granulosum*	3	10
Orchidaceae	*Bulbophyllum micranthum*	1	2
Orchidaceae	*Bulbophyllum micropetaliforme*	3	6
Orchidaceae	*Bulbophyllum napellii*	7	20
Orchidaceae	*Bulbophyllum perii*	1	1
Orchidaceae	*Bulbophyllum plumosum*	3	8
Orchidaceae	*Campylocentrum crassirhizum*	3	8
Orchidaceae	*Campylocentrum hirtellum*	1	1
Orchidaceae	*Campylocentrum ornithorrhynchum*	1	8
Orchidaceae	*Campylocentrum parahybunense*	1	6
Orchidaceae	*Campylocentrum robustum*	2	7
Orchidaceae	*Campylocentrum sellowii*	4	14
Orchidaceae	*Capanemia gehrtii*	1	5
Orchidaceae	*Catasetum atratum*	1	4
Orchidaceae	*Catasetum cernuum*	4	14
Orchidaceae	*Catasetum hookeri*	1	7
Orchidaceae	*Catasetum luridum*	2	8
Orchidaceae	*Catasetum socco*	1	3
Orchidaceae	*Cattleya coccinea*	17	36
Orchidaceae	*Cattleya crispa*	1	3

Orchidaceae	*Cattleya forbesii*	8	12
Orchidaceae	*Cattleya grandis*	1	1
Orchidaceae	*Cattleya granulosa*	2	5
Orchidaceae	*Cattleya guttata*	2	16
Orchidaceae	*Cattleya harrisoniana*	1	6
Orchidaceae	*Cattleya intermedia*	2	9
Orchidaceae	*Cattleya kerrii*	2	2
Orchidaceae	*Cattleya loddigesii*	2	9
Orchidaceae	*Cattleya warneri*	1	3
Orchidaceae	*Centroglossa greeniana*	2	1
Orchidaceae	*Centroglossa macroceras*	4	5
Orchidaceae	*Christensonella ferdinandiana*	4	11
Orchidaceae	*Christensonella neowiedii*	7	28
Orchidaceae	*Christensonella pachyphylla*	1	6
Orchidaceae	*Christensonella subulata*	6	32
Orchidaceae	*Cirrhaea dependens*	5	9
Orchidaceae	*Cirrhaea nasuta*	1	3
Orchidaceae	*Cirrhaea seidelii*	1	2
Orchidaceae	*Comparettia coccinea*	1	8
Orchidaceae	*Cyrtopodium gigas*	1	8
Orchidaceae	*Dichaea anchorifera*	2	4
Orchidaceae	*Dichaea australis*	1	2
Orchidaceae	*Dichaea brevicaulis*	2	4
Orchidaceae	*Dichaea bryophyla*	1	1
Orchidaceae	*Dichaea cogniauxiana*	24	52
Orchidaceae	*Dichaea mosenii*	2	4
Orchidaceae	*Dryadella auriculigera*	1	1
Orchidaceae	*Dryadella edwallii*	4	12
Orchidaceae	*Dryadella lilliputiana*	6	10
Orchidaceae	*Encyclia advena*	1	2
Orchidaceae	*Encyclia bracteata*	2	4
Orchidaceae	*Encyclia ionosma*	3	2
Orchidaceae	*Encyclia oncidioides*	2	15
Orchidaceae	*Encyclia patens*	8	35
Orchidaceae	*Epidendrum addae*	1	2
Orchidaceae	*Epidendrum bothryanthum*	1	1
Orchidaceae	*Epidendrum caldense*	1	3
Orchidaceae	*Epidendrum campaccii*	2	7
Orchidaceae	*Epidendrum chlorinum*	5	16
Orchidaceae	*Epidendrum cinnabarinum*	1	1
Orchidaceae	*Epidendrum cooperianum*	2	5
Orchidaceae	*Epidendrum filicaule*	4	7
Orchidaceae	*Epidendrum geniculatum*	1	6
Orchidaceae	*Epidendrum henschenii*	1	4

Orchidaceae	*Epidendrum latilabrum*	13	39
Orchidaceae	*Epidendrum mantiqueiranum*	5	6
Orchidaceae	*Epidendrum obergii*	1	1
Orchidaceae	*Epidendrum paniculosum*	1	2
Orchidaceae	*Epidendrum paranaense*	13	23
Orchidaceae	*Epidendrum proligerum*	7	31
Orchidaceae	*Epidendrum pseudodifforme*	4	20
Orchidaceae	*Epidendrum saximontanum*	1	1
Orchidaceae	*Epidendrum vesicatum*	6	16
Orchidaceae	*Eurystyles cotyledon*	2	18
Orchidaceae	*Gomesa ciliata*	6	18
Orchidaceae	*Gomesa cogniauxiana*	1	3
Orchidaceae	*Gomesa concolor*	4	16
Orchidaceae	*Gomesa cruciata*	1	2
Orchidaceae	*Gomesa cuneata*	1	3
Orchidaceae	*Gomesa gardneri*	9	11
Orchidaceae	*Gomesa glaziovii*	3	14
Orchidaceae	*Gomesa gomezoides*	11	19
Orchidaceae	*Gomesa imperatoris-maximiliani*	3	15
Orchidaceae	*Gomesa jucunda*	4	5
Orchidaceae	*Gomesa laxiflora*	3	10
Orchidaceae	*Gomesa longicornu*	7	24
Orchidaceae	*Gomesa microphyta*	2	11
Orchidaceae	*Gomesa pectoralis*	1	1
Orchidaceae	*Gomesa ranifera*	11	48
Orchidaceae	*Gomesa riograndensis*	6	17
Orchidaceae	*Gomesa sarcodes*	2	5
Orchidaceae	*Gomesa venusta*	5	7
Orchidaceae	*Gomesa welteri*	2	2
Orchidaceae	*Gongora bufonia*	4	8
Orchidaceae	*Grandiphyllum auricula*	5	8
Orchidaceae	*Grandiphyllum hians*	2	7
Orchidaceae	*Grobya amherstiae*	4	11
Orchidaceae	*Grobya galeata*	2	5
Orchidaceae	*Heterotaxis brasiliensis*	8	31
Orchidaceae	*Isabelia pulchella*	3	9
Orchidaceae	*Isabelia violacea*	3	9
Orchidaceae	*Lankesterella caespitosa*	1	5
Orchidaceae	*Lankesterella gnoma*	5	6
Orchidaceae	*Lepanthopsis densiflora*	1	1
Orchidaceae	*Leptotes tenuis*	1	1
Orchidaceae	*Lockhartia lunifera*	9	18
Orchidaceae	*Maxillaria bradei*	6	8
Orchidaceae	*Maxillaria candida*	1	2

