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POLINIZADORES E OS SISTEMAS DE POLINIZAÇÃO NO *CAMPO RUPESTRE*: REVISÃO E IMPLICAÇÕES PARA A CONSERVAÇÃO DE SERVIÇOS ECOSSISTÊMICOS

BEATRIZ LOPES MONTEIRO

Dissertação apresentada ao Instituto de Biociências do Câmpus de Rio Claro, Universidade Estadual Paulista, como parte dos requisitos para obtenção do título de Mestre em Ciências Biológicas (Biologia Vegetal).

Rio Claro – SP
2020

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Orientadora: Profª Drª Leonor Patricia Cerdeira Morellato

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“Vamos con el polen en el viento

Estamos vivos porque estamos en movimiento”

-Jorge Drexler

RESUMO

Ações antrópicas têm mudado os ecossistemas de forma extensiva causando o declínio da biodiversidade e gerando impactos a um importante serviço ecossistêmico, a polinização. A interação entre as espécies no processo de polinização pode ser interpretada como uma rede de interações. Dessa forma, o uso desta abordagem permite ampliar o entendimento das dinâmicas de comunidade e avaliar prioridades de conservação de acordo com o papel das espécies. O *campo rupestre* é uma vegetação distribuída em mosaicos associada a elevadas altitudes e que concentra alto endemismo e biodiversidade. É uma vegetação descrita como um OCBIL (Old, Climatically-Buffered Infertile Landscape), ou um sistema antigo, tamponado climaticamente, numa paisagem infértil ou empobrecida, o que explicaria os sua alta biodiversidade, endemismo e traços funcionais. Com isso, encontramos uma flora com populações localmente restritas, sendo previsto, de acordo com a teoria OCBIL, que voadores que alçam voos de maiores distâncias são essenciais para conectar a paisagem promovendo o fluxo gênico. Por ser uma vegetação diversa, mas também ameaçada, a partir do levantamento de seus polinizadores, caracterização dos sistemas de polinização e distribuição na paisagem, buscamos testar a hipótese proposta para os OCBILs de que polinizadores de longa distância seriam os principais vetores de polinização. Em seguida, com os dados de interação de uma comunidade de *campo rupestre*, buscamos caracterizar como esta rede de interações está estruturada, o papel das espécies de acordo com a sua posição na rede, buscando subsidiar estratégias de conservação. Reunimos 413 espécies de polinizadores, sendo a maioria abelhas (220 espécies) e moscas (69). Entre as 636 espécies de plantas avaliadas encontramos que o principal sistema de polinização é por abelhas (56%), seguido pelo vento (14%) e por beija-flores (10%). Vimos que a polinização pelo vento, abelhas pequenas e moscas aumenta com a altitude, enquanto a polinização por abelhas grandes e beija-flores não se altera na altitude. Os sistemas de polinização relacionados aos voadores de longa distância também são mais frequentes nos afloramentos rochosos, que é a tipologia de vegetação mais isolada. Em relação a rede de interações, encontramos uma meta rede aninhada e modular. Porém, esta modularidade é perdida ao simularmos a retirada da abelha exótica *Apis mellifera*. Abelhas grandes ocupam papéis importantes na rede, com destaque para a nativa *Bombus pauloensis*. Plantas polinizadas por abelhas, mas que são amplamente visitadas por outros grupos taxonômicos, também têm papéis centrais na rede. Nossos resultados corroboram a hipótese de OCBIL ao confirmarmos a importância de sistemas de polinização relacionados a voadores de longa distância no gradiente de altitude e sua prevalência nos afloramentos rochosos do *campo rupestre*. Além de

analisar a importância dos principais sistemas de polinização do *campo rupestre*, apresentamos o papel das plantas e polinizadores para a manutenção da estrutura da rede de interações, considerando o seu grau de ameaça e endemismo. Estes resultados, juntamente com a base de dados inédita de interações entre plantas e polinizadores, concetram informações chave para o conhecimento da evolução, dinâmica das comunidades e para a definição de estratégias de conservação da biodiversidade e serviços ecossistêmicos do *campo rupestre*.

Palavras-chave: abelhas grandes – anemofilia – afloramento rochoso – beija-flores – Cadeia do Espinhaço - conservação – OCBIL — Serra do Cipó – síndromes de polinização

ABSTRACT

Anthropogenic drivers have been changing ecosystems extensively causing loss of biodiversity and impacting the provision of the ecosystem services provided by pollination. Plant-pollinator interactions can be analyzed as mutualistic networks. Therefore, this approach allows to broaden the understanding of community dynamics and evaluate conservation priorities according to species's role in the network. The *campo rupestre* is an archipelago-like vegetation associated with high altitudes in Brazil and concentrates high species endemism and biodiversity. It is considered an OCBIL (Old, Climatically Buffered Infertile Landscape), this theory suggests that its ancient origin and infertile soils, both of which acting as the main environmental filters buffered by a mild climate explains its high biodiversity, endemism and functional traits. Thus, according to the theory, the *campo rupestre* flora with locally restricted populations, has dependence on pollinators capable to fly longer distances to act as connectors of the landscape. Considering the high species diversity of the *campo rupestre* along with the threats by anthropic factors, here we gathered information on *campo rupestre*'s pollinators and characterized the pollination system's composition and distribution in the landscape. We also tested the hypothesis proponed for OCBILs long-range flyers act as important vector for pollination. Then, with the interaction data of a *campo rupestre* community, we characterized how the network of interactions is structured and the role of species for the maintenance of the network structure, seeking for conservation strategies. We surveyed 413 pollinator species, mostly bees (220 species) and flies (69). Among 636 plant species surveyed, the bee pollination system was dominant (56%), followed by wind (14%), and hummingbird (10%). Wind, small-bee and fly pollination systems increased with altitude, while large-bee and hummingbird long-distance systems remained unchanged across altitudes. Long-distance systems were more frequent in highly isolated rocky outcrops. Regarding the pollination network we found both, nested and modular patterns, but when excluding the exotic species *Apis mellifera*, we found no significant modularity. Large bees occupy important roles in the network, highlighting the bumblebee *Bombus pauloensis*, as a network hub, and small insects acting as connectors. Species with the bee pollination system but visited by distincts functional groups of pollinators were the main plant species structuring the network. Our findings unravel the pollination systems across the *campo rupestre*, corroborating the OCBIL long-distance pollination prevalence in isolated vegetations, and its persistence across altitudinal gradients. This study provides an evaluation of the importance of species according to their functional role for the persistence of a threatened ecosystem, especially those that are already classified as near

threatened and endemic. The extensive database on plant-pollinator interactions here presented holds key information for the conservation and knowledge of ecosystem services of *campo rupestre*.

Keywords: anemophily - conservation – Espinhaço Range - hummingbirds - large bees - OCBIL - pollination syndrome - rocky outcrops - rupestrian grassland - Serra do Cipó

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INTRODUÇÃO GERAL

A importância da polinização

As Angiospermas são as plantas que possuem flor e compõem um sexto das espécies descritas no mundo (Christenhusz & Byng, 2016). Como parte do processo reprodutivo deste grupo, é necessário que, na maioria dos casos, ocorra a transferência do grão de pólen da antera para o estigma da mesma ou outra flor e este processo é conhecido como polinização. A transferência do pólen pode ser realizada por vetores abióticos, como o vento e a água ou por vetores bióticos, como diferentes grupos de animais, principalmente por uma grande diversidade de insetos (Ollerton et al., 2011; Wardhaugh, 2015; Ollerton, 2017). Estima-se que 87% de todas as Angiospermas dependam de vetores bióticos para a realização da polinização (Ollerton et al., 2011). Este processo é reconhecido um dos principais mutualismos terrestres (Herrera & Pellmyr, 2002) já que esta é uma relação benéfica para as espécies que interagem pois os animais utilizam recursos presentes nas flores e consequentemente transportam os grãos de pólen realizando parte essencial do processo reprodutivo deste grupo de plantas. A interação entre as plantas e animais pelo processo de polinização é apontada como uma das principais causas para a diversificação de grandes grupos de Angiospermas (Johnson, 2006; Vamosi & Vamosi ,2010; van der Van der Niet et al., 2014; Ollerton et al. 2019), sendo crucial para o estabelecimento de novos indivíduos, considerado um processo crítico para a manutenção da diversidade biológica (Kremen et al., 2007; Potts et al., 2010; Ollerton, 2017). Dessa forma, estudos sobre relações mutualísticas entre plantas e animais mostram-se fundamentais para o entendimento e manutenção da biodiversidade (Bascompte & Jordano, 2007). Dados de interação entre as espécies apresentam grande relevância na caracterização de uma comunidade e podem indicar, ao longo do tempo, as alterações sofridas pelas mudanças globais, pois estas interações são sensíveis a fenologia, comportamento, fisiologia e abundância relativa de diversas espécies (Tylianakis et al., 2008).

A partir de observações naturalísticas das plantas e seus polinizadores, foram descritas as síndromes de polinização (Faegri & Van der Pijl, 1979). Dentro desta proposta, um conjunto de atributos florais específicos - como cor, formato, tamanho, odor, presença ou ausência de nectário, podem ser relacionadas a um grupo taxonômico de agentes polinizadores. Entretanto, estudos posteriores (Waser et al., 1996; Ollerton et al., 2009) desafiam essa proposta e apontam que grande fração das Angiospermas apresentariam conjuntos de atributos que não se

encaixariam em nenhuma das síndromes sendo consideradas “generalistas” por serem amplamente visitadas por distintos grupos taxonômicos. Dessa forma, o conceito de síndromes demonstraria uma tendência de relacionar as flores apenas com polinizadores específicos, sendo que esta seria uma característica de poucos grupos de plantas e não uma tendência encontrada na natureza. Por outro lado, Rosas-Guerrero et al. (2014), a partir da reunião de todas as publicações que contam com a eficiência dos polinizadores e atributos florais, constataram que os conjuntos de características florais, de acordo com a síndrome de polinização, possuem sim uma força preditiva, sustentando a proposta ou hipótese das síndromes de polinização (mas ver Ollerton et al., 2015). Esta discussão sugere que prever polinizadores apenas a partir das características morfológicas pode apresentar um alto risco de erro. Dessa forma, para que seja possível definir o principal grupo de polinizadores de cada espécie de planta são essenciais a observação e validação das relações mutualísticas em campo, e a realização dos testes de eficiência de polinização para cada visitante floral, além de cautela ao realizar a classificação da polinização das flores apenas conforme as síndromes de polinização.

A polinização também é considerada um serviço ecossistêmico, que são funções dos ecossistemas capazes de prover benefícios diretos e/ou indiretos para populações humanas (Costanza et al., 1997; Wolowski et al., 2019). Pelo serviço da polinização, obtemos diretamente alimento e, indiretamente, diversos recursos indispensáveis como madeira, fibras, remédios, além de ser fundamental para a manutenção e restauração de comunidades locais a partir da reprodução das espécies nativas (Kremen et al., 2007; Joly et al., 2019). Porém, nos últimos anos, ações antrópicas têm mudado os ecossistemas de forma rápida e extensiva se comparada com qualquer outro período da história humana, por causa de grandes demandas de consumo da crescente população (MEA, 2005), ocasionando a fragmentação e perda de habitat que são os principais fatores relacionados a perda de biodiversidade (Mitchell et al., 2015a; Mitchell et al., 2015b; Joly et al., 2019), o que nos leva a atual crise de extinções (Barnosky et al., 2011). Esta perda de biodiversidade afeta a provisão de serviços ecossistêmicos, principalmente ao levarmos em consideração o declínio de populações de polinizadores que são necessários para a segurança alimentar no mundo e a manutenção das áreas naturais, afetando o bem estar humano, assim como a sobrevivência no planeta (Biesmeijer et al., 2006; Potts et al., 2010; Ollerton, 2017; Joly et al., 2019; Wolowski et al., 2019).

O *campo rupestre*: uma vegetação ameaçada

Estima-se que o Brasil concentra uma biodiversidade de cerca de 42 mil espécies vegetais vasculares (Lewinsohn & Prado, 2005). Em apenas 0,78% do território brasileiro, que é ocupado por uma vegetação específica denominada *campo rupestre*, é possível encontrar cerca de 15% das plantas vasculares estimadas para o Brasil (Silveira et al., 2016), sendo também considerado um importante centro de endemismos (Silveira et al., 2016; Colli-Silva et al., 2019). A alta diversidade encontrada em *campo rupestre* pode ser explicada pelo acúmulo de espécies associada a baixas taxas de extinção durante o longo período de evolução que sucedeu a orogênese da Cadeia do Espinhaço (Hopper, 2009; Vieira et al., 2015; Vasconcelos et al., 2020).

O *campo rupestre* é definido como um complexo vegetacional de topo de montanha em áreas com altitude maior que 900 metros, ocupando trechos de litossolo associados a afloramentos de quartzo e arenito (Alves et al., 2014; Silveira et al., 2016; Colli-Silva et al., 2019). Esta vegetação é encontrada de forma descontínua nas áreas mais elevadas da Cadeia do Espinhaço e Chapada dos Veadeiros (Colli-Silva et al., 2019). Porém, este importante centro de biodiversidade e endemismo vem sofrendo impactos pela urbanização desenfreada, mineração intensa, incêndios não controlados, invasões biológicas, coleta descontrolada de plantas ornamentais, turismo não sustentável e a falta de regularização ambiental para áreas não florestais (Veldman et al., 2015; Morellato & Silveira, 2018; Monteiro et al., 2020). Neste contexto, a porção sudeste da Cadeia do Espinhaço, que inclui o Parque Nacional da Serra do Cipó, onde se insere a área do presente estudo, foi reconhecida como Reserva da Biosfera pela UNESCO em 2005 (Fernandes, 2016).

Sua composição florística é caracterizada por uma vegetação montanhosa herbácea-arbustiva, com espécies adaptadas a regimes de fogo. Por ser considerada uma vegetação Neotropical Azonal (i.e. quando o desenvolvimento da comunidade vegetal é influenciada mais por questões edáficas do que climáticas), encontramos no *campo rupestre* diferentes tipologias de vegetação associadas às diferentes composições de solos, sendo eles: afloramentos rochosos, campos arenosos, campos pedregosos e campos úmidos (Alves et al., 2014; Silveira et al., 2016, Mattos et al. 2019). Também é possível encontrar vegetação transicional de cerrado, caatinga e floresta estacional, matas de galeria e ilhas ou encraves florestais localizados no topo das montanhas (Silveira et al., 2016; Coelho et al., 2016; 2018). Dessa forma, esta vegetação tem a conformação considerada como um "arquipélago continental", onde é possível encontrar

populações de plantas localmente restritas e associadas as diferentes tipologias de vegetação (Vasconcelos et al., 2020).

Silveira et al. (2016) descreve o *campo rupestre* como uma OCBIL Neotropical (Old Climatically-Buffered Infertile Landscapes) com o intuito de compará-la a outras poucas vegetações do mundo já consideradas nessa categoria, contribuindo para compreensão de padrões ecológicos globais. Esta classificação ressalta a importância e fragilidade deste sistema em face aos distúrbios do Antropoceno, e a necessidade de estratégias de conservação. As predições de uma OCBIL citadas por Hopper (2009) e que podem ser validadas no *campo rupestre* são: 1. Predominância de espécies com reduzido poder de dispersão, alto endemismo e raridade; 2. Predominância de linhagens filogenéticas antigas; 3. Estratégias para a conservação da heterozigosidade devido as populações pequenas e restritas; 4. Adaptações associadas à manutenção e absorção de recursos e 5. Baixa resiliência à distúrbios antrópicos. Pela baixa capacidade de dispersão nesta formação, com populações de plantas restritas espacialmente no mosaico de vegetação e predominância de dispersão abióticas de suas sementes (Guerra et al., 2016), a polinização por agentes bióticos, principalmente que alcem maiores distâncias de vôo, propiciaria maiores possibilidades de fluxo gênico e conexão destas populações na paisagem (Giulietti et al., 1997; Silveira et al., 2016; Guerra et al., 2016; Silveira et al., 2020). Além disso, a falta de resiliência e dificuldades para a recuperação da vegetação original prevista para *campo rupestre* (Le Stradic et al., 2014) e outras OCBILs enfatiza a necessidade de estratégias de conservação e monitoramento dessas áreas, especialmente em relação aos vetores de pólen e propágulos que asseguram sua movimentação no ambiente.

Conservação de biodiversidade e redes de interação mutualísticas

O primeiro passo para a conservação da biodiversidade é medi-la e mapeá-la (Margules & Pressey, 2000; Ollerton, 2017), nessa perspectiva, algumas iniciativas são utilizadas para a conservação de áreas naturais, como a realização de listas que catalogam a biodiversidade e a avaliam quanto ao seu risco de ameaça de extinção e a criação de áreas de proteção ambiental (Martinelli & Moraes, 2013; ICMBio, 2018; Flora do Brasil 2020, em construção). A criação da metodologia proposta pela IUCN (“International Union for Conservation of Nature”) para avaliar espécies de acordo com o seu risco de extinção depende do acesso a identificação adequada, registros completos, contagens e modelagens para a distribuição das espécies (IUCN, 2012; Martinelli & Moraes, 2013). A última lista vermelha da flora brasileira, com as

espécies avaliadas de acordo com o seu risco de ameaça, avalia apenas 8% do que é estimado da sua diversidade (Martinelli & Moraes, 2013). As principais dificuldades para a realização desta avaliação, relacionam-se principalmente ao "impedimento taxonômico", que é a dificuldade de acessar informações taxonômicas adequadas e o declínio do número de taxonomistas numa escala global para a realização dessa importante função (Hopkins & Freckleton, 2002; Martinelli & Moraes, 2013). Dessa forma, catalogação de toda a biodiversidade brasileira mostra-se um grande desafio. Assim como a avaliação das espécies quanto ao seu risco de ameaça de extinção, pois é um processo custoso e lento em um país, como o Brasil, que no cenário atual restringe recursos para a produção de ciência.

Em comunidades naturais, as interações entre espécies geralmente seguem padrões não randômicos (Bascompte & Jordano, 2007). Assim, estas interações podem ser interpretadas e estudadas como redes complexas de interação. Bascompte & Jordano (2007) apontam que a rede de interações mutualísticas pode ser considerada a "arquitetura da biodiversidade", onde cada espécie é representada por um nó e a interação entre elas simbolizada por uma conexão entre esses pontos que interagem. O conhecimento da estrutura das redes amplia o entendimento sobre diversidade, dinâmicas de comunidade e permitem acessar probabilidades e a magnitude de cascatas de coextinção (Bascompte & Jordano, 2007). Mais especificamente, a partir das redes de interação de polinização também é possível acessar a resiliência e vulnerabilidade de um sistema (Armbruster, 2017). Nessa perspectiva, muitos estudos utilizam a abordagem de redes com objetivos de poder relacioná-la a conservação da biodiversidade (e.g. Tylianakis et al., 2010; Kaiser-Bunbury & Blüthgen, 2015; Biella et al., 2017). Essa abordagem se mostra adequada ao monitorar a comunidade a partir dos cálculos de principais métricas e destacar funcionalmente qual é o papel das espécies dentro da rede de interações, sendo possível criar estratégias de conservação que vão além da contagem de indivíduos (Martín Gonzalez et al., 2010; Kaiser-Bunbury & Blüthgen, 2015). Porém, trabalhos de interações que fornecem informações a respeito da diversidade de interações, muitas vezes são ignorados em levantamentos de biodiversidade (Hagen et al., 2012), por ser um dado de difícil acesso (Tylianakis et al., 2010).

Em áreas de *campo rupestre* não é diferente, pois há poucos estudos que utilizam a abordagem de redes de interação entre plantas e polinizadores a nível de comunidade (Carstensen et al. 2014; 2016; 2018; Guerra et al. 2016, Gustafsson, 2017). Assim como identificamos a falta de uma caracterização dos sistemas de polinização presentes nessa vegetação a partir de observações de interação em campo. Encontramos apenas os trabalhos

como o de Conceição et al., (2007) e Jacobi & Carmo (2011) que realizam a categorização das flores de *campo rupestre* de acordo com a sua síndrome em nível de comunidade. Para maiores detalhes do estado da arte dos estudos sobre a fauna polinizadora da Cadeia do Espinhaço, que inclui áreas de *campo rupestre*, apontamos o trabalho de Queiroz et al. (2019). Estudos a respeito da biologia reprodutiva ou polinização são realizados principalmente para uma ou poucas espécies (e.g. Sazima, 1977; Sazima et al., 1989; Bittencourt Jr & Semir, 2004; Ferreira & Viana, 2010; Soares & Morellato, 2018; Maruyama et al., 2018), ou em relação a grupos específicos de polinizadores como beija-flores (Machado et al., 2007; Guerra et al., 2014; Rodrigues & Rodrigues, 2014). Considerando a alta diversidade, grau de endemismos e de ameaça das espécies do *campo rupestre*, estes dados são fundamentais para a ampliação do entendimento das dinâmicas de comunidade, conservação, manejo e delineamento de estratégias de recuperação.

Dividida em dois capítulos, esta dissertação tem como objetivo principal o levantamento dos polinizadores e sistemas de polinização do *campo rupestre* reunindo dados de observação em campo e levantamento bibliográfico sistemático. No primeiro capítulo, temos como foco descrever os polinizadores e sistemas de polinização de *campo rupestre* e entender a distribuição dos sistemas de polinização de acordo com o gradiente altitudinal e os diferentes tipos vegetacionais, buscando testar a hipótese de que polinizadores que voam maiores distancias, como as abelhas grandes e beija-flores, seriam os principais polinizadores, de acordo com a teoria de OCBIL (Hopper, 2009; Guerra et al., 2016; Silveira et al., 2020). Mais especificamente, no primeiro capitulo perguntamos: 1) quais são os principais polinizadores e sistemas de polinização do *campo rupestre*; 2) como a proporção dos sistemas de polinização se altera ao longo do gradiente altitudinal e das diferentes tipologias de vegetação e 3) qual é a frequência dos sistemas de polinização relacionados aos polinizadores de longas distâncias.

No segundo capítulo, considerando apenas os dados de observações em campo sobre interações realizadas em uma comunidade de *campo rupestre* e a abordagem de redes de interação, buscamos caracterizar o papel das espécies de acordo com a sua posição na rede (Olesen et al., 2007). Assim, ampliamos a nossa perspectiva sobre o funcionamento deste importante ecossistema e subsidiando o planejamento de estratégias de conservação e restauração. Mais especificamente, buscamos responder 1) como as relações entre plantas e polinizadores estão estruturadas de acordo com a abordagem de redes complexas de interações; 2) quais são as principais espécies para a manutenção das interações planta-polinizador; e 3)

qual o grau de endemismo e risco de ameaça de extinção das espécies de plantas e animais que compõe essa rede de interações.

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CAPÍTULO 1.

Manuscrito submetido ao volume especial "A new ecology for old ecosystems" do períodico Biological Journal of the Linnean Society

Pollination of the *campo rupestre*: a test of hypothesis for an ancient tropical mountain vegetation

ABSTRACT

The *campo rupestre* is a Neotropical OCBIL (Old, Climatically Buffered Infertile Landscape), a grassy-shrub vegetation with high species richness and endemism, characterized by rocky outcrops surrounded by grasslands distributed in South American ancient mountain-tops. We tested one OCBILs prediction: the prevalence of long-distance pollinators ensuring crosspollination across the archipelago-like landscapes of *campo rupestre*. We described the pollination systems and tested whether their occurrence differed across vegetation types and altitudinal gradient, focusing on long-distance systems. We performed non-systematic and systematic surveys of plants and plant-pollinator interactions across the altitudinal gradient and vegetation types. We also reviewed the literature on *campo rupestre* pollination and applied an accuracy criterion to infer 11 pollination systems. Bee system was split on large bee (long-distance) and small bee test the prevalence of long-distance pollination systems. We surveyed 413 pollinator species, mostly bees (220) and flies (69). Among 636 plant species inferred, bee pollination system was dominant (56%), followed by wind, and hummingbird. Wind, small-bee and fly pollination systems increased with altitude, and small-bee and wind pollination systems prevailed in grasslands. Large-bee and hummingbird long-distance pollination systems remained unchanged with altitude and were both more frequent in the highly isolated rocky outcrops corroborating the OCBIL theory.

Keywords: Espinhaço Range - long distance pollinators - OCBIL - pollination systems – rocky outcrops - rupestrian grassland - Serra do Cipó - The James

1.INTRODUCTION

Ancient mountains hold some of the world's highest plant species richness and endemism (Hopper, 2009; Hopper et al., 2016). They are also living laboratories for studies, ranging from species evolution and origins of biodiversity to climate change (Körner, 2004; Payne et al., 2017; Silveira et al., 2019). The high diversity in ancient mountains is overall explained by an accumulation of species, coupled to low extinction rates over long periods of evolution, that followed the orogeneses of those mountains (Hopper, 2009; Vieira et al., 2015; Vasconcelos et al., 2020). The *campo rupestre* is a tropical grassy-shrub vegetation, distributed on the eastern mountain tops and highlands of South America, mainly across the Espinhaço Range (Fernandes, 2016; Silveira et al., 2016). One key feature of the *campo rupestre* is the archipelago-like vegetation system, in which the rocky outcrops are surrounded by sandy, stony and wet grasslands, bordered by cerrado on the South, caatinga dry forest on the North and tropical forest on the eastern side (Silveira et al., 2016; Morellato & Silveira, 2018; Vasconcelos et al., 2020). A feature that may sustain its high diversity and the extensive composition of endemic flora (Vasconcelos et al., 2020).

The high species diversity and endemism of this ancient mountain top vegetation system has been explained by the OCBIL theory (Old, Climate-Buffered Infertile Landscape) (Hopper, 2009). OCBIL theory suggests that the *campo rupestre* is shaped by its ancient origin and by its infertile soils, both of which acting as the main environmental filters buffered by a mild climate (Hopper et al., 2016; Silveira et al., 2016). The OCBIL theory has established grounds for testing seven predictions concerning the patterns of species evolution, diversification, and functional traits (Hopper, 2009), further explored by Silveira et al. (2020) in the context of Neotropics, including the *campo rupestre*. However, most predictions still need testing and quantitative assessment, especially for Neotropical OCBILs (Hopper et al., 2016; Silveira et al., 2016; 2020; Morellato & Silveira, 2018).

Here, we explore one important prediction of the OCBIL theory: the prevalence of long-distance pollinators, necessary for assuring cross-pollination across the archipelago-like landscape, and locally restricted plant populations in the context of the *campo rupestre* Neotropical OCBIL (Hopper, 2009). The hypotheses, broadly named as the James effect, sustains that the selection for heterozygosity in small/isolated populations is mainly through long-distance pollination and genomic coalescence (Hopper, 2009; Hopper et al., 2016; Silveira et al., 2020). The James effect can be especially relevant because several species in

campo rupestre present reduced dispersibility, relying on self- or undetected mechanisms for seed dispersal (Morellato, L.P.C. pers. observation; Monteiro et al., 2020), which is another prediction from the OCBIL theory (Hopper, 2009). In this scenario, to avoid inbreeding and ensure genetic variability, small sized populations are expected to select for strategies such as long-distance cross pollination.

We focus our OCBIL hypotheses' evaluation on the presence, relevance and pervasiveness of long-distance pollination, based on the first extensive survey of the biotic and abiotic pollination systems of the *campo rupestre*, an archipelago-like vegetation that dominates the mountain tops of the third largest mountain chain in South America, the Espinhaço Range (Silveira et al., 2016; 2019). Preliminary reports indicate a high proportion of hummingbird pollination on *campo rupestre*, compared to other tropical vegetations (Carstensen et al., 2014; 2016; Guerra et al., 2016; Silveira et al., 2016). However, those previous assessments were based on locally intensive surveys on rocky outcrops and surrounding grasslands (Carstensen et al., 2014; 2016). A general evaluation for the pollination systems across the *campo rupestre* vegetation complex and along the elevational gradient has never been conducted until now. We performed a systematic survey of plant-pollination interactions, a non-systematic plant collection, and a systematic quantitative plant sampling across the altitudinal gradient and vegetation types of Serra do Cipó, South Espinhaço Mountain Range (Carstensen et al., 2014; Gustafsson, 2017; Mattos et al., 2019). We widened our dataset by a systematic review of the *campo rupestre* pollination literature. To assure the reliability of the 11 pollination systems assigned for each species, we established criterions of accuracy for our inferences of each species' pollination systems, a necessary measure to support our predictions (Fenster et al., 2004).

Therefore, we described, for the first time, the *campo rupestre* main pollinators and plant pollination systems over the altitudinal gradient and vegetation types according to our accuracy criterions. Considering the OCBIL theory prediction of long-distance pollination, we asked: how the pollination systems differ along the altitudinal gradient and across vegetation types? Are the long-distance pollination systems evenly distributed through this archipelago-like landscape? Do the long-distance pollination systems prevail on isolated vegetation types? We expected a predominance of bee-pollinated plants among the *campo rupestre* biotic pollination systems (Carstensen et al., 2014; 2016; Guerra et al., 2016) as for most plant communities (Ollerton et al., 2011). As predicted by the OCBIL theory, we expected that most plant species would be pollinated by medium to long range movement animals, such as large bees and

hummingbirds, due to the barriers imposed by this archipelago-like landscape to gene flow (see Guerra et al., 2016; Carstensen et al., 2018). Accordingly, we expected that plant species from the rocky outcrop vegetation, the most isolated *campo rupestre* vegetation type, would be more dependent on biotic long-distance pollination than their surrounding grassland matrix, dominated by Poaceae and Cyperaceae (Carstensen et al., 2014, Mattos et al. 2019). We also expected a high proportion of wind pollinated species, considering the dominance of grasslands and graminoids species in this vegetation (Wolowski & Freitas, 2015; Mattos et al., 2019). Lastly, we anticipated that altitude would impose a more severe environmental filter to pollination systems than vegetation types. As elevation increases, the occurrence of some pollinators such as bees will be reduced, while others such as fly pollinators may be favored (e.g. Arroyo et al., 1982; Wolda, 1987; Perillo et al., 2017; Santos et al., 2020).

2.METHODS

Study area

We performed a survey of the plant-pollination studies carried out on *campo rupestre*, an ecosystem dominated by grasslands, covering the Brazilian ancient mountain tops (Silveira et al., 2016). Our focus was the Espinhaço Range, the largest inside country mountain chain in Brazil, extending North-South for about 1200 km across the states of Bahia and Minas Gerais, reaching up to 2100 m of altitude (see Silveira & Morellato 2018; Silveira et al., 2019). Due to its large geographic extent, the Espinhaço Range borders with key vegetation domains or ecoregions in Brazil: the Atlantic Forest, the Cerrado, and the Dry forest or Caatinga, all considered hotspots of species' diversity and endemism (Myers et al., 2000; Streher et al., 2017; Morellato & Silveira, 2018).

Considered a Neotropical OCBIL (Silveira et al., 2016; 2020), the *campo rupestre* is an overall fire-prone vegetation, characterized by a unique, highly diverse flora that evolved in the mountain tops of the ancient Espinhaço Range as an archipelago-like system dominated by grasslands (Morellato & Silveira, 2018; Vasconcelos et al., 2020). These archipelago-like systems occur across the altitudinal gradient, and the dominant vegetation types, associated to specific soil conditions, are sandy grasslands, stony grasslands, wet grasslands, rocky outcrops and peatbogs, interspaced by cerrado, hilltop forest islands and gallery forests (Alves et al., 2014; Rocha et al., 2016; Coelho et al., 2018; Mattos et al., 2019).

We conducted our sampling in the *campo rupestre* of the Serra do Cipó, South of Espinhaço Range, Southeastern Brazil. This area has recently been considered as a separate phytogeographic domain denominated as Southern Espinhaço Province, with the type locality in the Serra do Cipó National Park, which includes three counties: Santana do Riacho, Jaboticatubas and Cardeal Mota (Colli-Silva et al., 2019). Along the Serra do Cipó mountain, up to 900 m a.s.l., the cerrado wood- and shrubland dominates the landscape. There is a transitional zone around 900 m to 1100 m a.s.l. with a mixing of cerrado and *campo rupestre* species on sandy and stony grasslands and large rocky outcrops; the *campo rupestre* defines the landscape on altitudes above 1100 m a.s.l. (Silveira et al., 2019). The *campo rupestre* floristic composition is dominated by grasses, and also by sedges and herbs from the families Poaceae, Cyperaceae, Xyridaceae, Eriocaulaceae, and Velloziaceae, along with small shrubs from Asteraceae, Melastomataceae, Fabaceae and Rubiaceae (Mattos et al., 2019).

Our plant survey and sampling sites were distributed in the Serra do Cipó National Park and its buffer zone, the Morro da Pedreira protection area (Mattos et al., 2019), hereafter referred to as Serra do Cipó. The local climate is classified as subtropical highland climate (Cwb) by the Köppen (1948) system, with a dry and cold season (winter) from April/May to October and a wet and warm season (summer) from October/November to April (Alvares et al., 2013; Le Stradic et al., 2018).

Plants and plant-pollinator interactions

The survey for plant-pollination interactions was based on a threefold field collection effort led by some of the authors (Tables S1 and S2: Supporting Information): (i) a non-systematic plant survey (flora); (ii) a systematic sampling of plant-pollinator interactions; and (iii) a systematic plant survey across the altitudinal gradient. The (i) non-systematic plant survey was conducted from 2012 to 2018 along the altitudinal gradient of Serra do Cipó, covering five sites ranging from 824-1420 m a.s.l. (see Camargo et al. 2019). These five study sites are included in the Longterm Ecological Research – Campo Rupestre of Serra do Cipó program (LTER-CRSC) established in 2011 (Silveira et al., 2019), described by Rocha et al. (2016), Camargo et al. (2019) and Mattos et al. (2019). The plants collected were opportunistically observed for flower visitors, which were considered pollinators when they contacted the flower reproductive parts (Table 1). We took photos of almost all the species to access information on flower colour, shape, and size. More than half of the species were also measured for flower colour spectra (Camargo et al., 2019). These floral traits were used for the inference of the pollination system.

The vegetation sampling included woody and shrubby cerrado, wet, stony, and sandy grasslands, and rocky outcrops (Rocha et al., 2016).

The second collection (ii) was a result of the systematic sampling of diurnal plant-pollinator interactions conducted during the years of 2012 and 2016 (Carstensen et al., 2014; 2016; Gustafsson, 2017). The sampling was carried out at seven sites covering an altitudinal range of 1073–1260 m a.s.l. with similar wind exposition, soil substrate, vegetation structure dominated by rocky outcrops, sandy or rocky grasslands) and floral species richness (Carstensen et al., 2014). The flower visitor contacting the reproductive parts was considered pollinator (Carstensen et al., 2014; 2016).

The (iii) systematic plant survey was conducted at the same five sites of PELD-CRSC defined in the (i) non-systematic plant survey, described by Mattos et al. (2019). The systematic survey was conducted in 2016, in 36 plots of 1 m2 per site, summing up 180 plots. At every site, we established four 270 m long transects in which we set up nine plots, one at every 30 m where all plant life forms, including grasses and sedges, were sampled (Mattos et al. 2019). Transects were independently distributed in each site to guarantee that all the plots were established in similar altitudes. Details for each study site, altitude and plant richness sampled per site are found in Mattos et al. (2019). The systematic plant survey allowed us to perform the quantitative assessment for plant-pollinator interactions and for biotic and abiotic (wind) pollination systems.

The sites surveyed include all *campo rupestre* vegetation types and represent an altitudinal gradient associated with environmental variables collected by local weather stations (Fernandes, 2016; Silveira et al., 2019). If a plant species sampled in the systematic survey of plant-pollinators interactions (ii) or in the systematic survey of plants (iii) was new for our local flora, it was added to the previous survey (i) to produce the final plant species list for this study. The plant species surveyed were identified by taxonomists, comparison with local flora, specialized bibliography, and herbaria collections. Voucher specimens are deposited in the Herbarium Rioclarense (HRCB) of the São Paulo State University.

Literature review

To widen the comprehensiveness of our local survey for plant pollination systems and pollinators, we performed an exhaustive, systematic review of papers published and other material (theses, local papers) addressing plant-pollinator interactions on *campo rupestre*. Our search was performed in the databases: ISI Web of Science (http://apps.isiknowledge.com) all

databases option, and Scopus. We also search Google Scholar and BDTD (Biblioteca Digital Brasileira de Teses e Dissertações – Brazilian Digital Database on Thesis and Dissertations) to access unpublished material and "gray" literature. The literature review comprised all the studies available in the cited databases until June 2018. We used the terms: "pollinat*", "floral biology", "reproductive biology", also in portuguese (polin*, "biologia floral",biologia reprodutiva") combined with the terms for the region of interest: "campo rupestre"; "serra do cipo"; "rupestrian"; "montane grassland*"; "altitudinal"; "espinha*o"; "cerrado" e "rupic*". The search results were further filtered to retain just the research conducted in Brazil and in habitats similar to those sampled here (cerrado, campo rupestre, and other montane grasslands). Finally, for species on our final plant list with no information for pollinators, we performed a crosssearch in the same databases using the species name (e.g. Palicourea rigida), regardless of the vegetation type.

List of pollinators

Each flower visitor of the plant species collected during our (ii) plant-pollination systematic field survey and in the literature review was annotated, along with the data on visitation frequency, when available. Most of the pollinators in our list were identified based on our field observations (Carstensen et al., 2014; 2016; Gustafsson, 2017). For the literature review, we noted the visitor as a pollinator based on the author's indication and, if not available, on the description of the animal touching the reproductive parts of the flower, visitation frequency, and whether it was listed as the main pollinator. We organized pollinator species in eight functional groups *sensu* Fenster et al. (2004) (Table S2: Supporting Information): bees, wasps, hummingbirds, beetles, butterflies, moths, bats, and flies. We checked species' names looking for synonyms and the most recent accepted name for bees according to Moure's Bee Catalog (http://moure.cria.org.br/), for other pollinator species, at the Brazilian Fauna Taxonomic Catalog (http://fauna.jbrj.gov.br/) and for plant species we used Plantminer (Carvalho et al., 2010) and Flora do Brasil 2020 (BFG, 2020).