Orchidaceae	*Maxillaria leucaimata*	7	12
Orchidaceae	*Maxillaria lindleyana*	3	9
Orchidaceae	*Maxillaria spiritusanctensis*	1	3
Orchidaceae	*Maxillariella robusta*	3	8
Orchidaceae	*Miltonia candida*	1	2
Orchidaceae	*Miltonia clowesii*	1	5
Orchidaceae	*Miltonia cuneata*	3	3
Orchidaceae	*Miltonia regnellii*	3	14
Orchidaceae	*Miltonia russelliana*	1	3
Orchidaceae	*Miltonia spectabilis*	3	8
Orchidaceae	*Myoxanthus lonchophyllus*	1	2
Orchidaceae	*Myoxanthus punctatus*	2	6
Orchidaceae	*Notylia hemitricha*	3	4
Orchidaceae	*Octomeria decumbens*	1	1
Orchidaceae	*Octomeria diaphana*	3	7
Orchidaceae	*Octomeria estrellensis*	1	1
Orchidaceae	*Octomeria fibrifera*	3	3
Orchidaceae	*Octomeria gracilis*	1	6
Orchidaceae	*Octomeria juncifolia*	4	7
Orchidaceae	*Octomeria lichenicola*	1	2
Orchidaceae	*Octomeria ochroleuca*	1	1
Orchidaceae	*Octomeria octomeriantha*	1	1
Orchidaceae	*Octomeria palmyrabellae*	1	5
Orchidaceae	*Octomeria sancti-angeli*	1	2
Orchidaceae	*Octomeria wawrae*	2	1
Orchidaceae	*Pabstia jugosa*	2	3
Orchidaceae	*Pabstiella alligatorifera*	2	7
Orchidaceae	*Pabstiella arcuata*	3	7
Orchidaceae	*Pabstiella bacillaris*	1	3
Orchidaceae	*Pabstiella bradei*	2	4
Orchidaceae	*Pabstiella campestris*	1	4
Orchidaceae	*Pabstiella colorata*	2	5
Orchidaceae	*Pabstiella curti-bradei*	4	4
Orchidaceae	*Pabstiella fluminensis*	3	2
Orchidaceae	*Pabstiella henrique-aragonii*	1	2
Orchidaceae	*Pabstiella lineolata*	1	2
Orchidaceae	*Pabstiella matinhensis*	2	14
Orchidaceae	*Pabstiella mirabilis*	3	10
Orchidaceae	*Pabstiella miragliae*	1	1
Orchidaceae	*Pabstiella parvifolia*	2	6
Orchidaceae	*Pabstiella pleurothalloides*	4	4
Orchidaceae	*Pabstiella pterophora*	2	6
Orchidaceae	*Pabstiella punctatifolia*	5	6
Orchidaceae	*Pabstiella quadridentata*	2	6

Orchidaceae	*Pabstiella transparens*	1	1
Orchidaceae	*Pabstiella trifida*	10	21
Orchidaceae	*Pabstiella villosisepala*	1	1
Orchidaceae	*Pabstiella wacketii*	3	2
Orchidaceae	*Phymatidium aquinoi*	3	5
Orchidaceae	*Phymatidium falcifolium*	10	18
Orchidaceae	*Phymatidium hysteranthum*	2	8
Orchidaceae	*Platyrhiza quadricolor*	1	4
Orchidaceae	*Polystachya caespitosa*	3	6
Orchidaceae	*Prescottia lancifolia*	2	4
Orchidaceae	*Promenaea guttata*	2	3
Orchidaceae	*Promenaea stapelioides*	4	8
Orchidaceae	*Promenaea xanthina*	8	25
Orchidaceae	*Prosthechea allemanoides*	3	8
Orchidaceae	*Prosthechea calamaria*	5	13
Orchidaceae	*Prosthechea fausta*	3	19
Orchidaceae	*Prosthechea pachysepala*	1	5
Orchidaceae	*Prosthechea papilio*	1	1
Orchidaceae	*Pygmaeorchis brasiliensis*	2	1
Orchidaceae	*Rodriguezia bracteata*	1	6
Orchidaceae	*Rodriguezia pubescens*	1	3
Orchidaceae	*Rodriguezia sticta*	1	2
Orchidaceae	*Rodriguezia venusta*	4	10
Orchidaceae	*Saundersia mirabilis*	1	1
Orchidaceae	*Saundersia paniculata*	1	2
Orchidaceae	*Scuticaria hadwenii*	2	5
Orchidaceae	*Specklinia scabripes*	2	1
Orchidaceae	*Specklinia subpicta*	2	3
Orchidaceae	*Stanhopea insignis*	2	3
Orchidaceae	*Stanhopea lietzei*	3	7
Orchidaceae	*Stelis argentata*	2	9
Orchidaceae	*Stelis deregularis*	7	13
Orchidaceae	*Stelis loefgrenii*	1	1
Orchidaceae	*Stelis megantha*	12	18
Orchidaceae	*Stelis oligantha*	1	1
Orchidaceae	*Stelis parvifolia*	1	1
Orchidaceae	*Stelis pauciflora*	3	6
Orchidaceae	*Stelis pauloensis*	2	3
Orchidaceae	*Stelis ruprechtiana*	2	8
Orchidaceae	*Trichopilia santoslimae*	1	2
Orchidaceae	*Trichosalpinx mathildae*	1	1
Orchidaceae	*Trichosalpinx montana*	3	5
Orchidaceae	*Trigonidium latifolium*	4	7
Orchidaceae	*Trigonidium obtusum*	3	5

Orchidaceae	*Warmingia eugenii*	1	8
Orchidaceae	*Zygopetalum crinitum*	3	11
Orchidaceae	*Zygostates cornuta*	2	8
Orchidaceae	*Zygostates dasyrhiza*	2	9
Orchidaceae	*Zygostates grandiflora*	2	2
Orchidaceae	*Zygostates lunata*	3	16
Orchidaceae	*Zygostates pellucida*	1	2
Orchidaceae	*Zygostates pustulata*	1	2
Piperaceae	*Peperomia campinasana*	3	7
Piperaceae	*Peperomia clivicola*	1	7
Piperaceae	*Peperomia crinicaulis*	2	13
Piperaceae	*Peperomia glazioui*	8	41
Piperaceae	*Peperomia hilariana*	4	23
Piperaceae	*Peperomia mandioccana*	11	11
Piperaceae	*Peperomia pseudoestrellensis*	17	36
Piperaceae	*Peperomia rizzinii*	3	7
Piperaceae	*Peperomia subemarginata*	1	3
Piperaceae	*Peperomia subretusa*	3	1
Piperaceae	*Peperomia subternifolia*	7	7
Piperaceae	*Peperomia tetraphylla*	67	188
Piperaceae	*Peperomia velloziana*	4	11
Polypodiaceae	*Alansmia reclinata*	5	13
Polypodiaceae	*Ceradenia albidula*	1	2
Polypodiaceae	*Ceradenia spixiana*	1	1
Polypodiaceae	*Cochlidium punctatum*	12	23
Polypodiaceae	*Lellingeria brevistipes*	2	3
Polypodiaceae	*Leucotrichum organense*	9	16
Polypodiaceae	*Leucotrichum schenckii*	2	8
Polypodiaceae	*Microgramma geminata*	4	4
Polypodiaceae	*Microgramma tecta*	5	10
Polypodiaceae	*Moranopteris achilleifolia*	8	9
Polypodiaceae	*Pleopeltis pleopeltifolia*	24	115
Polypodiaceae	*Serpocaulon menisciifolium*	2	13
Polypodiaceae	*Zygophlebia longipilosa*	6	3

Supplementary material 5 - Number of species by families that have records inside and outside, only inside and outside the Conservation Units.

Family	**Nº of species inside and outside CUs**	**Nº of species only inside CUs**	**Nº of species just outside CUs**
Orchidaceae	272	39	171

Bromeliaceae	249	30	137
Gesneriaceae	32	2	5
Cactaceae	31	6	1
Piperaceae	13	2	8
Polypodiaceae	13	7	4
Dryopteridaceae	11	3	3
Araceae	8	-	5
Melastomataceae	8	3	1
Lycopodiaceae	6	-	-
Hymenophyllaceae	2	-	1
Acanthaceae	1	-	-
Amaryllidaceae	1	-	1
Aspleniaceae	1	-	1
Begoniaceae	1	-	1
Marcgraviaceae	1	-	-
Oleandraceae	1	1	1
Onagraceae	1	-	-

Supplementary material 6 – The 85 Conservation Units that obtained records of vascular endemic epiphytes.

Conservation Units	Category	States	Political Region	Sphere	Nº of Records
Environmental Protection Area of Guaraqueçaba	Environmental Protection Area	Paraná - PR	South	Federal	264
Environmental Protection Area Costa of Itacari/Serra Grande	Environmental Protection Area	Bahia - BA	North East	Estadual	172
Environmental Protection Area Estadual of Piraquara	Environmental Protection Area	Paraná - PR	South	Estadual	169
State Park Carlos Botelho	Parque	São Paulo - SP	Southeast	Estadual	155
National Park of Serra of Itajaí	Parque	Santa Catariana - SC	South	Federal	151
Environmental Protection Area of Petrópolis	Environmental Protection Area	Rio of Janeiro - RJ	Southeast	Federal	149
Environmental Protection Area Estadual of Guaratuba	Environmental Protection Area	Paraná - PR	South	Estadual	136
National Park of Serra ofs Orgãos	Parque	Rio of Janeiro - RJ	Southeast	Federal	124
National Park of Serra of Itabaiana	Parque	Sergipe - SE	North East	Federal	117
Environmental Protection Area of Bacia of Rio São João / Mico-Leão-Dourado	Environmental Protection Area	Rio of Janeiro - RJ	Southeast	Federal	97
Environmental Protection Area Baía of Camamu	Environmental Protection Area	Bahia - BA	North East	Estadual	82
National Park of Saint-Hilaire/Lange National Park	Parque	Paraná - PR	South	Federal	82
Biological Reserve of Una	Biological Reserve	Bahia - BA	North East	Federal	80

Environmental Protection Area of Iraí	Environmental Protection Area	Paraná - PR	South	Estadual	63
RDS of Barra Una	Reserva of ofsenvolvimento Sustentável	São Paulo - SP	Southeast	Estadual	60
State Park of Serra of Mar	Parque	São Paulo - SP	Southeast	Estadual	58
National Park of Itatiaia	Parque	Rio of Janeiro - RJ	Southeast	Federal	50
State Park of Itinguçu	Parque	São Paulo - SP	Southeast	Estadual	48
State Park of Forno Grande	Parque	Espírito Santo - ES	Southeast	Estadual	45
State Park of Serra Furada	Parque	Santa Catariana - SC	South	Estadual	45
National Park of Serra ofs Lontras	Parque	Bahia - BA	North East	Federal	44
Environmental Protection Area Serra of Mantiqueira	Environmental Protection Area	Rio of Janeiro - RJ	Southeast	Federal	43
Environmental Protection Area of Cananeia-Iguapé-Peruíbe	Environmental Protection Area	São Paulo - SP	Southeast	Federal	40
Ecological Station Estadual Wenceslau Guimarães	Ecological Station	Bahia - BA	North East	Estadual	39
Environmental Protection Area Lagoa Encantada	Environmental Protection Area	Bahia - BA	North East	Estadual	35
National Park of São Joaquim	Parque	Santa Catariana - SC	South	Federal	34
Environmental Protection Area of Macaé of Cima	Environmental Protection Area	Rio of Janeiro - RJ	Southeast	Estadual	30
State Park of Serra of Conduru	Parque	Bahia - BA	North East	Estadual	29
Environmental Protection Area Campos of Jordão	Environmental Protection Area	São Paulo - SP	Southeast	Estadual	26

Environmental Protection Area of Massambaba	Environmental Protection Area	Rio of Janeiro - RJ	Southeast	Estadual	25
State Park of Costa of Sol	Parque	Rio of Janeiro - RJ	Southeast	Estadual	25
State Park of Serra of Tabuleiro	Parque	Santa Catariana - SC	South	Estadual	25
National Park Restinga of Jurubatiba	Parque	Rio of Janeiro - RJ	Southeast	Federal	24
State Park of Ilha of Cardoso	Parque	São Paulo - SP	Southeast	Estadual	24
Ecological Station of Ilha of Mel	Ecological Station	Paraná - PR	South	Estadual	23
Environmental Protection Area of Murici	Environmental Protection Area	Alagoas - AL	North East	Estadual	19
Environmental Protection Area Serra of Mar	Environmental Protection Area	São Paulo - SP	Southeast	Estadual	16
State Park Serra of Brigadeiro	Parque	Minas Gerais - MG	Southeast	Estadual	15
Environmental Protection Area of Mangaratiba	Environmental Protection Area	Rio of Janeiro - RJ	Southeast	Estadual	15
Environmental Protection Area of Tamoios	Environmental Protection Area	Rio of Janeiro - RJ	Southeast	Estadual	15
Environmental Protection Area Jundiaí	Environmental Protection Area	São Paulo - SP	Southeast	Estadual	15
State Park of Campinado of Encantado	Parque	São Paulo - SP	Southeast	Estadual	15
Ecological Station of Murici	Ecological Station	Alagoas - AL	North East	Federal	14
Environmental Protection Area of Sistema of Catareira	Environmental Protection Area	São Paulo - SP	Southeast	Estadual	14
Environmental Protection Area Estadual da Serra of	Environmental Protection Area	Paraná - PR	South	Estadual	13