Pollination systems

We established 11 pollination systems considering the categories generally used in the studies of plant-pollination systems (Ollerton et al., 2019), our field observations and literature survey: bee, hummingbird, fly, butterfly, moth, bat, wasp, beetle, bee and others, diverse animals and wind (Figure 1 and Figure 2). For the plant pollination system characterized as bee and others, two functional groups of pollinators were considered of similar relevance for pollination

according to the frequency of visitation (e.g. bees and hummingbirds, bees and flies, bees and butterflies; modified from Ollerton et al., 2019). The category "diverse animals" was assigned when a flower species receives three or more different functional groups of pollinators with same frequency of visitation (Ollerton et al., 2019). Some pollination systems and pollinators were not detected in our study, such as non-flying mammals, ants, and saprophytic flies. Ants and hemipterans were frequent visitors, but our survey did not indicate those insects as main pollinators and they were included in the diverse animals' pollination system.

To specifically analyze the role of long-distance pollinators along the altitudinal gradient and vegetation types, we separated bees, within the bee pollination system, into two guilds, only for the plants specieis from the systematic survey (iii). Considering that bee's body size is positively related to their flight range (Greenleaf et al., 2007), we separated bees in: small bees with body size < 12 mm, considered to pollinate over short distances, and large bees, including medium (12-13 mm) and large (> 13 mm) size bees, capable to fly over long distances (Frankie et al., 1983; Gottsberger & Silberbauer-Gottsberger, 2006). Bee size was determined based on the authors collection during field work, literature survey and specialized literature (e.g. Urban, 2006; Marchi & Alves-dos-Santos, 2013; Borges, 2018). For eighteen bee species identified at tribe or subfamily level, size was considered indeterminate and were disregarded in the analysis. Therefore, according to the frequency of visitation, large bee included plants pollinated mainly by medium to large to bees (long-distance pollinators), and small bee included plants pollinated mainly by the small bees (short-distance pollinators), hereafter considered in the analyses as Large bee pollination system and Small bee pollination system. Bats and hummingbirds were considered as long-distance pollinators based on their body size and flight distance. Even though some territorial hummingbirds are reported not to fly over long distances, when resources are scarce, they might fly for larger areas reducing their territorial behavior (Justino et al., 2012). A recent study also indicated that plants pollinated by birds show higher paternal diversity compared to plants pollinated solely by insects (Krauss et al., 2017), a combination of the behaviour and specially the high mobility of this functional group. However, contradictory results are reported for *campo rupestre* systems pollinated by bees and hummingbirds (e.g. Frabceschinelli et al. 2006), a matter worthy additional investigation. We recognize that other pollination systems may include long-distance pollinators (e.g. moth, butterfly, and fly) but our actual knowledge of species natural history and the number of species was not sufficient for a quantitative analysis, deserving future research.

We conceived five categories, or levels, of accuracy of the pollination system assigned for each plant species surveyed based on the criteria applied to define the pollinator (Table 1), adapted from Ollerton et al. (2019). The categories 1 to 3 include direct observations in the field of flower visitors. The categories 4 and 5 are indirect inferences of the pollination system in which no direct observation was performed by the authors or found in the literature. In the category 4, the pollination system was assigned based on the same pollination system of a close-related species with similar flower morphology observed in the field. Category 5 included all species with none of the previous information (Categories 1 - 4), and the inference of pollination system was based on flower morphology observed in the field, photos and in the general literature on pollination (e.g. Faegri & Van der Pijl, 1979; Gottsberger & Silberbauer-Gottsberger, 2006). The accuracy criteria were largely applied for biotic pollination, the focus of most pollination studies on *campo rupestre* (Carstensen et al., 2014; 2016; Guerra et al. 2016). Abiotic pollination by wind predominates among grassland species of Poales (Wolowski & Freitas, 2015), in which flowers are small and unattractive. Wind pollination has been largely inferred based on flower morphology (Whitehead, 1969; Faegri & Van der Pijl, 1979; Wolowski & Freitas, 2015), a pollination system that fit our category 5, while we recognize the accuracy is high when inferring for this kind of system. Few studies address anemophily, and the ambophily have been observed for a limited number of species from groups broadly considered anemophilous (e.g. Oriani et al. 2009; Costa & Machado, 2012; Wolowski & Freitas, 2015; Schulze-Albuquerque et al., 2020). In most cases, we inferred the pollination systems of the plants identified up to species level, to achieve the best accuracy. However, for our analysis based on the plant systematic survey (iii), the pollination systems of taxonomic complex groups such as Poaceae and Cyperaceae species, considered mostly anemophilous, were inferred regardless of the species identification level (Table S1: Supporting Information).

Data analyses

To test whether there was a difference in the pollination systems along the altitudinal gradient, we used the pollination systems and their respective occurrence based on the number of plant species sampled by plot in the systematic survey (iii). Each plant species was assigned to one pollination system, given that the bee pollination system was split into two guilds hereafter considered as Large bee and Small bee pollination systems. We first applied linear regression

models, with the number of species within each pollination system per plot, that is, the frequency of pollination systems per plot, and the altitude of the plots.

To verify whether vegetation types differed concerning their pollination systems along the altitudinal gradient, we applied generalized linear mixed effect models (GLMM, Bates et al., 2015), using altitude and vegetation types as fixed factors. We calculated the plant richness of each plot and used it, together with the transects of the experimental design, as random factors. Then we applied ANOVA tests ($p < 0.05$) to select the best model explaining the variance of our data of each pollination system, following the AIC criteria (Bates et al., 2015). We tested the significance of each explanatory variable using the Anova function in the car package (Firth et al., 2009). We then performed multiple comparisons, based on LMM, to compare the occurrence of pollination systems across vegetation types using the emmeans package (Lenth et al., 2019). All analyses were implemented in R v. 4.0.0 (R Development Core Team, 2020).

3.RESULTS

Plant survey - We compiled a list of 689 plant species, 555 identified up to species level and remaining at morpho-species, from about 1,285 samples collected in the plant surveys (i) and (ii), plus species included by the systematic plant survey (iii) (Table S1: Supporting Information).

Literature review – the literature survey returned a total of 296 works, from which 82 were retained according to the established search criteria. From the selected studies, 39 were carried out in rupestrian grasslands or *campo rupestre*, 34 were in cerrado and nine studies were conducted in other vegetations. From the 39 studies developed in the *campo rupestre*, 16 were in the Serra do Cipó, 12 in the North of Espinhaço range (Chapada Diamantina) and the remaining 11, in other localities (Table S1: Supporting Information). From our literature review, we added to our list the pollinators and pollination system for 81 plant species from Serra do Cipó and other *campo rupestre* localities (Table S1: Supporting Information).

List of pollinators – We surveyed a total of 413 species of pollinators belonging to 47 animal families, observed and identified to the species level or morphospecies both in the studies conducted by the authors, and from the literature review. We just included pollinators identified to species level from literature review (Table S2: Supporting Information). The number of species according to the eight broad functional groups of pollinators (Table S2: Supporting Information) is displayed on Figure 3, showing a prevalence of bees as pollinators and a similar number of large and small bees.

Based on our systematic plant-pollinator survey (ii), we found 1511 interactions among 413 species of pollinators and 218 species of plants from *campo rupestre*. Bees were responsible for 67.6% of all pollinator interactions, followed by flies and hummingbirds, with 8.8% and 7.1%, respectively. The other five functional groups accounted for the remaining 16.5% of the interactions: wasps (6.0%), beetles (5.8%), butterflies (4.4%), bats (0.2%) and moths (0.07%). The main pollinators were Apidae bees from the subfamilies Apinae, Halictinae and Megachilinae, the Trochilidae hummingbirds, and the Vespidae wasps (Table 2). The main species in number of interactions were the bees: *Dialictus* sp.1, *Apis mellifera* and *Bombus pauloensis*, responsible for 11% of all the observed interactions.

Pollination systems - We determined and quantified the pollination systems for a total of 770 plant species, 689 from our surveys, 555 identified up to species level, plus 81 from literature review (Table S1: Supporting Information). From the total of 636 fully identified plant species, 48% of the pollination systems were assigned based on direct observations (Category 1 to 3, Table 1): 5.5% of the pollination systems were inferred based on direct observations in the field of pollen transfer, our most accurate criteria (Category 1, see full description in Table 1), 32% were inferred based on direct observation in the field of a floral visitor contacting flower reproductive parts (the Category 2 – Table 1) and 10.5% on the Category 3 (Table 1). The remaining 52% of species the pollination systems were inferred indirectly: for 28.5% of species the inferences were based on direct observations of a congeneric species with similar flowers (Category 4, table 1), and for 23.6% of species pollination system were based on the flower morphology and floral traits (Category 5, Table 1). Wind pollination represented 51.3% of the system species in Category 5.

Our survey showed a dominance of biotic pollination, present on 86.2% of the 636 species evaluated, with the remaining 13.8% of species present abiotic pollination by wind (Figure 2, Table S1: Supporting Information). Overall, bee was the main pollination system, found for 56.3% of the plant species, followed by wind (13.8%) and hummingbird (9.9%) pollination systems (Figure 2).

Pollination systems across the altitudinal gradient and campo rupestre vegetational mosaic - We determined the pollination systems of 437 angiosperms sampled in the systematic survey (Figure 4, Table S1: Supporting Information). The systematic survey showed the predominance of bee pollination system across the altitudinal gradient and vegetation types (Figures 4A and 4B), representing 45-50% of species, except in wet grasslands (27.8% of species). Considering

the occurrence of all pollination systems in *campo rupestre*, wind pollination predominated in all altitudes and vegetation types (Figure S1: Supporting Information). Along the altitudinal gradient, the proportion of hummingbird pollination system decreased from 7.0% at the lower altitude to 2.9% in the highest elevation site (Figure 4A). Conversely, fly pollination system reached the highest proportion (6.6%) at higher altitude, decreasing to less than 2% at lower elevations. The proportion of bee and wind pollination systems did not change with altitude (Figure 4A). The wind pollination system dominated the wet grasslands, reaching 59.5% of species, followed by 27.8% of bee pollination (Figure 4B). There was no hummingbird, bat, moth, or beetle pollination system in wet grasslands (Figure 4, Table S1: Supporting Information). Indeed, the butterfly, moth, bat, wasp, and beetle pollination systems were usually absent or reached values below 1% of species sampled in any vegetation type, except for wasp on wet grasslands and moth pollination in cerrado (Figure 4B). Diverse animals was generally the third most frequent pollination system, similar to the hummingbird system in cerrado and rocky outcrops.

Linear regression models indicated significant positive relationships between the frequency of wind, fly and small bee pollination systems and elevation (Figure 5A to 5C, Table 3). Large bees and moth pollination system frequency showed significant relationships with altitude, however with unreliably low predictive power (~ $R^2 = 0.05$). Therefore, we did not consider these as valid relationships (Figure 5D and 5E). The hummingbird pollination system was not related to elevation (Figure 5F).

Generalized mixed-models revealed significant factors influencing the distribution of the pollination systems along the environmental gradient (i.e. elevation and vegetation types). The Anova selection accounted for vegetation types in most cases, whilst altitude was selected in only one case, explaining the distribution of fly pollination system (Table 4). Transects were selected in the hummingbird model, and plant richness was selected in all other pollination systems (Table 4). Wind pollination system was positively related to altitude (R2 = 0.25, Table 3), and it was significant in the mixed-models, however the lower AIC model included vegetation type (R2 = 0.56, Table 4) and not altitude. The differences among vegetation types through mixed-models indicated that sandy and stony grasslands presented higher frequency of wind and small bee pollination systems (Figure 6A and 6B). The frequency of species with diverse animals pollination system was high in the cerrado and remarkably low in stony grasslands (Figure 6F). The mixed-models for the fly pollination system selected altitude,

accounting for species richness, increasing the explanation of the simple linear model to 30 % (Table 4).

The generalized mixed-models selected to both large and small bee pollination systems included vegetation types and plant richness(Table 4). Variation on the small bee pollination system was supported by the full-model (Conditional $R^2 = 0.74$, Table 4) and it occurred more often in sandy and stony grasslands (Figure 6B). Large bee pollination system was slightly positively related to altitude, and differed in some vegetation types when accounting for plant richness ($p < 0.001$, Conditional $R^2 = 0.29$), being more frequent in the rocky outcrops and stony grasslands (Figure 6C). The distribution of hummingbird and wasp (Figures 6D and 6E) pollination systems were not related to altitude and less explained by any of the models (mixed-models were the best, explaining 20 and 11%, respectively), with an outstanding role of rocky outcrops, hosting most of these long distance pollination systems (Figures 6C and 6D).

4.DISCUSSION

Our study provided the first systematic, broad description of pollinators and pollination systems for the *campo rupestre*, a Neotropical OCBIL. Our data and analysis supported the OCBILs theory prediction of high occurrence of long-distance pollinators and its prevalence in isolated vegetation type. We demonstrated (i) the overall occurrence of long-distance pollination systems (mainly large bees and hummingbirds) along the *campo rupestre* altitudinal gradient and vegetation types; and (ii) their prevalence on isolated rocky outcrops, essential for crosspollination across this archipelago-like landscape. We also demonstrated the expected dominance of bee and wind pollination systems in the *campo rupestre* grassy landscape and, for the first time, revealed the increase of fly pollination system with altitude, along with small bee and wind systems. We suggest that further studies must focus on reproductive systems, pollen flow and population genetics.

The campo rupestre pollinators and pollination systems

Combining field work and literature review, we disclosed 413 species of pollinators, mainly bees (220 species) and flies (69 species) at *campo rupestre*, a result expected for tropical vegetations and mountain systems (see Table 5 for references; Queiroz et al., 2019). Most plant-animal interactions were also mediated by bees (67.6% of 1511 interactions), mainly from three subfamilies (Apinae, Halictinae and Megachilinae), followed by the Trochilidae

hummingbirds (7.1%), confirming the relevance of bees and hummingbirds for free-living mutualistic interactions in the *campo rupestre* (Carstensen et al., 2014; 2016; Guerra et al., 2016). Along with bees, flies responded for 8.8% of the plant-pollinator interactions, a result anticipated for mountain systems (Lefebvre et al., 2018). Freitas & Sazima (2006) describe 12% of flies as pollinators from altitudinal grasslands, another Brazilian OCBIL system (Silveira et al., 2020). Flies may account for up to 25% of the pollination systems of the young mountain systems studied by Arroyo et al., (1982), considered a YODFELs (Young, Often disturbed, fertile landscapes (Table 5), opposed to OCBILs.

Regarding pollination systems, we confirmed the expected prevalence of bee pollination for *campo rupestre* (56% of the 636 plant species, Table 5), followed by wind (14%) and hummingbird (10%) pollination systems. Only one study of *campo rupestre* from North Espinhaço (Chapada Diamantina Province, sensu Colli-Silva et al., 2019) inferred anemophily for 6% of the plant species, and about 30% of hummingbird pollination (Conceição et al., 2007), the highest proportion of bird pollination among all our surveys (Table 5). A study conducted at the canga, an iron rocky grassland in Southern Espinhaço Province, reported 13% of hummingbird pollination (Jacobi & Carmo, 2011) and only 5% is reported for altitudinal grasslands (Freitas & Sazima, 2006). The diverse animals pollination system is characterized by minuscules whitish flowers combined into multiple globose inflorescences that may have similarities to the pollination system under the designation of “small diverse insects (SDI)” by Bawa et al., (1985) and Gottsberger & Silberbauer-Gottsberger, (2006). However, we have found animals from different taxonomic groups and sizes interacting with plant species with those flowers, such as wasps, beetles, bees of all sizes to hummingbirds. We therefore considered more appropriate the denomination diverse animals pollination system. This system includes many Eriocaulaceae, one of the most abundant plant families in *campo rupestre* (Mattos et al., 2019). The small contribution of some pollination systems, such as bats and moths, might be partially explained by the focus on daily observations gathered by this study.

Pollination systems across the campo rupestre vegetations and altitudinal gradient: testing the OCBIL hypothesis

Our study provided evidence for the predominance of pollination systems related to long-range pollinators, necessary for ensuring cross-pollination in the archipelago-like landscape, and locally restricted plant populations of the *campo rupestre*, as proposed by the OCBIL theory. Firstly, we demonstrated, based on systematic plant survey, that the frequency of long-distance

pollination systems, such as large bee and hummingbird, were not affected by altitude. The occurrence of both long-distance pollination systems across altitudes supported the OCBIL hypotheses, assuming that the constancy of long-range pollinators likely assures cross pollination (Hopper, 2009; Silveira et al., 2020). Hummingbirds and large bees are known to occur along the altitudinal gradient of Serra do Cipó. Rodrigues et al. (2011) indicate Trochilidae is the species rich families of hummingbirds on high altitudes of Serra do Cipó grasslands. Similar pattern has been described for some groups of medium and large bees (Perillo et al., 2017; Santos et al., 2020). Secondly, long-distance pollination systems as hummingbird and large bee were associated with rocky outcrops, the most isolated vegetation type in *campo rupestre*, while small bee and wind prevailed across the grasslands and diverse animals in the cerrado. Therefore, our findings corroborated the OCBIL long-distance pollination hypothesis, indicating its prevalence on isolated vegetation of rocky outcrops. Hummingbirds represent one of the most diverse bird families on rocky outcrops and are highly dependent on the floral resources present in this vegetation type (Rodrigues et al., 2011; Rodrigues & Rodrigues, 2014), although they can use alternative food sources such as insects. Our findings are also sustained by the overall dominance of bee (65%), hummingbird (11%), and fly (7.3%) amongst the animal pollination systems on *campo rupestre* (Table 5). The higher proportion of species pollinated by hummingbirds in *campo rupestre* and other OCBILs, when compared to YODFEL and other cerrado, added support for the prevalence of long-distance pollination (Table 5 and references therein).

It is of utmost importance our evidences that in a low, old, snow free mountain system, altitude indeed affected the frequency of species within some pollination systems. To our knowledge, there is no available community-level study specifically addressing the influence of altitude gradients and landscape heterogeneity on the patterns of distributions of plant pollination systems on *campo rupestre* (see Table 5). Our analysis demonstrated that bee and wind are the main pollination systems along the altitudinal gradient. There was a significant increase in the frequency of wind, small bee and fly pollination systems with altitude, here described for the first time for a tropical snow-free mountain vegetation. The increase of fly pollination is especially relevant, since some Syrphidae flies may act as long-distance pollinators (Rader et al., 2011). This pattern has long been described for the young, high mountain systems (Wolda, 1987; Lefebvre et al., 2018) and some Neotropical YODFEL (see Table 5), where there is a change in importance from bee to fly pollination with increasing altitude (Arroyo et al., 1982; Medan et al., 2002; Lefebvre et al., 2018). However, in these old tropical mountains there is

no strong environmental restriction related to the altitude gradient to bee movement (Perillo et al., 2017; Santos et al., 2020), and they could act as important pollen vectors all over the landscape. In fact, Syrphidae and Tachinidae species represented 20% and 13% of the observed flies, respectively, in our survey and were responsible for 36% and 18%, of the registered fly interactions in our *campo rupestre* sites.

Finally, around 94% of plants from tropical communities are expected to rely on biotic vectors for pollination (Ollerton et al., 2011). In *campo rupestre*, 86% of the species presented biotic pollination, but when considering the systematic plant survey, the proportion dropped to 68%. Wind represented the most important pollination system when accounting for species' frequency in the plant systematic survey, reaching around 50% to up 70% of the plant species (Figure S1: Supporting Information). The wind pollination system was prevalent on all grasslands dominated by anemophilous grasses and sedges (Wolowski & Freitas, 2015; Schulze-Albuquerque et al., 2020), and was exceptionally dominant in wet grasslands, a vegetation type lacking rosette herbs, shrubs and treelets (Mattos et al. 2019). Moreover, recent studies revealed ambophily and insect pollination on plants from groups assumed as anemophilous (Costa & Machado, 2012; Wolowski & Freitas 2015; Schulze-Albuquerque et al., 2020 and see Friedman & Barrett, 2009). Conversely, the reduced occurrence of grasses and sedges in the rocky outcrops and cerrado (Mattos et al., 2019), explained the decline of wind pollination in those vegetation types. Therefore, resources for pollinators seem nested in the outcrops, otherwise sparsely distributed over the dominant grassland matrix, stressing the relevance of long-range pollination systems for cross-pollination and gene flow among isolated endemic plant populations but see, Franceschinelli et al. (2006).

Concluding remarks

Our findings revealed, for the first time, the pollination systems, and main groups of pollinators across the *campo rupestre*, confirming the importance of bees and hummingbirds and the high frequency of wind pollinated species. We demonstrated the increased importance of fly pollination in high altitudes, a pattern new for our Neotropical ancient mountains, along with an increase of small bee pollination system. It is worth notice that fly pollination is a particularly important, highly specialized pollination system on South African fynbos, relevant for plant species diversification in that OCBIL vegetation (Johnson, 2010). However, the extreme specialization of southern African pollination guilds is unmatched, and more natural

history observation is needed to uncover the role of “pollination system niche” (Johnson, 2010; Phillips et al., 2020) on the evolution and diversification of *campo rupestre*.

Future investigations might address the pollination on the "mixed" systems, such as “bee and others" (*Lychnophora*, *Declieuxia*, *Vochysia* genra, for example) with especial attention to those related to wind pollination, such as Rhyncosphora spp (Costa & Machado, 2012; Schulze-Albuquerque et al., 2020), that may give us some clues on the diversification patterns for this ecosystem.

We corroborate the OCBIL long-distance pollination hypothesis, by demonstrating the prevalence of pollination systems associated to large bees and hummingbirds on isolated rocky outcrops, likely promoting outcrosses among plant populations, as well as its persistence across the altitudinal gradient. The comparison of pollination systems among OCBILs, YODFELs (young, often disturbed, fertile landscapes) and cerrado, although offered support for the prevalence of long-range pollination systems represented mainly by birds (Table 5), needs in-depth analysis. Methods vary, from the sampling design to the definition and determination of pollination systems all affecting the final proportions. We argue that differences might be more significant among vegetation systems if one can account for all those biases.

Half of the *campo rupestre*'s flora is estimated to be endemic (Colli-Silva et al., 2019) and, as a result, lower levels of genetic diversity due to inbreeding are expected for the small populations with restricted distribution (Silveira et al., 2020; Vasconcelos et al., 2020). The dependence on pollinators that fly over long distances could be among the strategies adopted by endemic species to endure and escape genetic erosion (Vasconcelos et a., 2020). Indeed, overall genetic studies are still limited, as seen in the review by Silveira et al. (2020), covering only nine botanical families, 21 genera and 78 species, but most information is concentrated in Orchidaceae (24 species), Cactaceae (14), Fabaceae (12) and Asteraceae (10). Results are divergent even within the same family regarding high or reduced intrapopulation genetic diversity. Furthermore, just a few studies address the specific case of species isolated on rocky outcrops, gene flow and reproductive systems (e.g. Borba et al., 2001; Franceschinelli et al. 2006; Bonatelli et al., 2014). Recent genetic evidence indicates that gene flow via seeds is comparatively less efficient than gene exchange via pollen across the Espinhaço range (Dantas-Queiroz et al., 2020). Further studies on microevolutionary processes should estimate pollen dispersal distance, degree of heterozygosity, reproductive system, and overall gene flow across the landscape and the relation to seed dispersal limitation (Dantas-Queiroz et al., 2020, Silveira

et al., 2020). Also, it is important to check whether the reproductive traits are associated with the presence of ancient plant lineages using time-calibrated phylogenies (e.g. Alcantara et al., 2018; Vasconcelos et al., 2020) and apply recent macroecological approaches to study evolutionary patterns at the geographical scale (Dantas-Queiroz et al., 2020; Villalobos et al., 2020).

The present extensive database on plant-pollinator interactions holds key information for the conservation and knowledge of ecosystem services of *campo rupestre*. Likewise, it also opens a huge opportunity for the study of pollination in grasses and sedges, adding to the debate of questions on evolution, restoration, and management of grasslands. Our unprecedented study on pollination systems of the *campo rupestre* indicated the relevance of plant-animal interactions that is possibly shaping the diversity of this unique archipelago-like landscape. We advocated that the pollination niche may act as an important selective force, along with the unfertile soils, driving the evolution and diversification of *campo rupestre* vegetation, as proposed by Johnson (2010) for south African OCBIL vegetation.

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6.TABLES

Table 1. Criteria of accuracy applied for the inference of the pollination system of plant species. From the most (Category 1) to the less (Category 5) accurate method of inference. For the categories 1 to 3, the determination of the pollination system is based on direct field observations of the target species; the 4 - 5 categories the pollination system is inferred based on indirect evidence. N = number of species characterized in each category (Total = 636 plant species).

Code	Category	Description	N
1	Pollinator proven	Systematic, direct observations in the field of pollen transfer among flowers by floral visitors, pollinating the flower. Data may include evaluation of reproductive success, pollen counting/viability, seed production/viability, time and frequency of visits, floral biology, and collection of floral visitors	35
2	Pollinator inferred by direct observation	Systematic, direct observation in the field of a flower visitor contacting the stamen/stigma, flower reproductive apparatus, inferred as pollinator. Data may include time and frequency of the visits, information on floral biology	203
3	Pollinator inferred by opportunistic observation	Pollinator inferred by circumstantial, opportunistic field observation of flower visitors contacting the stamen/stigma. Consider eventual qualitative evaluation of visitation frequency and floral biology	67
4	Inference from close-related species	Pollinator inferred based on direct observations of close-related species of the same genus and with similar floral morphology	181
5	Indirect inference	Pollinator inferred based just on floral morphology and floral attributes observed on the field, photos, herbarium vouchers and general literature	150

Table 2. Table 2. The five broad functional groups (family) of pollinators in the campo rupestre, their pollination system, and the number (N) and proportion (%) of plant-pollinator interactions (total of 1511 records). Note four out the five families are Hymenoptera (bee or wasp). For details see Table S2: Supporting Information.

		Pollinator interactions	
Family	Functional Group	N	%
Apidae (Apinae)	Bee	637	42.2
Apidae (Halictinae)	Bee	263	17.4
Trochilidae	Hummingbird	107	7.1
Apidae (Megachilinae)	Bee	104	6.9
Vespidae	Wasp	50	3.3
Other families	Other	350	23.2

Table 3. Results of linear regression models to each pollinator system and the altitude of the plots.

Pollination System	*p* value	R^2	Coef1	Coef2
Bee	< 0.0001	0.13	-0.96	0.005
Small Bee	< 0.0001	0.11	-2.48	0.004
Large Bee	0.001	0.03	0.66	0.001
Wind	< 0.0001	0.25	-1.63	0.008
Hummingbird	0.40	0.002		
Diverse	0.97	0.001		
Fly	< 0.0001	0.13	-1.48	0.001
Butterfly	0.50	0.002		
Bee+other	0.92	7E-04		
Moth	0.001	0.05		-2.93
Bat	0.45	0.003		
Wasp	0.28	0.06		
Beetle	0.48	0.002		

Table 4. Results of Mixed Models (GLMM), after ANOVA selection, to each pollination system, showing fixed and random factors selected in the best model to each pollination system. The p value shown refers to the ANOVA results over models; conditional Pseudo-R2 shows a measure of power of the entire model (Nakagawa & Schielzeth, 2013). Vegtype = vegetation type (wet, stony, and sandy grasslands, rocky outcrops and cerrado).

Pollination System	**Fixed**	**Random**	***p* value**	**R2 Cond.**
Bee	vegtype	richness	< 0.001	0.87
Small Bee	vegtype	richness	< 0.001	0.74
Large Bee	vegtype	richness	< 0.001	0.29
Wind	vegtype	richness	< 0.001	0.56
Hummingbird	vegtype	transect	< 0.001	0.20
Diverse	vegtype	richness	< 0.001	0.46
Fly	elevation + vegtype	richness	< 0.001	0.30
Wasp	vegtype	richness	< 0.001	0.11

Table 5. Comparison of pollination systems among diverse vegetations. The green shade indicates OCBILs (old, climatically buffered, infertile landscapes) and the light gray YODFELs (young, often disturbed, fertile landscapes) following Hopper (2009) and Silveira et al. (2020). Symbols: *Entomophily, ** Sunbirds, *** Include Moths, §Pollination Syndromes.

Vegetation	Study Site	Country	Bee(total)	Bird	Fly	Butterfly	Moth	Bat	Beetle	Wasp	Wind	Diverse	Thrip	Reference
Altitudinal grassland	Serra da Bocaina, SP/RJ	Brazil	43.3	4.7	12.3	-	-	-	-	20.8	-	18.9	-	Freitas & Sazima (2006)
Campo rupestre	Mãe Inácia Peak, Palmeiras, BA	Brazil	63*	29.0	-	-	-	2.0	-	-	6.0	-	-	Conceição et al. (2007)§
Campo rupestre	Serra do Cipó, MG	Brazil	56.3	9.9	5.0	2.7	1.4	1.1	0.5	0.9	13.8	6.3	-	This study
Campo rupestre	Serra do Cipó, MG	Brazil	48.3	5.3	3.0	1.1	1.4	0.5	0.2	1.1	31.4	6.6	-	This study (systematic)
Canga	Iron Quadrangule, MG	Brazil	77.0*	13.0	-	-	-	-	-	-	16.0	-	-	Jacobi & Carmo (2011)§
Cape floristic region (Fynbos)	Jonaskop Mountain	South Africa	53.5	-	8.9	-	-	-	28.5	9.1	-	-	-	Adedoja et al. (2018)
Altitudinal schrubland	Parque Nacional Canaima	Venezuela	56.2	12.3	9.6	10.9***	-	-	2.7	-	8.2	-	-	Ramirez et al. (1990)
Andean	Higher Altitude	Argentina	28.6	0.0	4.8	0.0	-	0.0	4.8	4.8	-	0.0	4.8	Medan et al. (2002)
Andean	Lower Altitude	Argentina	39.1	8.7	8.7	8.7	-	0.0	0.0	0.0	-	0.0	0.0	Medan et al. (2002)
Andean	Andes	Chile	11.4	0.0	25.7	0.0	0.0	0.0	0.0	0.0	-	0.0	0.0	Arroyo et al. (1982)
Cerrado	Brasilia Botanic Garden, DF	Brazil	32*	2.0	-	0.0	12.0	3.0	2.0	-	0.0	44.0	0.0	Oliveira & Gibbs (2000)
Cerrado	Fazenda UFMT	Brazil	39.4	1.8	-	-	8.3	9.2	8.3	-	5.5	27.5	-	Borges (2000)
Cerrado	Fazenda Treze de Maio, Botucatu-SP	Brazil	37.9	1.7	1.3	1.0	4.3	1.0	2.7	-	13.3	36.9	-	Gottsberger & Silberbauer-Gottsberger (2006)
Cerrado	Triangulo mineiro, MG	Brazil	83.2	3.4	2.3	2.3	3.4	3.9	1.7	-	-	-	-	Silva et al. (2012)

7.FIGURES

Figure 1. Flowers of plant species from the *campo rupestre* exemplifying the pollination systems adopted in this study. (A) Bee: small bee pollinated *Microlicia hirticalyx*; (B) Bee: medium/large bee pollinated *Chamaecrista ochnacea*; (C) Bees and others: *Declieuxia fruticosa*; (D) Hummingbirds: *Spigelia sellowiana*; (E) Fly: *Xerosiphon aphyllus*; (F) Butterfly: *Hirtella glandulosa*; (G) Moth: *Habenaria magniscutata*; (H) Bat: *Caryocar brasiliense*; (I) Wasp: *Baccharis platypoda*; (J) Beetle: *Duguetia furfuracea*; (K) Diverse animals: *Actinocephalus polyanthus*; and (L) Wind: *Echinolaena inflexa*. Photos: M.G.G. Camargo.

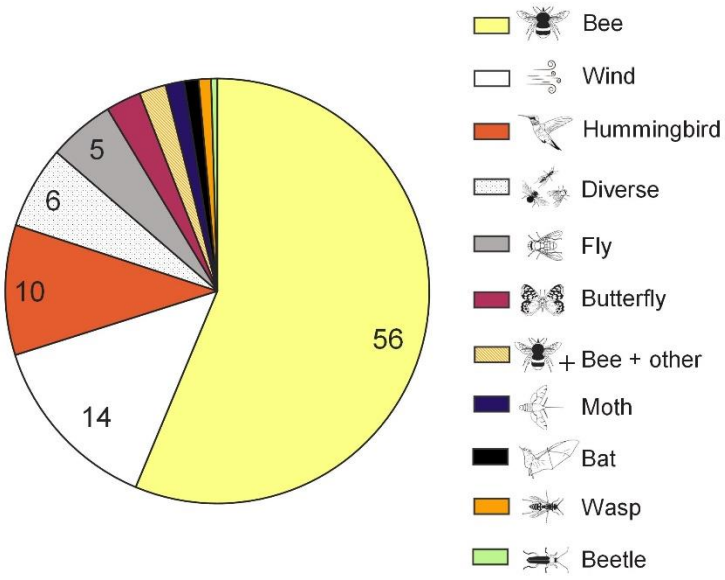

Figure 2. Figure 2. Percentage of *campo rupestre* plant species by pollination system: bee, wind, hummingbird, diverse animals, fly, butterfly, bees and others, moth, bat, wasp and beetle, for the total of 636 plant species. See Table S1 on Supporting Information for details.

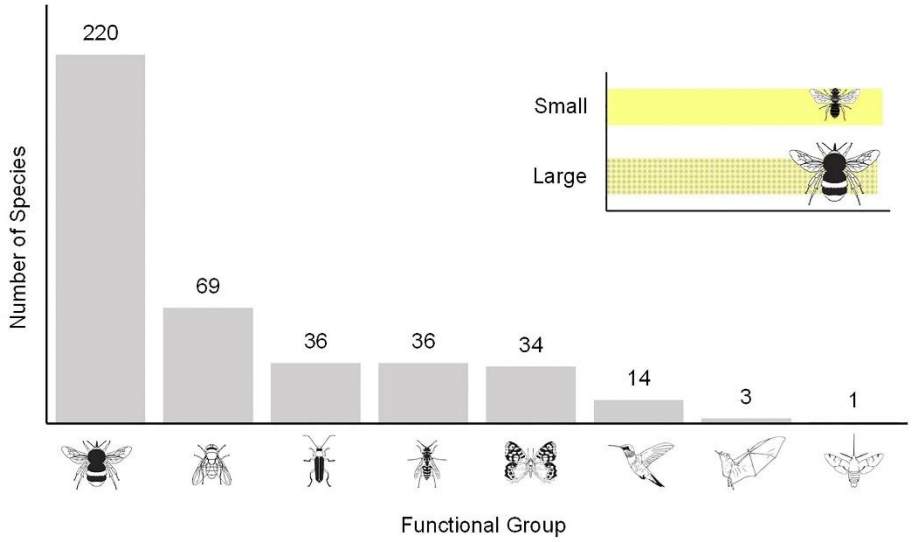

Figure 3. Number of pollinators species (N = 413) observed in the systematic sampling of plant-pollinator interactions in the *campo rupestre* of Serra do Cipó according to the taxonomic groups: bees, flies, beetles, wasps, butterflies, birds (hummingbirds), bats and moths. At upright, a detail shows the number of bee species by the size class: Small (< 12mm) and Large (medium to large bees >12mm). For eight species the bee size was undetermined. See Table S2 on Supporting Information for details.

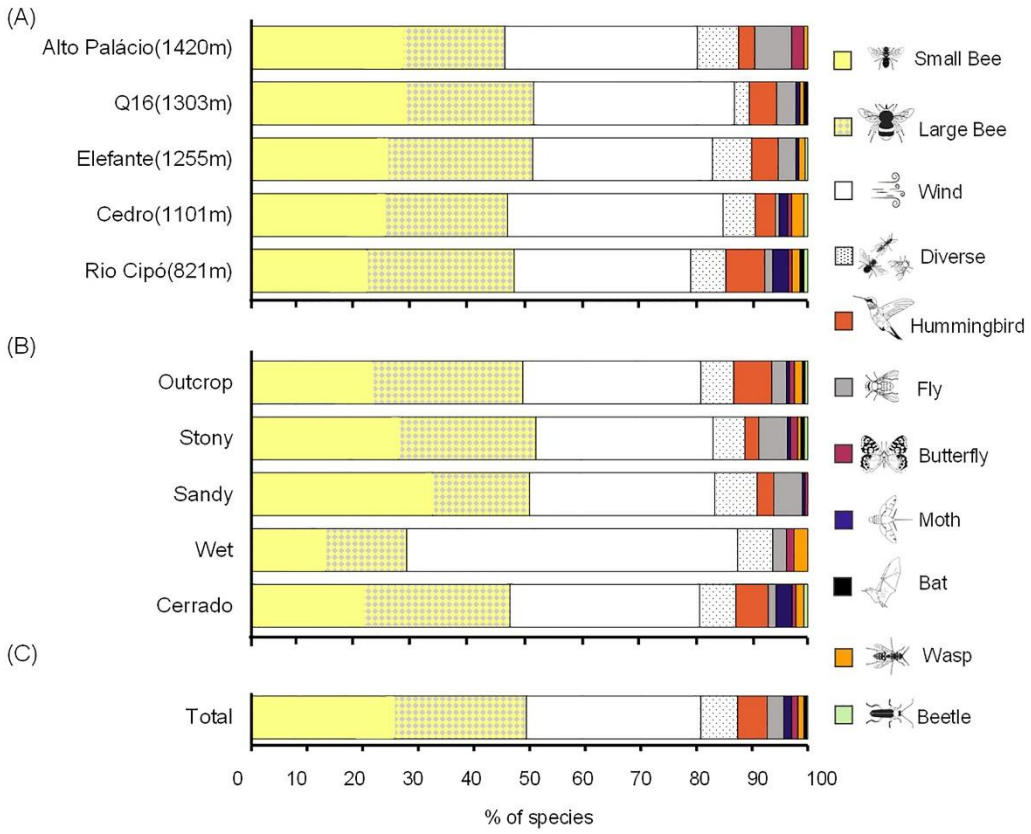

Figure 4. Percentage of plant species sampled in the systematic survey along the altitudinal gradient of Serra do Cipó, by pollination system: wind, bee, diverse animal, hummingbird, fly, butterfly, bees and others, moth, bat, wasp and beetle. (A) According to the altitude: Alto Palácio (N=136 species), Q16 (N=144), Elefante (N=186), Cedro (N=137 species), Rio Cipó (N=142 species); (B) By vegetation type: rocky outcrop (219 species), stony grassland (157 species), sandy grassland (198 species), wet grassland (79 species) and cerrado (138 species); and (C) total of species systematically sampled (437 species). Large bees are the hatched area in the yellow bee-pollination system.

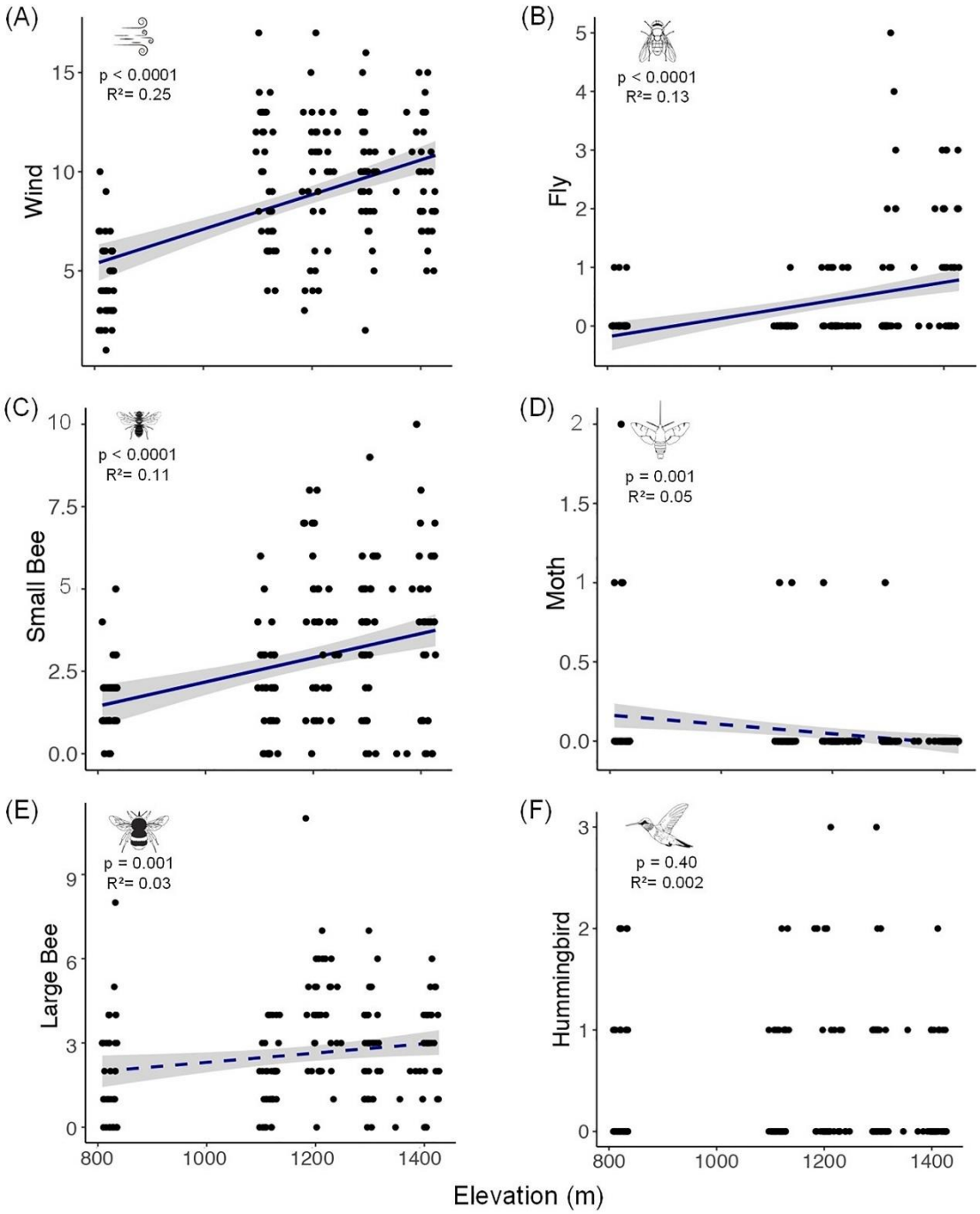

Figure 5. Linear regression between the frequency of pollination systems in 180 plots along the elevational gradient in the *campo rupestre*. The relationship significance (p) and predictive power (R^2) are indicated in each graph.

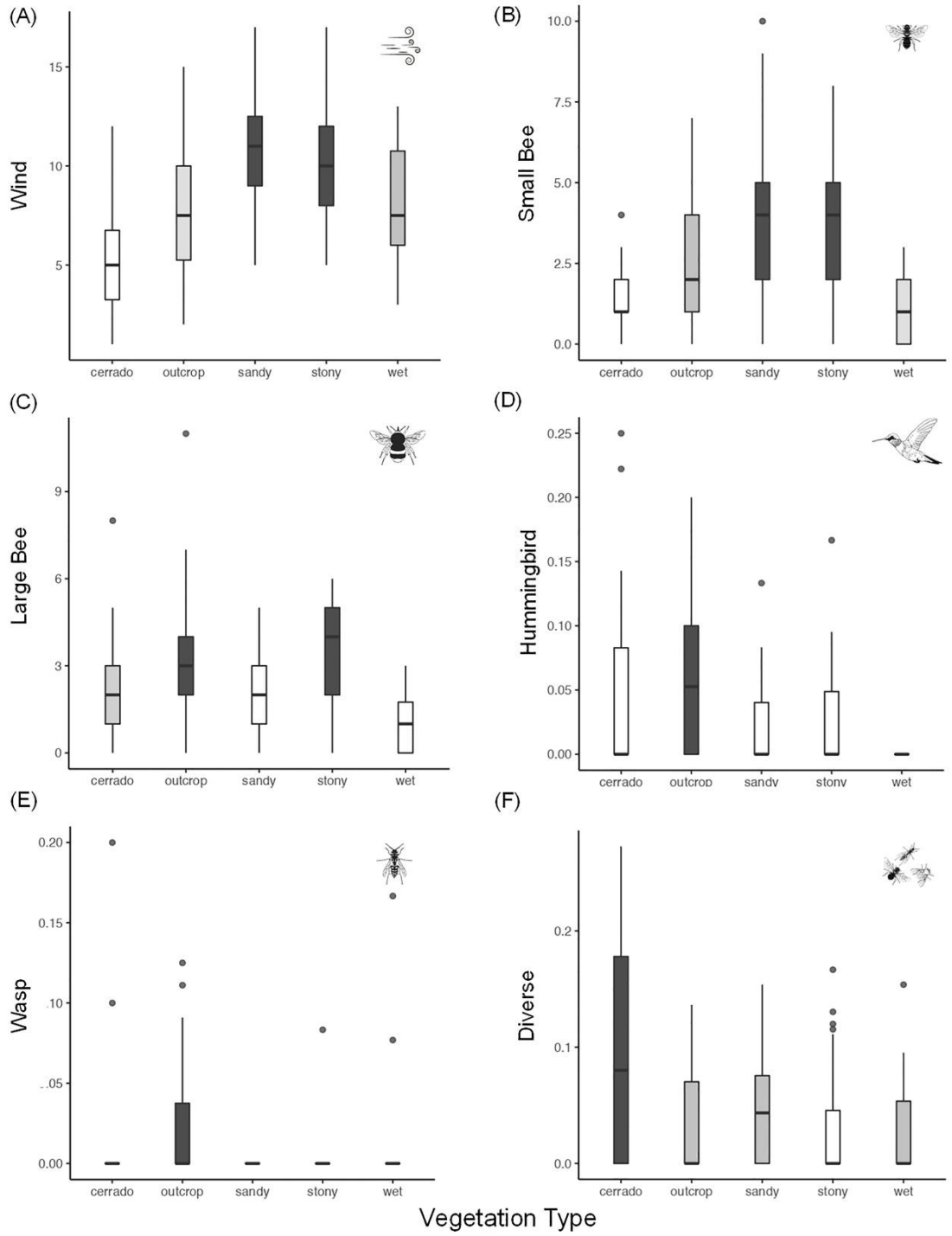

Figure 6. Frequency of pollination systems in 180 plots of *campo rupestre* according to the vegetation types: cerrado, rocky outcrop, sandy grassland, stony grassland and wet grassland. The grey intensity of each box indicates significant relationship and white boxes indicate non-significant relationships according to the generalized linear mixed-models.

8. SUPPORTING INFORMATION

Table S1. Metadata

Column	Information
Voucher	Herbarium voucher number in Harbarium Rioclarense
Survey	How the plant was included to the campo rupestre's flora: i, ii, iii or literature (see methods)
Family	Plant species family
Species	Plant species identification or morphospecies
Author	Plant species author(s)
Source(s)	Source used to determine the pollination systems. For more info access "references"
Cat	Category of accurance: how the pollination system was determined (see methods and Table1)
System	Pollination system: 11 categories (see methods) ANE=wind, BAT, BEE, BEE2=bee and other, BUT=butterfly, COL=beetle, DIP=fly, DIV=diverse animals, HUM=hummingbird, MOT=moth and WASP.
Bee Size Sys	Bee pollination system categorized by size according to the size of the most frequent bee visitors
Vegetation	Vegetation where the source consulted was done
Study Site	Study site where the source was done

Table S1. List of species, organized by family, and respective pollination systems (System), and information on Voucher number (HRCB), Survey type, Source (this study or literature review), category (Cat) of the Accuracy criterions, Bee size system, Vegetation and Study site. For more details, see Methods.

Voucher	Survey	Family	Species	Author	Source(s)	Cat	System	Bee size system	Vegetation	Study site
67336	iii	Acanthaceae	*Ruellia brevifolia*	(Pohl) C.Ezcurra	Matias et al. (2016)	2	HUM	-	cerrado and seasonally dry forests	parque municipal natural do setor santa cruz and PESC
76682	i,iii	Acanthaceae	*Ruellia villosa*	(Nees) Lindau	Faria (1994)	2	HUM	-	campo rupestre	serra do cipó
67330	i,iii	Amaranthaceae	*Gomphrena incana*	Mart.	This study	5	BEE	small	campo rupestre	serra do cipó
67329	iii	Amaranthaceae	*Gomphrena moquinii*	Seub.	This study	5	BEE	small	campo rupestre	serra do cipó
67334	i,iii	Amaranthaceae	*Gomphrena scapigera*	Mart.	This study	5	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Amaranthaceae	*Gomphrena* sp	L.	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	small	cerrado	fazenda treze de maio
67605	i,iii	Amaranthaceae	*Xerosiphon aphyllus*	(Pohl ex Moq.) Pedersen	This study	5	DIP	-	campo rupestre	serra do cipó
literature	literature	Amaryllidaceae	*Hippeastrum aulicum*	(Ker Gawl.) Herb.	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
67318	i	Amaryllidaceae	*Hippeastrum cipoanum*	(Ravenna) Meerow	Freitas & Sazima (2006)	4	HUM	-	campo de altitude	parque nacional serra da bocaina
literature	literature	Anacardiaceae	*Spondias tuberosa*	Arruda	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
67338	i	Anacardiaceae	*Tapirira guianensis*	Aubl.	Gottsberger & Silberbauer-Gottsberger (2006),Morellato (1991)	3	BEE	-	cerrado	fazenda treze de maio
67324	i	Annonaceae	*Duguetia furfuracea*	(A.St.-Hil.) Saff.	Gottsberger & Silberbauer-Gottsberger (2006)	3	COL	-	cerrado	fazenda treze de maio
67327	i	Apiaceae	*Eryngium ebracteatum*	Lam.	This study	5	DIP	-	campo rupestre	serra do cipó
67328	i,iii	Apiaceae	*Klotzschia rhizophylla*	Urb.	This study	5	DIP	-	campo rupestre	serra do cipó

67342	iii	Apocynaceae	*Aspidosperma tomentosum*	Mart. & Zucc.	This study	5	MOT	-	campo rupestre	serra do cipó
no_collect	iii	Apocynaceae	*Barjonia chlorifolia*	Decne.	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67346	iii	Apocynaceae	*Hancornia speciosa*	Gomes	Darrault & Schlindwein (2005)	2	MOT	-	cerrado	national reserve guaribas
67344	iii	Apocynaceae	*Hemipogon hatschbachii*	(Fontella & Marquete) Rapini	This study	5	DIP	-	campo rupestre	serra do cipó
67351	i	Apocynaceae	*Mandevilla tenuifolia*	(J.C.Mikan) Woodson	Araújo et al. (2014)	2	BUT	-	caatinga	rppn fazenda almas
67392	i,iii	Apocynaceae	*Minaria decussata*	(Mart.) T.U.P.Konno & Rapini	This study	4	BEE	small	campo rupestre	serra do cipó
67339	iii	Apocynaceae	*Minaria ditassoides*	(Silveira) T.U.P.Konno & Rapini	This study	2	BEE	small	campo rupestre	serra do cipó
literature	literature	Apocynaceae	*Minaria micromeria*	(Decne.) T.U.P.Konno & Rapini	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
67341	i	Apocynaceae	*Odontadenia lutea*	(Vell.) Markgr.	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	-	cerrado	fazenda treze de maio
67353	i	Apocynaceae	*Oxypetalum strictum*	Mart.	This study	3	BUT	-	campo rupestre	serra do cipó
67345	i	Apocynaceae	*Prestonia erecta*	(Malme) J.F.Morales	This study	3	BUT	-	campo rupestre	serra do cipó
67349	i	Apocynaceae	*Prestonia erecta*	(Malme) J.F.Morales	This study	3	BUT	-	campo rupestre	serra do cipó
67322	i	Aquifoliaceae	*Ilex conocarpa*	Reissek	This study	4	BEE	-	campo rupestre	serra do cipó
67319	i	Aquifoliaceae	*Ilex dumosa*	Reissek	Freitas & Sazima (2006)	2	BEE	-	campo de altitude	parque nacional serra da bocaina
67320	ii,iii	Aquifoliaceae	*Ilex nummularia*	Reissek	This study,Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
literature	literature	Araceae	*Thaumatophyllum adamantinum*	(Schott) Sakur., Calazans & Mayo	Pereira et al. (2014)	1	COL	-	campo rupestre	parque estadual do rio preto PERP
67325	iii	Araliaceae	*Didymopanax villosissimus*	(Fiaschi & Pirani) Fiaschi & G.M. Plunkett	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó

no_collect	iii	Arecaceae	*Syagrus* cf *glaucescens*	Glaz. ex Becc.	This study	3	BEE	small	campo rupestre	serra do cipó
66862	iii	Asteraceae	*Achyrocline satureioides*	(Lam.) DC.	Freitas & Sazima (2006)	2	WASP	-	campo de altitude	parque nacional serra da bocaina
66873	ii	Asteraceae	*Acritopappus longifolius*	(Gardner) R.M.King & H.Rob.	This study,Rodrigues & Rodrigues (2014)	2	BEE	-	campo rupestre	serra do cipó
67641	i,iii	Asteraceae	*Ageratum fastigiatum*	(Gardner) R.M.King & H.Rob.	This study	5	BUT	-	campo rupestre	serra do cipó
66854	i	Asteraceae	*Aldama robusta*	E.E.Schill. & Panero	This study	5	BEE	-	campo rupestre	serra do cipó
66877	i	Asteraceae	*Aspilia* cf *foliosa*	(Gardner) Baker	Maruyama et al. (2018)	4	BEE	-	campo rupestre	serra do cipó
66876	ii	Asteraceae	*Aspilia fruticosa*	(Gardner) Baker	This study	2	BEE	-	campo rupestre	serra do cipó
66879	ii,iii	Asteraceae	*Aspilia jolyana*	G.M.Barroso	This study,Maruyama et al. (2018)	1	BEE	large	campo rupestre	serra do cipó
literature	literature	Asteraceae	*Aspilia laevissima*	(Less. ex Baker) Baker	Araújo et al. (2006),Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
66875	i	Asteraceae	*Aspilia procumbens*	Baker	Maruyama et al. (2018)	4	BEE	-	campo rupestre	serra do cipó
no_collect	i,iii	Asteraceae	*Aspilia* sp	Thouars	Maruyama et al. (2018)	4	BEE	large	campo rupestre	serra do cipó
66894	i	Asteraceae	*Ayapana amygdalina*	(Lam.) R.M.King & H.Rob.	This study	5	BUT	-	campo rupestre	serra do cipó
66887	iii	Asteraceae	*Baccharis concinna*	G.M.Barroso	This study	2	DIV	-	campo rupestre	serra do cipó
no_collect	iii	Asteraceae	*Baccharis dracunculifolia*	DC.	This study	4	DIV	-	campo rupestre	serra do cipó
67696	i	Asteraceae	*Baccharis montana*	DC.	This study	4	DIV	-	campo rupestre	serra do cipó
66890	iii	Asteraceae	*Baccharis platypoda*	DC.	Freitas & Sazima (2006)	2	WASP	-	campo de altitude	parque nacional serra da bocaina
66888	ii	Asteraceae	*Baccharis serrulata*	(Lam.) Pers.	This study	2	DIV	-	campo rupestre	serra do cipó
literature	literature	Asteraceae	*Baccharis sessiliflora*	Vahl	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
no_collect	iii	Asteraceae	*Chaptalia* cf *integerrima*	(Vell.) Burkart	This study	5	BUT	-	campo rupestre	serra do cipó

66852	iii	Asteraceae	*Chaptalia cipoensis*	Roque	This study	5	BUT	-	campo rupestre	serra do cipó
literature	literature	Asteraceae	*Chromolaena barbacensis*	(Hieron.) R.M.King & H.Rob.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
66901	iii	Asteraceae	*Chromolaena squalida*	(DC.) R.M.King & H.Rob.	This study	5	BEE	small	campo rupestre	serra do cipó
66824	i	Asteraceae	*Chrysolaena desertorum*	(Mart. ex DC.) Dematt.	Freitas & Sazima (2006)	4	BEE	-	campo de altitude	parque nacional serra da bocaina
66899	i	Asteraceae	*Chrysolaena obovata*	(Less.) Dematt.	Freitas & Sazima (2006)	2	BEE	-	campo de altitude	parque nacional serra da bocaina
66863	i	Asteraceae	*Chrysolaena simplex*	(Less.) Dematt.	Freitas & Sazima (2006)	4	BEE	-	campo de altitude	parque nacional serra da bocaina
67644	ii,iii	Asteraceae	*Cyrtocymura scorpioides*	(Lam.) H.Rob.	This study	2	BEE	small	campo rupestre	serra do cipó
67869	iii	Asteraceae	*Dasyphyllum reticulatum*	(DC.) Cabrera	This study	4	HUM	-	campo rupestre	serra do cipó
no_collect	ii	Asteraceae	*Dasyphyllum sprengelianum*	(Gardner) Cabrera	This study	2	HUM	-	campo rupestre	serra do cipó
66865	i	Asteraceae	*Echinocoryne schwenkiifolia*	(Mart. ex DC.) H.Rob.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
literature	literature	Asteraceae	*Emilia sonchifolia*	(L.) DC. ex Wight	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
66853	i	Asteraceae	*Eremanthus elaeagnus*	(Mart. ex DC.) Sch.Bip.	Freitas & Sazima (2006)	4	BEE	-	campo de altitude	parque nacional serra da bocaina
literature	literature	Asteraceae	*Eremanthus erythropappus*	(DC.) MacLeish	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
66903	iii	Asteraceae	*Eremanthus glomerulatus*	Less.	Freitas & Sazima (2006)	4	BEE	small	campo de altitude	parque nacional serra da bocaina
no_collect	ii	Asteraceae	*Gochnatia pulchra*	Cabrera	This study	2	BEE	-	campo rupestre	serra do cipó
66851	iii	Asteraceae	*Heterocondylus pumilus*	(Gardner) R.M.King & H.Rob.	This study	5	BEE	small	campo rupestre	serra do cipó
66818	i,iii	Asteraceae	*Inulopsis camporum*	(Gardner)G.L.Nesom	This study	5	BEE	large	campo rupestre	serra do cipó
67646	i,iii	Asteraceae	*Lepidaploa*	(A.St.-Hil.) H.Rob.	This study	5	BEE	small	campo	serra do cipó

			rufogrisea						rupestre	
literature	literature	Asteraceae	*Lessingianthus laevigatus*	(Mart. ex DC.) H.Rob.	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
66837	i,iii	Asteraceae	*Lessingianthus linearifolius*	(Less.) H.Rob.	This study	5	BEE	large	campo rupestre	serra do cipó
66838	i	Asteraceae	*Lessingianthus linearis*	(Spreng.) H.Rob.	This study	5	BEE	-	campo rupestre	serra do cipó
66829	i,iii	Asteraceae	*Lessingianthus psilophyllus*	(DC.) H.Rob.	This study	5	BEE	large	campo rupestre	serra do cipó
66836	ii	Asteraceae	*Lessingianthus pycnostachyus*	(DC.) H.Rob.	This study	2	BEE2	-	campo rupestre	serra do cipó
66840	i	Asteraceae	*Lessingianthus roseus*	(Mart. ex DC.) H.Rob.	Freitas & Sazima (2006),Rodrigues & Rodrigues (2014)	2	BEE2	-	campo rupestre	serra do cipó
67634	ii,iii	Asteraceae	*Lessingianthus warmingianus*	(Baker) H.Rob.	This study	2	BEE	large	campo rupestre	serra do cipó
no_collect	ii	Asteraceae	*Lychnophora ericoides*	Mart.	This study	2	BEE2	-	campo rupestre	serra do cipó
66886	iii	Asteraceae	*Lychnophora humillima*	Sch.Bip.	This study	5	BEE	large	campo rupestre	serra do cipó
66902	i	Asteraceae	*Lychnophora mello-barretoi*	G.M.Barroso	This study	5	BEE	-	campo rupestre	serra do cipó
67637	ii,iii	Asteraceae	*Lychnophora passerina*	(Mart. ex DC.) Gardner	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
66882	ii,iii	Asteraceae	*Lychnophora rupestris*	Semir	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
66881	i	Asteraceae	*Lychnophora salicifolia*	Mart.	This study	4	BEE2	-	campo rupestre	serra do cipó
67845	i,iii	Asteraceae	*Lychnophora* sp	Mart.	This study	4	BEE	large	campo rupestre	serra do cipó
66891	ii	Asteraceae	*Lychnophora uniflora*	Sch.Bip.	This study	2	BEE2	-	campo rupestre	serra do cipó
66885	i	Asteraceae	*Lychnophoriopsis damazioi*	(Beauverd) H.Rob.	This study	5	BEE	-	campo rupestre	serra do cipó
66897	i	Asteraceae	*Mikania* cf *hartbergii*	W.C.Holmes	Freitas & Sazima (2006)	4	DIP	-	campo de altitude	parque nacional serra da bocaina
66842	i,iii	Asteraceae	*Mikania cipoensis*	G.M.Barroso	Freitas & Sazima (2006)	4	DIP	-	campo de altitude	parque nacional serra da bocaina

66896	i	Asteraceae	*Mikania nummularia*	DC.	Freitas & Sazima (2006)	2	DIP	-	campo de altitude	parque nacional serra da bocaina
67628	i,iii	Asteraceae	*Mikania sessilifolia*	DC.	Freitas & Sazima (2006)	2	DIP	-	campo de altitude	parque nacional serra da bocaina
no_collect	iii	Asteraceae	*Mikania* sp1	Willd.	Freitas & Sazima (2006)	4	DIP	-	campo de altitude	parque nacional serra da bocaina
66855	iii	Asteraceae	*Minasia pereirae*	H.Rob.	This study	5	BUT	-	campo rupestre	serra do cipó
66857	i	Asteraceae	*Piptocarpha rotundifolia*	(Less.) Baker	Gottsberger & Silberbauer-Gottsberger (2006)	3	BUT	-	cerrado	fazenda treze de maio
66848	i	Asteraceae	*Piptolepis buxoides*	(Less.) Sch.Bip.	This study	4	BEE	-	campo rupestre	serra do cipó
66864	iii	Asteraceae	*Porophyllum obscurum*	(Spreng.) DC.	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	small	cerrado	fazenda treze de maio
66846	i,iii	Asteraceae	*Prestelia eriopus*	Sch.Bip.	This study	5	BEE	indet	campo rupestre	serra do cipó
66856	i	Asteraceae	*Proteopsis argentea*	Mart. & Zucc. ex Sch.Bip.	This study	5	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Asteraceae	*Pseudobrickellia angustissima*	(Spreng. ex Baker) R.M.King & H.Rob.	This study	5	BEE	indet	campo rupestre	serra do cipó
66900	i	Asteraceae	*Pseudobrickellia brasiliensis*	(Spreng.) R.M.King & H.Rob.	This study	5	BEE	-	campo rupestre	serra do cipó
66892	iii	Asteraceae	*Richterago angustifolia*	(Gardner) Roque	This study	4	BEE	small	campo rupestre	serra do cipó
66812	iii	Asteraceae	*Richterago arenaria*	(Baker) Roque	This study	4	BEE	small	campo rupestre	serra do cipó
66820	ii	Asteraceae	*Richterago* cf *caulescens*	Roque	This study	2	BEE	-	campo rupestre	serra do cipó
66819	ii	Asteraceae	*Richterago* cf *conduplicata*	Roque	This study	2	BEE	-	campo rupestre	serra do cipó
66908	i	Asteraceae	*Richterago discoidea*	(Less.) Kuntze	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
66816	i	Asteraceae	*Richterago hatschbachii*	(Zardini) Roque	This study	4	BEE	-	campo rupestre	serra do cipó
66811	i	Asteraceae	*Richterago lanata*	Roque	This study	4	BEE	-	campo rupestre	serra do cipó
66810	ii,iii	Asteraceae	*Richterago polymorpha*	(Less.) Roque	This study	2	BEE	small	campo rupestre	serra do cipó
67698	ii,iii	Asteraceae	*Richterago*	(Baker) Ferreyra	This study,Faria (1994)	2	BEE	small	campo	serra do cipó

			polyphylla						rupestre	
66893	iii	Asteraceae	*Richterago stenophylla*	(Cabrera) Roque	This study	4	BEE	small	campo rupestre	serra do cipó
66867	i	Asteraceae	*Stenocline chionaea*	DC.	This study	5	BEE	-	campo rupestre	serra do cipó
66850	ii	Asteraceae	*Symphyopappus compressus*	(Gardner) B.L.Rob.	Freitas & Sazima (2006)	2	BEE	-	campo de altitude	parque nacional serra da bocaina
67627	iii	Asteraceae	*Symphyopappus cuneatus*	(DC.) Sch.Bip. ex Baker	Freitas & Sazima (2006)	2	BEE	large	campo de altitude	parque nacional serra da bocaina
no_collect	i,iii	Asteraceae	*Symphyopappus reticulatus*	Baker	Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
literature	literature	Asteraceae	*Symphyopappus reticulatus* var *itacolumensis*	Baker	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
66843	ii	Asteraceae	*Trichogonia hirtiflora*	(DC.) Sch.Bip. ex Baker	Araújo et al. (2006),This study	2	BEE	-	campo rupestre	serra do cipó
66844	i	Asteraceae	*Trichogonia villosa*	(Spreng.) Sch.Bip. ex Baker	This study	4	BEE	-	campo rupestre	serra do cipó
66828	iii	Asteraceae	*Vernonanthura rubriramea*	(Mart. ex DC.) Loeuille & P.N.Soares	This study	5	BEE	small	campo rupestre	serra do cipó
67376	ii	Begoniaceae	*Begonia grisea*	A.DC.	This study	2	BEE	-	campo rupestre	serra do cipó
literature	literature	Bignoniaceae	*Adenocalymma dichilum*	A.H.Gentry	Machado & Vogel (2004)	3	BAT	-	campo rupestre	chapada da diamantina (pai inacio)
67365	i	Bignoniaceae	*Adenocalymma pedunculatum*	(Vell.) L.G.Lohmann	Sampaio et al. (2016)	4	BEE	-	cerrado	PESC, MG
67842	i	Bignoniaceae	*Amphilophium elongatum*	(Vahl) L.G.Lohmann	This study	5	BEE	-	campo rupestre	serra do cipó
67367	iii	Bignoniaceae	*Fridericia speciosa*	Mart.	This study	5	HUM	-	campo rupestre	serra do cipó
no_collect	iii	Bignoniaceae	*Handroanthus ochraceus*	(Cham.) Mattos	Barros (1998),Oliveira & Gibbs (2000)	2	BEE	large	cerrado	fazenda agua limpa UNB
67882	ii	Bignoniaceae	*Jacaranda caroba*	(Vell.) DC.	This study	2	BEE	-	campo rupestre	serra do cipó
67364	iii	Bignoniaceae	*Jacaranda paucifoliolata*	Mart. ex DC.	This study	4	BEE	small	campo rupestre	serra do cipó
67366	i	Bignoniaceae	*Jacaranda racemosa*	Cham.	This study	4	BEE	-	campo	serra do cipó

67368	i	Bignoniaceae	*Zeyheria montana*	Mart.	Bittencourt Jr & Semir (2004)	1	HUM	-	campo rupestre	serra do cipó
literature	literature	Bromeliaceae	*Aechmea bromeliifolia*	(Rudge) Baker	Machado et al. (2007),Santana & Machado (2010)	2	HUM	-	campo rupestre	chapada da diamantina
no_collect	iii	Bromeliaceae	Bromeliaceae Indet1	A.Juss.	This study	5	HUM	-	campo rupestre	serra do cipó
67866	iii	Bromeliaceae	*Dyckia macedoi*	L.B.Sm.	Freitas & Sazima (2006)	4	HUM	-	campo de altitude	parque nacional serra da bocaina
no_collect	iii	Bromeliaceae	*Dyckia saxatilis*	Mez	Freitas & Sazima (2006)	4	HUM	-	campo de altitude	parque nacional serra da bocaina
no_collect	i,iii	Bromeliaceae	*Encholirium heloisae*	(L.B.Sm.) Forzza & Wand.	Sazima et al. (1989)	4	BAT	-	campo rupestre	conceicao do mato dentro
literature	literature	Bromeliaceae	*Encholirium subsecundum*	(Baker) Mez	Sazima et al. (1989)	1	BAT	-	campo rupestre	conceicao do mato dentro
literature	literature	Bromeliaceae	*Hohenbergia ramageana*	Mez	Machado et al. (2007),Santana & Machado (2010)	2	HUM	-	campo rupestre	chapada da diamantina
no_collect	ii	Bromeliaceae	*Neoregelia bahiana*	(Ule) L.B.Sm.	This study,Machado et al. (2007),Santana & Machado (2010)	2	HUM	-	campo rupestre	serra do cipó
literature	literature	Bromeliaceae	*Sincoraea albopicta*	(Philcox) Louzada & Wand.	Machado et al. (2007),Santana & Machado (2010)	2	HUM	-	campo rupestre	chapada da diamantina
literature	literature	Bromeliaceae	*Sincoraea mucugensis*	(Wand. & A.A.Conc.) Louzada & Wand.	Santana & Machado (2010)	2	HUM	-	campo rupestre	chapada da diamantina
literature	literature	Bromeliaceae	*Vriesea minarum*	L.B.Sm.	Lavor et al. (2014)	3	HUM	-	campo rupestre	quadrilatero ferrifero
67378	i	Bromeliaceae	*Vriesea stricta*	L.B.Sm.	This study	5	HUM	-	campo rupestre	serra do cipó
67375	i	Cactaceae	*Cipocereus minensis*	(Werderm.) Ritter	Martins et al. (2016)	3	BAT	-	campo rupestre	chapada da diamantina
literature	literature	Cactaceae	*Melocactus ernestii*	Vaupel	Colaço et al. (2006)	1	HUM	-	campo rupestre	chapada da diamantina (morro do chapeu)

literature	literature	Cactaceae	*Melocactus glaucescens*	Buining & Brederoo	Colaço et al. (2006)	1	HUM	-	campo rupestre	chapada da diamantina (morro do chapeu)
literature	literature	Cactaceae	*Melocactus xalbicephalus*	Buining & Brederoo	Colaço et al. (2006)	1	HUM	-	campo rupestre	chapada da diamantina (morro do chapeu)
literature	literature	Cactaceae	*Uebelmannia buiningii*	Donald	Teixeira et al. (2018)	3	BEE	-	campo rupestre	parque estadual da serra negra
67717	i,iii	Calophyllaceae	*Kielmeyera coriacea*	Mart.&Zucc.	Barros (1998),Oliveira & Sazima (1990)	2	BEE	large	cerrado	fazenda agua limpa UNB
67383	iii	Calophyllaceae	*Kielmeyera petiolaris*	Mart.&Zucc.	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
67384	i,iii	Calophyllaceae	*Kielmeyera regalis*	Saddi	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
67718	ii	Calophyllaceae	*Kielmeyera speciosa*	A.St.-Hil.	Barros (2002),This study,Oliveira & Sazima (1990)	2	BEE	-	campo rupestre	serra do cipó
literature	literature	Campanulaceae	*Siphocampylus imbricatus*	(Cham.) G.Don	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
67373	i	Campanulaceae	*Siphocampylus nitidus*	Pohl	Machado et al. (2007)	4	HUM	-	campo rupestre	chapada da diamantina
67372	i	Campanulaceae	*Siphocampylus westinianus*	(Thunb.) Pohl	Machado et al. (2007)	4	HUM	-	campo rupestre	chapada da diamantina
67360	iii	Campanulaceae	*Wahlenbergia brasiliensis*	Cham.	Freitas & Sazima (2006)	2	BEE2	large	campo de altitude	parque nacional serra da bocaina
67363	i	Caryocaraceae	*Caryocar brasiliense*	Cambess.	Gribel & Hay (1993)	1	BAT	-	cerrado	fazenda agua limpa UNB
no_collect	iii	Celastraceae	*Peritassa campestris*	(Cambess.) A.C. Sm.	Gottsberger & Silberbauer-Gottsberger (2006)	3	DIP	-	cerrado	fazenda treze de maio
67374	iii	Celastraceae	*Plenckia populnea*	Reissek	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	small	cerrado	fazenda treze de maio
67362	i	Chrysobalanaceae	*Couepia grandiflora*	(Mart.&Zucc.) Benth.	Gottsberger & Silberbauer-Gottsberger (2006)	3	MOT	-	cerrado	fazenda treze de maio
67361	i	Chrysobalanaceae	*Hirtella glandulosa*	Spreng.	Arista et al. (1997)	1	BUT	-	Mesophyllous Forest	parque do sabiá
67466	i	Clethraceae	*Clethra scabra*	Pers.	Freitas & Sazima (2006)	2	BEE	-	campo de altitude	parque nacional serra da bocaina

no_collect	ii	Clusiaceae	*Clusia mexiae*	P.F.Stevens	Carmo & Franceschinelli (2002),This study	1	BEE	-	campo rupestre	serra do cipó
67412	i	Clusiaceae	*Tovomitopsis paniculata*	(Spreng.) Planch. & Triana	This study	5	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Combretaceae	*Terminalia glabrescens*	Mart.	This study	5	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Connaraceae	*Rourea induta*	Planch.	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	small	cerrado	fazenda treze de maio
no_collect	iii	Convolvulaceae	*Cuscuta* cf *racemosa*	Mart.	This study	5	DIV	-	campo rupestre	serra do cipó
literature	literature	Convolvulaceae	*Daustinia montana*	(Moric.) Buril & A.R.Simões	Silva et al. (2010)	2	BEE	-	campo rupestre	chapada da diamantina
67400	i,iii	Convolvulaceae	*Distimake tomentosus*	(Choisy) Petrongari & Sim.-Bianch.	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	small	cerrado	fazenda treze de maio
67408	i	Convolvulaceae	*Evolvulus cf macroblepharis*	Mart.	Faria (1994)	4	BEE	-	campo rupestre	serra do cipó
literature	literature	Convolvulaceae	*Evolvulus kramerioides*	Mart.	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
67405	i,iii	Convolvulaceae	*Evolvulus lithospermoides*	Mart.	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Convolvulaceae	*Ipomea* sp	L.	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67403	i	Convolvulaceae	*Ipomoea cf maurandioides*	Meisn.	Faria (1994)	4	BEE	-	campo rupestre	serra do cipó
literature	literature	Convolvulaceae	*Ipomoea procumbens*	Mart. ex Choisy	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67714	iii	Convolvulaceae	*Jacquemontia prostrata*	Choisy	Paz et al. (2018)	4	BEE	small	urban area	UEFS, BA
67657	i	Cyperaceae	*Bulbostylis* cf *capillaris*	(L.) C.B.Clarke	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67872	iii	Cyperaceae	*Bulbostylis* cf *conspicua*	(Boeckeler) H.Pfeiff.	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67051	i	Cyperaceae	*Bulbostylis* cf *jacobinae*	(Steud.) Lindm.	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67036	i	Cyperaceae	*Bulbostylis* cf *tenuifolia*	(Rudge) J.F.Macbr.	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio

67040	i	Cyperaceae	*Bulbostylis cf tenuifolia*	(Rudge) J.F.Macbr.	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67865	iii	Cyperaceae	*Bulbostylis* cf *vestita*	(Kunth) C.B.Clarke	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67059	i,iii	Cyperaceae	*Bulbostylis eleocharioides*	Kral & M.T.Strong	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
no_collect	iii	Cyperaceae	*Bulbostylis emmerichiae*	T.Koyama	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67871	i,iii	Cyperaceae	*Bulbostylis junciformis*	(Kunth)C.B.Clarke	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67061	iii	Cyperaceae	*Bulbostylis lombardii*	Kral & M.T.Strong	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67060	iii	Cyperaceae	*Bulbostylis paradoxa*	(Spreng.) Lindm.	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67606	iii	Cyperaceae	*Bulbostylis truncata*	(Nees) M.T.Strong	Gottsberger & Silberbauer-Gottsberger (2006)	4	ANE	-	cerrado	fazenda treze de maio
67058	i,iii	Cyperaceae	*Cryptangium junciforme*	(Kunth) Boeckeler	This study	5	ANE	-	campo rupestre	serra do cipó
67049	i	Cyperaceae	*Cryptangium verticillatum*	(Spreng.) Vitta & S.M.Costa	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	Cyperaceae sp1	Juss.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	Cyperaceae sp2	Juss.	This study	5	ANE	-	campo rupestre	serra do cipó
67057	iii	Cyperaceae	*Lagenocarpus albo-niger*	(A.St.-Hil.) C.B.Clarke	This study	5	ANE	-	campo rupestre	serra do cipó
67047	iii	Cyperaceae	*Lagenocarpus bracteosus*	C.B.Clarke	This study	5	ANE	-	campo rupestre	serra do cipó
67673	i,iii	Cyperaceae	*Lagenocarpus inversus*	C.B.Clarke	This study	5	ANE	-	campo rupestre	serra do cipó
67065	i,iii	Cyperaceae	*Lagenocarpus rigidus*	Nees	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	*Lagenocarpus* sp1	Nees	This study	5	ANE	-	campo rupestre	serra do cipó
67675	i,iii	Cyperaceae	*Lagenocarpus tenuifolius*	(Boeckeler) C.B.Clarke	This study	5	ANE	-	campo rupestre	serra do cipó
67676	i,iii	Cyperaceae	*Lagenocarpus tenuifolius*	(Boeckeler) C.B.Clarke	This study	5	ANE	-	campo rupestre	serra do cipó