Esperança					
Environmental Protection Area of Bacia Hydrographic of Rio Machado	Environmental Protection Area	Minas Gerais - MG	Southeast	Estadual	13
National Park of Serra Geral	Parque	Santa Catariana - SC	South	Federal	13
Ecological Station Juréia - Itatins	Reserva Natural Estrita	São Paulo - SP	Southeast	Estadual	12
Environmental Protection Area Estadual	Environmental Protection Area	Paraná - PR	South	Estadual	11
da Escarpa ofvoniana					
National Park of Iguaçu	Parque	Paraná - PR	South	Federal	11
Natural Park Municiapl of ofmingos Martins	Parque	Espírito Santo - ES	Southeast	Municipal	9
National Park of Aparados of Serra	Parque	Rio Grande of Sul - RS Santa Catarina - SC	South	Federal	9

Supplementary material 7 - To the 212 species of vascular endemic epiphytes and their occurrences.

Family	Species	Occurrence
Araceae	*Anthurium comtum*	28
	Anthurium jilekii	16
	Anthurium longifolium	20
	Anthurium solitarium	25
	Philodendron crassinervium	24
	Philodendron martianum	12
Araeococcus	*Araeococcus parviflorus*	13
Aspleniaceae	*Asplenium incurvatum*	12
	Aechmea aquilega	24
	Aechmea blumenavii	15
	Aechmea capixabae	11
	Aechmea caudata	40
	Aechmea coelestis	24

	Aechmea conifera	12
	Aechmea cylindrata	13
	Aechmea distichantha	73
	Aechmea fasciata	11
	Aechmea froesii	12
	Aechmea fulgens	14
	Aechmea gamosepala	34
	Aechmea gracilis	10
	Aechmea kertesziae	11
	Aechmea lamarchei	34
	Aechmea leptantha	11
	Aechmea marauensis	13
	Aechmea miniata	16
	Aechmea multiflora	13
Bromeliaceae	*Aechmea nudicaulis*	106
	Aechmea organensis	17
	Aechmea ornata	25
	Aechmea pectinata	23
	Aechmea pineliana	13
	Aechmea racinae	11
	Aechmea ramosa	26
	Aechmea turbinocalyx	11
	Billbergia amoena	50
	Billbergia distachia	65
	Billbergia euphemiae	34
	Billbergia horrida	13
	Billbergia iridifolia	22
	Billbergia morelii	13
	Billbergia saundersii	13
	Billbergia vittata	11
	Billbergia zebrina	45
	Canistropsis billbergioides	29
	Canistropsis microps	17
	Catopsis berteroniana	11
	Edmundoa lindenii	44
	Hohenbergia augusta	13
	Hohenbergia belemii	10
	Hohenbergia ramageana	11
	Hohenbergia ridleyi	12
	Lymania smithii	15
	Nidularium amazonicum	19
	Nidularium cariacicaense	10
	Nidularium innocentii	95
	Nidularium longiflorum	19
	Nidularium procerum	49
	Portea petropolitana	20

	Quesnelia quesneliana	16
	Tillandsia dura	11
	Tillandsia mallemontii	25
	Vriesea altodaserrae	25
	Vriesea atra	13
	Vriesea bituminosa	18
Bromeliaceae	*Vriesea carinata*	208
	Vriesea corcovadensis	12
	Vriesea drepanocarpa	15
	Vriesea duvaliana	16
	Vriesea ensiformis	107
	Vriesea erythrodactylon	42
	Vriesea flammea	80
	Vriesea flava	27
	Vriesea friburgensis	91
	Vriesea gigantea	65
	Vriesea gradata	25
	Vriesea guttata	54
	Vriesea heterostachys	28
	Vriesea incurvata	96
	Vriesea inflata	65
	Vriesea jonghei	14
	Vriesea longicaulis	28
	Vriesea longiscapa	10
	Vriesea lubbersii	23
	Vriesea paraibica	13
	Vriesea pauperrima	10
	Vriesea philippocoburgii	58
	Vriesea poenulata	15
	Vriesea psittacina	48
	Vriesea reitzii	21
	Vriesea rodigasiana	73
Bromeliaceae	*Vriesea scalaris*	54
	Vriesea tijucana	24
	Vriesea unilateralis	39
	Vriesea vagans	66
	Wittrockia cyathiformis	17
	Wittrockia superba	15
	Hatiora salicornioides	71
	Rhipsalis campos-portoana	31
	Rhipsalis clavata	14
	Rhipsalis crispata	14
Cactaceae	*Rhipsalis elliptica*	58
	Rhipsalis grandiflora	12
	Rhipsalis juengeri	12
	Rhipsalis lindbergiana	33

	Rhipsalis neves-armondii	12
	Rhipsalis oblonga	11
	Rhipsalis pachyptera	56
	Rhipsalis paradoxa	24
	Rhipsalis pulchra	14
	Rhipsalis puniceodiscus	24
	Rhipsalis teres	106
Dryopteridaceae	*Elaphoglossum glaziovii*	63
	Elaphoglossum lingua	13
	Elaphoglossum scolopendrifolium	11
	Elaphoglossum vagans	16
Gesneriaceae	*Codonanthe cordifolia*	23
	Codonanthe devosiana	70
	Codonanthe gracilis	49
	Nematanthus albus	10
	Nematanthus australis	44
	Nematanthus corticola	11
	Nematanthus crassifolius	53
	Nematanthus fissus	34
	Nematanthus fornix	16
	Nematanthus fritschii	26
	Nematanthus gregarius	18
	Nematanthus hirtellus	16
	Nematanthus lanceolatus	26
	Nematanthus sericeus	13
	Nematanthus striatus	13
	Nematanthus strigillosus	10
	Nematanthus tessmannii	55
Gesneriaceae	*Nematanthus villosus*	10
	Nematanthus wettsteinii	14
	Sinningia cooperi	25
Hymenophyllaceae	*Hymenophyllum rufum*	12
Lycopodiaceae	*Phlegmariurus quadrifariatus*	11
	Phymatidium falcifolium	18
Melastomataceae	*Pleiochiton blepharodes*	51
	Pleiochiton ebracteatum	14
Onagraceae	*Fuchsia regia*	22
	Acianthera aphthosa	14
	Acianthera bragae	11
	Acianthera glanduligera	15
	Acianthera saurocephala	19
	Acianthera sonderiana	35
	Anathallis adenochila	15
	Anathallis sclerophylla	29
	Brasiliorchis gracilis	15
	Brasiliorchis marginata	20

	Brasiliorchis ubatubana	14
	Bulbophyllum glutinosum	11
	Bulbophyllum granulosum	10
	Bulbophyllum napellii	19
	Campylocentrum sellowii	14
	Catasetum cernuum	14
	Cattleya coccinea	35
	Cattleya forbesii	12
	Cattleya guttata	15
	Christensonella ferdinandiana	11
	Christensonella neowiedii	28
	Christensonella subulata	32
Orchidaceae	*Dichaea cogniauxiana*	45
	Dryadella edwallii	12
	Dryadella lilliputiana	10
	Encyclia oncidioides	15
	Encyclia patens	35
	Epidendrum chlorinum	16
	Epidendrum latilabrum	38
	Epidendrum paranaense	22
	Epidendrum proligerum	30
	Epidendrum pseudodifforme	19
	Epidendrum vesicatum	16
	Eurystyles cotyledon	18
	Gomesa ciliata	17
	Gomesa concolor	16
	Gomesa gardneri	10
	Gomesa glaziovii	14
	Gomesa gomezoides	19
	Gomesa imperatoris-maximiliani	14
	Gomesa laxiflora	10
	Gomesa longicornu	24
	Gomesa microphyta	11
	Gomesa ranifera	47
	Gomesa riograndensis	17
	Grobya amherstiae	11
Orchidaceae	*Heterotaxis brasiliensis*	30
	Lockhartia lunifera	16
	Maxillaria leucaimata	12
	Miltonia regnellii	13
	Pabstiella matinhensis	14
	Pabstiella trifida	21
	Promenaea xanthina	25
	Prosthechea calamaria	12
	Prosthechea fausta	19
	Stelis deregularis	13

	Stelis megantha	16
	Zygopetalum crinitum	11
	Zygostates lunata	16
Piperaceae	*Peperomia crinicaulis*	13
	Peperomia glazioui	41
	Peperomia hilariana	23
	Peperomia mandioccana	11
	Peperomia pseudoestrellensis	34
	Peperomia tetraphylla	181
	Peperomia velloziana	11
Polypodiaceae	*Alansmia reclinata*	13
	Cochlidium punctatum	22
	Leucotrichum organense	14
	Microgramma tecta	10
	Pleopeltis pleopeltifolia	90

Supplementary Material 8 - The 52 species of endemic vascular epiphytes that were observed in the Conservation Units and their frequency.

Family	**Species**	**Frequency of CUs**
Araceae	*Anthurium jilekii*	1
Araeococcus	*Araeococcus parviflorus*	31
Bromeliaceae	*Aechmea conifera*	26
	Aechmea froesii	16
	Aechmea gamosepala	11
	Aechmea marauensis	21
	Aechmea miniata	45
	Aechmea nudicaulis	105
	Aechmea turbinocalyx	20
	Billbergia distachia	3
	Billbergia morelii	2
	Billbergia saundersii	17
	Edmundoa lindenii	24
	Hohenbergia belemii	27
	Lymania smithii	33
	Nidularium innocentii	89
	Vriesea bituminosa	1
	Vriesea carinata	214
	Vriesea duvaliana	41
	Vriesea ensiformis	120
	Vriesea erythrodactylon	6
	Vriesea flammea	47
	Vriesea friburgensis	71

	Vriesea gigantea	36
	Vriesea incurvata	72
	Vriesea philippocoburgii	61
	Vriesea psittacina	65
	Vriesea rodigasiana	5
	Vriesea tijucana	20
	Vriesea vagans	58
Cactaceae	*Hatiora salicornioides*	5
	Rhipsalis campos-portoana	17
	Rhipsalis elliptica	4
	Rhipsalis juengeri	5
	Rhipsalis pachyptera	17
	Rhipsalis teres	105
Gesneriaceae	*Codonanthe devosiana*	9
	Codonanthe gracilis	2
	Nematanthus australis	34
	Nematanthus corticola	21
	Nematanthus fissus	20
	Nematanthus tessmannii	54
Onagraceae	*Fuchsia regia*	4
Orchidaceae	*Cattleya coccinea*	34
	Cattleya forbesii	2
	Gomesa ranifera	10
	Prosthechea fausta	1
Piperaceae	*Peperomia mandioccana*	1
	Peperomia tetraphylla	219
Polypodiaceae	*Alansmia reclinata*	1
	Cochlidium punctatum	2
	Pleopeltis pleopeltifolia	1

Supplementary Material 9 - To 390 Conservation Units that obtained occurrence of species and the number of species in each one of them.

Conservation Units	**Nº of Species**
Environmental Protection Area Cajamar	1
Environmental Protection Area of Várzea Country Club	1
Environmental Protection Area Bacia of Paraíba of Sul	10
Environmental Protection Area Bororé-Colônia	9

Environmental Protection Area Cabreúva	1
Environmental Protection Area Cajati	9
Environmental Protection Area Campos Do Jordão	2
Environmental Protection Area of Bacia Do Rio Dos Frades	5
Environmental Protection Area of Bacia Do Rio Macacu	4
Environmental Protection Area of Bacia Do Rio Slo Jo-O - Mico Ledo	4
Environmental Protection Area of Pedra Branca	6
Environmental Protection Area of Serra of Capoeira Grande	1
Environmental Protection Area of Serra De Sapiatiba	3
Environmental Protection Area of Serra Dos Pretos Forros	2
Environmental Protection Area ofs Brisas	1
Environmental Protection Area of Engenheiro Passos Apaep	1
Environmental Protection Area of Gericinó/Mendanha	4
Environmental Protection Area of Macaé of Cima	4
Environmental Protection Area of Massambaba	2
Environmental Protection Area of Petrópolis	5
Environmental Protection Area of Sepetiba II	1
Environmental Protection Area of Bairro Da Freguesia	1
Environmental Protection Area of Banhado Grande	1
Environmental Protection Area of Brilhante	17
Environmental Protection Area of Iguaçu	5