67056	iii	Cyperaceae	*Lagenocarpus velutinus*	Nees	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	*Rhynchospora albobracteata*	A.C.Araujo	This study,Costa & Machado (2012)	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	*Rhynchospora brevirostris*	Griseb.	This study	5	ANE	-	campo rupestre	serra do cipó
67670	i	Cyperaceae	*Rhynchospora* cf *brasiliensis*	Boeckeler	This study,Costa & Machado (2012)	5	ANE	-	campo rupestre	serra do cipó
67024	i,iii	Cyperaceae	*Rhynchospora* cf *emaciata*	(Nees) Boeckeler	This study,Costa & Machado (2012)	5	ANE	-	campo rupestre	serra do cipó
67044	i	Cyperaceae	*Rhynchospora* cf *polyantha*	Steud.	This study,Costa & Machado (2012)	5	ANE	-	campo rupestre	serra do cipó
67019	ii	Cyperaceae	*Rhynchospora* cf *setigera**	(Kunth) Griseb.	This study	5	ANE	-	campo rupestre	serra do cipó
67680	i,iii	Cyperaceae	*Rhynchospora ciliolata*	Boeckeler	This study,Costa & Machado (2012)	5	ANE	-	campo rupestre	serra do cipó
67662	ii,iii	Cyperaceae	*Rhynchospora consanguinea**	(Kunth) Boeckeler	This study	5	ANE	-	campo rupestre	serra do cipó
67648	i,iii	Cyperaceae	*Rhynchospora emaciata*	(Kunth) Boeckeler	This study	5	ANE	-	campo rupestre	serra do cipó
67067	iii	Cyperaceae	*Rhynchospora exaltata*	Kunth	This study	5	ANE	-	campo rupestre	serra do cipó
67053	i,iii	Cyperaceae	*Rhynchospora globosa*	(Kunth) Roem. & Schult.	This study	5	ANE	-	campo rupestre	serra do cipó
67652	i,iii	Cyperaceae	*Rhynchospora patuligluma**	C.B.Clarke ex Lindm.	Faria (1994)	5	ANE	-	campo rupestre	serra do cipó
67029	iii	Cyperaceae	*Rhynchospora pilosa*	Boeckeler	This study	5	ANE	-	campo rupestre	serra do cipó
67691	i,iii	Cyperaceae	*Rhynchospora recurvata*	(Schrad. ex Nees) Steud.	This study	5	ANE	-	campo rupestre	serra do cipó
67684	i,iii	Cyperaceae	*Rhynchospora riedeliana*	C.B.Clarke	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	*Rhynchospora* sp1	Vahl.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	*Rhynchospora* sp2	Vahl.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Cyperaceae	*Rhynchospora speciosa**	(Kunth) Boeckeler	Faria (1994)	5	ANE	-	campo rupestre	serra do cipó
67653	i	Cyperaceae	*Rhynchospora tenuis*	Link	This study	5	ANE	-	campo rupestre	serra do cipó

76690	i,iii	Cyperaceae	*Rhynchospora terminalis*	Nees ex Steud.	This study	5	ANE	-	campo rupestre	serra do cipó
67678	i,iii	Cyperaceae	*Scleria cuyabensis*	Pilg.	This study	5	ANE	-	campo rupestre	serra do cipó
67409	ii,iii	Dilleniaceae	*Davilla elliptica*	A.St.-Hil.	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Dioscoreaceae	*Dioscorea polygonoides*	Humb. & Bonpl. ex Willd.	This study	5	DIV	-	campo rupestre	serra do cipó
67410	i	Dioscoreaceae	*Dioscorea stenophylla*	Uline ex R.Knuth	This study	5	DIP	-	campo rupestre	serra do cipó
67401	iii	Droseraceae	*Drosera chrysolepis*	Taub.	Freitas & Sazima (2006)	4	DIP	-	campo de altitude	parque nacional serra da bocaina
67399	iii	Droseraceae	*Drosera montana*	A.St.-Hil.	Freitas & Sazima (2006)	2	DIP	-	campo de altitude	parque nacional serra da bocaina
no_collect	iii	Ebenaceae	*Diospyros lasiocalyx*	(Mart.) B.Walln.	Gottsberger & Silberbauer-Gottsberger (2006)	3	MOT	-	cerrado	fazenda treze de maio
67601	i	Ericaceae	*Agarista angustissima*	Taub.	This study	4	HUM	-	campo rupestre	serra do cipó
67070	ii	Ericaceae	*Agarista cf duartei*	(Sleumer) Judd	This study	2	HUM	-	campo rupestre	serra do cipó
67069	ii	Ericaceae	*Agarista coriifolia*	(Thunb.) Hook. ex Nied.	This study,Rodrigues & Rodrigues (2014)	2	HUM	-	campo rupestre	serra do cipó
67072	ii,iii	Ericaceae	*Gaylussacia montana*	(Pohl) Sleumer	This study	2	BEE	large	campo rupestre	serra do cipó
67068	iii	Ericaceae	*Gaylussacia riedelii*	Meisn.	This study	4	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Ericaceae	*Gaylussacia virgata*	Mart. ex Meisn.	Freitas & Sazima (2006)	4	BEE	large	campo de altitude	parque nacional serra da bocaina
67106	iii	Eriocaulaceae	*Actinocephalus bongardii*	(A.St.-Hil.)Sano	This study	5	DIV	-	campo rupestre	serra do cipó
67096	i	Eriocaulaceae	*Actinocephalus* cf *deflexus*	F.N.Costa	This study	5	DIV	-	campo rupestre	serra do cipó
67099	i,iii	Eriocaulaceae	*Actinocephalus geniculatus*	(Bong.) F. N. Costa	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
67104	iii	Eriocaulaceae	*Actinocephalus polyanthus*	(Bong.)Sano	Freitas & Sazima (2006)	2	DIV	-	campo de altitude	parque nacional serra da bocaina
67092	iii	Eriocaulaceae	*Comanthera* cf *centauroides*	(Bong.) L.R.Parra & Giul.	Ramos et al. (2005)	4	DIV	-	campo rupestre	chapada da diamantina (morro do

										chapeu)
67819	i,iii	Eriocaulaceae	*Comanthera cipoensis*	(Bong.) L.R.Parra & Giul.	Ramos et al. (2005)	4	DIV	-	campo rupestre	chapada da diamantina (morro do chapeu)
67075	iii	Eriocaulaceae	*Comanthera circinnata*	(Bong.) L.R.Parra & Giul.	Ramos et al. (2005)	4	DIV	-	campo rupestre	chapada da diamantina (morro do chapeu)
literature	literature	Eriocaulaceae	*Comanthera curralensis*	(Moldenke) L.R.Parra & Giul.	Ramos et al. (2005)	1	DIP	-	campo rupestre	chapada da diamantina (morro do chapeu)
literature	literature	Eriocaulaceae	*Comanthera elegans*	(Bong.) L.R.Parra & Giul.	Oriani et al. (2009)	1	DIV	-	campo rupestre	serra do cipó
literature	literature	Eriocaulaceae	*Comanthera mucugensis*	(Giul.) L.R. Parra & Giul.	Ramos et al. (2005)	1	DIP	-	campo rupestre	chapada da diamantina (morro do chapeu)
literature	literature	Eriocaulaceae	*Leiothrix arrecta*	Ruhland	Neves (2012)	1	DIP	-	campo rupestre	serra do cipó
67102	i,iii	Eriocaulaceae	*Leiothrix crassifolia*	(Bong.) Ruhland	Neves (2012)	1	DIP	-	campo rupestre	serra do cipó
67094	i,iii	Eriocaulaceae	*Leiothrix curvifolia*	(Bong.) Ruhland	Neves (2012)	4	DIP	-	campo rupestre	serra do cipó
no_collect	iii	Eriocaulaceae	*Leiothrix* sp1	(Körn.) Ruhland	Neves (2012)	4	DIV	-	campo rupestre	serra do cipó
67109	iii	Eriocaulaceae	*Leiothrix spiralis*	(Bong.) Ruhland	Neves (2012)	1	DIP	-	campo rupestre	serra do cipó
67085	ii	Eriocaulaceae	*Paepalanthus argenteus*	(Bong.) Körn.	This study	2	DIV	-	campo rupestre	serra do cipó
67817	ii,iii	Eriocaulaceae	*Paepalanthus bromelioides*	Silveira	This study,Faria (1994)	2	DIV	-	campo rupestre	serra do cipó
67091	i	Eriocaulaceae	*Paepalanthus* cf *homomallus*	(Bong.)Mart. ex Körn.	This study	4	DIV	-	campo rupestre	serra do cipó
67084	iii	Eriocaulaceae	*Paepalanthus* cf *nigrescens*	Silveira	This study	4	DIV	-	campo rupestre	serra do cipó
67076	i	Eriocaulaceae	*Paepalanthus* cf	Ruhland	This study	4	DIV	-	campo	serra do cipó

			superbus						rupestre	
literature	literature	Eriocaulaceae	*Paepalanthus chiquitensis*	Herzog	Faria (1994)	2	DIV	-	campo rupestre	serra do cipó
no_collect	iii	Eriocaulaceae	*Paepalanthus chlorocephalus*	Silveira	This study	4	DIV	-	campo rupestre	serra do cipó
67107	i,iii	Eriocaulaceae	*Paepalanthus erectifolius*	Silveira	This study	4	DIV	-	campo rupestre	serra do cipó
no_collect	iii	Eriocaulaceae	*Paepalanthus eriophaeus*	Ruhland	This study	4	DIV	-	campo rupestre	serra do cipó
67081	iii	Eriocaulaceae	*Paepalanthus globulifer*	(Bong.)Mart. ex Körn.	This study	4	DIV	-	campo rupestre	serra do cipó
67080	iii	Eriocaulaceae	*Paepalanthus macrocephalus*	Mart.	This study	4	DIV	-	campo rupestre	serra do cipó
no_collect	iii	Eriocaulaceae	*Paepalanthus paulinus*	Ruhland	This study	4	DIV	-	campo rupestre	serra do cipó
no_collect	i,iii	Eriocaulaceae	*Paepalanthus* sp	Mart.	This study	4	DIV	-	campo rupestre	serra do cipó
no_collect	iii	Eriocaulaceae	*Paepalanthus* sp4	Mart.	This study	4	DIV	-	campo rupestre	serra do cipó
no_collect	i,iii	Eriocaulaceae	*Paepalanthus* sp5	Mart.	This study	4	DIV	-	campo rupestre	serra do cipó
67082	iii	Eriocaulaceae	*Syngonanthus anthemiflorus*	(Bong.) Ruhland	Oriani et al. (2009)	4	DIV	-	campo rupestre	serra do cipó
67079	i	Eriocaulaceae	*Syngonanthus* cf *gracilis*	(Bong.) Ruhland	Oriani et al. (2009)	4	DIV	-	campo rupestre	serra do cipó
67721	i	Erythroxylaceae	*Erythroxylum* cf *subrotundum*	A.St.-Hil.	This study	4	WASP	-	campo rupestre	serra do cipó
67389	ii	Erythroxylaceae	*Erythroxylum microphyllum*	A.St.-Hil.	This study,Freitas & Sazima (2006)	2	WASP	-	campo rupestre	serra do cipó
67387	ii,iii	Erythroxylaceae	*Erythroxylum suberosum*	A.St.-Hil.	Barros (1998),This study	1	WASP	-	campo rupestre	serra do cipó
no_collect	iii	Euphorbiaceae	*Bernardia crassifolia*	Müll.Arg.	Faria (1994)	2	BEE	indet	campo rupestre	serra do cipó
67397	iii	Euphorbiaceae	*Bernardia similis*	Pax & K.Hoffm.	Faria (1994)	4	BEE	indet	campo rupestre	serra do cipó
67394	iii	Euphorbiaceae	*Croton campestris*	A.St.-Hil.	Freitas & Sazima (2006)	4	DIV	-	campo de altitude	parque nacional serra da bocaina
67707	iii	Euphorbiaceae	*Croton subferrugineus*	Müll.Arg.	Freitas & Sazima (2006)	4	DIV	-	campo de altitude	parque nacional serra da bocaina
literature	literature	Euphorbiaceae	*Croton timandroides*	(Didr.) Müll.Arg.	Faria (1994)	2	BEE	-	campo	serra do cipó

									rupestre	
no_collect	iii	Euphorbiaceae	*Manihot esculenta*	Crantz	Borges (2000)	4	BEE	large	cerrado	UFMT
no_collect	iii	Euphorbiaceae	*Manihot* sp2	Mill.	Borges (2000)	4	BEE	large	cerrado	UFMT
67391	iii	Euphorbiaceae	*Manihot tripartita*	(Spreng.) Müll.Arg.	Borges (2000)	4	BEE	large	cerrado	UFMT
67883	iii	Euphorbiaceae	*Maprounea guianensis*	Juss.	This study	5	DIV	-	campo rupestre	serra do cipó
67393	i	Euphorbiaceae	*Microstachys* cf *corniculata*	(Vahl) Griseb.	Faria (1994),Gottsberger & Silberbauer-Gottsberger (2006)	2	DIV	-	campo rupestre	serra do cipó
67706	iii	Euphorbiaceae	*Microstachys daphnoides*	(Vahl) Griseb.	Faria (1994),Gottsberger & Silberbauer-Gottsberger (2006)	2	DIV	-	campo rupestre	serra do cipó
literature	literature	Euphorbiaceae	*Sapium glandulosum*	(L.) Morong	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Fabaceae	*Andira humilis*	Mart. ex Benth.	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	large	cerrado	fazenda treze de maio
67152	i,iii	Fabaceae	*Bionia coccinea*	Mart. ex Benth.	This study	4	HUM	-	campo rupestre	serra do cipó
67154	ii	Fabaceae	*Bionia coriacea*	(Nees & Mart.) Benth.	This study,Machado et al. (2007)	2	HUM	-	campo rupestre	serra do cipó
67111	i	Fabaceae	*Bowdichia virgilioides*	Kunth	Silva et al. (2011)	2	BEE	-	cerrado	chapadinha alto munim
no_collect	iii	Fabaceae	*Calliandra dysantha*	Benth.	Gottsberger & Silberbauer-Gottsberger (2006)	3	HUM	-	cerrado	fazenda treze de maio
67159	iii	Fabaceae	*Calliandra fasciculata*	Benth.	This study	5	HUM	-	campo rupestre	serra do cipó
literature	literature	Fabaceae	*Calliandra hygrophila*	Mackinder & G.P.Lewis	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
67160	i,iii	Fabaceae	*Calliandra linearis*	Benth.	Gottsberger & Silberbauer-Gottsberger (2006)	4	HUM	-	cerrado	fazenda treze de maio
literature	literature	Fabaceae	*Calliandra mucugeana*	Renvoize	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
67121	i	Fabaceae	*Camptosema isopetalum*	(Lam.) Taub.	This study	3	HUM	-	campo rupestre	serra do cipó
76683	iii	Fabaceae	*Chamaecrista arrojadoana*	(Harms) Rando	This study,Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
76685	i	Fabaceae	*Chamaecrista brachystachya*	(Benth.) Conc. et al.	This study	4	BEE	-	campo rupestre	serra do cipó

76684	i,iii	Fabaceae	*Chamaecrista* cf *cathartica*	(Mart.) H.S.Irwin & Barneby	This study	4	BEE	large	campo rupestre	serra do cipó
67150	i,iii	Fabaceae	*Chamaecrista* cf *rotundifolia*	(Benth.) H.S.Irwin & Barneby	This study	4	BEE	large	campo rupestre	serra do cipó
literature	literature	Fabaceae	*Chamaecrista cipoana*	(H.S.Irwin & Barneby) H.S.Irwin & Barneby	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67141	i	Fabaceae	*Chamaecrista conferta*	(Benth.) H.S.Irwin & Barneby	This study	4	BEE	-	campo rupestre	serra do cipó
67151	ii,iii	Fabaceae	*Chamaecrista desvauxii* var *graminea*	H.S.Irwin & Barneby	This study,Costa et al. (2007),Costa et al. (2013),This study	1	BEE	large	campo rupestre	serra do cipó
67622	ii,iii	Fabaceae	*Chamaecrista ochnacea*	(Vogel) H.S.Irwin & Barneby	Araújo et al. (2006),This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
67147	iii	Fabaceae	*Chamaecrista ramosa*	(Vogel) H.S.Irwin & Barneby	This study	2	BEE	large	campo rupestre	serra do cipó
no_collect	ii	Fabaceae	*Chamaecrista rotundata*	(Vogel) H.S.Irwin & Barneby	This study	2	BEE	-	campo rupestre	serra do cipó
literature	literature	Fabaceae	*Chamaecrista seticrenata*	(H.S.Irwin & Barneby) H.S.Irwin & Barneby	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67139	iii	Fabaceae	*Chamaecrista* sp1	Moench	This study	4	BEE	large	campo rupestre	serra do cipó
67123	i	Fabaceae	*Clitoria* cf *guianensis*	(Aubl.) Benth.	This study	3	BEE	-	campo rupestre	serra do cipó
67137	i	Fabaceae	*Collaea* cf *speciosa*	(Loisel.) DC.	This study	3	HUM	-	campo rupestre	serra do cipó
literature	literature	Fabaceae	*Collaea cipoensis*	Fortunato	Gélvez-Zúñiga et al. (2018)	1	HUM	-	campo rupestre	serra do cipó
67614	i,iii	Fabaceae	*Dalbergia miscolobium*	Benth.	Oliveira (1991)	3	BEE	large	cerrado	cerrado
67112	i,iii	Fabaceae	*Leptolobium dasycarpum*	Vogel	Oliveira & Gibbs (2000)	3	BEE	small	cerrado	cerrado
67864	iii	Fabaceae	*Lupinus coriaceus*	Benth.	Freitas & Sazima (2006)	4	BEE	indet	campo de altitude	parque nacional serra da bocaina
67164	i	Fabaceae	*Machaerium acutifolium*	Vogel	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	-	cerrado	fazenda treze de maio
67115	iii	Fabaceae	*Mimosa bombycina*	Barneby	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	large	cerrado	fazenda treze de maio

no_collect	ii	Fabaceae	*Mimosa cf claussenii*	Benth.	This study	2	BEE	-	campo rupestre	serra do cipó
67119	i	Fabaceae	*Mimosa* cf *dolens*	Vell.	This study	5	BEE	-	campo rupestre	serra do cipó
67611	ii	Fabaceae	*Mimosa* cf *maguirei*	Barneby	This study,Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67116	ii	Fabaceae	*Mimosa claussenii*	Benth.	This study	2	BEE2	-	campo rupestre	serra do cipó
literature	literature	Fabaceae	*Mimosa foliolosa* var *multipinna*	(Benth.) Barneby	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67169	ii	Fabaceae	*Periandra mediterranea*	(Vell.) Taub.	Araújo et al. (2006),This study	2	BEE	-	campo rupestre	serra do cipó
67612	i	Fabaceae	*Senna* cf *rugosa*	(G.Don) H.S.Irwin & Barneby	Carvalho & Oliveira (2003)	4	BEE	-	cerrado	EEP and Macaubas, MG
67125	i,iii	Fabaceae	*Senna* cf *rugosa*	(G.Don) H.S.Irwin & Barneby	Carvalho & Oliveira (2003)	4	BEE	large	cerrado	EEP and Macaubas, MG
67165	iii	Fabaceae	*Stryphnodendron adstringens*	(Mart.) Coville	This study	2	BEE	small	campo rupestre	serra do cipó
67166	i	Fabaceae	*Stryphnodendron rotundifolium*	Mart.	This study	4	BEE	-	campo rupestre	serra do cipó
67175	i	Fabaceae	*Stylosanthes* cf *guianensis*	(Aubl.) Sw.	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	-	cerrado	fazenda treze de maio
67174	iii	Fabaceae	*Zornia latifolia*	Sm.	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	small	cerrado	fazenda treze de maio
67357	i	Gentianaceae	*Calolisianthus pedunculatus*	(Cham. & Schltdl.) Gilg	Freitas e Sazima (2009)	3	HUM	-	campo de altitude	parque nacional serra da bocaina
67356	i	Gentianaceae	*Curtia tenuifolia*	(Aubl.) Knobl.	This study	5	BEE	-	campo rupestre	serra do cipó
67358	i	Gentianaceae	*Deianira nervosa*	Cham. & Schltdl.	Freitas e Sazima (2009)	5	BEE	-	campo de altitude	parque nacional serra da bocaina
67359	iii	Gentianaceae	*Schultesia gracilis*	Mart.	This study	5	BEE	indet	campo rupestre	serra do cipó
literature	literature	Gentianaceae	*Zygostigma australe*	(Cham. & Schltdl.) Griseb.	Freitas e Sazima (2009)	2	BEE	-	campo de altitude	parque nacional serra da bocaina
67419	ii	Gesneriaceae	*Nematanthus wettsteinii*	(Fritsch)H.E.Moore	This study	2	HUM	-	campo rupestre	serra do cipó
no_collect	ii	Gesneriaceae	*Paliavana sericiflora*	Benth.	This study	2	HUM	-	campo rupestre	serra do cipó

literature	literature	Gesneriaceae	*Paliavana tenuiflora*	Mansf.	Ferreira & Viana (2010)	1	BEE	-	campo rupestre	chapada da diamantina (mucuge municipal park)
literature	literature	Humiriaceae	*Humiria balsamifera*	(Aubl.) A.St.-Hil.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67426	i	Iridaceae	*Deluciris* cf *violacea*	(Klatt) A.Gil & Lovo	This study	4	BEE	-	campo rupestre	serra do cipó
67423	iii	Iridaceae	*Deluciris rupestris*	(Ravenna) Lovo & A.Gil	This study	4	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Iridaceae	Iridaceae Indet15	Juss.	This study	5	DIV	-	campo rupestre	serra do cipó
67837	i	Iridaceae	*Pseudotrimezia* cf *truncata*	(Ravenna) Lovo & A.Gil	This study	4	BEE	-	campo rupestre	serra do cipó
67428	iii	Iridaceae	*Pseudotrimezia cipoana*	Ravenna	This study	5	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Iridaceae	*Pseudotrimezia fistulosa*	(R.C.Foster) Lovo & A.Gil	This study	4	BEE	large	campo rupestre	serra do cipó
67821	iii	Iridaceae	*Pseudotrimezia juncifolia*	(Klatt) Lovo & A.Gil	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
67425	i,iii	Iridaceae	*Sisyrinchium vaginatum*	Spreng.	Freitas & Sazima (2006)	2	BEE	indet	campo de altitude	parque nacional serra da bocaina
67430	i	Iridaceae	*Trimezia euoneotrimezia*	Salisb. ex Herb.	This study	4	BEE	-	campo rupestre	serra do cipó
no_collect	i	Iridaceae	*Trimezia meliifolia*	Salisb. ex Herb.	This study	4	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Iridaceae	*Trimezia* sp2	Salisb. ex Herb.	This study	4	BEE	large	campo rupestre	serra do cipó
66919	i	Lamiaceae	*Aegiphila verticillata*	Vell.	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	-	cerrado	fazenda treze de maio
67443	i	Lamiaceae	*Cyanocephalus* cf *lippioides*	(Pohl ex Benth.) Harley & J.F.B.Pastore	Freitas & Sazima (2006)	2	BEE	-	campo de altitude	parque nacional serra da bocaina
67431	i	Lamiaceae	*Cyanocephalus peduncularis*	(Benth.) Harley & J.F.B.Pastore	Freitas & Sazima (2006)	4	BEE	-	campo de altitude	parque nacional serra da bocaina
literature	literature	Lamiaceae	*Eriope angustifolia*	Epling	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Lamiaceae	*Eriope arenaria*	Harley	This study	4	BEE	small	campo rupestre	serra do cipó

67827	ii	Lamiaceae	*Eriope macrostachya*	Mart. ex Benth.	This study	2	BEE	-	campo rupestre	serra do cipó
no_collect	ii	Lamiaceae	*Hypenia macrantha*	(A.St.-Hil. ex Benth.) Harley	This study	2	HUM	-	campo rupestre	serra do cipó
67832	i	Lamiaceae	*Hypenia reticulata*	(Mart. ex Benth.) Harley	This study	4	HUM	-	campo rupestre	serra do cipó
67884	i,iii	Lamiaceae	*Hyptidendron canum*	(Pohl ex Benth.) Harley	Freitas & Sazima (2006)	4	BEE	indet	campo de altitude	parque nacional serra da bocaina
67433	iii	Lamiaceae	*Hyptidendron vauthieri*	(Briq.) Harley	Freitas & Sazima (2006)	2	BEE	indet	campo de altitude	parque nacional serra da bocaina
literature	literature	Lamiaceae	*Hyptidendron vepretorum*	(Mart. ex Benth.) Harley	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67833	iii	Lamiaceae	*Hyptis crenata*	Pohl ex Benth.	Freitas & Sazima (2006)	2	BEE	small	campo de altitude	parque nacional serra da bocaina
67434	i	Lamiaceae	*Hyptis ditassoides*	Mart. ex Benth.	Faria (1994)	4	BEE	-	campo rupestre	serra do cipó
67822	ii,iii	Lamiaceae	*Hyptis proteoides*	A.St.-Hil. ex Benth.	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Lamiaceae	*Hyptis* sp2	Jacq.	Faria (1994)	4	BEE	large	campo rupestre	serra do cipó
67437	i	Lamiaceae	*Rhabdocaulon* cf *denudatum*	(Benth.) Epling	This study	5	HUM	-	campo rupestre	serra do cipó
67444	i	Lauraceae	*Ocotea langsdorffii*	(Meisn.) Mez	This study	4	BEE	-	campo rupestre	serra do cipó
67446	i	Lauraceae	*Ocotea tristis*	(Nees&Mart.)Mez	This study	4	BEE	-	campo rupestre	serra do cipó
literature	literature	Lentibulariaceae	*Genlisea violacea*	A.St.-Hil.	Aranguren et al. (2018)	2	BEE	-	campo rupestre	serra da canastra
67835	iii	Lentibulariaceae	*Utricularia* cf *tricolor*	A.St.-Hil.	This study	5	BEE	indet	campo rupestre	serra do cipó
67834	i	Lentibulariaceae	*Utricularia* cf *triloba*	Benj.	This study	5	BEE	-	campo rupestre	serra do cipó
67448	i	Loganiaceae	*Antonia ovata*	Pohl	Oliveira et al. (2004)	1	MOT	-	cerrado	brasilia botanicgarden
67450	iii	Loganiaceae	*Spigelia aceifolia*	Woodson	This study	4	HUM	-	campo rupestre	serra do cipó
67791	i	Loganiaceae	*Spigelia* cf *spartioides*	Cham.	This study	4	HUM	-	campo rupestre	serra do cipó

literature	literature	Loganiaceae	*Spigelia pulchella*	Mart.	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
67447	iii	Loganiaceae	*Spigelia schlechtendaliana*	Mart.	This study	4	HUM	-	campo rupestre	serra do cipó
67449	ii,iii	Loganiaceae	*Spigelia sellowiana*	Cham. & Schltdl.	This study	2	HUM	-	campo rupestre	serra do cipó
no_collect	iii	Loganiaceae	*Spigelia* sp	L.	This study	4	HUM	-	campo rupestre	serra do cipó
67451	i	Loranthaceae	*Psittacanthus* cf *plagiophyllus*	Eichler	Guerra et al. (2014)	4	HUM	-	campo rupestre	serra do cipó
67454	ii	Loranthaceae	*Psittacanthus robustus*	(Mart.) Mart.	This study,Guerra et al. (2014)	1	HUM	-	campo rupestre	serra do cipó
67808	ii	Loranthaceae	*Struthanthus flexicaulis*	(Mart.) Mart.	This study,Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67807	ii,iii	Lythraceae	*Cuphea ericoides*	Cham. & Schltdl.	This study,Rodrigues & Rodrigues (2014)	2	BEE	large	campo rupestre	serra do cipó
67794	ii,iii	Lythraceae	*Cuphea linarioides*	Cham. & Schltdl.	This study	2	BEE	large	campo rupestre	serra do cipó
literature	literature	Lythraceae	*Cuphea pseudovaccinium*	A.St.-Hil.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
no_collect	i,iii	Lythraceae	*Cuphea* sp1	P.Browne	This study	4	BEE	large	campo rupestre	serra do cipó
literature	literature	Lythraceae	*Cuphea sperguloides*	A.St.-Hil.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67796	i	Lythraceae	*Diplusodon hirsutus*	(Cham. & Schltdl.) A.DC.	Jacobi et al. (2000)	2	BEE	-	campo rupestre	serra do cipó
67464	iii	Lythraceae	*Diplusodon lanceolatus*	Pohl	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67800	i,iii	Lythraceae	*Diplusodon orbicularis*	Koehne	Araújo et al. (2006),Faria (1994),Jacobi et al. (2000)	2	BEE	small	campo rupestre	serra do cipó
67456	i,iii	Lythraceae	*Lafoensia pacari*	A.St.-Hil.	Oliveira et al. (2004),Sazima e Sazima (1975)	1	BAT	-	campo rupestre	serra do cipó
76680	i,iii	Malpighiaceae	*Banisteriopsis campestris*	(A.Juss.) Little	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	large	cerrado	fazenda treze de maio
76675	iii	Malpighiaceae	*Banisteriopsis cipoensis*	B.Gates	Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
67933	i	Malpighiaceae	*Byrsonima* cf *basiloba*	A.Juss.	This study	4	BEE	-	campo rupestre	serra do cipó
76677	i	Malpighiaceae	*Byrsonima* cf	(L.) Kunth	This study	4	BEE	-	campo	serra do cipó

			crassifolia						rupestre	
76676	ii	Malpighiaceae	*Byrsonima* cf *guilleminiana*	A.Juss.	This study	2	BEE	-	campo rupestre	serra do cipó
67311	i	Malpighiaceae	*Byrsonima* cf *sericea*	DC.	Freitas & Sazima (2006)	2	BEE	-	campo de altitude	parque nacional serra da bocaina
67309	i	Malpighiaceae	*Byrsonima* cf *variabilis*	A.Juss.	Freitas & Sazima (2006)	2	BEE	-	campo de altitude	parque nacional serra da bocaina
67315	i	Malpighiaceae	*Byrsonima coccolobifolia*	Kunth	Amorim & De Marco (2011),Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
76681	i,iii	Malpighiaceae	*Byrsonima dealbata*	Griseb.	Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
67305	i	Malpighiaceae	*Byrsonima ligustrifolia*	A.Juss.	This study	4	BEE	-	campo rupestre	serra do cipó
67316	ii	Malpighiaceae	*Byrsonima pachyphylla*	A.Juss.	Alves-dos-Santos et al. (2007),This study,Vilas Boas et al. (2013)	2	BEE	-	campo rupestre	serra do cipó
no_collect	i,iii	Malpighiaceae	*Byrsonima* sp	Rich. ex Kunth	This study	4	BEE	large	campo rupestre	serra do cipó
76678	i	Malpighiaceae	*Byrsonima subterranea*	Brade & Markgr.	This study	4	BEE	-	campo rupestre	serra do cipó
67300	ii,iii	Malpighiaceae	*Byrsonima vacciniifolia*	A.Juss.	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
76679	i	Malpighiaceae	*Byrsonima verbascifolia*	(L.) DC.	This study	3	BEE	-	campo rupestre	serra do cipó
67295	i	Malpighiaceae	*Heteropterys bullata*	Amorim	This study	4	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Malpighiaceae	*Heteropterys* cf *campestris*	A.Juss.	This study	4	BEE	large	campo rupestre	serra do cipó
no_collect	ii	Malpighiaceae	*Heteropterys pteropetala*	A.Juss.	This study	2	BEE	-	campo rupestre	serra do cipó
67290	i	Malpighiaceae	*Peixotoa cf cipoana*	C.E.Anderson	Araújo et al. (2006)	4	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
literature	literature	Malpighiaceae	*Peixotoa reticulata*	Griseb.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67289	i,iii	Malpighiaceae	*Peixotoa tomentosa*	A.Juss.	Araújo et al. (2006)	3	BEE	large	campo rupestre	hematitic canga/ouro

										branco mountains
67291	i,iii	Malpighiaceae	*Pterandra pyroidea*	A.Juss.	Cappellari et al. (2011)	3	BEE	large	cerrado	reserva ecologica do ibge
76674	ii,iii	Malpighiaceae	*Tetrapterys microphylla*	(A.Juss.) Nied.	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
67286	i	Malpighiaceae	*Tetrapterys salicifolia*	(A.Juss.) Nied.	This study	4	BEE	-	campo rupestre	serra do cipó
67271	iii	Malvaceae	*Ayenia angustifolia*	A.St.-Hil. & Naudin	This study	5	BUT	-	campo rupestre	serra do cipó
no_collect	iii	Malvaceae	*Eriotheca* sp1	Schott & Endl.	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	large	cerrado	fazenda treze de maio
67270	i	Malvaceae	*Luehea grandiflora*	Mart. & Zucc.	Gottsberger & Silberbauer-Gottsberger (2006)	3	BAT	-	cerrado	fazenda treze de maio
literature	literature	Malvaceae	*Pavonia luetzelburgii* var *cordata*	Ulbr.	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
literature	literature	Malvaceae	*Pavonia malvaviscoides*	A.St.-Hil.	Sazima (1981)	1	HUM	-	campo rupestre	serra do cipó
literature	literature	Malvaceae	*Pavonia montana*	Garcke ex Gürke	Sazima (1981)	1	HUM	-	campo rupestre	serra do cipó
no_collect	iii	Malvaceae	*Pavonia* sp	Cav.	Sazima (1981)	4	HUM	-	campo rupestre	serra do cipó
no_collect	iii	Malvaceae	*Sida aurantiaca*	A.St.-Hil.	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	small	cerrado	fazenda treze de maio
67180	i	Melastomataceae	*Cambessedesia corymbosa*	Mart. & Schrank ex DC.	Faria (1994)	4	BEE	-	campo rupestre	serra do cipó
67192	i	Melastomataceae	*Cambessedesia hilariana*	(Kunth) DC.	Faria (1994),Fracasso & Sazima (2004)	1	BEE	-	campo rupestre	serra do cipó
67208	ii,iii	Melastomataceae	*Cambessedesia semidecandra*	A.St.-Hil. ex A.B.Martins	This study	2	BEE	large	campo rupestre	serra do cipó
literature	literature	Melastomataceae	*Cambessedesia wurdackii*	A.B.Martins	Franco & Gimenes (2011)	2	BEE	-	campo rupestre	chapada da diamantina
no_collect	iii	Melastomataceae	cf *Marcetia* sp	DC.	Faria (1994)	4	BEE	large	campo rupestre	serra do cipó
67870	i,iii	Melastomataceae	*Chaetostoma armatum*	(Spreng.) Cogn.	This study,Maia et al. (2016)	2	BEE	large	campo rupestre	serra do cipó

67191	i	Melastomataceae	*Fritzschia sertularia*	(Schrank & Mart. ex DC.) M.J.R.Rocha & P.J.F.Guim.	This study	5	BEE	-	campo rupestre	serra do cipó
67209	iii	Melastomataceae	*Lavoisiera campos-portoana*	Barreto	This study	2	BEE	large	campo rupestre	serra do cipó
67204	i	Melastomataceae	*Lavoisiera caryophyllea*	A.St.-Hil. ex Naudin	This study	4	BEE	-	campo rupestre	serra do cipó
67763	ii,iii	Melastomataceae	*Lavoisiera confertiflora*	Rich. ex Naudin	This study	2	BEE	large	campo rupestre	serra do cipó
67770	ii	Melastomataceae	*Lavoisiera cordata*	Cogn.	This study,Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67181	iii	Melastomataceae	*Lavoisiera crassifolia*	DC.	This study	4	BEE	large	campo rupestre	serra do cipó
67203	i	Melastomataceae	*Lavoisiera glandulifera*	Naudin	This study	4	BEE	-	campo rupestre	serra do cipó
67200	i	Melastomataceae	*Lavoisiera imbricata*	(Thunb.) DC.	Maia et al. (2016)	2	BEE	-	cerrado	parque estadual guartela
67190	ii	Melastomataceae	*Lavoisiera subulata*	Triana	This study	2	BEE	-	campo rupestre	serra do cipó
67206	ii	Melastomataceae	*Leandra aurea*	(Cham.) Cogn.	This study,Maia et al. (2016)	2	BEE	-	campo rupestre	serra do cipó
67202	i	Melastomataceae	*Leandra coriacea*	Cogn.	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela
67772	i	Melastomataceae	*Macairea radula*	(Bonpl.)DC.	This study	3	BEE	-	campo rupestre	serra do cipó
67201	iii	Melastomataceae	*Marcetia acerosa*	Schrank & Mart. ex DC.	Faria (1994)	4	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Melastomataceae	*Marcetia* cf *acerosa*	Schrank & Mart. ex DC.	Faria (1994)	4	BEE	large	campo rupestre	serra do cipó
67839	i,iii	Melastomataceae	*Marcetia taxifolia*	(A.St.-Hil.) DC.	Araújo et al. (2006),Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Melastomataceae	*Miconia alborufescens*	Naudin	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
literature	literature	Melastomataceae	*Miconia elegans*	Cogn.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Melastomataceae	*Miconia fallax*	DC.	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67179	i	Melastomataceae	*Miconia ferruginata*	DC.	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela

67786	i	Melastomataceae	*Miconia irwinii*	Wurdack	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela
67183	i	Melastomataceae	*Miconia ligustroides*	(DC.)Naudin	Goldenberg & Shepherd (1998),Maia et al. (2016)	3	BEE	-	cerrado	estacao ecologica itirapina
67193	i	Melastomataceae	*Miconia rubiginosa*	(Bonpl.) DC.	Goldenberg & Shepherd (1998)	3	BEE	-	cerrado	estacao ecologica itirapina
no_collect	iii	Melastomataceae	*Miconia* sp1	Ruiz & Pav.	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67199	i	Melastomataceae	*Microlicia amplexicaulis*	Cogn.	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela
no_collect	i	Melastomataceae	*Microlicia amplexicaulis*	Cogn.	This study	4	BEE	-	campo rupestre	serra do cipó
no_collect	i	Melastomataceae	*Microlicia candolleana*	R. Romero & Versiane	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela
67198	i,iii	Melastomataceae	*Microlicia cardiophora*	Naudin	Maia et al. (2016)	4	BEE	small	cerrado	parque estadual guartela
no_collect	i	Melastomataceae	*Microlicia graveolens*	DC.	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela
no_collect	iii	Melastomataceae	*Microlicia hirticalyx*	R.Romero&Woodgyer	Maia et al. (2016)	4	BEE	small	cerrado	parque estadual guartela
no_collect	ii	Melastomataceae	*Microlicia juniperina*	A. St. Hil.	This study,Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67767	i	Melastomataceae	*Microlicia multicaulis*	Mart.exNaudin	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela
no_collect	i	Melastomataceae	*Microlicia regeliana*	Cogn.	Maia et al. (2016)	4	BEE	-	cerrado	parque estadual guartela
no_collect	i,ii,iii	Melastomataceae	*Microlicia* sp	D.Don	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Melastomataceae	*Microlicia* sp1	D.Don	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67849	iii	Melastomataceae	*Microlicia* sp2	D.Don	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Melastomataceae	*Microlicia* sp3	D.Don	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67182	i	Melastomataceae	*Pleroma candolleanum*	(Mart. ex DC.) Triana	This study	3	BEE	-	campo rupestre	serra do cipó
67178	ii,iii	Melastomataceae	*Pleroma cardinale*	(Bonpl.) Triana	This study	2	BEE	large	campo	serra do cipó

67194	ii,iii	Melastomataceae	*Pleroma heteromallum*	(D. Don) D.Don	This study	2	BEE	large	campo rupestre	serra do cipó
literature	literature	Melastomataceae	*Pterolepis alpestris*	(DC.) Triana	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67189	i	Melastomataceae	*Rhynchanthera cordata*	DC.	This study	5	BEE	-	campo rupestre	serra do cipó
67773	i,iii	Melastomataceae	*Siphanthera arenaria*	(DC.)Cogn.	This study	5	BEE	large	campo rupestre	serra do cipó
67197	i	Melastomataceae	*Tibouchina martiusiana*	(DC.) Cogn.	This study	4	BEE	-	campo rupestre	serra do cipó
literature	literature	Melastomataceae	*Tibouchina multiflora*	(Gardner) Cogn.	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
literature	literature	Melastomataceae	*Tococa guianensis*	Aubl.	Ranieri et al. (2013)	2	BEE	-	campo rupestre	parque estadual do rio preto PERP
67185	i,iii	Melastomataceae	*Trembleya laniflora*	(D.Don) Cogn.	Soares & Morellato (2018)	1	BEE	large	campo rupestre	serra do cipó
67187	i	Melastomataceae	*Trembleya tridentata*	Naudin	Maia et al. (2016)	2	BEE	-	cerrado	parque estadual guartela
no_collect	iii	Moraceae	*Ficus* sp1	L.	This study	5	WASP	-	campo rupestre	serra do cipó
67761	i,iii	Myrtaceae	*Campomanesia adamantium*	(Cambess.) O.Berg	Nucci (2016)	2	BEE	large	cerrado	fazenda carambola
67868	iii	Myrtaceae	*Campomanesia cf pubescens*	(Mart.ex DC.) O.Berg	Proença & Gibbs (1994)	2	BEE	large	cerrado	brasilia botanic garden
67518	iii	Myrtaceae	*Myrcia bella*	Cambess.	This study	4	BEE	large	campo rupestre	serra do cipó
67522	i	Myrtaceae	*Myrcia* cf *splendens*	(Sw.) DC.	This study	4	BEE	-	campo rupestre	serra do cipó
67754	ii,iii	Myrtaceae	*Myrcia guianensis*	(Aubl.) DC.	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Myrtaceae	Myrtaceae Indet1	Juss.	This study	5	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Nyctaginaceae	*Guapira noxia*	(Netto) Lundell	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	small	cerrado	fazenda treze de maio
67552	i,iii	Nyctaginaceae	*Guapira opposita*	(Vell.) Reitz	Oliveira & Gibbs (2000)	4	DIV	-	cerrado	cerrado

no_collect	iii	Nyctaginaceae	*Neea theifera*	Oerst.	Amorim et al. (2011),Gottsberger & Silberbauer-Gottsberger (2006)	1	COL	-	campo rupestre	parque estadual da serra de caldas novas
67752	ii	Ochnaceae	*Luxemburgia ciliosa*	(Mart.) Gardner	This study	2	BEE	-	campo rupestre	serra do cipó
67546	ii	Ochnaceae	*Luxemburgia schwackeana*	Taub.	This study,Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67876	ii,iii	Ochnaceae	*Ouratea floribunda*	(A.St.-Hil.)Engl.	This study	2	BEE	small	campo rupestre	serra do cipó
67551	i	Onagraceae	*Ludwigia* cf *myrtifolia*	(Cambess.) H.Hara	Gimenes (2002)	4	BEE	-		campos do jordão state park, SP
literature	literature	Orchidaceae	*Acianthera adamantinensis*	(Brade) F.Barros	Borba & Semir (2001)	1	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera fabiobarrosii*	(Borba & Semir) F.Barros & F.Pinheiro	Borba & Semir (2001)	1	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera hamosa*	(Barb. Rodr.) Pridgeon & M.W.Chase	Melo et al. (2011)	2	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera johannensis*	(Barb. Rodr.) Pridgeon & M.W.Chase	Borba & Semir (2001)	1	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera limae*	(Porto & Brade) Pridgeon & M.W.Chase	Melo et al. (2011)	2	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera modestissima*	(Rchb.f. & Warm.) Pridgeon & M.W.Chase	Melo et al. (2011)	2	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera ochreata*	(Lindl.) Pridgeon & M.W.Chase	Borba & Semir (2001)	1	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera prolifera*	(Herb. ex Lindl.) Pridgeon & M.W.Chase	Melo et al. (2011)	2	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Acianthera teres*	(Lindl.) Borba	Borba & Semir (2001)	1	DIP	-	campo rupestre	div
literature	literature	Orchidaceae	*Bulbophyllum exaltatum*	Lindl.	Borba & Semir (1998)	2	DIP	-	campo rupestre	serra do cipó

literature	literature	Orchidaceae	*Bulbophyllum involutum*	Borba et al.	Borba & Semir (1998)	2	DIP	-	campo rupestre	serra do cipó
literature	literature	Orchidaceae	*Bulbophyllum weddellii*	(Lindl.) Rchb.f.	Borba & Semir (1998)	2	DIP	-	campo rupestre	serra do cipó
literature	literature	Orchidaceae	*Bulbophyllum* x*cipoense*	Borba et al.	Borba & Semir (1998)	3	DIP	-	campo rupestre	serra do cipó
literature	literature	Orchidaceae	*Cattleya elongata*	Barb.Rodr.	Smidt et al. (2006)	2	BEE	-	campo rupestre	chapada da diamantina
literature	literature	Orchidaceae	*Cattleya tenuis*	Campacci & Vedovello	Smidt et al. (2006)	2	BEE	-	campo rupestre	chapada da diamantina
67538	i	Orchidaceae	*Epidendrum campestre*	Lindl.	This study	5	BEE	-	campo rupestre	serra do cipó
67537	i	Orchidaceae	*Epidendrum saxatile*	Lindl.	This study	5	BEE	-	campo rupestre	serra do cipó
67533	i	Orchidaceae	*Epistephium sclerophyllum*	Lindl.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67541	i	Orchidaceae	*Gomesa* cf *ramosa*	(Lindl.) M.W.Chase & N.H.Williams	This study	5	BEE	-	campo rupestre	serra do cipó
67539	i	Orchidaceae	*Gomesa gracilis*	(Lindl.) M.W.Chase & N.H.Williams	This study	5	BEE	-	campo rupestre	serra do cipó
67744	i	Orchidaceae	*Gomesa hydrophila*	(Barb.Rodr.) M.W.Chase & N.H.Williams	This study	5	BEE	-	campo rupestre	serra do cipó
67532	i	Orchidaceae	*Habenaria cf hamata*	Barb.Rodr.	This study	5	MOT	-	campo rupestre	serra do cipó
67531	iii	Orchidaceae	*Habenaria magniscutata*	Catling	This study	5	MOT	-	campo rupestre	serra do cipó
no_collect	iii	Orchidaceae	Orchidaceae Indet1	A.Juss.	This study	5	BEE	indet	campo rupestre	serra do cipó
no_collect	iii	Orchidaceae	Orchidaceae Indet3	A.Juss.	This study	5	BEE	indet	campo rupestre	serra do cipó
no_collect	iii	Orchidaceae	Orchidaceae Indet4	A.Juss.	This study	5	BEE	indet	campo rupestre	serra do cipó
no_collect	iii	Orchidaceae	Orchidaceae Indet5	A.Juss.	This study	5	BEE	indet	campo rupestre	serra do cipó
no_collect	iii	Orchidaceae	Orchidaceae Indet6	A.Juss.	This study	5	BEE	indet	campo rupestre	serra do cipó
67740	i,iii	Orobanchaceae	*Agalinis brachyphylla*	(Cham. & Schltdl.) D'Arcy	This study	5	BEE	indet	campo rupestre	serra do cipó

67738	iii	Orobanchaceae	*Buchnera lavandulacea*	Cham. & Schltdl.	Araújo et al. (2006)	3	BEE	large	campo rupestre	hematitic canga/ouro branco mountains
no_collect	iii	Orobanchaceae	*Buchnera palustris*	(Aubl.) Spreng.	Araújo et al. (2006)	4	BEE	large	campo rupestre	hematitic canga/ouro branco mountains
67555	i	Orobanchaceae	*Esterhazya splendida*	J.C.Mikan	Rodrigues & Rodrigues (2014)	2	HUM	-	campo rupestre	serra do cipó (alto palácio)
67557	i	Orobanchaceae	*Physocalyx major*	Mart.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67553	iii	Oxalidaceae	*Oxalis densifolia*	Mart. & Zucc. ex Zucc.	This study	5	BEE	indet	campo rupestre	serra do cipó
no_collect	iii	Phyllanthaceae	*Phyllanthus choretroides*	Müll.Arg.	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67735	ii	Phyllanthaceae	*Phyllanthus klotzschianus*	Müll.Arg.	This study,Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67013	i,iii	Poaceae	*Andropogon bicornis*	L.	This study	5	ANE	-	campo rupestre	serra do cipó
67006	i	Poaceae	*Andropogon brasiliensis*	A. Zanin & Longhi-Wagner	This study	5	ANE	-	campo rupestre	serra do cipó
67014	i	Poaceae	*Andropogon gayanus*	Kunth	This study	5	ANE	-	campo rupestre	serra do cipó
67483	i,iii	Poaceae	*Andropogon leucostachyus*	Kunth	This study	5	ANE	-	campo rupestre	serra do cipó
67010	i	Poaceae	*Andropogon macrothrix*	Trin.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp1	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp10	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp11	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp12	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp13	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp14	L.	This study	5	ANE	-	campo rupestre	serra do cipó

no_collect	iii	Poaceae	*Andropogon* sp2	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp3	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp5	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp6	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp7	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Andropogon* sp9	L.	This study	5	ANE	-	campo rupestre	serra do cipó
67261	i	Poaceae	*Andropogon virgatus*	Desv. ex Ham.	This study	5	ANE	-	campo rupestre	serra do cipó
67247	i,iii	Poaceae	*Anthaenantia lanata*	(Kunth) Benth.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Anthaenantia* sp1	P.Beauv.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Apochloa* aff *cipoensis*	(Renvoize & Send.) Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
66992	i,iii	Poaceae	*Apochloa cipoensis*	(Renvoize&Send.)Zuloaga&Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
67602	i,iii	Poaceae	*Apochloa euprepes*	(Renvoize) Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
67475	i,iii	Poaceae	*Apochloa lorea*	(Trin.) Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
67474	i	Poaceae	*Apochloa lutzii*	(Swallen) Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Apochloa* sp2	Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Apochloa* sp3	Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
67248	i,iii	Poaceae	*Aristida ekmaniana*	Henrard	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67254	iii	Poaceae	*Aristida longifolia*	Trin.	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
66989	i	Poaceae	*Aristida riparia*	Trin.	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio

67246	i,iii	Poaceae	*Aristida setifolia*	Kunth	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
no_collect	iii	Poaceae	*Aristida* sp3	L.	This study	5	ANE	-	campo rupestre	serra do cipó
67604	i,iii	Poaceae	*Aristida torta*	(Nees) Kunth	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
no_collect	iii	Poaceae	*Aulonemia effusa*	(Hack.) McClure	This study	5	ANE	-	campo rupestre	serra do cipó
67477	i,iii	Poaceae	*Axonopus aureus*	P.Beauv.	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67252	i,iii	Poaceae	*Axonopus brasiliensis*	(Spreng.) Kuhlm.	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67480	i	Poaceae	*Axonopus cf pressus*	(Nees ex Steud.) Parodi	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67003	i,iii	Poaceae	*Axonopus fastigiatus*	(Nees ex Trin.) Kuhlm.	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67255	i,iii	Poaceae	*Axonopus marginatus*	(Trin.) Chase	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67001	i	Poaceae	*Axonopus pellitus*	(Nees ex Trin.) Hitchc. & Chase	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
no_collect	iii	Poaceae	*Axonopus* sp1	P. Beauv.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Axonopus* sp2	P. Beauv.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Axonopus* sp4	P. Beauv.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Ctenium brevispicatum*	J.G.Sm.	This study	5	ANE	-	campo rupestre	serra do cipó
67496	i,iii	Poaceae	*Echinolaena inflexa*	(Poir.) Chase	This study	5	ANE	-	campo rupestre	serra do cipó
67263	iii	Poaceae	*Homolepis longispicula*	(Döll) Chase	This study	5	ANE	-	campo rupestre	serra do cipó
67492	i	Poaceae	*Loudetiopsis chrysothrix*	(Nees) Conert	This study	5	ANE	-	campo rupestre	serra do cipó
67600	iii	Poaceae	*Melinis minutiflora*	P.Beauv.	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67265	i	Poaceae	*Mesosetum cf loliiforme*	(Hochst.) Chase	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Mesosetum*	(Trin.) Chase	This study	5	ANE	-	campo	serra do cipó

			exaratum						rupestre	
67497	i,iii	Poaceae	*Mesosetum loliiforme*	(Hochst.) Chase	This study	5	ANE	-	campo rupestre	serra do cipó
67015	iii	Poaceae	*Mnesithea subgibbosa*	(C. Winkl. ex Hack.) de Koning & Sosef	This study	5	ANE	-	campo rupestre	serra do cipó
67485	i,iii	Poaceae	*Paspalum erianthum*	Nees ex Trin.	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67603	iii	Poaceae	*Paspalum gardnerianum*	Nees	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
no_collect	iii	Poaceae	*Paspalum hyalinum*	Nees_ex_Trin.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Paspalum pectinatum*	Nees ex Trin.	This study	5	ANE	-	campo rupestre	serra do cipó
66984	i	Poaceae	*Paspalum polyphyllum*	Nees	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
no_collect	iii	Poaceae	*Paspalum* sp1	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Paspalum* sp2	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Paspalum* sp3	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Paspalum* sp4	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Paspalum* sp5	L.	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp1	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp10	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp11	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp12	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp13	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp14	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp15	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp16	Barnhart	This study	5	ANE	-	campo	serra do cipó

no_collect	iii	Poaceae	Poaceae sp17	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp18	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp19	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp2	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp20	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp21	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp22	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp23	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp24	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp26	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp27	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp28	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp29	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp3	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp30	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp31	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp32	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp33	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp34	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp35	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó

no_collect	iii	Poaceae	Poaceae sp36	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp37	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp38	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp39	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp4	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp40	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp42	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp43	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp44	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp46	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp5	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp6	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp7	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	Poaceae sp8	Barnhart	This study	5	ANE	-	campo rupestre	serra do cipó
67018	i,iii	Poaceae	*Schizachyrium sanguineum*	(Retz.) Alston	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67016	i,iii	Poaceae	*Schizachyrium tenerum*	Nees	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67259	i	Poaceae	*Setaria parviflora*	(Poir.) Kerguélen	This study	5	ANE	-	campo rupestre	serra do cipó
67260	i	Poaceae	*Sporobolus aeneus*	(Trin.) Kunth	This study	5	ANE	-	campo rupestre	serra do cipó
67256	i	Poaceae	*Sporobolus metallicolus*	Longhi-Wagner & Boechat	This study	5	ANE	-	campo rupestre	serra do cipó
67493	i,iii	Poaceae	*Tatianyx arnacites*	(Trin.) Zuloaga & Soderstr.	This study	5	ANE	-	campo rupestre	serra do cipó

67262	i,iii	Poaceae	*Trachypogon spicatus*	(L. f.) Kuntze	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67468	iii	Poaceae	*Trichanthecium cyanescens*	(Nees ex Trin.) Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
67000	i,iii	Poaceae	*Trichanthecium distichophyllum*	(Spreng.) Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
no_collect	iii	Poaceae	*Trichanthecium wettsteinii*	(Hack.) Zuloaga & Morrone	This study	5	ANE	-	campo rupestre	serra do cipó
67250	iii	Poaceae	*Tristachya leiostachya*	Nees	Gottsberger & Silberbauer-Gottsberger (2006)	5	ANE	-	cerrado	fazenda treze de maio
67568	i	Polygalaceae	*Asemeia hirsuta*	(A.St.-Hil. & Moq.) J.F.B.Pastore & J.R.Abbott	Gottsberger & Silberbauer-Gottsberger (2006)	4	BEE	-	cerrado	fazenda treze de maio
67573	i	Polygalaceae	*Monnina richardiana*	A.St.-Hil.&Moq.	This study	5	BEE	-	campo rupestre	serra do cipó
67564	iii	Polygalaceae	*Polygala apparicioi*	Brade	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
67562	i,iii	Polygalaceae	*Polygala celosioides*	Mart. ex A.W.Benn.	This study	4	BEE	small	campo rupestre	serra do cipó
67575	i	Polygalaceae	*Polygala cf janciflora*	L.	This study	4	BEE	-	campo rupestre	serra do cipó
67567	i	Polygalaceae	*Polygala cf subtilis*	Kunth	This study	4	BEE	-	campo rupestre	serra do cipó
67569	i,iii	Polygalaceae	*Polygala cneorum*	A.St.-Hil. & Moq.	Freitas & Sazima (2006)	2	BEE	small	campo de altitude	parque nacional serra da bocaina
67726	iii	Polygalaceae	*Polygala glochidata*	Kunth	This study	4	BEE	small	campo rupestre	serra do cipó
67563	iii	Polygalaceae	*Polygala hygrophila*	Brade	This study,Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Polygalaceae	*Polygala* sp5	L.	Faria (1994)	4	BEE	small	campo rupestre	serra do cipó
67578	ii	Polygonaceae	*Coccoloba brasiliensis*	Nees & Mart.	This study	2	DIV	-	campo rupestre	serra do cipó
no_collect	ii	Polygonaceae	*Coccoloba cereifera*	Schwacke	This study,Silva et al. (2008)	2	DIV	-	campo rupestre	serra do cipó
67576	i	Polygonaceae	*Coccoloba* cf *acrostichoides*	Cham.	This study	4	DIV	-	campo rupestre	serra do cipó
67582	iii	Primulaceae	*Myrsine monticola*	Mart.	This study	4	WASP	-	campo rupestre	serra do cipó

no_collect	iii	Proteaceae	*Roupala montana*	Aubl.	Gottsberger & Silberbauer-Gottsberger (2006)	3	MOT	-	cerrado	fazenda treze de maio
67596	iii	Rapataceae	*Cephalostemon riedelianus*	Körn.	This study	5	BEE	indet	campo rupestre	serra do cipó
66974	i	Rubiaceae	*Augusta longifolia*	(Spreng.) Rehder	Machado (2009)	3	HUM	-	caatinga	serra do bastiao
66948	i,iii	Rubiaceae	*Borreria capitata*	(Ruiz & Pav.) DC.	Freitas & Sazima (2006)	2	DIV	-	campo de altitude	parque nacional serra da bocaina
67903	i	Rubiaceae	*Borreria* cf *schumannii*	(Standl. ex Bacigalupo) E.L. Cabral & Sobrado	This study	4	BEE	-	campo rupestre	serra do cipó
67914	ii	Rubiaceae	*Borreria poaya*	(A.St.-Hil.) DC.	This study	2	BEE	-	campo rupestre	serra do cipó
66951	i	Rubiaceae	*Borreria rosmarinifolia*	E.L.Cabral & Bacigalupo	This study	4	BEE	-	campo rupestre	serra do cipó
66954	iii	Rubiaceae	*Borreria tenella*	(Kunth) Cham. & Schltdl.	Freitas & Sazima (2006)	2	BEE	small	campo de altitude	parque nacional serra da bocaina
66961	ii,iii	Rubiaceae	*Chomelia ribesioides*	Benth. ex A.Gray	This study	2	BEE	small	campo rupestre	serra do cipó
67904	i	Rubiaceae	*Declieuxia* cf *deltoidea*	Müll.Arg.	This study	4	BEE2	-	campo rupestre	serra do cipó
66963	i,iii	Rubiaceae	*Declieuxia diantheroides*	Standl.	This study	4	BEE2	large	campo rupestre	serra do cipó
66964	ii,iii	Rubiaceae	*Declieuxia fruticosa*	(Willd. ex Roem. & Schult.) Kuntze	This study,Faria (1994),Matias et al. (2016)	2	BEE2	large	campo rupestre	serra do cipó
66968	i	Rubiaceae	*Declieuxia irwinii*	J.H.Kirkbr.	This study	4	BEE2	-	campo rupestre	serra do cipó
67896	i,iii	Rubiaceae	*Declieuxia passerina*	Mart. & Zucc. ex Schult. & Schult.f.	This study	4	BEE2	large	campo rupestre	serra do cipó
67910	i	Rubiaceae	*Galianthe angustifolia*	(Cham. & Schltdl.) E.L.Cabral	Freitas & Sazima (2006)	2	DIV	-	campo de altitude	parque nacional serra da bocaina
66956	i	Rubiaceae	*Galianthe peruviana*	(Pers.) E.L.Cabral	Freitas & Sazima (2006)	4	DIV	-	campo de altitude	parque nacional serra da bocaina
66957	i	Rubiaceae	*Hexasepalum mello-barretoi*	(Standl.) J.H. Kirkbr. & Delprete	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
literature	literature	Rubiaceae	*Manettia cordifolia*	Mart.	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
literature	literature	Rubiaceae	*Palicourea marcgravii*	A.St.-Hil.	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina

66950	ii,iii	Rubiaceae	*Palicourea rigida*	Kunth	This study,Faria (1994),Justino et al. (2012),Matias et al. (2016)	2	HUM	-	campo rupestre	serra do cipó
67895	i	Rubiaceae	*Perama* cf *holosericea*	(Naudin) Wurdack & Steyerm.	This study	5	BUT	-	campo rupestre	serra do cipó
66949	i	Rubiaceae	*Polycarpaea corymbosa*	(L.) Lam.	This study	5	BEE	-	campo rupestre	serra do cipó
66977	i	Rubiaceae	*Psyllocarpus laricoides*	Mart. ex Mart. & Zucc.	This study	5	BUT	-	campo rupestre	serra do cipó
66976	ii,iii	Rubiaceae	*Remijia ferruginea*	(A.St.-Hil.) DC.	This study	2	HUM	-	campo rupestre	serra do cipó
66972	ii,iii	Rubiaceae	*Sabicea brasiliensis*	Wernham	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
66969	ii	Rubiaceae	*Tocoyena formosa*	(Cham. & Schltdl.) K.Schum.	This study,Oliveira et al. (2004)	2	MOT	-	campo rupestre	serra do cipó
67595	iii	Salicaceae	*Casearia sylvestris*	Sw.	Silva et al. (2012)	2	DIP	-	cerrado	trinagulo mineiro
67724	i,iii	Santalaceae	*Thesium aphyllum*	Mart. ex A. DC.	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Sapotaceae	*Pouteria* sp	Aubl.	Gottsberger & Silberbauer-Gottsberger (2006)	3	MOT	-	cerrado	fazenda treze de maio
67592	i	Sapotaceae	*Pouteria torta*	(Mart.) Radlk.	Gama et al. (2011)	2	DIV	-	cerrado	reserva particular clube de caca e pesca itororo
no_collect	ii	Solanaceae	*Brunfelsia uniflora*	(Pohl) D.Don	This study	2	BEE	-	campo rupestre	serra do cipó
67418	i,iii	Solanaceae	*Schwenckia americana*	Rooyen ex L.	Gottsberger & Silberbauer-Gottsberger (2006)	3	BEE	small	cerrado	fazenda treze de maio
67415	i	Solanaceae	*Solanum lycocarpum*	A.St.-Hil.	Gottsberger & Silberbauer-Gottsberger (2006),Oliveira-Filho & Oliveira (1988)	2	BEE	-	cerrado	fazenda treze de maio
67417	i	Solanaceae	*Solanum mellobarretoi*	Agra & Stehmann	This study	5	BEE	-	campo rupestre	serra do cipó
67414	i	Solanaceae	*Solanum viscosissimum*	Sendtn.	This study	5	BEE	-	campo rupestre	serra do cipó
67597	ii	Styracaceae	*Styrax ferrugineus*	Nees&Mart.	Barbosa-Filho & Araújo (2013),This study,Maruyama et al.	1	BEE	-	campo rupestre	serra do cipó

					(2012)					
literature	literature	Symplocaceae	*Symplocos oblongifolia*	Casar.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67927	ii,iii	Trigonaceae	*Trigonia cf cipoensis*	Fromm & E.Santos	This study,Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Turneraceae	*Turnera cf cipoensis*	Arbo	This study	4	BEE	large	campo rupestre	serra do cipó
67591	ii,iii	Turneraceae	*Turnera hilaireana*	Urb.	This study	2	BEE	large	campo rupestre	serra do cipó
literature	literature	Turneraceae	*Turnera oblongifolia*	Cambess.	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
no_collect	i,iii	Turneraceae	*Turnera* sp2	L.	This study	4	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Velloziaceae	*Barbacenia* aff *rubrovirens*	Mart.	This study	4	HUM	-	campo rupestre	serra do cipó
literature	literature	Velloziaceae	*Barbacenia blanchetii*	Goethart & Henrard	Machado et al. (2007)	3	HUM	-	campo rupestre	chapada da diamantina
67515	iii	Velloziaceae	*Barbacenia* cf *flava*	Mart. ex Schult. & Schult.f.	This study,Faria (1994),Rodrigues & Rodrigues (2014),Sazima (1977)	1	HUM	-	campo rupestre	serra do cipó
67227	iii	Velloziaceae	*Barbacenia* cf *gentianoides*	Taub. ex Goethart & Henrard	This study	4	HUM	-	campo rupestre	serra do cipó
no_collect	ii	Velloziaceae	*Barbacenia* cf *nana*	L.B.Sm. & Ayensu	This study	2	HUM	-	campo rupestre	serra do cipó
no_collect	i,iii	Velloziaceae	*Barbacenia* sp1	Vand.	This study	4	HUM	-	campo rupestre	serra do cipó
no_collect	iii	Velloziaceae	*Barbacenia* sp4	Vand.	This study	4	HUM	-	campo rupestre	serra do cipó
67500	ii,iii	Velloziaceae	*Vellozia albiflora*	Pohl	This study	2	BEE	small	campo rupestre	serra do cipó
67240	iii	Velloziaceae	*Vellozia caruncularis*	Mart. ex Seub.	This study	4	BEE	large	campo rupestre	serra do cipó
66929	i	Velloziaceae	*Vellozia* cf *gigantea*	N.L.Menezes & Mello-Silva	This study	4	BEE	-	campo rupestre	serra do cipó
67219	i	Velloziaceae	*Vellozia* cf *stipitata*	L.B.Sm. & Ayensu	This study	4	BEE	-	campo rupestre	serra do cipó
67237	iii	Velloziaceae	*Vellozia* cf *variabilis*	Mart. ex Schult. & Schult.f.	Faria (1994)	2	BEE	large	campo rupestre	serra do cipó

67510	i	Velloziaceae	*Vellozia compacta*	Mart. ex Schult. & Schult.f.	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
67213	ii,iii	Velloziaceae	*Vellozia epidendroides*	Mart. ex Schult. & Schult.f.	This study,Jacobi & Sarto (2007),Rodrigues & Rodrigues (2014)	2	BEE	large	campo rupestre	serra do cipó
67230	i	Velloziaceae	*Vellozia glabra*	J.C.Mikan	This study	4	BEE	-	campo rupestre	serra do cipó
literature	literature	Velloziaceae	*Vellozia glandulifera*	Goethart & Henrard	Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
67507	i	Velloziaceae	*Vellozia lilacina*	L.B.Sm. & Ayensu	This study	4	BEE	-	campo rupestre	serra do cipó
67222	ii,iii	Velloziaceae	*Vellozia nivea*	L.B.Sm. & Ayensu	This study	2	BEE	large	campo rupestre	serra do cipó
67220	iii	Velloziaceae	*Vellozia patens*	L.B.Sm. & Ayensu	This study	4	BEE	large	campo rupestre	serra do cipó
no_collect	i	Velloziaceae	*Vellozia prolifera*	Mello-Silva	This study	4	BEE	-	campo rupestre	serra do cipó
67245	ii,iii	Velloziaceae	*Vellozia resinosa*	Mart. ex Schult. & Schult.f.	This study	2	BEE	large	campo rupestre	serra do cipó
67506	i	Velloziaceae	*Vellozia seubertiana*	Goethart & Henrard	This study	4	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Velloziaceae	*Vellozia* sp2	Vand.	This study	4	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Velloziaceae	*Vellozia* sp4	Vand.	This study	4	BEE	large	campo rupestre	serra do cipó
no_collect	iii	Velloziaceae	*Vellozia* sp5	Vand.	This study	4	BEE	large	campo rupestre	serra do cipó
67235	i	Velloziaceae	*Vellozia taxifolia*	(Mart. ex Schult. & Schult.f.) Mart. ex Seub.	This study	4	BEE	-	campo rupestre	serra do cipó
67241	i	Velloziaceae	*Vellozia tragacantha*	(Mart. ex Schult. & Schult.f.) Mart. ex Seub.	This study	4	BEE	-	campo rupestre	serra do cipó
literature	literature	Verbenaceae	*Lantana camara*	L.	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains

67584	ii,iii	Verbenaceae	*Lippia florida*	Cham.	Araújo et al. (2006),This study,Faria (1994)	3	BEE	large	campo rupestre	serra do cipó
67585	ii	Verbenaceae	*Lippia hermannioides*	Cham.	This study	2	BEE	-	campo rupestre	serra do cipó
67587	i	Verbenaceae	*Lippia lacunosa*	Mart. & Schauer	This study	5	BUT	-	campo rupestre	serra do cipó
67924	i	Verbenaceae	*Lippia origanoides*	Kunth	This study	5	BUT	-	campo rupestre	serra do cipó
67583	i	Verbenaceae	*Lippia stachyoides* var *martiana*	(Schauer) Salimena & Múlgura	This study	5	BUT	-	campo rupestre	serra do cipó
67921	ii	Verbenaceae	*Stachytarpheta confertifolia*	Moldenke	This study	2	BEE	-	campo rupestre	serra do cipó
67925	ii	Verbenaceae	*Stachytarpheta linearis*	Moldenke	This study,Faria (1994)	2	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Verbenaceae	*Stachytarpheta procumbens*	Moldenke	This study	4	BEE	small	campo rupestre	serra do cipó
literature	literature	Verbenaceae	*Verbena bonariensis*	L.	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
67278	ii,iii	Vochysiaceae	*Qualea cordata*	Spreng.	This study,Faria (1994)	2	BEE	large	campo rupestre	serra do cipó
76687	ii	Vochysiaceae	*Qualea dichotoma*	(Mart.) Warm.	This study	2	BEE	-	campo rupestre	serra do cipó
76688	i,iii	Vochysiaceae	*Qualea parviflora*	Mart.	Barbosa-Filho & Araújo (2013),Oliveira (1998)	2	BEE	large	cerrado	rppn ufms
67276	i	Vochysiaceae	*Vochysia cinnamomea*	Pohl	Santos et al. (1997)	3	BEE	-	cerrado	reserva particular clube de caca e pesca itororo
67280	i,iii	Vochysiaceae	*Vochysia elliptica*	Mart.	Oliveira & Gibbs (1994)	2	BEE	large	cerrado	brasilia botanic garden
literature	literature	Vochysiaceae	*Vochysia emarginata*	(Vahl) Poir.	Araújo et al. (2006)	3	BEE	-	campo rupestre	hematitic canga/ouro branco mountains
76686	ii,iii	Vochysiaceae	*Vochysia pygmaea*	Bong.	This study	2	BEE	large	campo rupestre	serra do cipó

67275	i	Vochysiaceae	*Vochysia rufa*	Mart.	Oliveira & Gibbs (1994)	2	BEE	-	cerrado	brasilia botanic garden
76689	ii,iii	Vochysiaceae	*Vochysia thyrsoidea*	Pohl	This study,Oliveira & Gibbs (1994)	2	BEE2	large	campo rupestre	serra do cipó
67877	iii	Xyridaceae	*Xyris* aff *itatiayensis*	(Malme) Wand. & Sajo	This study	4	BEE	small	campo rupestre	serra do cipó
66909	i,iii	Xyridaceae	*Xyris asperula*	Mart.	Freitas & Sazima (2006)	2	BEE	small	campo de altitude	parque nacional serra da bocaina
67355	i	Xyridaceae	*Xyris atrospicata*	Wand. & J.Guedes	This study	4	BEE	-	campo rupestre	serra do cipó
66937	i	Xyridaceae	*Xyris blepharophylla*	Mart.	This study	4	BEE	-	campo rupestre	serra do cipó
66930	i	Xyridaceae	*Xyris cervii*	E.D.Lozano & Wand.	This study	4	BEE	-	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* cf *nubigena*	Kunth	This study	4	BEE	small	campo rupestre	serra do cipó
67885	iii	Xyridaceae	*Xyris cf tortula*	Mart.	This study	4	BEE	small	campo rupestre	serra do cipó
66941	i	Xyridaceae	*Xyris cipoensis*	L.B.Sm. & Downs	This study	4	BEE	-	campo rupestre	serra do cipó
66922	iii	Xyridaceae	*Xyris glaucescens*	Malme	Freitas & Sazima (2006)	2	BEE	small	campo de altitude	parque nacional serra da bocaina
no_collect	iii	Xyridaceae	*Xyris hystrix*	Seub.	This study	4	BEE	small	campo rupestre	serra do cipó
67879	iii	Xyridaceae	*Xyris insignis*	L.A.Nilsson	This study	4	BEE	small	campo rupestre	serra do cipó
66938	iii	Xyridaceae	*Xyris itatiayensis*	(Malme) Wand. & Sajo	This study	4	BEE	small	campo rupestre	serra do cipó
66939	i,iii	Xyridaceae	*Xyris longiscapa*	L.A.Nilsson	This study	4	BEE	small	campo rupestre	serra do cipó
66925	ii,iii	Xyridaceae	*Xyris melanopoda*	L.B.Sm. & Downs	This study	2	BEE	large	campo rupestre	serra do cipó
67874	iii	Xyridaceae	*Xyris minarum*	Seub.	This study	4	BEE	small	campo rupestre	serra do cipó
67873	iii	Xyridaceae	*Xyris nanuzae*	Wand.	This study	4	BEE	large	campo rupestre	serra do cipó
66920	i,iii	Xyridaceae	*Xyris obtusiuscula*	L.A.Nilsson	Faria (1994)	2	BEE	small	campo rupestre	serra do cipó
66924	i,iii	Xyridaceae	*Xyris pilosa*	Kunth	This study	4	BEE	small	campo rupestre	serra do cipó

66932	i,iii	Xyridaceae	*Xyris pterygoblephara*	Steud.	This study	4	BEE	small	campo rupestre	serra do cipó
66916	ii,iii	Xyridaceae	*Xyris* sp1	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
66923	iii	Xyridaceae	*Xyris* sp10	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp11	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp12	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp13	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp14	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp15	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp16	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp17	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
66917	iii	Xyridaceae	*Xyris* sp18	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
66918	iii	Xyridaceae	*Xyris* sp19	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
67867	iii	Xyridaceae	*Xyris* sp2	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
67878	iii	Xyridaceae	*Xyris* sp20	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
67875	iii	Xyridaceae	*Xyris* sp3	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp4	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp5	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp6	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp7	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp8	Gronov. ex L.	This study	4	BEE	small	campo rupestre	serra do cipó
no_collect	iii	Xyridaceae	*Xyris* sp9	Gronov. ex L.	This study	4	BEE	small	campo	serra do cipó

66936	i	Xyridaceae	*Xyris subsetigera*	Malme	This study	4	BEE	-	rupestre campo rupestre	serra do cipó
66914	iii	Xyridaceae	*Xyris tenella*	Kunth	Freitas & Sazima (2006)	2	BEE	small	campo de altitude	parque nacional serra da bocaina
67889	i,iii	Xyridaceae	*Xyris trachyphylla*	Mart.	This study	4	BEE	small	campo rupestre	serra do cipó

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Table S2. List of pollinators observed in campo rupestre, organized by family and species, their functional group, and bee size category.