Environmental Protection Area of Iraí	10
Environmental Protection Area of Morro of SílVIo	1
Environmental Protection Area of Morro of Valqueire	2
Environmental Protection Area of Passaúna	4
Environmental Protection Area of Pequeno	12
Environmental Protection Area of Pico Do Goiapaba-Açu	1
Environmental Protection Area of Rio Guandu	3
Environmental Protection Area of Rio Verde	3
Environmental Protection Area of Sana	4
Environmental Protection Area Estadual of Escarpa Devoniana	4
Environmental Protection Area Estadual of Serra of Esperança	1
Environmental Protection Area Estadual of Piraquara	14
Environmental Protection Area Estadual Mestre Álvaro	1
Environmental Protection Area Fernando Dias	1
Environmental Protection Area Itupararanga	4
Environmental Protection Area Jundiaí	1
Environmental Protection Area Municipal Do Capivari-Monos	8
Environmental Protection Area Municipal of Monte Mochuara	2
Environmental Protection Area Municipal Serra Do Sambê	4
Environmental Protection Area Parque E Fazenda Do Carmo	2
Environmental Protection Area Piracicaba Juqueri-Mirim Área II	1

Environmental Protection Area Planalto Do Turvo	9
Environmental Protection Area Quilombos Do Mundo Ribeira	7
Environmental Protection Area Rio Do Colégio	1
Environmental Protection Area Rio Pardinho E Rio Vermelho	12
Environmental Protection Area Rota Do Sol	9
Environmental Protection Area Sapucaí Mirim	1
Environmental Protection Area Serra Da Mantiqueira	4
Environmental Protection Area Serra Do Mar	13
Environmental Protection Area Serra Dona Francisca	23
Environmental Protection Area Silveiras	1
Environmental Protection Area Sistema Cantareira	1
Environmental Protection Area Sul-Rmbh	2
Environmental Protection Area Surur	1
Environmental Protection Area Várzea Do Rio Tietê	3
Area of Relevant Ecological Interest Corredor Ecológico Lagoa Encantada / Serra Do Conduru	14
Area of Relevant Ecological Interest of Serra Do Tigre	1
Area of Relevant Ecological Interest De São Domingos	1
Area of Relevant Ecological Interest of Morro of Iririú	18
Area of Relevant Ecological Interest Ilha Ameixal	14
Area of Relevant Ecological Interest Serra Da Abelha	5
Ecological Station	4
Ecological Station Bananal	3
Ecological Station Chasas	12
Ecological Station of Aracuri-Esmeralda	1
Ecological Station of Mata Preta	1

Ecological Station of Guaraguaçu	11
Ecological Station Estadual Wenceslau Guimarães	1
Ecological Station Fernandes Pinheiro	1
Ecological Station Rio Dos Touros	1
Ecological Strait of Itapeti	2
Ecological Strait of Xituo	2
State Forest Córrego Da Biquinha	1
State Forest of Passa ofis	1
National Forest of Açungui	1
National Forest of Canela	2
National Forest of Caçador	1
National Forest of Goytacazes	1
National Forest of Ibirama	2
National Forest of Irati	1
National Forest of Passo Fundo	1
National Forest of Pira Do Sul	2
National Forest of São Francisco de Paula	2
National Forest of Três Barras	1
State Natural Monument Da Pedra Do Baa	1
State Natural Monument Da Pedra Grande	1
State Natural Monument Serra Das Torres	2
Municipal Natural Monument Da Pedra Do Colégio	1
Municipal Natural Monument Do Pico Do Itaguaré	2
State Park Carlos Botelho	3
State Park Caverna Do Diabo	11
State Park Cunhambebe	11
State Park Da Campina Do Encantado	12
State Park Da Cantareira	1
State Park Da Costa Do Sol	3
State Park Da Ilha Grande	12
State Park Da Pedra Selada	1
State Park Da Serra Da Esperança	1
State Park Da Serra Do Conduru	11
State Park Da Serra Furada	10

State Park Das Araucária	1
State Park Das Fontes Do Ipiranga	3
State Park De Campos Do Jordão	2
State Park De Espigão Alto	1
State Park De Itaberaba	1
State Park De Itapetinga	1
State Park De Palmas	1
State Park De Santa Clara	1
State Park Do Alto Do Ribeira	3
State Park Do Boguaçu	19
State Park Do Caxambu	1
State Park Do Desengano	3
State Park Do Forno Grande	2
State Park Do Ibitiriá	1
State Park Do Itacolomi	3
State Park Do Jaraguá	1
State Park Do Jurupará	7
State Park Do Mendanha	4
State Park Do Rio Turvo	17
State Park Do Tainhas	2
State Park Dos Mananciais De Campos Do Jordão	1
State Park Intervales	6
State Park Lagamar De Cananéia	19
State Park Nascentes Do Paranapanema	3
State Park Ponta Da Tulha	16
State Park Restinga De Bertioga	10
State Park Rio Canoas	1
State Park Serra Do Brigadeiro	5
State Park Serra Do Papagaio	3
State Park Vale Do C Do	1
Municipal Natural Park Da Boa Esperança	11
National Park Da Serra Das Lontras	4

National Park Da Serra Do Gandarela	1
National Park Da Serra Do Itajaí	16
National Park Da Serra Dos Órgãos	5
National Park Da Serra Geral	14
National Park Da Tijuca	5
National Park Das Araucária	1
National Park De Aparados Da Serra	10
National Park De Caparaó	2
National Park De Saint-Hilaire/Lange	24
National Park De São Joaquim	15
National Park Do Descobrimento	5
National Park Do Iguaçu	1
National Park Do Itatiaia	3
National Park Do Monte Pascoal	13
National Park Dos Campos Gerais	1
National Park Guaricana	22
National Park Pau Brasil	12
Municipal Natural Park Bororo	6
Municipal Natural Park Caixa D'água	3
Municipal Natural Park Carijós	13
Municipal Natural Park Chapéu Das Águas	6
Municipal Natural Park Da Caieira	13
Municipal Natural Park Da Cratera De Colônia	7
Municipal Natural Park Da Mata Atlântica Aldeense	2
Municipal Natural Park Da Serra Da Capoeira Grande	1
Municipal Natural Park Da Serra Do Mendanha	3
Municipal Natural Park De Domingos Martins	1
Municipal Natural Park De Navegantes	12
Municipal Natural Park De Petrópolis	1
Municipal Natural Park De Sertão	1
Municipal Natural Park Do Aricanga Waldemar Devens	1
Municipal Natural Park Do Jardim Do Carmo	1
Municipal Natural Park Do Monte Mochuara	1
Municipal Natural Park Do Morro Da Cruz	11