Family	Species	Author	Functional Group	Bee Size
Phyllostomidae	*Anoura* sp	Gray, 1838	Bat	-
Phyllostomidae	*Glossophaga soricina*	(Pallas, 1766)	Bat	-
Phyllostomidae	*Lonchophylla bokermanni*	Sazima, Vizotto & Taddei, 1978	Bat	-
Apidae (Andreninae)	*Oxaea flavescens*	Klug, 1807	Bee	large
Apidae (Andreninae)	*Oxaea* sp	Klug, 1807	Bee	large
Apidae (Apinae)	*Apis mellifera*	Linnaeus, 1758	Bee	large
Apidae (Apinae)	*Arhysoceble huberi*	(Ducke, 1908)	Bee	small
Apidae (Apinae)	*Arhysoceble* sp1	Moure, 1948	Bee	small
Apidae (Apinae)	*Arhysoceble* sp2	Moure, 1948	Bee	small
Apidae (Apinae)	*Bombus brasiliensis*	Lepeletier, 1836	Bee	large
Apidae (Apinae)	*Bombus brevivillus*	Franklin, 1913	Bee	large
Apidae (Apinae)	*Bombus morio*	(Swederus, 1787)	Bee	large
Apidae (Apinae)	*Bombus pauloensis*	Friese, 1913	Bee	large
Apidae (Apinae)	*Centris (Xanthemisia)* sp1	Moure, 1945	Bee	large
Apidae (Apinae)	*Centris aenea*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Centris bicolor*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Centris fuscata*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Centris klugii*	Friese, 1899	Bee	large
Apidae (Apinae)	*Centris lutea*	Friese, 1899	Bee	large
Apidae (Apinae)	*Centris nitens*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Centris obsoleta*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Centris scopipes*	Friese, 1899	Bee	large
Apidae (Apinae)	*Centris* sp1	(Fabricius, 1804)	Bee	large
Apidae (Apinae)	*Centris* sp2	Fabricius, 1804	Bee	large
Apidae (Apinae)	*Centris* sp3	Fabricius, 1804	Bee	large
Apidae (Apinae)	*Centris* sp4	Fabricius, 1804	Bee	large
Apidae (Apinae)	*Centris spilopoda*	Moure, 1969	Bee	large
Apidae (Apinae)	*Centris tarsata*	Smith, 1874	Bee	large
Apidae (Apinae)	*Centris trigonoides*	Lepeletier	Bee	large
Apidae (Apinae)	*Centris varia*	(Erichson, 1849)	Bee	large
Apidae (Apinae)	*Centris violacea*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Ceratina (Ceratinula)* sp1	Moure, 1941	Bee	small
Apidae (Apinae)	*Ceratina (Ceratinula)* sp2	Moure, 1941	Bee	small
Apidae (Apinae)	*Ceratina (Ceratinula)* sp3	Moure, 1941	Bee	small
Apidae (Apinae)	*Ceratina (Ceratinula)* sp4	Moure, 1941	Bee	small
Apidae (Apinae)	*Ceratina (Ceratinula)* sp5	Moure, 1941	Bee	small
Apidae (Apinae)	*Ceratina (Ceratinula)* sp6	Moure, 1941	Bee	small
Apidae (Apinae)	*Ceratina (Crewella)* sp2	Cockerell, 1903	Bee	small
Apidae (Apinae)	*Ceratina (Crewella)* sp3	Cockerell, 1903	Bee	small
Apidae (Apinae)	*Ceratina (Crewella)* sp6	Cockerell, 1903	Bee	small
Apidae (Apinae)	*Ceratina asunciana*	Strand, 1910	Bee	small
Apidae (Apinae)	*Ceratina asuncionis*	Strand, 1910	Bee	small
Apidae (Apinae)	*Ceratina gossypii*	Schrottky, 1907	Bee	small
Apidae (Apinae)	*Ceratina muelleri*	Friese, 1910	Bee	small
Apidae (Apinae)	*Ceratina oxalidis*	Schrottky, 1907	Bee	small
Apidae (Apinae)	*Ceratina paraguayensis*	Schrottky, 1907	Bee	small
Apidae (Apinae)	*Ceratina* sp1	Latreille, 1802	Bee	small
Apidae (Apinae)	*Ceratina* sp2	Latreille, 1802	Bee	small
Apidae (Apinae)	*Ceratina* sp3	Latreille, 1802	Bee	small
Apidae (Apinae)	*Ceratina* sp4	Latreille, 1802	Bee	small
Apidae (Apinae)	*Ceratina volitans*	Schrottky, 1907	Bee	small
Apidae (Apinae)	*Cyphomelissa diabolica*	(Friese, 1900)	Bee	large

Apidae (Apinae)	*Epicharis (Cyphepicharis)* sp1	Moure, 1945	Bee	large
Apidae (Apinae)	*Epicharis albofasciata*	Smith, 1874	Bee	large
Apidae (Apinae)	*Epicharis dejeanii*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Epicharis flava*	Friese, 1900	Bee	large
Apidae (Apinae)	*Epicharis iheringi*	Friese, 1899	Bee	large
Apidae (Apinae)	*Epicharis picta*	(Smith, 1874)	Bee	large
Apidae (Apinae)	*Epicharis* sp	Klug, 1807	Bee	large
Apidae (Apinae)	*Epicharis* sp1	Klug, 1807	Bee	large
Apidae (Apinae)	*Eufriesea danielis*	(Schrottky, 1907)	Bee	large
Apidae (Apinae)	*Eufriesea nigrohirta*	(Friese, 1899)	Bee	large
Apidae (Apinae)	*Eufriesea* sp	Cockerell, 1908	Bee	large
Apidae (Apinae)	*Euglossa* cf *melanotricha*	Moure, 1967	Bee	large
Apidae (Apinae)	*Euglossa melanotricha*	Moure, 1967	Bee	large
Apidae (Apinae)	*Euglossa* sp	Latreille, 1802	Bee	large
Apidae (Apinae)	*Euglossa* sp1	Latreille, 1802	Bee	large
Apidae (Apinae)	*Euglossa* sp2	Latreille, 1802	Bee	large
Apidae (Apinae)	*Eulaema cingulata*	(Fabricius, 1804)	Bee	large
Apidae (Apinae)	*Eulaema nigrita*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Exomalopsis auropilosa*	Spinola, 1853	Bee	small
Apidae (Apinae)	*Exomalopsis fulvofasciata*	Smith, 1879	Bee	small
Apidae (Apinae)	*Exomalopsis* sp1	Spinola, 1853	Bee	small
Apidae (Apinae)	*Exomalopsis* sp2	Spinola, 1853	Bee	small
Apidae (Apinae)	*Exomalopsis* sp3	Spinola, 1853	Bee	small
Apidae (Apinae)	*Gaesischia nigra*	Moure, 1968	Bee	large
Apidae (Apinae)	*Gaesischia* sp1	Michener, Laberge & Moure, 1955	Bee	large
Apidae (Apinae)	*Gaesischia* sp2	Michener, Laberge & Moure, 1955	Bee	large
Apidae (Apinae)	*Geotrigona* sp	Moure, 1943	Bee	small
Apidae (Apinae)	*Geotrigona* sp1	Moure, 1943	Bee	small
Apidae (Apinae)	*Geotrigona* sp2	Moure, 1943	Bee	small
Apidae (Apinae)	*Geotrigona* sp3	Moure, 1943	Bee	small
Apidae (Apinae)	*Leurotrigona muelleri*	(Friese, 1900)	Bee	small
Apidae (Apinae)	*Lophopedia haeckeli*	(Friese, 1910)	Bee	small
Apidae (Apinae)	*Lophopedia* sp1	Michener & Moure, 1957	Bee	small
Apidae (Apinae)	*Melipona quadrifasciata*	Lepeletier, 1836	Bee	large
Apidae (Apinae)	*Melipona quinquefasciata*	Lepeletier, 1836	Bee	large
Apidae (Apinae)	*Melipona* sp1	Illiger, 1806	Bee	large
Apidae (Apinae)	Meliponini sp	Lepeletier, 1836	Bee	indet
Apidae (Apinae)	*Melissoptila cnecomala*	(Moure, 1944)	Bee	large
Apidae (Apinae)	*Melitoma segmentaria*	(Fabricius, 1804)	Bee	large
Apidae (Apinae)	*Melitoma* sp1	Lepeletier & Serville, 1828	Bee	large
Apidae (Apinae)	*Monoeca* sp1	Lepeletier & Serville, 1828	Bee	small
Apidae (Apinae)	*Monoeca* sp3	Lepeletier & Serville, 1828	Bee	small
Apidae (Apinae)	*Paratetrapedia* sp1	Moure, 1941	Bee	small
Apidae (Apinae)	*Paratrigona lineata*	(Lepeletier, 1836)	Bee	small
Apidae (Apinae)	*Paratrigona subnuda*	Moure, 1947	Bee	small
Apidae (Apinae)	*Plebeia* sp	Schwarz, 1938	Bee	small
Apidae (Apinae)	*Schwarziana quadripunctata*	(Lepeletier, 1836)	Bee	large
Apidae (Apinae)	Tapinotaspidini sp1	Roig-Alsina & Michener, 1993	Bee	indet
Apidae (Apinae)	Tapinotaspidini sp2	Roig-Alsina & Michener, 1993	Bee	indet
Apidae (Apinae)	*Tetragonisca angustula*	(Latreille, 1811)	Bee	small
Apidae (Apinae)	*Tetrapedia* sp1	Klug, 1810	Bee	small
Apidae (Apinae)	*Tetrapedia* sp2	Klug, 1810	Bee	small
Apidae (Apinae)	*Tetrapedia* sp3	Klug, 1810	Bee	small
Apidae (Apinae)	*Thygater analis*	(Lepeletier, 1841)	Bee	large
Apidae (Apinae)	*Thygater* sp	Holmberg, 1884	Bee	large
Apidae (Apinae)	*Thygater* sp1	Holmberg, 1884	Bee	large

Apidae (Apinae)	*Trigona fulviventris*	Guérin, 1844	Bee	small
Apidae (Apinae)	*Trigona hyalinata*	(Lepeletier, 1836)	Bee	small
Apidae (Apinae)	*Trigona* sp	Jurine, 1807	Bee	small
Apidae (Apinae)	*Trigona spinipes*	(Fabricius, 1793)	Bee	small
Apidae (Apinae)	*Trigonopedia oligotricha*	Moure, 1941	Bee	small
Apidae (Apinae)	*Trigonopedia* sp1	Moure, 1941	Bee	small
Apidae (Apinae)	*Xanthopedia* cf *larocai*	Moure, 1995	Bee	small
Apidae (Apinae)	*Xanthopedia* sp1	Michener & Moure, 1957	Bee	small
Apidae (Apinae)	*Xylocopa (Neoxylocopa)* sp1	Michener, 1954	Bee	large
Apidae (Apinae)	*Xylocopa (Schonnherria)* sp1	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Xylocopa (Stenoxylocopa)* sp1	Hurd & Moure, 1960	Bee	large
Apidae (Apinae)	*Xylocopa abbreviata*	Hurd & Moure, 1963	Bee	large
Apidae (Apinae)	*Xylocopa bimaculata*	Friese, 1903	Bee	large
Apidae (Apinae)	*Xylocopa cearensis*	Ducke, 1910	Bee	large
Apidae (Apinae)	*Xylocopa grisescens*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Xylocopa hirsutissima*	Maidl, 1912	Bee	large
Apidae (Apinae)	*Xylocopa macrops*	Lepeletier, 1841	Bee	large
Apidae (Apinae)	*Xylocopa muscaria*	(Fabricius, 1775)	Bee	large
Apidae (Apinae)	*Xylocopa nogueira*	Hurd & Moure	Bee	large
Apidae (Apinae)	*Xylocopa* sp	Latreille, 1802	Bee	large
Apidae (Apinae)	*Xylocopa* sp big	Latreille, 1802	Bee	large
Apidae (Apinae)	*Xylocopa* sp1	Latreille, 1802	Bee	large
Apidae (Apinae)	*Xylocopa* sp2	Latreille, 1802	Bee	large
Apidae (Apinae)	*Xylocopa* sp3	Latreille, 1802	Bee	large
Apidae (Apinae)	*Xylocopa* sp4	Latreille, 1802	Bee	large
Apidae (Apinae)	*Xylocopa* sp5	Latreille, 1802	Bee	large
Apidae (Apinae)	*Xylocopa subcyanea*	Pérez, 1901	Bee	large
Apidae (Apinae)	*Xylocopa truxali*	Hurd & Moure, 1963	Bee	large
Apidae (Colletinae)	*Chilicola (Oediscelis)* sp	Philippi, 1866	Bee	small
Apidae (Colletinae)	*Chilicola (Oediscelis)* sp1	Philippi, 1866	Bee	small
Apidae (Colletinae)	*Chilicola (Prosopoides)* sp1	Friese, 1908	Bee	small
Apidae (Colletinae)	*Chilicola (Prosopoides)* sp2	Friese, 1908	Bee	small
Apidae (Colletinae)	*Colletes meridionalis*	Schrottky, 1902	Bee	small
Apidae (Colletinae)	*Colletes rufipes*	Smith, 1879	Bee	small
Apidae (Colletinae)	*Colletes* sp	Latreille, 1802	Bee	large
Apidae (Colletinae)	*Colletes* sp1	Latreille, 1802	Bee	small
Apidae (Colletinae)	*Hylaeus* sp	Fabricius, 1793	Bee	small
Apidae (Colletinae)	*Hylaeus* sp1	Fabricius, 1793	Bee	small
Apidae (Colletinae)	*Ptiloglossa* cf *dubia*	Moure, 1945	Bee	large
Apidae (Colletinae)	*Tetraglossula* sp1	Ogloblin, 1948	Bee	small
Apidae (Halictinae)	*Augochlora (Augochlora)* sp1	Smith, 1853	Bee	small
Apidae (Halictinae)	*Augochlora (Oxystoglossella)* sp1	Eickwort, 1969	Bee	small
Apidae (Halictinae)	*Augochlora (Oxystoglossella)* sp2	Eickwort, 1969	Bee	small
Apidae (Halictinae)	*Augochlora iphigenia*	Holmberg, 1886	Bee	small
Apidae (Halictinae)	*Augochlorella* sp1	Sandhouse, 1937	Bee	small
Apidae (Halictinae)	*Augochlorella* sp2	Sandhouse, 1937	Bee	small
Apidae (Halictinae)	*Augochlorella* sp3	Sandhouse, 1937	Bee	small
Apidae (Halictinae)	*Augochloropsis callichroa*	(Cockerell, 1900)	Bee	small
Apidae (Halictinae)	*Augochloropsis cleopatra*	(Schrottky, 1902)	Bee	small
Apidae (Halictinae)	*Augochloropsis multiplex*	(Vachal, 1903)	Bee	small
Apidae (Halictinae)	*Augochloropsis semiramis*	(Jörgensen, 1912)	Bee	small
Apidae (Halictinae)	*Augochloropsis sp1*	Cockerell, 1897	Bee	small
Apidae (Halictinae)	*Augochloropsis sp2*	Cockerell, 1897	Bee	small
Apidae (Halictinae)	*Augochloropsis sp3*	Cockerell, 1897	Bee	small
Apidae (Halictinae)	*Augochloropsis sp4*	Cockerell, 1897	Bee	small
Apidae (Halictinae)	*Augochloropsis sp5*	Cockerell, 1897	Bee	small

Apidae (Halictinae)	*Ceratalictus sp*	Moure, 1943	Bee	small
Apidae (Halictinae)	*Dialictus (Chloralictus) sp1*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus opacus*	(Moure, 1940)	Bee	small
Apidae (Halictinae)	*Dialictus osmioides*	(Ducke, 1902)	Bee	small
Apidae (Halictinae)	*Dialictus sp*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp1*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp2*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp3*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp4*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp5*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp6*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp7*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp8*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Dialictus sp9*	Robertson, 1902	Bee	small
Apidae (Halictinae)	*Megalopta sodalis*	(Vachal, 1904)	Bee	large
Apidae (Halictinae)	*Paroxystoglossa jocasta*	(Schrottky, 1910)	Bee	small
Apidae (Halictinae)	*Paroxystoglossa sp1*	Moure, 1941	Bee	small
Apidae (Halictinae)	*Pseudagapostemon anasimus*	Cure, 1989	Bee	small
Apidae (Halictinae)	*Pseudagapostemon ochromerus*	(Vachal, 1904)	Bee	small
Apidae (Halictinae)	*Pseudagapostemon pissisi*	(Vachal, 1903)	Bee	small
Apidae (Halictinae)	*Pseudagapostemon sp1*	Schrottky, 1909	Bee	small
Apidae (Halictinae)	*Pseudaugochlora graminea*	(Fabricius, 1804)	Bee	small
Apidae (Megachilinae)	Anthidiini sp	Ashmead, 1899	Bee	indet
Apidae (Megachilinae)	*Anthidium sertanicola*	Moure & Urban, 1964	Bee	large
Apidae (Megachilinae)	Anthiidini sp1	Ashmead, 1899	Bee	indet
Apidae (Megachilinae)	Anthiidini sp2	Ashmead, 1899	Bee	indet
Apidae (Megachilinae)	*Coelioxys sp*	Latreille, 1809	Bee	large
Apidae (Megachilinae)	*Coelioxys sp1*	Latreille, 1809	Bee	large
Apidae (Megachilinae)	Dianthidiini sp1	Moure & Urban	Bee	indet
Apidae (Megachilinae)	*Dichranthidium sp*	Moure & Urban	Bee	small
Apidae (Megachilinae)	*Dicranthidium gregarium*	(Schrottky, 1905)	Bee	small
Apidae (Megachilinae)	*Dicranthidium sp*	Moure & Urban, 1975	Bee	small
Apidae (Megachilinae)	*Dicranthidium sp1*	Moure & Urban, 1975	Bee	small
Apidae (Megachilinae)	*Epanthidium sp n*	Moure, 1947	Bee	small
Apidae (Megachilinae)	*Lithurgus huberi*	Ducke, 1907	Bee	large
Apidae (Megachilinae)	*Megachile (Acentron) sp*	Mitchell, 1943	Bee	large
Apidae (Megachilinae)	*Megachile (Acentron) sp1*	Mitchell, 1943	Bee	large
Apidae (Megachilinae)	*Megachile (Acentron) sp2*	Mitchell, 1943	Bee	large
Apidae (Megachilinae)	*Megachile (Acentron) sp3*	Mitchell, 1943	Bee	large
Apidae (Megachilinae)	*Megachile (Chrysosarus) sp*	Mitchell, 1943	Bee	large
Apidae (Megachilinae)	*Megachile (Chrysosarus) sp1*	Mitchell, 1943	Bee	large
Apidae	*Megachile (Dasymegachile) sp*	Mitchell, 1943	Bee	large

(Megachilinae)				
Apidae (Megachilinae)	*Megachile (Pseudocentron) sp*	Mitchell, 1934	Bee	large
Apidae (Megachilinae)	*Megachile (Pseudocentron) sp1*	Mitchell, 1934	Bee	large
Apidae (Megachilinae)	*Megachile (Pseudocentron) sp2*	Mitchell, 1934	Bee	large
Apidae (Megachilinae)	*Megachile (Pseudocentron) sp3*	Mitchell, 1934	Bee	large
Apidae (Megachilinae)	*Megachile (Pseudocentron) sp4*	Mitchell, 1934	Bee	large
Apidae (Megachilinae)	*Megachile (Sayapis) sp*	Titus, 1906	Bee	large
Apidae (Megachilinae)	*Megachile cf maculata*	Smith, 1853	Bee	large
Apidae (Megachilinae)	*Megachile curvipes*	Smith, 1853	Bee	large
Apidae (Megachilinae)	*Megachile guaranitica*	Schrottky, 1908	Bee	large
Apidae (Megachilinae)	*Megachile iheringi*	Schrottky, 1913	Bee	large
Apidae (Megachilinae)	*Megachile inscita*	Mitchell, 1930	Bee	large
Apidae (Megachilinae)	*Megachile sp*	Latreille, 1802	Bee	large
Apidae (Megachilinae)	*Megachile sp1*	Latreille, 1802	Bee	large
Apidae (Megachilinae)	*Megachile sp2*	Latreille, 1802	Bee	large
Apidae (Megachilinae)	*Megachile sp3*	Latreille, 1802	Bee	large
Apidae (Megachilinae)	*Megachile terrestris*	Schrottky, 1902	Bee	large
Apidae (Megachilinae)	Megachilinae sp	Latreille, 1802	Bee	indet
-	Coleoptera sp	Linnaeus, 1758	Beetle	-
-	Coleoptera sp2	Linnaeus, 1758	Beetle	-
Cantharidae	*Chauliognathini sp1*	LeConte, 1861	Beetle	-
Cantharidae	*Chauliognathini sp2*	LeConte, 1861	Beetle	-
Cerambycidae	*Cerambycidae sp*	Latreille, 1802	Beetle	-
Cerambycidae	*Chrysoprasis sp1*	Audinet-Serville, 1834	Beetle	-
Cerambycidae	*Chrysoprasis sp2*	Audinet-Serville, 1834	Beetle	-
Chrysomelidae	*Alticini sp1*	Newman, 1834	Beetle	-
Chrysomelidae	*Alticini sp2*	Newman, 1834	Beetle	-
Chrysomelidae	*Chrysomelidae (Galerucinae) sp1*	Latreille, 1802	Beetle	-
Chrysomelidae	*Chrysomelidae sp*	Latreille, 1818	Beetle	-
Chrysomelidae	*Cryptocephalini sp1*	Gyllenhal, 1813	Beetle	-
Chrysomelidae	*Cryptocephalini sp5*	Gyllenhal, 1813	Beetle	-
Chrysomelidae	*Eumolpini sp1*	Hope, 1840	Beetle	-
Chrysomelidae	*Eumolpini sp4*	Hope, 1840	Beetle	-
Chrysomelidae	*Galerucinae sp1*	Latreille, 1802	Beetle	-
Chrysomelidae	*Galerucinae sp3*	Latreille, 1802	Beetle	-
Chrysomelidae	*Homophoeta sp*	Linnaeus, 1758	Beetle	-
Chrysomelidae	*Spintherophyta (Eumolpinae) sp1*	Hope, 1840	Beetle	-
Chrysomelidae	*Spintherophyta sp1*	Dejean, 1836	Beetle	-
Chrysomelidae	*Urodera sp1*	Lacordaire, 1848	Beetle	-
Cleridae	*Trichodes sp*	Herbst, 1792	Beetle	-
Coccinellidae	*Brachiacantha australe*	Leng	Beetle	-
Coccinellidae	*Brachiacantha sp*	Dejean, 1837	Beetle	-

Curculionidae	Baridinae sp1	Schönherr, 1836	Beetle	-
Curculionidae	*Madarini sp1*	Jekel, 1865	Beetle	-
Curculionidae	*Madarini sp2*	Jekel, 1865	Beetle	-
Curculionidae	*Madopterini sp*	Lacordaire, 1866	Beetle	-
Curculionidae	*Nicentrus brasiliensis*	Hustache, 1950	Beetle	-
Curculionidae	*Parisoschoenus sp*	Faust, 1896	Beetle	-
Curculionidae	*Sibinia sp*	Germar, 1817	Beetle	-
Elateridae	Elateridae sp1	Leach, 1815	Beetle	-
Melolonthidae	*Erioscelis emarginata*	(Mannerheim, 1829)	Beetle	-
Nitidulidae	Nitidulidae sp1	Latreille, 1802	Beetle	-
Staphylinidae	Staphylinidae sp	Latreille, 1802	Beetle	-
Tenebrionidae	*Tenebrionidae sp*	Latreille, 1802	Beetle	-
-	Lepidoptera sp	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp1	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp2	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp3	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp4	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp5	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp6	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp7	Linnaeus, 1758	Butterfly	-
-	Lepidoptera sp8	Linnaeus, 1758	Butterfly	-
-	Microlepidoptera sp	Linnaeus, 1758	Butterfly	-
Hesperiidae	*Elbella luteizona*	(Mabille, 1877)	Butterfly	-
Hesperiidae	*Hesperiidae sp1*	Latreille, 1809	Butterfly	-
Hesperiidae	*Hesperiinae sp*	Latreille, 1809	Butterfly	-
Hesperiidae	*Hesperiinae sp2*	Latreille, 1809	Butterfly	-
Hesperiidae	*Pyrginae sp*	Burmeister, 1878	Butterfly	-
Hesperiidae	*Urbanus proteus*	(Linnaeus, 1758)	Butterfly	-
Lycaenidae	cf *Leptotes* sp1	Scudder, 1876	Butterfly	-
Lycaenidae	*Leptotes sp*	Scudder, 1876	Butterfly	-
Lycaenidae	*Polyommatinae sp*	Swainson, 1827	Butterfly	-
Lycaenidae	Theclinae sp	Swainson, 1831	Butterfly	-
Lycaenidae	Theclinae sp2	Swainson, 1831	Butterfly	-
Nymphalidae	cf Nymphalidae sp2	Rafinesque, 1815	Butterfly	-
Nymphalidae	*cf Vanessa sp1*	Fabricius, 1807	Butterfly	-
Nymphalidae	*Junonia genoveva*	(Cramer, 1780)	Butterfly	-
Nymphalidae	*Junonia sp*	Hübner, [1819]	Butterfly	-
Nymphalidae	Nymphalidae sp1	Rafinesque, 1815	Butterfly	-
Nymphalidae	*Satyrinae sp*	Boisduval, 1833	Butterfly	-
Nymphalidae	*Vanessa sp*	Fabricius, 1807	Butterfly	-
Papilionidae	cf Papilionidae sp1	Latreille, 1802	Butterfly	-
Papilionidae	Papilionidae sp	Latreille, 1802	Butterfly	-
Pieridae	*Phoebis sennae*	(Linnaeus, 1758)	Butterfly	-
Pieridae	*Phoebis sp1*	Hübner, [1819]	Butterfly	-
Pieridae	*Pierinae sp*	Swainson, 1820	Butterfly	-
Riodinidae	Riodininae sp	Grote, 1895	Butterfly	-
-	Diptera sp	Linnaeus, 1758	Fly	-
-	Diptera sp1	Linnaeus, 1758	Fly	-
-	Diptera sp2	Linnaeus, 1758	Fly	-
-	Diptera sp3	Linnaeus, 1758	Fly	-
-	Diptera sp4	Linnaeus, 1758	Fly	-
-	Diptera sp5	Linnaeus, 1758	Fly	-
-	Diptera sp7	Linnaeus, 1758	Fly	-
Bibionidae	*Plecia sp*	Wiedemann, 1828	Fly	-
Bombyliidae	*Apolysis sp*	Hesse	Fly	-
Bombyliidae	*Bryodemina sp1*	(Wiedemann, 1830)	Fly	-
Bombyliidae	*Mythichomyia sp2*	Latreille, 1802	Fly	-
Bombyliidae	*Mythichomyia sp4*	Latreille, 1802	Fly	-

Bombyliidae	*Mythichomyia spp*	Latreille, 1802	Fly	-
Bombyliidae	*Poecilognathus sp*	Jaennicke, 1867	Fly	-
Bombyliidae	*Villa sp*	Latreille, 1804	Fly	-
Ceratopogonidae	*Dasyhelea spp*	Kieffer, 1911	Fly	-
Chironomidae	*Bryophaenocladius sp*	Thienemann, 1934	Fly	-
Chloropidae	*Apallates sp*	Sabrosky, 1980	Fly	-
Chloropidae	Chloropidae sp	Verrall, 1888	Fly	-
Chloropidae	*Conioscinella sp*	Duda, 1929	Fly	-
Chloropidae	*Ectecephala sp*	Macquart, 1851	Fly	-
Chloropidae	*Elachiptera sacculicornis*	(Enderlein, 1911)	Fly	-
Chloropidae	*Hippelates carrerai*	Paganelli & Sabrosky, 1993	Fly	-
Chloropidae	*Hippelates sp*	Loew, 1863	Fly	-
Chloropidae	*Tricimba sp*	Lioy, 1864	Fly	-
Milichiidae	*Pholeomyia sp*	Bilimek, 1867	Fly	-
Muscidae	Muscidae sp1	Latreille, 1802	Fly	-
Muscidae	*Neodexiopsis sp*	Malloch, 1920	Fly	-
Muscidae	*Stomopogon argentina*	(Snyder, 1957)	Fly	-
Muscidae	*Stomopogon hirtitibia*	(Stein, 1911)	Fly	-
Muscidae	*Stomopogon sp*	Malloch	Fly	-
Mydidae	*Protomydas sp*	Wilcox, Papavero & Pimentel, 1989	Fly	-
Phoridae	*Megaselia sp1*	Rondani, 1856	Fly	-
Phoridae	*Megaselia sp2*	Rondani, 1856	Fly	-
Phoridae	*Megaselia sp3*	Rondani, 1856	Fly	-
Phoridae	*Megaselia sp4*	Rondani, 1856	Fly	-
Phoridae	*Megaselia sp5*	Rondani, 1856	Fly	-
Pipunculidae	Pipunculidae sp	Walker, 1834	Fly	-
Richardiidae	*Spheneuolena sp*	Hendel	Fly	-
Sarcophagidae	*Peckia lambens*	(Wiedemann, 1830)	Fly	-
Sarcophagidae	Sarcophagidae sp	Macquart, 1834	Fly	-
Sarcophagidae	*Tricharaea (Sarcophagula) sp*	Wulp, 1887	Fly	-
Sciaridae	*Sciara sp*	Meigen, 1800	Fly	-
Syrphidae	*Allograpta exotica*	(Wiedemann, 1830)	Fly	-
Syrphidae	*Chrysotoxum sp*	Lindl	Fly	-
Syrphidae	*Copestylum sp*	Macquart, 1846	Fly	-
Syrphidae	*Palpada doris*	(Curran, 1930)	Fly	-
Syrphidae	*Palpada melanaspis*	(Wiedemann, 1830)	Fly	-
Syrphidae	*Palpada sp*	Macquart, 1834	Fly	-
Syrphidae	*Pseudodorus clavatus*	(Fabricius)	Fly	-
Syrphidae	Syrphidae sp	Latreille, 1802	Fly	-
Syrphidae	Syrphidae sp2	Latreille, 1802	Fly	-
Syrphidae	*Toxomerus sp1*	Macquart, 1855	Fly	-
Syrphidae	*Toxomerus sp2*	Macquart, 1855	Fly	-
Syrphidae	*Toxomerus spp*	Macquart, 1855	Fly	-
Syrphidae	*Toxomerus tibicen*	(Wiedemann, 1830)	Fly	-
Syrphidae	Toxophorinae sp2	Schiner, 1868	Fly	-
Tabanidae	*Diachlorini sp*	Lutz, 1909	Fly	-
Tabanidae	*Dichelacera sp*	Macquart, 1838	Fly	-
Tachinidae	*Archytas diaphanus*	(Fabricius, 1805)	Fly	-
Tachinidae	*Deopalpus sp*	Townsend, 1908	Fly	-
Tachinidae	*Gnadochaeta sp*	Macquart, 1851	Fly	-
Tachinidae	*Imitomyia sp*	Townsend, 1912	Fly	-
Tachinidae	*Imitomyia sp2*	Townsend, 1912	Fly	-
Tachinidae	*Leskia sp*	Robineau-Desvoidy, 1830	Fly	-
Tachinidae	*Spallanzania sp*	Robineau-Desvoidy, 1830	Fly	-
Tachinidae	*Tachinidae sp1*	Robineau-Desvoidy, 1830	Fly	-
Tachinidae	*Trichopoda sp*	Berthold, 1827	Fly	-
Tephritidae	*Trupanea sp*	Schrank, 1795	Fly	-

Trochilidae	*Amazilia lactea*	Brisson, 1760	Hummingbird	-
Trochilidae	*Anthracothorax nigricollis*	Vieillot, 1818	Hummingbird	-
Trochilidae	*Augastes lumachella*	(Kuhl, 1820)	Hummingbird	-
Trochilidae	*Augastes scutatus*	Kuhl, 1820	Hummingbird	-
Trochilidae	*Calliphlox amethystina*	(Harcourt, 1851)	Hummingbird	-
Trochilidae	*Campylopterus largipennis*	Mathews, 1912	Hummingbird	-
Trochilidae	*Chlorostilbon lucidus*	Mathews, 1915	Hummingbird	-
Trochilidae	*Chrysolampis mosquitus*	(Linnaeus, 1758)	Hummingbird	-
Trochilidae	*Colibri serrirostris*	(Reichenbach, 1849)	Hummingbird	-
Trochilidae	*Eupetomena macroura*	Boddaert, 1783	Hummingbird	-
Trochilidae	*Heliactin bilophus*	(Linnaeus, 1766)	Hummingbird	-
Trochilidae	*Phaethornis pretrei*	(Leach, 1820)	Hummingbird	-
Trochilidae	*Thalurania furcata*	Gmelin, 1789	Hummingbird	-
Trochilidae	Trochilidae sp	Molina, 1782	Hummingbird	-
Sphingidae	*Aellopos sp*	Hübner, 1819	Moth	-
Braconidae	*Braconidae sp1*	Nees, 1811	Wasp	-
Braconidae	*Braconidae sp2*	Nees, 1811	Wasp	-
Braconidae	*Braconidae sp3*	Nees, 1811	Wasp	-
Crabronidae	*Cerceris sp1*	Latreille, 1802	Wasp	-
Crabronidae	*Rubrica nasuta*	(Christ, 1791)	Wasp	-
Ichneumonidae	*Ichneumonidae sp*	Latreille, 1802	Wasp	-
Pompilidae	Pompilidae sp	Latreille, 1804	Wasp	-
Pteromalidae	*Pteromalidae sp1*	Dalman, 1820	Wasp	-
Scoliidae	*Campsomeris sp1*	Guérin-Méneville, 1838	Wasp	-
Scoliidae	*Campsomeris sp2*	Guérin-Méneville, 1838	Wasp	-
Scoliidae	*Campsomeris sp3*	Guérin-Méneville, 1838	Wasp	-
Scoliidae	*Scolia sp1*	Fabricius, 1775	Wasp	-
Scoliidae	*Scolia sp2*	Fabricius, 1775	Wasp	-
Sphecidae	*Ammophila gracilis*	Lepeletier, 1845	Wasp	-
Sphecidae	*Sphex sp*	Linnaeus, 1758	Wasp	-
Tiphiidae	*Myzinum sp*	Latreille, 1803	Wasp	-
Vespidae	*Brachygastra lecheguana*	(Latreille, 1804)	Wasp	-
Vespidae	*Brachygastra sp*	Perty, 1833	Wasp	-
Vespidae	*Mischocyttarus drewseni*	Saussure, 1857	Wasp	-
Vespidae	*Pachodynerus guadulpensis*	(Saussure, 1853)	Wasp	-
Vespidae	*Polistes consobrinus*	Saussure, 1858	Wasp	-
Vespidae	*Polistes satan*	Bequaert, 1940	Wasp	-
Vespidae	*Polistes sp1*	Latreille, 1802	Wasp	-
Vespidae	*Polybia flavifrons*	Richards, 1978	Wasp	-
Vespidae	*Polybia ignobilis*	(Haliday, 1836)	Wasp	-
Vespidae	*Polybia occidentalis*	(Olivier, 1792)	Wasp	-
Vespidae	*Polybia sericea*	Saussure, 1854	Wasp	-
Vespidae	*Polybia sp1*	Lepeletier, 1836	Wasp	-
Vespidae	*Synoeca sp1*	Saussure, 1852	Wasp	-
Vespidae	*Synoeca surinama*	(Linnaeus, 1767)	Wasp	-
Vespidae	Vespidae sp1	Laicharting, 1781	Wasp	-
Vespidae	Vespidae sp2	Laicharting, 1781	Wasp	-
Vespidae	*Zeta argillaceum*	(Linnaeus, 1758)	Wasp	-
Vespidae	*Zethus brasiliensis*	Saussure, 1852	Wasp	-
Vespidae	*Zethus fraternus*	Saussure, 1852	Wasp	-
Vespidae	*Zethus productus*	Fox, 1899	Wasp	-

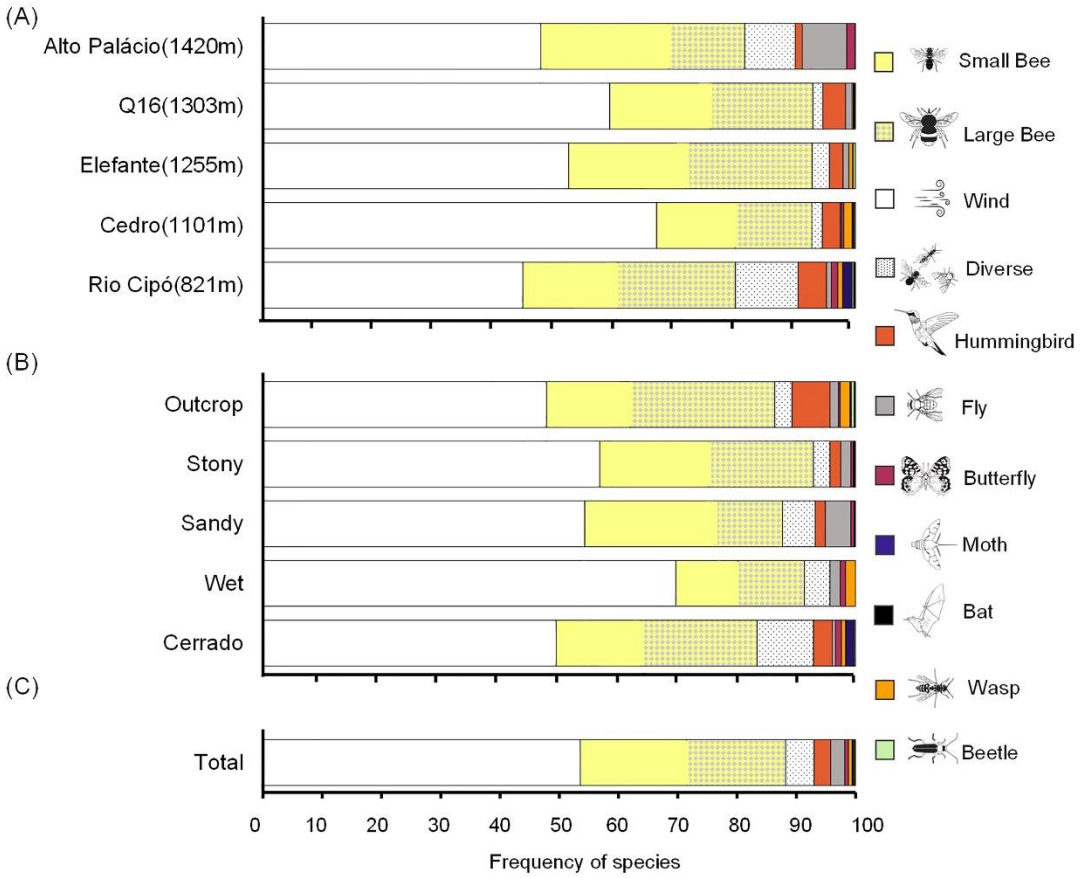

Figure S1. Number of species of each pollination system (wind, small bee, large bee, diverse animals, hummingbird, fly, butterfly, moth, bat, wasp and beetle) per plot, or occurrence of species, in the systematic survey at the *campo rupestre* of Serra do Cipó. Species occurrence are represented by the number of plots in which a given plant species was recorded: (A) along the altitudinal gradient: Alto Palácio (636 records), Q16 (630 records), Elefante (681 records), Cedro (504 records), Rio Cipó (378 records); (B) by vegetation type: rocky outcrop (579 records); stony grassland (722 records); sandy grassland (1069 records); wet grassland (115 records); and cerrado (401 records) and (C) total of record of species systematically sampled (2886 records). Large bees are the hatched area in the yellow bee-pollination system.