Municipal Natural Park Estoril -Virgílio Simionato	9
Municipal Natural Park Fazenda Do Carmo	2
Municipal Natural Park Fazenda Do Viegas	2
Municipal Natural Park Freymund Germer	9
Municipal Natural Park Ilha Das Capivaras/Sibara	10
Municipal Natural Park Itaim	6
Municipal Natural Park Jaceguava	4
Municipal Natural Park Montanhas De Teresópolis	3
Municipal Natural Park Morada Dos Corr As	2
Municipal Natural Park Morro Do Baú	13
Municipal Natural Park Morro Do Cmu	10
Municipal Natural Park Morro Dos Stinghen	9
Municipal Natural Park Nascentes De Paranapiacaba	7
Municipal Natural Park Três Coqueiros	2
Municipal Natural Park Varginha	6
Municipal Natural Park Verde Vale	3
Municipal Natural Park Vista Alegre	4
Refuge	1
Refuge	1
Biological Reserve Augusto Ruschi	1
Biological Reserve Bom Jesus	19
Biological Reserve Da Serra Geral	9
Biological Reserve Das Araucária	1
Biological Reserve De Araras	2
Biological Reserve De Poço Das Antas	3
Biological Reserve De Sooretama	1
Biological Reserve Do Carrego Grande	1
Biological Reserve Do Tinguá	2
Biological Reserve Estadual Da Praia Do Sul	11
Biological Reserve Estadual Do Aguaí	16
Biological Reserve Estadual Do Sassafras	9
Biological Reserve Estadual Mata Paludosa	6
Biological Reserve Unibo	3
Sustainable Development Reserve Barreiro Anhemas	6
Sustainable Development Reserve Do Despraiado	13

Sustainable Development Reserve Dos Pinheirinhos	10
Sustainable Development Reserve Lavras	3
Sustainable Development Reserve Quilombos De Barra Do Turvo	10
Reserva Do Jacu	1
Reserva Extrativista Ilha Do Tumba	13
Reserva Particular De Patrimônio Natural Rancho Letty	2
Reserva Particular Do Natural Mutinga	1
Private Natural Heritage Reserve Tayne	1
Private Natural Heritage Reserve Águas Vertentes	1
Private Natural Heritage Reserve Alto Da Mantiqueira	1
Private Natural Heritage Reserve Alto Gururu	2
Private Natural Heritage Reserve Alvorada Do Itaverá	1
Private Natural Heritage Reserve Bacchus	2
Private Natural Heritage Reserve Bei Cantoni	1
Private Natural Heritage Reserve Bicho Preguiçaa	2
Private Natural Heritage Reserve Boa Esperança	1
Private Natural Heritage Reserve Boa União	14
Private Natural Heritage Reserve Bom Sossego II	10
Private Natural Heritage Reserve Bom Sossego III	11
Private Natural Heritage Reserve Bosque De Canela	2
Private Natural Heritage Reserve Bosque Dos Samambaia Us - Resgate V	1
Private Natural Heritage Reserve Botujuru-Serra Do Itapety	2
Private Natural Heritage Reserve Bozi	2
Private Natural Heritage Reserve Cachoeirinha	1
Private Natural Heritage Reserve Cahy	5
Private Natural Heritage Reserve Canto Da Araponga	4
Private Natural Heritage Reserve Capão Redondo	1
Private Natural Heritage Reserve Carpi	2

Private Natural Heritage Reserve Chácara Edith	10
Private Natural Heritage Reserve Cisne Branco	3
Private Natural Heritage Reserve Corredeiras Do Rio Itajaí I	2
Private Natural Heritage Reserve Corredeiras Do Rio Itajaí II	2
Private Natural Heritage Reserve Corumbau	2
Private Natural Heritage Reserve Corumbau I	2
Private Natural Heritage Reserve Corvo Branco	9
Private Natural Heritage Reserve Cruz Preta	2
Private Natural Heritage Reserve Curucaca 1	2
Private Natural Heritage Reserve Curucaca 2	2
Private Natural Heritage Reserve Curucaca 3	2
Private Natural Heritage Reserve Curucaca 4	2
Private Natural Heritage Reserve da Cabeceira do Cafôfo	2
Private Natural Heritage Reserve Da Mata	11
Private Natural Heritage Reserve Das Araucárias Gigantes	1
Private Natural Heritage Reserve Demuner	2
Private Natural Heritage Reserve Dois Irmãos	1
Private Natural Heritage Reserve Duas Pedras	1
Private Natural Heritage Reserve Emílio Einsfeld Filho	1
Private Natural Heritage Reserve Emílio Fiorentino Battistella	8
Private Natural Heritage Reserve Engelhardt	2

Private Natural Heritage Reserve Espinita	4
Private Natural Heritage Reserve Estadual Das Cascatas	6
Private Natural Heritage Reserve Estadual Pedra Branca	9
Private Natural Heritage Reserve Estadual Rio Da Prata Bugio	9
Private Natural Heritage Reserve Estância Rio Do Ouro	1
Private Natural Heritage Reserve Fargo	3
Private Natural Heritage Reserve Fazenda Figueira	11
Private Natural Heritage Reserve Fazenda Minas Gerais	1
Private Natural Heritage Reserve Fazenda Sambaiba	1
Private Natural Heritage Reserve Fazenda Santa Terezinha	1
Private Natural Heritage Reserve Fazenda Serra Do Ribeirão	1
Private Natural Heritage Reserve Fazenda Suspiro	1
Private Natural Heritage Reserve Fernandes I, II E III	2
Private Natural Heritage Reserve Flor Do Norte I	6
Private Natural Heritage Reserve Flor Do Norte II	5
Private Natural Heritage Reserve Grande Floresta Das Araucárias	9
Private Natural Heritage Reserve Graziela Maciel Barroso	1
Private Natural Heritage Reserve Grutinha	6
Private Natural Heritage Reserve Guanandi	9
Private Natural Heritage Reserve Helico	10
Private Natural Heritage Reserve Itacolomy	2
Private Natural Heritage Reserve Jacuba Velha	9