CAPÍTULO 2.

Evaluating the conservation status of plant-pollinator interactions in *campo rupestre* using mutualistic networks

ABSTRACT

Pollination is considered a key ecosystem service for maintaining wild areas and crops which have been facing severe disruptions caused by anthropogenic drivers. Plant-pollinator interactions can be understood as mutualistic networks that enhances our understanding of their dynamics and resilience, providing tools to evaluate conservation priorities Mutualistic networks may enhance our understanding of community's dynamics and resilience, providing tools to evaluate conservation priorities. The Brazilian *campo rupestre* vegetation is an important center of endemism and biodiversity threatened by different anthropogenic factors. Considering the importance of enhancing the knowledge of *campo rupestre*'s community dynamics and guide conservation action, we asked: 1) how the interactions between plants and pollinators is structured according to the network analysis; 2) what are the main plant and pollinators species according to their role in the network? Based on information of plant-pollinator interaction from the Serra do Cipó National Park, we calculated plant-pollinator network metrics and defined the species role according to their z and c-scores values. We found that large bees were responsible for the network structure, mainly the bumblebee *Bombus pauloensis* and the introduced species *Apis mellifera*, acting as network hubs, and small insects as connectors. Plant species with bee pollination system were important as network hubs. We also found a modular network but when excluding the introduced species *Apis mellifera*, there was no significant modularity. This study provides an evaluation of species according to their functional role for the persistence of a threatened ecosystem, especially those already classified as near threatened and endemic. We suggest further studies on the effect of the introduced *A. mellifera* and the observation of plant-pollinator interactions for a hole year, to improve our understanding on the community dynamics and to better guide conservation priorities.

Keywords: *Aspilia jolyana* - *campo rupestre* – grassland conservation – hummingbirds - large bees – metanetwork - Neotropical OCBIL – rupestrian grassland

1.INTRODUCTION

Pollination is considered a key ecosystem service globally (Costanza et al., 1997; IPBES, 2019; Joly et al., 2019) since this process provides many resources for human beings, ensuring food production and commodities (Klein et al., 2007). Pollinators are also of utmost importance for maintaining wild areas (IPBES, 2016), since 85% of the Angiosperms depend on the interaction with animals to ensure its reproduction (Ollerton et al., 2011). Currently, we have been facing severe disruptions on these interactions caused by the large demands of our growing population (MEA, 2005; IPBES, 2019). Direct anthropogenic drivers, such as land use change, pollution, use of pesticides, pathogens, climate change and competing alien species, have been extensively changing ecosystems, threatening pollinator populations (IPBES, 2016). These disruptions are affecting wild areas with consequences to human wellbeing and survival. Because of these impacts and the consequent loss of biodiversity, the current century might face Earth's sixth mass extinction (Barnosky et al., 2011). In this context, some initiatives are being made to evaluate the species' risk of extinction using records of population sizes and distribution gathered with some modelling methodology (e.g. Marinelli & Moraes, 2013; ICMBio, 2018). But those iniciatives do not consider the loss of ecological interactions, which in a subtle way, is as harmuful as the loss of biodiversity (Janzen, 1974).

Interactions found in natural communities usually follow a nonrandom pattern, resulting in complex forms of interaction networks (Bascompte & Jordano, 2007). The knowledge of these complex networks structure enhances our understanding of community's dynamics, vulnerability, and resilience (Tylianakis et al., 2010; Kaiser-Bunbury & Blüthgen, 2015; Armbruster, 2017). The network analyses are relatively simple to perform and the values of the main indices can be related to ecosystem stability (Kaiser-Bunbury & Blüthgen, 2015). For instance, plant-pollinator networks that present a nested pattern, which implies in a highly centralized structure composed of a periphery of specialist species attached to a densely connected core of generalists (Bascompte et al., 2003) suggests that this core of generalist species play a key role in persistence of pollinator communities (Bascompte et al., 2003; Kaiser-Bunbury & Blüthgen, 2015). Or the modular pattern that indicates the presence of compartments of species strongly connected that are weakly interlinked with the other compartments (Olesen et al., 2007). Modularity is a common pattern to large networks and the analysis of the modules provide information for maintenance of key groups of taxa that play a fundamental role to the network persistence. (Olesen et al., 2007; Kaiser-Bunbury & Blüthgen, 2015) so it is possible to evaluate species role and their importance for maintaining the network

stability (Olesen et al., 2007; Martín González et al., 2010). A species which act as a hub is highly linked to other species within their own module; while a connector species links different modules, or the ones that do both, acting as a network hub (Olesen et al., 2007). The loose of species with these important roles might break the modules apart initiating cascades of extinction (Olesen et al., 2007). In that way, these species deserve conservation priorities. Thus, the network approach provides us tools to evaluate conservation priorities in a community that goes beyond species count and distribution and consider their role according to their interactions (Martín González et al., 2010; Tylianakis et al., 2010).

Less than 1% of the Brazilian territory is dominated by *campo rupestre* vegetation holding 15% of the estimated diversity of vascular plants for the whole country (Silveira et al., 2016). This vegetation is also considered an important center of endemism (Colli-Silva et al., 2019) and it is under great threat due to several anthropic pressures (Morellato & Silveira, 2018; Fernandes et al. 2018, Monteiro et al., 2020). The *campo rupestre* is a fire-prone vegetation, characterized by a unique, highly diverse flora that evolved in the mountain tops of the ancient Espinhaço Range as an archipelago-like system dominated by grasslands with rocky outcrops (Silveira et al., 2016; Morellato & Silveira 2018; Vasconcelos et al., 2020). It is characterized by a mosaic of different vegetation types, in this Neotropical OCBIL (Old Climatically-Buffered Infertile Landscapes) (see Hopper, 2009 and Silveira et al., 2020) plant populations are locally restricted with low dispersal capacity, low resilience and potential for restoration. Therefore, plant population present a high dependency on long distance pollinators to connect this archipelago-like landscape (Le Stradic et al., 2014; Guerra et al., 2016; Carstensen et al. 2014; 2016; 2018; Chapter 1, this thesis). Studies in plant-pollinator interactions also show a great presence of the introduced species *Apis mellifera* L. (Apidae) interacting to the local flora (e.g. Carstensen et al., 2014; Gustafsson, 2017; Maruyama et al., 2018, Chapter 1, this thesis) in National Parks and its buffer zones.

Considering its high diversity, huge endemism and threats suffered by the anthropogenic drivers, we see the importance of enhancing the knowledge of *campo rupestre*'s community to guide conservation action. Based on a systematic observation of plant-pollinator interaction in a *campo rupestre* community, the indication of the specieis' endemism and extinction risk according to the IUCN (2012) parameters presented by local Red Lists, we specifically asked: 1) how the mutualistic relationship between plants and pollinators are structured according to the network analysis; 2) what are the main species according to their role in structuring the network and whether these species are endemic or under any risk of extinction? We expect to

find low connectance, due to the large number of interacting species with different pollination systems. In that matter, many species are not expected to interact due to morphological and/or phenological mismatches (Olesen et al., 2007; Vazquez et al., 2009). Which may also explain the expectance of a modular network with compartments explained by the pollination systems (Danieli-Silva et al., 2012; Araújo et al., 2018); we also expect to find the nested pattern, which is usual for pollination networks and the high abundance of generalists species (Maruyama et al., 2018; Mattos et al., 2019). We expect long distance pollinators, as large bees and hummingbirds, playing important roles in the network, as expected for OCBIL vegetations (Guerra et al., 2016; Silveira et al., 2016; Chapter 1, this thesis). According to previous studies, the invasive species *Apis mellifera* will probably act as a network hub (Santos et al., 2012; Hung et al., 2018). We further, discuss our results in the perspective of species' conservation status and suggest preservation actions.

2.METHODS

Study Site - This study gathered information of plant-pollinator interaction conducted at the Serra do Cipó National Park and its buffer zone, the Morro da Pedreira protection area (Carstensen et al., 2014; 2016; Gustafsson, 2017), hereafter referred just as Serra do Cipó. This area includes three counties of Minas Gerais State: Santana do Riacho, Jaboticatubas, and Cardeal Mota (details in Carstensen et al., 2014 and Rocha et al., 2016). The study site is located within the Espinhaço Range, the largest inside country mountain chain in Brazil, extending North-South for about 1200 km reaching up to 2100 m of altitude across the states of Bahia and Minas Gerais (Silveira et al., 2019) and given its unique endemic flora is the type locality of the Southern Espinhaço Range Province (Colli-Silva et al., 2019).

The Serra do Cipó, as well as the highest altitudes of the Espinhaço Range, is dominated by *campo rupestre*, a mountain ecosystem considered a Neotropical OCBIL (Silveira et al., 2016; 2020). The *campo rupestre* is a fire-prone vegetation overall, characterized by a unique, highly diverse flora that evolved in the mountain tops of the ancient mountain chain as an archipelago-like system dominated by grasslands with rocky outcrops important for connecting this landscape (Silveira et al., 2016; Morellato & Silveira, 2018; Mattos et al., 2019; Vasconcelos et al., 2020).

At Serra do Cipó, the *campo rupestre* defines the landscape on altitudes above 1100 m a.s.l. (Silveira et al., 2019) and the floristic composition is dominated by grasses, and also sedges and

herbs from the families Poaceae, Cyperaceae, Xyridaceae, Eriocaulaceae, and Velloziaceae, along with small shrubs from Asteraceae, Melastomataceae, Fabaceae, and Rubiaceae (Mattos et al., 2019). The local climate classified as subtropical highland climate (Cwb) by the Köppen (1948) system with a dry and cold season (winter) from April/May to October and a wet and warm season (summer) from October/November to April (Alvares et al., 2013; Le Stradic et al., 2018).

Plant-pollinator interaction data - The interaction data of plant-pollinators at the Serra do Cipó is a result of two systematic sampling conducted during 2012 and 2016, fully described in Carstensen et al. (2014; 2016) and Gustafsson (2017), respectively. The sampling was carried out at seven sites covering an altitudinal range of 1073–1260 m.a.s.l. with similar wind exposition, soil substrate, vegetation structure (dominated by rocky outcrops, sandy or rocky grasslands) and floral species richness (Carstensen et al., 2014). Both samplings were carried during the peak flowering season (October–December) with the same sampling design (see Carstensen et al., 2014 for details). Both studies considered the flower's visitors touching the reproductive floral parts as pollinators and summing up ~500 hours of observation. Data gathered by the previous studies, performed network analysis for each site surveyed separately, but here we transformed all observations into a metanetwork.

Voucher specimens of plants and pollinators are deposited at Herbário Rioclarense, UNESP, Rio Claro (HRCB), Universidade Federal de Minas Gerais (UFMG), and Coleção Entomológica Padre Jesus Santiago Moure, UFPR (DZUP), Brazil. Scientific name for each plant species was checked at Plantminer (Carvalho et al., 2010) and Flora Brazil 2020 for updates. The animal's determination is according to the Brazilian Fauna Taxonomic Catalog (http://fauna.jbrj.gov.br/) and Moure's Bee Catalog (http://moure.cria.org.br/).

Pollinators were classified according to their functional group (Fenster et al., 2004) as ant, bee, beetle, butterfly, fly, hemipteran, hummingbird, moth, and wasp. (Table S1: Supporting Inforamation). Plants were categorized with a pollination system (see methods in Chapter 1, this thesis) according to the most frequent pollinator functional group visitor. The pollination systems established were bee, bee and other, diverse animals, hummingbird, and wasp (Table S2: Supporting Information).

For each plant and pollinator specie, we incorporated data on extinction risk according to the (IUCN, 2012) parameters found in Flora 2020 website (http://floradobrasil.jbrj.gov.br) and most recent Brazilian's Flora and Fauna Red List of threatened Species (Martinelli & Moraes,

2013; ICMBio, 2018). The information of distribution and endemism of species evaluated by the Red lists were used, but we also accessed endemism information in other lists for plants (Pirani et al., 2015; Colli-Silva et al., 2019) and pollinators (Azevedo, 2008; Vasconcelos et al., 2008).

According to IUCN (2012) there are nine categories in which a species can be classified: extinct (EX) and extinct in the wild (EW) indicated extinct species; critically endangered (CR), endangered (EN) and vulnerable (VU) are the categories for the threatened species; near threatened (NT) and least concern (LC) indicate species that are not under extinction risk; not evaluated (NE) and data deficient (DD) for non-evaluated species.

Network analysis – In mutualistic networks each species is represented by a node and the interaction by a connection between nodes (Bascompte & Jordano, 2007). Bipartite networks are built upon an adjacency matrix (d) where plants and pollinators are represented in rows and columns, respectively. In this study we used a qualitative (binary) matrix, where the interaction between species is represented by 1 or the absence of interaction, 0.

We describe six metrics for qualitative networks (Almeida & Mikich, 2018): size (S), which is the number of nodes (species); total of interactions (L); mean interaction ($\bar{L}x$) which is the total number of interaction (L) divided by its Size (S). Connectance (C) that is the ratio between the number of interactions observed by all interactions possible (Olesen & Jordano, 2002). Nestedness (NODF) (Almeida-Neto et al., 2008) to describe an important pattern for mutualistic networks, which is necessary to compare to null models to find if there is a significative nested pattern. The nestedness significance was compared to 1000 random models where rows are preserved, and the marginal frequency is used to select the species by the columns. Network indices were calculated by "Bipartite" package (Dormann et al., 2008; Dormann et al., 2009; Dormann, 2011) in R 4.0.0 (R Core Team, 2020).

The modularity (Q) metric indicates the presence of compartments (modules) of species that interact more within their own module than to the other compartments (Araujo et al., 2018), and it is a value between 0 and 1 (Olesen et al., 2007). This metric was calculated by MODULAR 0.21 (Marquitti et al., 2014) software with the "simulated annealing" algorithm which maximizes the modularity and makes it possible to detect the presence and number of modules (Barber, 2007; Marquitti et al., 2014). The optimization algorithm is stochastic, so the modules arrangement varies within the analysis (Marquitti et al., 2014). In that way, we conducted 30 matrix entrances independently so we could choose the higher value of

modularity (Heilmann-Clausen et al., 2016). To test the significance of the modularity pattern we contrasted the matrix with 100 randomizations for 2 types of null models performed by the software (Marquitti et al., 2014).

Species' role – Within the modularity analysis and the detection of modules, it is possible to calculate species' roles according to their position in the network. One of the indices possible to calculate is the "c-score" that detects if the species act as connectors, measuring the quantity of interactions that they perform outside of its own module (Olesen et al., 2007). Another index, called "z-score" measures if a species act as hub, which is regarded to the high number of interactions that they perform within its own module (Olesen et al., 2007). Details in how these indices were calculated is found at Olesen et al. (2007).

According to the c and z-scores values in a cartesian plot and cut off values it is possible to characterize the specialist species in four groups (Guimerà & Amaral, 2005; Olesen et al., 2007): the "peripherals", that show low value of z and c-score ($z \leq 2.5$ and $c \leq 0.62$) that characterizes species specialists that made few links and mostly inside their own module; the "module hubs" that are highly connected species within their own module, showing importance to the coherence of its own module, with high z and low c-score values ($z > 2.5$ and $c \leq 0.62$); the "connectors" that links several modules thus acting as important to the network coherence, with low z and high c-score ($z \leq 2.5$ and $c > 0.62$); lastly the "network hubs" or supergeneralists that act as hubs and connectors with high values of z and c-scores ($z > 2.5$ and $c > 0.62$), representing high importance to the coherence of network structure.

Network simulation – Given that our plant-pollinator data includes the participation of *Apis mellifera* which is considered a supergeneralist invader species (Santos et al., 2012; Hung et al., 2018; Valido et al., 2019), we also performed the same metrics calculation without the presence of this species and any of its interactions, by excluding the correspondent matrix column.

3.RESULTS

We compiled a network of 106 plant species and 247 species of pollinators, performing 980 interactions. The network size was of 353 nodes (or total number of species) with a mean number of 2.78 interactions. The network connectance was of 0.04 and we found significant values of nestedness (NODF) and modularity (Q) (Table 1), divided in eight modules. When

excluding *Apis mellifera*, we found similar values for all metrics but no significant modularity (Table 1).

Of the 106 plant species included in our network, 29 were evaluated according to the IUCN parameters of extinction risk and endemism. Five plant species were characterized as threatened: *Richterago polyphylla, R. conduplicata, R. caulescens* (Asteraceae), *Lavoisiera cordata* (Melastomataceae) and *Vochysia pygmaea* (Vochysiaceae) (Table S1 and S2: Supporting Information), but none of these had important roles for the network structure (Figure 1). However, among endemic species, *Paepalanthus bromelioides* (Eriocaulaceae) act as a module hub and the introduced bee pollinator *Apis mellifera* as a network hub (Figure 1). Eight plant species were considered endemic from Serra do Cipó and three pollinators species from the Espinhaço Range (Table S1 and S2: Supporting Information).

Bee pollinated species performed the three roles in the networks: network hubs, module hubs and connectors (Figure 2a). We detected the prevalence of bee pollinated plants as connectors, and species pollinated by diverse pollinators as module hubs. As network hubs, we observed the plant species *Cuphea linarioides, C. ericoides* (Lythraceae) and *Aspilia jolyana* (Asteraceae), all bee pollinated species with a high number of interactions. Also *Lychnophora uniflora* (Asteraceae), pollinated mainly by bees and butterflies in a possible mixed system, and *Erythroxylum suberosum*, characterized as wasp pollinated but visited by all functional groups of pollinators (Figure 2a). Regarding the pollinator's species, there was no species acting as module hubs. We detected some bees as network hubs: *Bombus pauolensis* (Apidae), *Trigona spinipes*, *Augochloropsis* sp1, *Lasioglossum (Dialictus)* sp1, and the introduced *A. mellifera* (that were responsible for 3.3% of all interactions). As connectors we observed manly bee species, but also some ants, beetles, butterflies, flies, and wasps (Figure 2b).

4.DISCUSSION

Network structure - The *campo rupestre* plant-pollinator network showed low connectance, as expected for mutualist networks with many interacting species with different pollination systems (Vazquez et al., 2009). Considering *campo rupestre* as a threatened vegetation, we detect a nested pattern which might indicate a stability of this community (Tylianakis et al., 2010). The nested pattern ensures the presence of a core of generalist's species able to provide resources for other species to interact (Tylianakis et al 2010). However, nestedness calculation

deserve caution since it may reflect sampling limitations and indicate species that were under sampled as specialists (Tylianakis et al., 2010; Kaiser-Bunbury & Blüthgen, 2015).

As observed in previous studies based on a subset of our database of plant-pollinator interactions (Carstensen et al., 2014; 2016; Gustafsson, 2017), we found a modular network. It is an expected pattern for large networks, with more than 150 nodes (Olesen et al., 2007), and reflects the stability of the community since disturbances tend to spread more slowly through the modules (Tylianakis et al., 2010). Modular webs allow us to focus on the species that act as hubs and connectors, that are generalist's species, keeping the modules cohesiveness. Regarding conservation, modular networks allow us to indicate important species according to their role for keeping the network strucure and prevent cascades of extinction within or across modules (Olesen et al., 2007; Tylianakis et al., 2010).

However, based on our simulation after removing the introduced *Apis mellifera*, one of the five network hubs, this modular pattern was not significant (Table 1). This supergeneralist species is expected to perform an important role in the networks (Santos et al. 2012; Hung et al., 2018; Valido et al., 2019). According to Valido et al. (2019), the presence of this introduced species promotes the simplification of networks, stressing that species as *Apis mellifera* probably compete with native pollinators and do not act with the same pollinator effectiveness. However, the *A. mellifera* service of pollination in native plant species and effects on the network deserve further investigation. Evaluation on previous studies suggests that they act as effective pollinators alongside with native pollinators and its absence would not affect the reproduction of generalists' plant species (Maruyama et al., 2018). In that way, the simple simulation without the presence of this species promoting the lack of modularity, makes us wonder if the absence of this species will collapse the network or will promote rewiring and improve importance of native and endemic species as it should be before its arrival.

Species' role in the network – In an archipelago-like vegetation the long-distance pollinators are expected to act as connectors of the landscape, promoting gene flow according to the OCBIL theory (Silveira et al., 2020) as demonstrated by our findings in Chapter 1. By applying the network approach, we realized that large bees occupy important roles in the network, with the highlight of the *Bombus pauloensis* as a network hub and *Centris tarsata, C. lutea, Gaeishia sp. 2, Xylocopa sp.* and *Cyphomelissa diabolica* as connectors (Table S1: Supplementary Information). Hummingbirds act as peripherals, with a low number of interactions, might be a consequence of the data transformation in a binary matrix, losing the weight of their interactions. However, there are some plant species that we expect to depend on this functional

group for their reproduction, such as the connector *Declieuxia fruticosa* and the module hub *Palicourea rigida* (Justino et al., 2012). In that way, hummingbird, as a taxonomic group is an important pollinator for maintaining the cohesiveness of the network. Other species of supergeneralists pollinators performing important roles in the network are the small bees *Augochloropsis sp. 1*, *Lassioglossum (Dialictus) sp. 1* and *Trigona spinipes* (Apidae). Almost all connectors species we have found are small insects, specially ants and small bees, and three species of butterflies, since they perform many interactions out of their own module.

Regarding the main plant species according to their role, we found that network hubs, or supergeneralists, present the bee, bee and butterfly, and wasp pollination systems. However, these plant species also interact with other pollinators' functional groups than their pollination system. *Aspilia jolyana* is a great example, as demonstrated by the detailed reproductive biology study of Maruyama et al. (2018), pollination efficiency is ensured by different functional groups of pollinators, but the most frequent visitors are the native bumblebee *Bombus pauloensis* and the introduced *Apis mellifera*. *Aspilia jolyana* is also an abundant specie in Serra do Cipó (Mattos et al., 2019), providing resources for many pollinators' groups.

Conservation insights and conclusions - Extinction risk evaluation is scarce for the *campo rupestre* community. This study provides an evaluation from the perspective of mutualistic networks and the importance of species according to their functional role for the maitenence of a threatened ecosystem. Here, we indicated possible key species structuring plant-pollination interactions in the studied *campo rupestre*. Species that play important roles in the network deserve some attention for conservation strategies. Especially those that are not threatened yet but are classified as "near threatened" such as the module hub *Lychnophora passerina* (Asteraceae) and the connector *Vellozia albiflora* (Velloziaceae) as well as the endemic module hub *Paepalanthus bromeliodes* (Eriocaulaceae). Plant species acting as network hubs are of utmost importance for the cohesiveness of the network as they provide resources for different functional groups of pollinators.

According to the OCBIL theory we have found that large bees act as important pollinators in the *campo rupestre* pollination network. Native large bees such as *Bombus pauloensis*, *Centris tarsata, C. lutea*, *Gaeishia sp. 2, Cyphomelissa diabolica* and the genera *Xylocopa* as well as the hummingbird functional group are not threatened species but deserve further attention for conservation proposes. We have found that a significant number of ants are also performing important roles in the network, but their effectiveness as pollinators is questioned (Beattie, 2006; Matias et al., 2016, but see Del Claro et al., 2019; Delnevo & Van Etten, 2019) so, future

studies are needed to define the effectiveness of ants as pollinators and their role in the network of interactions in *campo rupestre*.

We suggest the development of further knowledge on the effect of the introduced *Apis mellifera* in the community dynamic by conducting simulations with probabilities of rewiring or even exclusion experiments. This introduced species is also considered a supergeneralist for the whole year in seasonal ecosystems (Souza et al., 2018) and here, data were sampled in the flowering peak of the vegetation to avoid forbidden links due to phenological mismatches (Carstensen et al., 2014). In that way, we also suggest observations of plant-pollinators interactions along all the year, to figure out possible shifts in species role and better understand the community dynamics.

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6.TABLES

Table 1. Values of network's metrics calculated in the observed matrix of plant-pollinator interactions and with the simulated network without the invasive *Apis mellifera* bee.

	Observed		Simulated	
Metric	value	p-value	value	p-value
size (S)	353	-	352	-
interactions (L)	980	-	948	-
mean interactions (Lx)	2.78	-	2.69	-
connectance (C)	0.04	-	0.04	-
nestedness (NODF)	16.62	<0.0001*	16.62	<0.0001*
modularity (Q)	0.42	0.03*	0.43	0.25

7.FIGURES

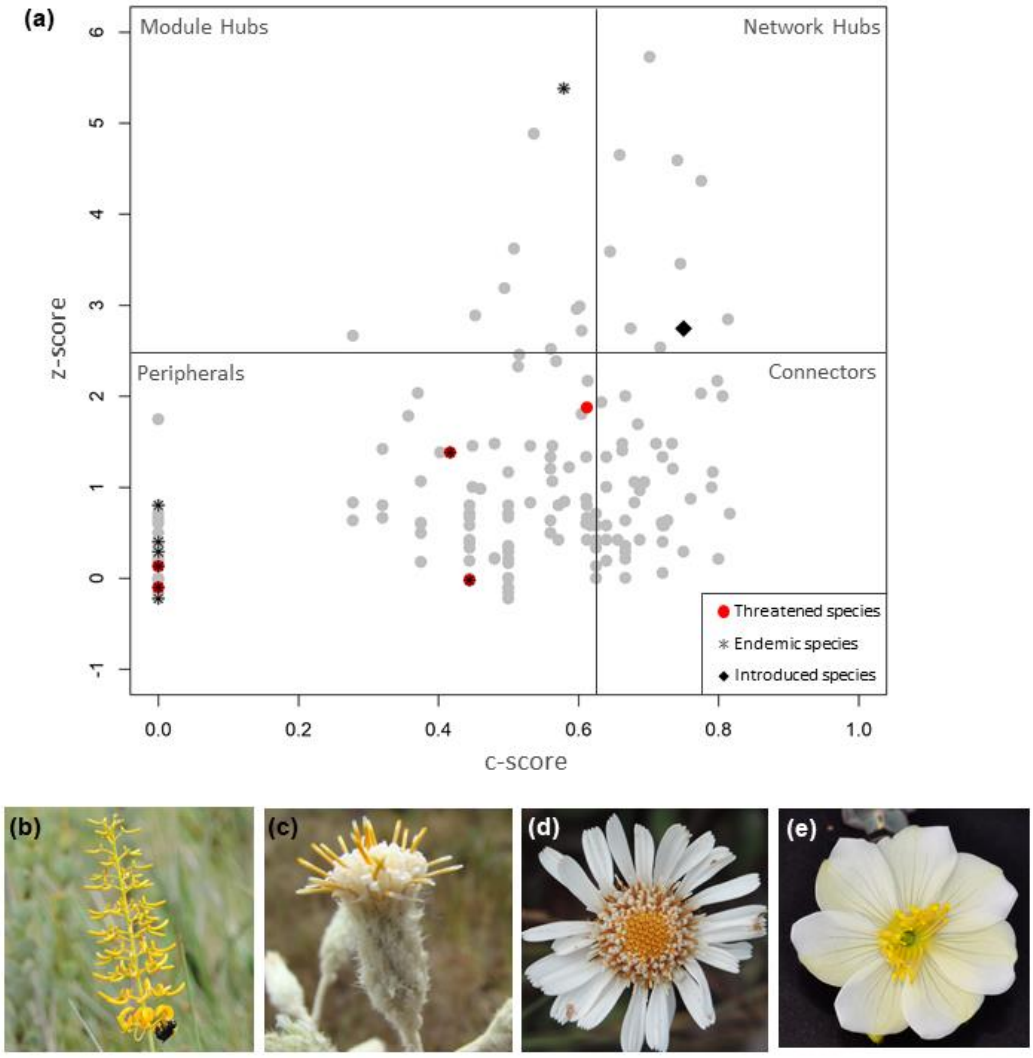

Figure 1. Scatterplot of the z- and c-scores and corresponding species' role according to their position in the plant-pollinator network (a) and the plant species under threat risk of extinction according to the IUCN (2012) categories: *Vochysia pygmaea* (Vochysiaceae) (b); *Richterago polyphylla* (Asteraceae) (c); *Richeterago conduplicata* (Asteraceae) (d); *Lavoisiera cordata* (Melastomataceae) (e) and *Richterago caulescens* (Asteraceae) is the fifth threatened species. Photos: MGG, Camargo.

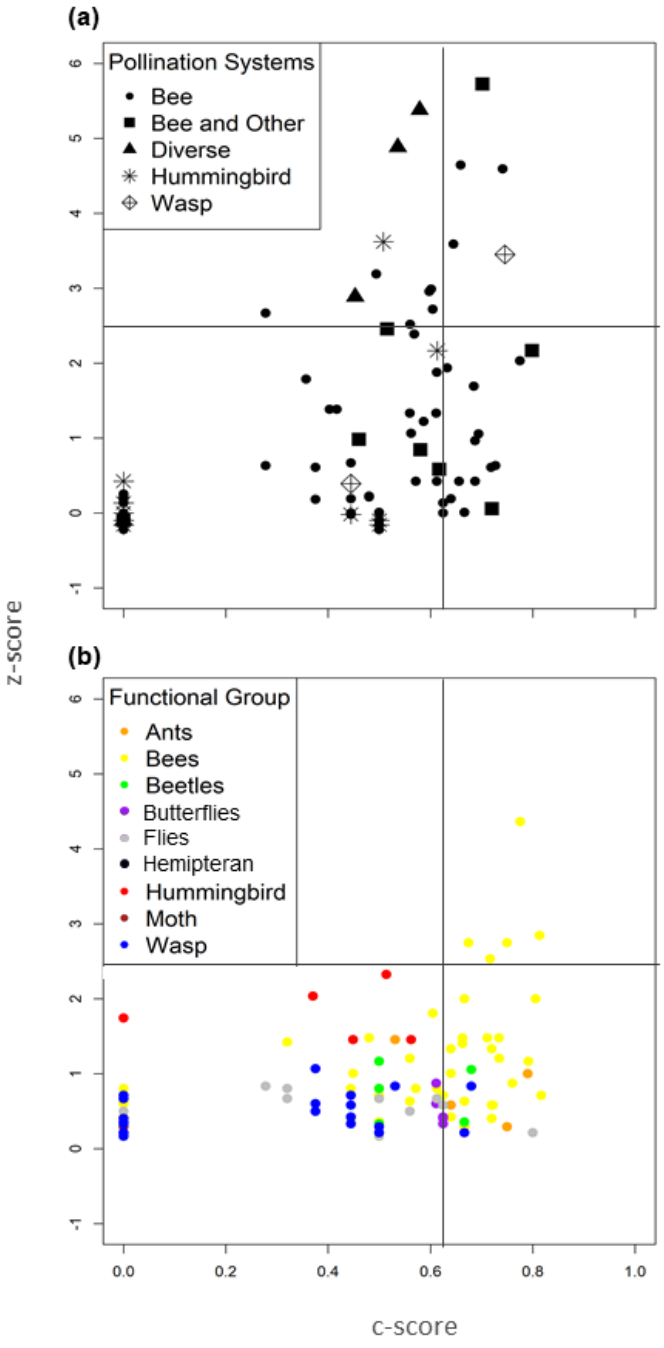

Figure 2. Scatterplot of z- and c-scores for plant species according to their pollination system (a) and pollinators species according to their functional group (b).

8.SUPPORTING INFORMATION

Table S1. Information about pollinators sampled in the campo rupestre of Serra do Cipó, MG. Their taxonomic family, functional group, module, z and c scores, their role, extinction risk according to ICMBio (2018) and endemism information.

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
Formicidae	*Brachymyrmex sp*	ant	6	0.581368065	0.625	connector	NA	-
Formicidae	*Camponotus arboreus*	ant	2	0.423808981	0.625	connector	NA	-
Formicidae	*Camponotus crassus*	ant	0	0.290917839	0.75	connector	NA	-
Formicidae	*Camponotus novogranadensis*	ant	6	0.581368065	0.64	connector	NA	-
Formicidae	*Camponotus punctulatus*	ant	7	0.166403622	0	peripheral	NA	-
Formicidae	*Camponotus renggeri*	ant	6	1.453420162	0.53125	peripheral	NA	-
Formicidae	*Camponotus rufipes*	ant	7	0.332807243	0.444444444	peripheral	NA	-
Formicidae	*Cephalotes pusillus*	ant	7	0.99842173	0.790123457	connector	NA	-
Formicidae	*Ectatomma tuberculatum*	ant	1	0.401062822	0.625	connector	NA	-
Formicidae	*Formicidae sp*	ant	7	0.166403622	0	peripheral	NA	-
Andrenidae	*Oxaea sp*	bee	4	0.355594387	0	peripheral	NA	-
Apidae	*Apis mellifera*	bee	5	2.745906044	0.75	network_hub	NA	intro
Apidae	*Arhysoceble sp1*	bee	1	0.802125644	0	peripheral	NA	-
Apidae	*Bombus morio*	bee	5	0.211223542	0	peripheral	NA	-
Apidae	*Bombus pauloensis*	bee	5	2.745906044	0.674556213	network_hub	NA	-
Apidae	*Centris lutea*	bee	4	0.711188775	0.625	connector	NA	-
Apidae	*Centris nitens*	bee	1	0.802125644	0	peripheral	NA	-
Apidae	*Centris sp1*	bee	3	0.666666667	0.5	peripheral	NA	-
Apidae	*Centris spilopoda*	bee	1	1.203188466	0.56	peripheral	NA	-
Apidae	*Centris tarsata*	bee	1	1.203188466	0.734693878	connector	NA	-
Apidae	*Centris varia*	bee	1	0.802125644	0.571428571	peripheral	NA	-
Apidae	*Ceratina (Crewella) sp2*	bee	5	1.478564793	0.733564014	connector	NA	-
Apidae	*Ceratina (Crewella) sp3*	bee	5	0.633670625	0	peripheral	NA	-
Apidae	*Ceratina (Crewella) sp6*	bee	1	0.200531411	0	peripheral	NA	-
Apidae	*Ceratina asunciana*	bee	5	0.422447084	0.444444444	peripheral	NA	-
Apidae	*Ceratina asuncionis*	bee	0	1.163671356	0.791666667	connector	NA	-
Apidae	*Ceratina muelleri*	bee	5	0.633670625	0.56	peripheral	NA	-
Apidae	*Ceratina sp1*	bee	1	0.802125644	0.612244898	peripheral	NA	-
Apidae	*Ceratina sp2*	bee	1	1.002657055	0.448979592	peripheral	NA	-

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
Apidae	*Ceratina volitans*	bee	6	0.290684032	0.666666667	connector	NA	-
Apidae	*Cyphomelissa diabolica*	bee	5	0.422447084	0.625	connector	NA	-
Apidae	*Epicharis albofasciata*	bee	1	0.200531411	0	peripheral	NA	-
Apidae	*Epicharis iheringi*	bee	1	0.200531411	0	peripheral	NA	-
Apidae	*Eufriesea nigrohirta*	bee	5	0.211223542	0.5	peripheral	NA	-
Apidae	*Euglossa cf melanotricha*	bee	1	0.802125644	0.32	peripheral	NA	-
Apidae	*Euglossa melanotricha*	bee	4	0.711188775	0.5	peripheral	NA	-
Apidae	*Euglossa sp1*	bee	6	0.872052097	0.611111111	peripheral	NA	-
Apidae	*Eulaema nigrita*	bee	1	0.401062822	0.444444444	peripheral	NA	-
Apidae	*Exomalopsis auropilosa*	bee	1	0.802125644	0	peripheral	NA	-
Apidae	*Exomalopsis fulvofasciata*	bee	6	0.581368065	0.722222222	connector	NA	-
Apidae	*Exomalopsis sp1*	bee	1	0.601594233	0.375	peripheral	NA	-
Apidae	*Exomalopsis sp2*	bee	5	0.422447084	0.64	connector	NA	-
Apidae	*Gaesischia sp1*	bee	2	0.211904491	0	peripheral	NA	-
Apidae	*Gaesischia sp2*	bee	0	0.290917839	0.666666667	connector	NA	-
Apidae	*Lophopedia haeckeli*	bee	1	0.401062822	0	peripheral	NA	-
Apidae	*Melipona quinquefasciata*	bee	1	0.802125644	0.5	peripheral	LC	-
Apidae	*Melipona sp1*	bee	2	0.211904491	0.666666667	connector	NA	-
Apidae	*Tapinotaspidini sp1*	bee	5	1.478564793	0.711111111	connector	NA	-
Apidae	*Tapinotaspidini sp2*	bee	5	0.422447084	0.444444444	peripheral	NA	-
Apidae	*Tetrapedia sp1*	bee	1	1.403719878	0.662721893	connector	NA	-
Apidae	*Tetrapedia sp2*	bee	1	1.002657055	0.64	connector	NA	-
Apidae	*Thygater sp*	bee	5	0.211223542	0	peripheral	NA	-
Apidae	*Trigona spinipes*	bee	4	2.8447551	0.813609467	network_hub	NA	-
Apidae	*Trigonopedia sp1*	bee	4	0.355594387	0	peripheral	NA	-
Apidae	*Xanthopedia cf larocai*	bee	1	0.601594233	0	peripheral	NA	-
Apidae	*Xylocopa (Stenoxylocopa) sp1*	bee	1	0.802125644	0.444444444	peripheral	NA	-
Apidae	*Xylocopa abbreviata*	bee	1	0.401062822	0	peripheral	NA	endemic
Apidae	*Xylocopa grisescens*	bee	3	0.666666667	0	peripheral	NA	-
Apidae	*Xylocopa macrops*	bee	5	0.211223542	0	peripheral	NA	-
Apidae	*Xylocopa sp big*	bee	4	1.42237755	0.32	peripheral	NA	-
Apidae	*Xylocopa sp1*	bee	5	0.633670625	0.666666667	connector	NA	-
Apidae	*Xylocopa sp2*	bee	6	0.581368065	0.72	connector	NA	-
Apidae	*Xylocopa sp3*	bee	5	0.633670625	0.56	peripheral	NA	-
Apidae	*Xylocopa sp4*	bee	5	0.633670625	0.666666667	connector	NA	-
Apidae	*Xylocopa sp5*	bee	5	0.211223542	0	peripheral	NA	-