Private Natural Heritage Reserve Jardim Das Del	2
Private Natural Heritage Reserve Jatobá	3
Private Natural Heritage Reserve Kahena	1
Private Natural Heritage Reserve Koehler	2
Private Natural Heritage Reserve Lembran	3
Private Natural Heritage Reserve Lembran	3
Private Natural Heritage Reserve Lençóis	1
Private Natural Heritage Reserve Macaco Barbado	1
Private Natural Heritage Reserve Mahayana	4
Private Natural Heritage Reserve Marie Camille	1
Private Natural Heritage Reserve Mata Da Serra	1
Private Natural Heritage Reserve Mata Do Professor Baptista	8
Private Natural Heritage Reserve Mata Dos Jacus – Resgate VI	1
Private Natural Heritage Reserve Matumbo	3
Private Natural Heritage Reserve Meu Cantinho	1
Private Natural Heritage Reserve Mico Leão Dourado	2
Private Natural Heritage Reserve Mutum Preto	1
Private Natural Heritage Reserve Neiva, Patrícia, Cláudia e Alexandra	3
Private Natural Heritage Reserve Nossa Senhora Aparecida	3
Private Natural Heritage Reserve Odir Zanelatto	2
Private Natural Heritage Reserve Oiutrem	2
Private Natural Heritage Reserve Olho D'água	1

Private Natural Heritage Reserve Palmares	1
Private Natural Heritage Reserve Panapaná	2
Private Natural Heritage Reserve Paraiso I	6
Private Natural Heritage Reserve Passarim	16
Private Natural Heritage Reserve Passarim II	12
Private Natural Heritage Reserve Pau A Pique	1
Private Natural Heritage Reserve Pedra Da Águia	7
Private Natural Heritage Reserve Pedra Da Mina	1
Private Natural Heritage Reserve Pedra Das Flores	2
Private Natural Heritage Reserve Perna Do Pirata	10
Private Natural Heritage Reserve Pianissoli	2
Private Natural Heritage Reserve Ponte Do Baião	2
Private Natural Heritage Reserve Portal Das Nascentes	9
Private Natural Heritage Reserve Portal Das Nascentes II	9
Private Natural Heritage Reserve Porto Franco	4
Private Natural Heritage Reserve Pousada Campos Da Bocaina	1
Private Natural Heritage Reserve Prima Luna	13
Private Natural Heritage Reserve Primavera	2
Private Natural Heritage Reserve Primavera I	2
Private Natural Heritage Reserve Quero-Quero	1
Private Natural Heritage Reserve Rabicho Da Serra	1
Private Natural Heritage Reserve Raso Do Mandi	1
Private Natural Heritage Reserve Recanto Das Antas	1
Private Natural Heritage Reserve Refuge Gio Do Macuco	2

Private Natural Heritage Reserve Refuge Do Bugio	1
Private Natural Heritage Reserve Réguas Claras	2
Private Natural Heritage Reserve Renascer	10
Private Natural Heritage Reserve Reserva Bianca	6
Private Natural Heritage Reserve Reserva Bohemia	5
Private Natural Heritage Reserve Reserva Córrego Vermelho	2
Private Natural Heritage Reserve Reserva Do Sossego I	1
Private Natural Heritage Reserve Reserva Do Sossego II	1
Private Natural Heritage Reserve Reserva Ecológica Chefe Rosa.	4
Private Natural Heritage Reserve Reserva Hinayana	4
Private Natural Heritage Reserve Reserva Leão Da Montanha	6
Private Natural Heritage Reserve Reserva Lukavec	5
Private Natural Heritage Reserve Reserva Maragato	1
Private Natural Heritage Reserve Reserva Mariana	6
Private Natural Heritage Reserve Reserva Maria Vicentini Lopes	10
Private Natural Heritage Reserve Reserva Mato Grosso II	3
Private Natural Heritage Reserve Reserva Mestre Bonina	10
Private Natural Heritage Reserve Reserva Rio Das Furnas	9
Private Natural Heritage Reserve Reserva São José	11
Private Natural Heritage Reserve Reserva Terra Vista I	12
Private Natural Heritage Reserve Reserva Terravista I	13
Private Natural Heritage Reserve Reserva Vitória Primavera	5

Private Natural Heritage Reserve Retiro Tun	11
Private Natural Heritage Reserve Riacho Das Pedras	2
Private Natural Heritage Reserve Rio Capitão	10
Private Natural Heritage Reserve Rio Das Furnas II	8
Private Natural Heritage Reserve Rio Das Lontras	12
Private Natural Heritage Reserve Rio Do Brasil I	13
Private Natural Heritage Reserve Rio Do Brasil II	14
Private Natural Heritage Reserve Rio Do Brasil III	14
Private Natural Heritage Reserve Rio Do Brasil IV	13
Private Natural Heritage Reserve Rio Do Brasil V	13
Private Natural Heritage Reserve Rio Fundo	2
Private Natural Heritage Reserve Rio Vermelho	1
Private Natural Heritage Reserve Rogerio Marinho	5
Private Natural Heritage Reserve Santa Ana I	10
Private Natural Heritage Reserve Santa Ana II	11
Private Natural Heritage Reserve Santa Dulce De Cima	2
Private Natural Heritage Reserve Santa Maria I	2
Private Natural Heritage Reserve Santa Maria II	2
Private Natural Heritage Reserve Santa Maria III	2
Private Natural Heritage Reserve Santa Rita De Cássia	1
Private Natural Heritage Reserve Santo Antônio	1
Private Natural Heritage Reserve Santuário Rã-Bugio II	8
Private Natural Heritage Reserve Santuário Rã-Bugio I	8
Private Natural Heritage Reserve São Judas Tadeu	5
Private Natural Heritage Reserve Serra Do Itatins	14

Private Natural Heritage Reserve Serra Do Lucindo	1
Private Natural Heritage Reserve Serra Grande	1
Private Natural Heritage Reserve São José	1
Private Natural Heritage Reserve Sítio Azul	2
Private Natural Heritage Reserve Sítio Da Luz	2
Private Natural Heritage Reserve Sítio Da Luz	2
Private Natural Heritage Reserve Sítio Serra Negra	2
Private Natural Heritage Reserve Taipa Rio Do Couro	1
Private Natural Heritage Reserve Taquaral	1
Private Natural Heritage Reserve Terra Do Sol E Da Lua	2
Private Natural Heritage Reserve Três Morenas	11
Private Natural Heritage Reserve Três Morros	3
Private Natural Heritage Reserve Triângulo	2
Private Natural Heritage Reserve Ur	1
Private Natural Heritage Reserve Vale Das Arapongas - Resgate II	1
Private Natural Heritage Reserve Vale Das Pedras	4
Private Natural Heritage Reserve Vale Do Cantassurí	10
Private Natural Heritage Reserve Vale Do Paraíso	2
Private Natural Heritage Reserve Vale Do Sol	1
Private Natural Heritage Reserve Verbicaro	1