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
Apidae	*Xylocopa subcyanea*	bee	1	0.601594233	0.375	peripheral	NA	-
Apidae	*Xylocopa truxali*	bee	1	0.802125644	0	peripheral	LC	endemic
Colletidae	*Chilicola (Oediscelis) sp*	bee	5	0.422447084	0	peripheral	NA	-
Colletidae	*Colletes sp1*	bee	7	0.166403622	0	peripheral	NA	-
Colletidae	*Hylaeus sp*	bee	5	0.211223542	0	peripheral	NA	-
Colletidae	*Hylaeus sp1*	bee	4	0.355594387	0	peripheral	NA	-
Halictidae	*Augochlora (Augochlora) sp1*	bee	0	0.290917839	0	peripheral	NA	-
Halictidae	*Augochlora (Oxystoglossella) sp1*	bee	5	0.422447084	0	peripheral	NA	-
Halictidae	*Augochlora (Oxystoglossella) sp2*	bee	3	1.333333333	0.64	connector	NA	-
Halictidae	*Augochlorella sp1*	bee	1	0.401062822	0	peripheral	NA	-
Halictidae	*Augochlorella sp2*	bee	1	0.401062822	0.444444444	peripheral	NA	-
Halictidae	*Augochloropsis sp1*	bee	5	2.534682502	0.7168	network_hub	NA	-
Halictidae	*Augochloropsis sp2*	bee	3	2	0.666666667	connector	NA	-
Halictidae	*Augochloropsis sp3*	bee	3	2	0.805555556	connector	NA	-
Halictidae	*Augochloropsis sp4*	bee	3	1.333333333	0.72	connector	NA	-
Halictidae	*Dialictus (Chloralictus) sp1*	bee	4	0.355594387	0	peripheral	NA	-
Halictidae	*Lasioglossum (Dialictus) sp1*	bee	0	4.363767586	0.775554354	network_hub	NA	-
Halictidae	*Lasioglossum (Dialictus) sp2*	bee	7	0.499210865	0.56	peripheral	NA	-
Halictidae	*Lasioglossum (Dialictus) sp6*	bee	1	0.401062822	0.444444444	peripheral	NA	-
Halictidae	*Lasioglossum (Dialictus) sp7*	bee	1	0.200531411	0	peripheral	NA	-
Halictidae	*Lasioglossum (Dialictus) sp8*	bee	1	0.601594233	0.611111111	peripheral	NA	-
Halictidae	*Lasioglossum (Dialictus) sp9*	bee	1	0.401062822	0.444444444	peripheral	NA	-
Halictidae	*Paroxystoglossa jocasta*	bee	1	1.8047827	0.604444444	peripheral	NA	-
Halictidae	*Paroxystoglossa sp1*	bee	5	1.478564793	0.48	peripheral	NA	-
Halictidae	*Pseudagapostemon ochromerus*	bee	1	0.401062822	0	peripheral	NA	-
Halictidae	*Pseudagapostemon sp1*	bee	2	0.211904491	0.666666667	connector	NA	-
Halictidae	*Pseudaugochlora graminea*	bee	4	0.355594387	0.5	peripheral	NA	-
Megachilidae	*Anthidiini sp*	bee	5	0.211223542	0	peripheral	NA	-
Megachilidae	*Coelioxys sp*	bee	1	0.401062822	0.72	connector	NA	-
Megachilidae	*Coelioxys sp1*	bee	1	0.401062822	0	peripheral	NA	-
Megachilidae	*Dicranthidium sp*	bee	5	0.211223542	0.5	peripheral	NA	-
Megachilidae	*Dicranthidium sp1*	bee	1	0.601594233	0.375	peripheral	NA	-
Megachilidae	*Megachile (Dasymegachile) sp*	bee	2	0.211904491	0	peripheral	NA	-
Megachilidae	*Megachile (Pseudocentron) sp1*	bee	5	1.478564793	0.662721893	connector	NA	-
Megachilidae	*Megachile (Pseudocentron) sp2*	bee	1	0.802125644	0.612244898	peripheral	NA	-
Megachilidae	*Megachile (Pseudocentron) sp3*	bee	1	0.802125644	0.612244898	peripheral	NA	-

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
Megachilidae	*Megachile (Sayapis) sp*	bee	6	0.581368065	0.444444444	peripheral	NA	-
Megachilidae	*Megachile cf maculata*	bee	4	0.711188775	0.816326531	connector	NA	-
Megachilidae	*Megachile sp*	bee	0	0.872753517	0.76	connector	NA	-
Cantharidae	*Chauliognathini sp1*	beetle	7	0.499210865	0.375	peripheral	NA	-
Cantharidae	*Chauliognathini sp2*	beetle	7	0.499210865	0	peripheral	NA	-
Cerambycidae	*Cerambycidae sp*	beetle	7	0.332807243	0.444444444	peripheral	NA	-
Cerambycidae	*Chrysoprasis sp1*	beetle	1	0.200531411	0	peripheral	NA	-
Cerambycidae	*Chrysoprasis sp2*	beetle	7	0.166403622	0.5	peripheral	NA	-
Chrysomelidae	*Alticini sp1*	beetle	4	0.355594387	0.666666667	connector	NA	-
Chrysomelidae	*Alticini sp2*	beetle	0	1.163671356	0.5	peripheral	NA	-
Chrysomelidae	*Chrysomelidae (Galerucinae) sp1*	beetle	0	0.290917839	0.5	peripheral	NA	-
Chrysomelidae	*Cryptocephalini sp1*	beetle	0	0.290917839	0	peripheral	NA	-
Chrysomelidae	*Cryptocephalini sp5*	beetle	7	0.166403622	0	peripheral	NA	-
Chrysomelidae	*Eumolpini sp1*	beetle	1	0.200531411	0	peripheral	NA	-
Chrysomelidae	*Eumolpini sp4*	beetle	0	0.872753517	0.611111111	peripheral	NA	-
Chrysomelidae	*Galerucinae sp1*	beetle	7	0.166403622	0	peripheral	NA	-
Chrysomelidae	*Galerucinae sp3*	beetle	0	0.290917839	0	peripheral	NA	-
Chrysomelidae	*Homophoeta sp*	beetle	2	0.211904491	0	peripheral	NA	-
Chrysomelidae	*Spintherophyta (Eumolpinae) sp1*	beetle	3	0.666666667	0	peripheral	NA	-
Chrysomelidae	*Spintherophyta sp1*	beetle	1	0.802125644	0.5	peripheral	NA	-
Chrysomelidae	*Urodera sp1*	beetle	0	0.290917839	0.5	peripheral	NA	-
Cleridae	*Trichodes sp*	beetle	7	0.166403622	0	peripheral	NA	-
Coccinellidae	*Brachiacantha sp*	beetle	0	0.290917839	0.5	peripheral	NA	-
Coleoptera	*Coleoptera sp*	beetle	7	0.166403622	0	peripheral	NA	-
Coleoptera	*Coleoptera sp2*	beetle	7	0.332807243	0.444444444	peripheral	NA	-
Coleoptera	*Madarini sp1*	beetle	3	0.666666667	0	peripheral	NA	-
Coleoptera	*Madarini sp2*	beetle	7	0.332807243	0.5	peripheral	NA	-
Curculionidae	*Baridinae sp1*	beetle	2	0.423808981	0.444444444	peripheral	NA	-
Curculionidae	*Nicentrus brasiliensis*	beetle	7	0.166403622	0	peripheral	NA	-
Curculionidae	*Parisoschoenus sp*	beetle	7	0.166403622	0	peripheral	NA	-
Curculionidae	*Sibinia sp*	beetle	7	0.166403622	0	peripheral	NA	-
Curculionoidea	*Madopterini sp*	beetle	7	0.665614486	0.612244898	peripheral	NA	-
Elateridae	*Elateridae sp1*	beetle	2	0.211904491	0.5	peripheral	NA	-
Nitidulidae	*Nitidulidae sp1*	beetle	5	1.056117709	0.68	connector	NA	-
Hesperiidae	*Elbella luteizona*	butterfly	5	0.211223542	0	peripheral	NA	-
Hesperiidae	*Hesperiidae sp1*	butterfly	1	0.401062822	0.625	connector	NA	-

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
Hesperiidae	*Hesperiinae sp*	butterfly	5	0.422447084	0.444444444	peripheral	NA	-
Hesperiidae	*Pyrginae sp*	butterfly	2	0.211904491	0.5	peripheral	NA	-
Hesperiidae	*Urbanus proteus*	butterfly	2	0.211904491	0	peripheral	NA	-
-	*Lepidoptera sp1*	butterfly	2	0.211904491	0	peripheral	NA	-
-	*Lepidoptera sp2*	butterfly	2	0.211904491	0	peripheral	NA	-
-	*Lepidoptera sp3*	butterfly	7	0.166403622	0	peripheral	NA	-
-	*Lepidoptera sp4*	butterfly	4	0.355594387	0	peripheral	NA	-
-	*Lepidoptera sp5*	butterfly	7	0.166403622	0	peripheral	NA	-
-	*Lepidoptera sp6*	butterfly	4	0.355594387	0	peripheral	NA	-
-	*Lepidoptera sp7*	butterfly	5	0.211223542	0	peripheral	NA	-
-	*Lepidoptera sp8*	butterfly	7	0.166403622	0	peripheral	NA	-
-	*Microlepidoptera sp*	butterfly	7	0.332807243	0.444444444	peripheral	NA	-
Lycaenidae	*cf Leptotes sp1*	butterfly	6	0.290684032	0.5	peripheral	NA	-
Lycaenidae	*Leptotes sp*	butterfly	4	0.355594387	0	peripheral	NA	-
Lycaenidae	*Polyommatinae sp*	butterfly	2	0.211904491	0.5	peripheral	NA	-
Lycaenidae	*Theclinae sp*	butterfly	7	0.332807243	0.625	connector	NA	-
Lycaenidae	*Theclinae sp2*	butterfly	2	0.211904491	0	peripheral	NA	-
Nymphalidae	*cf Nymphalidae sp2*	butterfly	4	0.355594387	0	peripheral	NA	-
Nymphalidae	*cf Vanessa sp1*	butterfly	7	0.166403622	0	peripheral	NA	-
Nymphalidae	*Junonia genoveva*	butterfly	6	0.290684032	0.5	peripheral	NA	-
Nymphalidae	*Junonia sp*	butterfly	2	0.211904491	0	peripheral	NA	-
Nymphalidae	*Nymphalidae sp1*	butterfly	6	0.290684032	0	peripheral	NA	-
Nymphalidae	*Satyrinae sp*	butterfly	1	0.601594233	0.611111111	peripheral	NA	-
Nymphalidae	*Vanessa sp*	butterfly	2	0.211904491	0.5	peripheral	NA	-
Papilionidae	*cf Papilionidae sp1*	butterfly	6	0.290684032	0.5	peripheral	NA	-
Papilionidae	*Papilionidae sp*	butterfly	6	0.290684032	0.5	peripheral	NA	-
Pieridae	*Phoebis sennae*	butterfly	6	0.872052097	0.611111111	peripheral	NA	-
Pieridae	*Phoebis sp1*	butterfly	6	0.290684032	0	peripheral	NA	-
Pieridae	*Pierinae sp*	butterfly	7	0.166403622	0	peripheral	NA	-
Riodinidae	*Riodininae sp*	butterfly	5	0.422447084	0.625	connector	NA	-
Bibionidae	*Plecia sp*	fly	7	0.499210865	0.56	peripheral	NA	-
Bombyliidae	*Bryodemina sp1*	fly	7	0.166403622	0.5	peripheral	NA	-
Bombyliidae	*Villa sp*	fly	2	0.211904491	0	peripheral	NA	-
-	*Diptera sp1*	fly	7	0.166403622	0	peripheral	NA	-
-	*Diptera sp2*	fly	7	0.499210865	0.375	peripheral	NA	-
-	*Diptera sp3*	fly	2	0.211904491	0	peripheral	NA	-

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
-	*Diptera sp4*	fly	2	0.211904491	0.8	connector	NA	-
-	*Diptera sp5*	fly	2	0.211904491	0.5	peripheral	NA	-
-	*Diptera sp7*	fly	7	0.166403622	0	peripheral	NA	-
-	*Masiphyia sp*	fly	7	0.665614486	0.32	peripheral	NA	-
-	*Masiphyia sp2*	fly	2	0.211904491	0	peripheral	NA	-
Milichiidae	*Pholeomyia sp*	fly	7	0.499210865	0	peripheral	NA	-
Muscidae	*Neodexiopsis sp*	fly	7	0.332807243	0	peripheral	NA	-
Mydidae	*Protomydas sp*	fly	6	0.290684032	0.5	peripheral	NA	-
Pipunculidae	*Pipunculidae sp*	fly	4	0.355594387	0	peripheral	NA	-
Richardiidae	*Spheneuolena sp*	fly	2	0.211904491	0	peripheral	NA	-
Sarcophagidae	*Sarcophagidae sp*	fly	4	0.711188775	0.444444444	peripheral	NA	-
Sciaridae	*Sciara sp*	fly	7	0.832018108	0.277777778	peripheral	NA	-
Syrphidae	*Allograpta exotica*	fly	0	0.581835678	0.625	connector	NA	-
Syrphidae	*Copestylum sp*	fly	3	0.666666667	0.5	peripheral	NA	-
Syrphidae	*Palpada doris*	fly	7	0.166403622	0	peripheral	NA	-
Syrphidae	*Palpada melanaspis*	fly	7	0.166403622	0	peripheral	NA	-
Syrphidae	*Palpada sp*	fly	7	0.166403622	0	peripheral	NA	-
Syrphidae	*Pseudodorus clavatus*	fly	7	0.166403622	0	peripheral	NA	-
Syrphidae	*Toxomerus sp1*	fly	7	0.166403622	0.5	peripheral	NA	-
Syrphidae	*Toxomerus tibicen*	fly	7	0.332807243	0	peripheral	NA	-
Syrphidae	*Toxophorinae sp2*	fly	2	0.211904491	0.5	peripheral	NA	-
Tabanidae	*Diachlorini sp*	fly	7	0.166403622	0	peripheral	NA	-
Tabanidae	*Dichelacera sp*	fly	7	0.166403622	0	peripheral	NA	-
Tachinidae	*Archytas diaphanus*	fly	7	0.166403622	0	peripheral	NA	-
Tachinidae	*Deopalpus sp*	fly	7	0.665614486	0.612244898	peripheral	NA	-
Tachinidae	*Gnadochaeta sp*	fly	7	0.332807243	0	peripheral	NA	-
Tachinidae	*Leskia sp*	fly	5	0.211223542	0	peripheral	NA	-
Tachinidae	*Spallanzania sp*	fly	7	0.166403622	0	peripheral	NA	-
Tachinidae	*Tachinidae sp1*	fly	1	0.802125644	0.32	peripheral	NA	-
Tephritidae	*Trupanea sp*	fly	7	0.332807243	0.444444444	peripheral	NA	-
Reduviidae	*Harpactorinae sp1*	Hemiptera	6	0.290684032	0.5	peripheral	NA	-
Trochilidae	*Anthracothorax nigricollis*	hummingbird	6	0.581368065	0.444444444	peripheral	LC	-
Trochilidae	*Augastes scutatus*	hummingbird	6	0.290684032	0	peripheral	LC	endemic
Trochilidae	*Campylopterus largipennis*	hummingbird	6	1.453420162	0.448979592	peripheral	LC	-
Trochilidae	*Chlorostilbon lucidus*	hummingbird	6	2.034788227	0.37037037	peripheral	LC	-
Trochilidae	*Colibri serrirostris*	hummingbird	6	1.744104195	0	peripheral	LC	-

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
Trochilidae	*Eupetomena macroura*	hummingbird	6	1.453420162	0.5625	peripheral	LC	-
Trochilidae	*Heliactin bilophus*	hummingbird	6	2.325472259	0.513888889	peripheral	LC	-
Trochilidae	*Thalurania furcata*	hummingbird	1	0.200531411	0	peripheral	LC	-
Sphingidae	*Aellopos sp*	moth	6	0.290684032	0	peripheral	NA	-
Braconidae	*Braconidae sp1*	wasp	2	0.423808981	0.444444444	peripheral	NA	-
Braconidae	*Braconidae sp2*	wasp	2	0.211904491	0	peripheral	NA	-
Braconidae	*Braconidae sp3*	wasp	2	0.211904491	0	peripheral	NA	-
Crabonidae	*Rubrica nasuta*	wasp	7	0.332807243	0.444444444	peripheral	NA	-
Crabronidae	*Cerceris sp1*	wasp	1	0.401062822	0	peripheral	NA	-
Ichneumonidae	*Ichneumonidae sp*	wasp	7	0.166403622	0	peripheral	NA	-
Pompilidae	*Pompilidae sp*	wasp	4	0.355594387	0	peripheral	NA	-
Pteromalidae	*Pteromalidae sp1*	wasp	7	0.499210865	0.375	peripheral	NA	-
Scoliidae	*Campsomeris sp1*	wasp	5	0.422447084	0.444444444	peripheral	NA	-
Scoliidae	*Campsomeris sp2*	wasp	2	0.211904491	0.666666667	connector	NA	-
Scoliidae	*Campsomeris sp3*	wasp	7	0.332807243	0	peripheral	NA	-
Scoliidae	*Scolia sp2*	wasp	6	0.290684032	0.5	peripheral	NA	-
Sphecidae	*Ammophila gracilis*	wasp	1	0.200531411	0	peripheral	NA	-
Sphecidae	*Sphex sp*	wasp	7	0.166403622	0	peripheral	NA	-
Tiphiidae	*Myzinum sp*	wasp	7	0.832018108	0.68	connector	NA	-
Vespidae	*Brachygastra lecheguana*	wasp	7	0.499210865	0.375	peripheral	NA	-
Vespidae	*Mischocyttarus drewseni*	wasp	4	0.711188775	0	peripheral	NA	-
Vespidae	*Pachodynerus guadulpensis*	wasp	7	0.166403622	0	peripheral	NA	-
Vespidae	*Polistes consobrinus*	wasp	7	0.166403622	0	peripheral	NA	-
Vespidae	*Polistes satan*	wasp	4	0.711188775	0.444444444	peripheral	NA	-
Vespidae	*Polistes sp1*	wasp	6	0.581368065	0.444444444	peripheral	NA	-
Vespidae	*Polybia flavifrons*	wasp	7	0.332807243	0	peripheral	NA	-
Vespidae	*Polybia ignobilis*	wasp	7	0.832018108	0.53125	peripheral	NA	-
Vespidae	*Polybia occidentalis*	wasp	7	0.166403622	0	peripheral	NA	-
Vespidae	*Polybia sericea*	wasp	7	0.332807243	0.444444444	peripheral	NA	-
Vespidae	*Polybia sp1*	wasp	5	0.211223542	0.5	peripheral	NA	-
Vespidae	*Synoeca sp1*	wasp	1	0.601594233	0.375	peripheral	NA	-
Vespidae	*Synoeca surinama*	wasp	2	0.211904491	0.5	peripheral	NA	-
Vespidae	*Vespidae sp1*	wasp	2	0.211904491	0.666666667	connector	NA	-
Vespidae	*Vespidae sp2*	wasp	3	0.666666667	0	peripheral	NA	-
Vespidae	*Zeta argillaceum*	wasp	7	0.332807243	0.444444444	peripheral	NA	-
Vespidae	*Zethus brasiliensis*	wasp	4	1.066783162	0.375	peripheral	NA	-

Family	Species	Functional Group	Module	z-score	c-score	Role	EXR	Endemism
Vespidae	*Zethus fraternus*	wasp	4	0.355594387	0	peripheral	NA	-
Vespidae	*Zethus productus*	wasp	7	0.166403622	0	peripheral	NA	-

Table S2. Information about plants sampled in the campo rupestre of Serra do Cipó, MG. Their herbarium voucher, taxonomic family, pollination system, module, z and c scores, their network role, extinction risk according to Martinelli & Moraes (2013) and endemism information. For pollination system BEE= pollinated by Bees, BEE2=Bee and other functional group, DIV=Diverse Animals, HUM=Hummingbird and WAS=Wasp.

Herbarium Voucher	Family	Species	Pollination System	Module	z-score	c-score	Role	EXR	Endemism
67339	Apocynaceae	*Minaria ditassoides*	BEE	4	2.385923632	0.568047337	peripheral	NE	-
67320	Aquifoliaceae	*Ilex nummularia*	BEE	5	0	0.625	connector	NE	-
no_collect	Asteraceae	*Acritopappus longifolius*	BEE	5	0	0.444444444	peripheral	NE	-
66876	Asteraceae	*Aspilia fruticosa*	BEE	1	-0.020343766	0	peripheral	NE	-
66879	Asteraceae	*Aspilia jolyana*	BEE	1	4.591878688	0.741166332	network_hub	NE	-
66888	Asteraceae	*Baccharis serrulata*	DIV	7	2.885849109	0.452662722	module_hub	NE	-
67644	Asteraceae	*Cyrtocymura scorpioides*	BEE	5	0.422447084	0.571428571	peripheral	NE	-
no_collect	Asteraceae	*Dasyphyllum sprengelianum*	HUM	6	-0.158554927	0	peripheral	NE	-
no_collect	Asteraceae	*Gochnatia pulchra*	BEE	0	-0.100316496	0.5	peripheral	NE	-
66836	Asteraceae	*Lessingianthus pycnostachyus*	BEE2	5	0.844894167	0.58	peripheral	NE	-
67634	Asteraceae	*Lessingianthus warmingianus*	BEE	6	0.132129106	0	peripheral	NE	-
no_collect	Asteraceae	*Lychnophora ericoides*	BEE2	1	0.581250467	0.617283951	peripheral	NT	-
67637	Asteraceae	*Lychnophora passerina*	BEE	1	3.188158811	0.49408284	module_hub	NT	-
66882	Asteraceae	*Lychnophora rupestris*	BEE	7	1.221812893	0.586666667	peripheral	NE	-
66891	Asteraceae	*Lychnophora uniflora*	BEE2	2	5.727842593	0.701754386	network_hub	NE	-
66820	Asteraceae	*Richterago cf caulescens*	BEE	0	-0.100316496	0	peripheral	CR	SDC
66819	Asteraceae	*Richterago cf conduplicata*	BEE	1	1.383376111	0.416666667	peripheral	EN	SDC
66810	Asteraceae	*Richterago polymorpha*	BEE	0	0.190601343	0.64	connector	NE	-
67698	Asteraceae	*Richterago polyphylla*	BEE	6	0.132129106	0	peripheral	EN	SDC
66850	Asteraceae	*Symphyopappus compressus*	BEE	6	-0.158554927	0.5	peripheral	NE	-
no_collect	Asteraceae	*Trichogonia hirtiflora*	BEE	3	0.666666667	0.444444444	peripheral	NT	-
67376	Begoniaceae	*Begonia grisea*	BEE	5	0.633670625	0.277777778	peripheral	NE	-
67882	Bignoniaceae	*Jacaranda caroba*	BEE	0	0.190601343	0	peripheral	NE	-
no_collect	Bromeliaceae	*Neoregelia bahiana*	HUM	0	-0.100316496	0.5	peripheral	LC	-
67718	Calophyllaceae	*Kielmeyera speciosa*	BEE	0	1.06335486	0.5625	peripheral	NE	-
no_collect	Clusiaceae	*Clusia arrudea*	BEE	4	0.252357307	0	peripheral	NE	-
67019	Cyperaceae	*Rhynchospora cf setigera*	BEE2	0	-0.100316496	0	peripheral	NE	-
67662	Cyperaceae	*Rhynchospora consanguinea*	BEE2	1	0.982313289	0.46	peripheral	NE	-

67409	Dilleniaceae	*Davilla elliptica*	BEE	5	0.211223542	0.48	peripheral	NE	-
67070	Ericaceae	*Agarista cf duartei*	HUM	0	-0.100316496	0	peripheral	NE	SDC
67069	Ericaceae	*Agarista coriifolia*	HUM	0	-0.100316496	0	peripheral	NE	-
67072	Ericaceae	*Gaylussacia montana*	BEE	5	0	0.444444444	peripheral	LC	-
67085	Eriocaulaceae	*Paepalanthus argenteus*	DIV	0	-0.100316496	0	peripheral	NE	-
67817	Eriocaulaceae	*Paepalanthus bromelioides*	DIV	7	5.381903434	0.578875171	module_hub	NE	SDC
67389	Erythroxylaceae	*Erythroxylum microphyllum*	WAS	7	0.389794785	0.444444444	peripheral	NE	-
67387	Erythroxylaceae	*Erythroxylum suberosum*	WAS	4	3.452706795	0.74556213	network_hub	NE	-
67154	Fabaceae	*Bionia coriacea*	HUM	5	0	0	peripheral	NE	-
67151	Fabaceae	*Chamaecrista desvauxii var graminea*	BEE	3	0	0.5	peripheral	NE	-
67622	Fabaceae	*Chamaecrista ochnacea*	BEE	6	0.132129106	0.625	connector	NE	-
tombar	Fabaceae	*Chamaecrista papillata*	BEE	3	0.666666667	0.444444444	peripheral	NE	-
67147	Fabaceae	*Chamaecrista ramosa*	BEE	1	0.180187645	0.375	peripheral	NE	-
no_collect	Fabaceae	*Chamaecrista rotundata*	BEE	0	0.190601343	0	peripheral	NE	-
no_collect	Fabaceae	*Mimosa calliandroides*	BEE	2	0.218325839	0	peripheral	NE	-
67611	Fabaceae	*Mimosa cf maguirei*	BEE	2	0.006421348	0.5	peripheral	NE	-
67116	Fabaceae	*Mimosa claussenii*	BEE2	7	0.056987542	0.72	connector	NE	-
67169	Fabaceae	*Periandra mediterranea*	BEE	4	-0.10323708	0	peripheral	NE	-
67165	Fabaceae	*Stryphnodendrum adstringens*	BEE	5	0	0	peripheral	LC	-
67419	Gesneriaceae	*Nematanthus wettsteinii*	HUM	6	0.422813138	0	peripheral	NE	-
no_collect	Gesneriaceae	*Paliavana sericiflora*	HUM	6	-0.158554927	0	peripheral	NE	-
67821	Iridaceae	*Trimezia juncifolia*	BEE	5	0.422447084	0.612244898	peripheral	NE	-
67827	Lamiaceae	*Eriope macrostachya*	BEE	5	0	0.444444444	peripheral	LC	-
no_collect	Lamiaceae	*Hypenia macrantha*	HUM	6	-0.158554927	0	peripheral	NE	-
67822	Lamiaceae	*Hyptis proteoides*	BEE	6	-0.158554927	0	peripheral	NE	-
67449	Loganiaceae	*Spigelia sellowiana*	HUM	6	0.132129106	0	peripheral	LC	-
67454	Loranthaceae	*Psittacanthus robustus*	HUM	6	-0.158554927	0.5	peripheral	NE	-
67808	Loranthaceae	*Struthanthus flexicaulis*	BEE	7	0.223391163	0.48	peripheral	NE	-
67807	Lythraceae	*Cuphea ericoides*	BEE	5	4.64691792	0.658765432	network_hub	NE	-
67794	Lythraceae	*Cuphea linarioides*	BEE	1	3.589221633	0.645061728	network_hub	LC	-
tombar	Malpighiaceae	*Byrsonima cf guilleminiana*	BEE	3	1.333333333	0.611111111	peripheral	NE	-
67316	Malpighiaceae	*Byrsonima pachyphylla*	BEE	5	1.056117709	0.693877551	connector	NE	-
67300	Malpighiaceae	*Byrsonima vacciniifolia*	BEE	1	2.9876274	0.601664685	module_hub	NE	-
no_collect	Malpighiaceae	*Heteropterys pteropetala*	BEE	1	-0.020343766	0	peripheral	NE	-
tombar	Malpighiaceae	*Tetrapterys microphylla*	BEE	1	1.784438933	0.357142857	peripheral	LC	-
67208	Melastomataceae	*Cambessedesia semidecandra*	BEE	1	-0.220875177	0	peripheral	NE	SDC
67870	Melastomataceae	*Chaetostoma armatum*	BEE	1	0.180187645	0	peripheral	NE	-

67209	Melastomataceae	*Lavoisiera camposportuana*	BEE	4	-0.10323708	0	peripheral	NE	-
67763	Melastomataceae	*Lavoisiera confertiflora*	BEE	1	0.180187645	0	peripheral	NE	-
no_collect	Melastomataceae	*Lavoisiera cordata*	BEE	1	-0.020343766	0.444444444	peripheral	VU	SDC
67190	Melastomataceae	*Lavoisiera subulata*	BEE	5	0.633670625	0.277777778	peripheral	NE	-
67206	Melastomataceae	*Leandra aurea*	BEE	5	0	0	peripheral	NE	-
no_collect	Melastomataceae	*Microlicia juniperina*	BEE	3	2.666666667	0.277777778	module_hub	DD	-
67178	Melastomataceae	*Pleroma cardinale*	BEE	3	1.333333333	0.56	peripheral	NE	-
67194	Melastomataceae	*Pleroma heteromallum*	BEE	4	0.963546082	0.6875	connector	NE	-
67754	Myrtaceae	*Myrcia guianensis*	BEE	5	1.689788334	0.685	connector	LC	-
67752	Ochnaceae	*Luxemburgia ciliosa*	BEE	4	0.607951695	0.375	peripheral	NE	-
67546	Ochnaceae	*Luxemburgia schwackeana*	BEE	5	0.422447084	0.65625	connector	NE	-
67876	Ochnaceae	*Ouratea floribunda*	BEE	5	0.633670625	0.727272727	connector	NE	-
67735	Phyllanthaceae	*Phyllanthus klotzschianus*	BEE	7	-0.10941608	0.5	peripheral	NE	-
67564	Polygalaceae	*Polygala apparicioi*	BEE	1	-0.220875177	0	peripheral	NE	-
67563	Polygalaceae	*Polygala hygrophila*	BEE	1	-0.220875177	0	peripheral	NE	-
67578	Polygonaceae	*Coccoloba brasiliensis*	DIV	7	4.882692569	0.535989135	module_hub	NE	-
67914	Rubiaceae	*Borreria poaya*	BEE	5	2.957129585	0.597633136	module_hub	NE	-
66961	Rubiaceae	*Chomelia ribesioides*	BEE	0	0.190601343	0.444444444	peripheral	NE	-
66964	Rubiaceae	*Declieuxia fruticosa*	BEE2	6	2.166917333	0.798367347	connector	LC	-
66950	Rubiaceae	*Palicourea rigida*	HUM	6	3.620337495	0.507936508	module_hub	NE	-
66976	Rubiaceae	*Remijia ferruginea*	HUM	6	-0.158554927	0	peripheral	NE	-
66972	Rubiaceae	*Sabicea brasiliensis*	BEE	4	0.607951695	0.71875	connector	NE	-
no_collect	Solanaceae	*Brunfelsia uniflora*	BEE	5	-0.211223542	0	peripheral	NE	-
67597	Styracaceae	*Styrax ferrugineus*	BEE	5	-0.211223542	0	peripheral	NE	-
67927	Trigonaceae	*Trigonia cipoensis*	BEE	7	2.719445488	0.604444444	module_hub	NE	-
67591	Turneraceae	*Turnera hilaireana*	BEE	1	-0.020343766	0	peripheral	LC	-
67515	Velloziaceae	*Barbacenia cf flava*	HUM	6	2.166917333	0.613333333	peripheral	NE	-
no_collect	Velloziaceae	*Barbacenia cf nana*	HUM	1	-0.020343766	0.444444444	peripheral	NE	SDC
67500	Velloziaceae	*Vellozia albiflora*	BEE	5	0.422447084	0.6875	connector	NT	-
67213	Velloziaceae	*Vellozia epidendroides*	BEE	0	2.517944055	0.560553633	module_hub	NE	-
67222	Velloziaceae	*Vellozia nivea*	BEE	0	1.936108377	0.632653061	connector	NE	-
67245	Velloziaceae	*Vellozia resinosa*	BEE	2	0.006421348	0.666666667	connector	NE	-
67584	Verbenaceae	*Lippia florida*	BEE	1	-0.220875177	0.5	peripheral	NE	-
67585	Verbenaceae	*Lippia hermannioides*	BEE	5	-0.211223542	0	peripheral	NE	-
67921	Verbenaceae	*Stachytarpheta confertifolia*	BEE	0	-0.100316496	0	peripheral	NE	-
67925	Verbenaceae	*Stachytarpheta linearis*	BEE	5	0	0	peripheral	NE	-
67278	Vochysiaceae	*Qualea cordata*	BEE	1	1.383376111	0.402777778	peripheral	NE	-

tombar	Vochysiaceae	*Qualea dichotoma*	BEE	4	2.030329245	0.775047259	connector	NE	-
tombar	Vochysiaceae	*Vochysia pygmaea*	BEE	6	1.8762333	0.612244898	peripheral	EN	-
tombar	Vochysiaceae	*Vochysia thyrsoidea*	BEE2	6	2.457601365	0.515555556	peripheral	NE	-
66925	Xyridaceae	*Xyris melanopoda*	BEE	1	-0.220875177	0	peripheral	NE	-

CONSIDERAÇÕES FINAIS

No primeiro capítulo, encontramos uma predominância de abelhas e beija-flores como polinizadores, assim como a predominância dos sistemas de polinização relacionados aos voadores de longa distância que são necessários para garantir a polinização cruzada nesta paisagem distribuída como um arquipélago, com populações de plantas restritas localmente, sustentado pela teoria de OCBIL. Também encontramos uma grande representatividade de polinização pelo vento, como esperado para essa vegetação montanhosa, marcada pela presença de gramíneas, principalmente, ao considerarmos a avaliação dos sistemas de polinização da coleta sistemática de plantas. Apontamos ainda a importância da existência de um critério de acurácia para a determinação do sistema de polinização, assim como a avaliação dos sistemas de polinização de forma sistemática para testar padrões e processos envolvidos.

Ao avaliar os sistemas de polinização ao longo do gradiente de altitude, encontramos que a polinização pelo vento e abelhas é predominante. Sendo que a polinização pelo vento, pequenas abelhas e por moscas aumentam com a altitude enquanto a polinização que depende dos voadores de longa distância não se altera. Nós também encontramos um padrão, até então não demonstrado para montanhas antigas, que é o aumento significativo da polinização por moscas com o aumento da altitude. Em relação aos diferentes tipos de vegetação, vimos que a polinização de longa distância está associada aos afloramentos rochosos, que estão mais isolados na paisagem. A polinização por pequenas abelhas e vento predomina na matriz dominante de campo e a polinização por diversos animais está mais associada à vegetação de cerrado.

Em relação ao segundo capítulo, encontramos que a rede de interação entre as plantas e polinizadores de *campo rupestre* está organizada de forma aninhada e modular, porém, ao realizarmos a simples simulação com a retirada da espécie de abelha introduzida *Apis mellifera*, a rede perde a significância de modularidade. Esta espécie introduzida atua como supergeneralista, sendo este um papel providencial para a coesão dos módulos e a conexão entre eles. *Apis mellifera* também atua como polinizadora junto com outras espécies nativas na Serra do Cipó, indicando que a sua possível retirada não afetaria a reprodução de plantas generalistas. Dessa forma, o efeito da *A. mellifera* em *campo rupestre* é um assunto que ainda demanda maiores investigações.

Os polinizadores com papéis principais na rede, que são considerados voadores de longa distância e essenciais para a conexão e evolução desta vegetação em arquipélago, são as abelhas

grandes que atuam como hub da rede e conectoras, importantes para a manutenção do padrão modular da rede. Pequenos insetos como formigas e pequenas abelhas também se destacaram no papel de conectoras da rede, porém, o papel das formigas como polinizadoras efetivas é controverso. Em relação ao papel das espécies de planta para a manutenção do padrão modular, encontramos que as principais espécies possuem o sistema de polinização por abelhas, mas são flores visitadas por quase todos os grupos funcionais de polinizadores. Por ser uma espécie abundante na Serra do Cipó, a supergeneralista *Aspilia jolyana* (Asteraceae) é a espécie que se destaca. Também apontamos que espécies com o sistema de polinização por beija-flores funcionam como conectoras. Portanto, apesar dos beija-flores não apresentarem papel central na rede de interações, as plantas por eles polinizadas são importantes para a manutenção da estrutura da rede.

A extensa base de dados de interação entre plantas e polinizadores aqui apresentada, concentra informações relevantes que podem ser utilizadas com propósitos de ampliar o conhecimento da dinâmica de comunidades, evolução, práticas de conservação e conhecimento dos serviços ecossistêmicos do *campo rupestre*. Estudos futuros podem abordar a distância percorrida pelo pólen, entrando em maiores detalhes como ocorre o fluxo gênico nesta paisagem em arquipélago com plantas que apresentam restrições na dispersão de sementes. Os sistemas de polinização que aqui apontados como “bimodais” também merecem futuras investigações, principalmente em relação às espécies que são polinizadas pelo vento e insetos, o que pode nos prover informações cruciais para o entendimento dos padrões de diversificação desta vegetação montanhosa.

Propomos que estratégias de conservação considerem as espécies que atuam como principais para a manutenção das principais características da rede para que sejam mais resilientes a distúrbios. Propomos que estratégias de conservação considerem principalmente as espécies que possuem papel principal na rede e já estão avaliadas como ameaçadas ou quase ameaçadas e que sejam endêmicas de *campo rupestre*. Reforçamos a necessidade de estudos para entender o efeito da espécie introduzida *Apis mellifera* a partir de simulações de rede de interação que considerem a reconexão entre as espécies ou até mesmo com experimentos de exclusão da invasora. Por fim, por se tratar de uma vegetação estacional, sugerimos a avaliação de um ano completo de interações para entender se o papel das espécies se altera em diferentes estações do ano.