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**EFEITO DA DIVERSIDADE FLORÍSTICA SOBRE A DIETA DA PREGUIÇA-DE-
COLEIRA (*Bradypus torquatus* Illiger, 1811)**

ILHÉUS - BAHIA

2022

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Dissertação apresentada à Universidade Estadual de Santa Cruz, como parte das exigências para obtenção do título de Mestre em Ecologia e Conservação da Biodiversidade.

Área de concentração: Ecologia e Conservação

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EFEITO DA DIVERSIDADE FLORÍSTICA SOBRE A DIETA DA PREGUIÇA-DE-COLEIRA (*Bradypus torquatus* Illiger, 1811)

RESUMO

A diversidade de recursos alimentares no ambiente pode afetar a diversidade e a similaridade da dieta de indivíduos de uma espécie. Estes efeitos, assim como outros aspectos da ecologia alimentar da preguiça-de-coleira (*Bradypus torquatus* Illiger, 1811), ainda necessitam ser estudados. A preguiça-de-coleira é um mamífero folívoro, ameaçado e endêmico da Mata Atlântica, onde grande parte dos fragmentos florestais vem perdendo sua diversidade florística. Como indivíduos, as preguiças são consideradas especialistas e altamente seletivas, e como a dieta individual varia entre si, elas são consideradas generalistas como espécie. É possível que tal variação da dieta individual previamente reportada seja resultante de uma seleção alimentar diferenciada entre indivíduos, ou da dissimilaridade da composição florística disponível em suas áreas de vida, aspectos ainda não testados. Ainda, é esperado que a redução da diversidade de árvores cause maior sobreposição da dieta de indivíduos dada a menor disponibilidade de espécies propícias para servirem como recurso alimentar. Neste contexto, o objetivo deste estudo foi: avaliar a composição e seleção alimentar da preguiça-de-coleira em duas regiões ainda não estudadas; testar se a dissimilaridade da dieta entre indivíduos e populações é explicada por mudanças nas composições florísticas locais e/ou por um padrão diferenciado de seleção de espécies vegetais; e avaliar o efeito da diversidade florística do ambiente sobre a diversidade e similaridade da dieta de indivíduos. Foram monitorados 13 indivíduos por radiotelemetria, e foram acessadas a disponibilidade e diversidade de espécies de árvores em cada área de vida. Foram identificadas 67 espécies de árvores compondo a dieta das preguiças, sendo a maior parte destas selecionadas, participando da dieta em maior proporção do que sua disponibilidade no ambiente. A dissimilaridade da dieta individual e populacional foi na maior parte explicada por diferenças na composição florística local, embora a seleção individual diferenciada também tenha contribuído. Em floresta menos diversa, indivíduos apresentaram uma maior seleção compartilhada para algumas espécies de plantas, tornando suas dietas mais similares, revelando recursos-chaves (espécies altamente consumidas e preferidas pela população) para serem usados em ações de conservação. A diversidade florística do ambiente teve efeito negativo sobre a similaridade das dietas individuais, mas não na diversidade e riqueza de espécies de árvores consumidas por indivíduo. Juntos os resultados indicam que as preguiças são seletivas em nível populacional e individual, especialistas em nível individual (baixa amplitude de suas dietas independente da diversidade florística) e a diversidade florística media a similaridade das dietas individuais. Por fim, apresentamos espécies de plantas que podem ser importantes para esta espécie ameaçada na Mata Atlântica e para o planejamento de ações de conservação.

Palavras-chave: Ecologia alimentar; folivoria; similaridade da dieta; preguiça de três dedos; Mata Atlântica.

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1 INTRODUÇÃO

O conhecimento da ecologia alimentar de uma espécie, tal como a composição e seleção de sua dieta, nos ajuda a entender seus requerimentos de habitat, recursos e nutrientes (GINÉ et al., 2010; GINÉ et al., 2020; NORSCIA et al., 2012; ROCHA-MENDES et al., 2010). Este entendimento é fundamental para o embasamento de ações e programas de conservação de espécies ameaçadas, tanto em nível *in situ*, tais como ações de enriquecimento, recuperação e restauração do habitat (BELTRÁN; HOWE, 2020; CROMSIGT et al., 2018); como em nível *ex situ*, tais como ações de manutenção, reprodução, reabilitação e/ou reintrodução de populações cativas (MUN et al., 2014; AGORAMOORTHY et al., 2004). A manutenção em cativeiro de mamíferos folívoros arborícolas, como preguiças, coalas e alguns primatas, tem sido historicamente um desafio enfrentado por instituições mantenedoras da fauna (COLLINS; ROBERTS, 1978; DINIZ; OLIVEIRA, 1999; MATSUDA et al., 2018). Isto acontece porque a dieta destes animais é baseada em um fino balanço entre seus requerimentos metabólicos, disponibilidade de alimento, custos de aquisição, digestão e desintoxicação (GANZHORN et al., 2017; JENSEN et al., 2015). Neste sentido, o estudo da dieta de espécimes em vida livre nos ajuda a entender suas preferências alimentares e requerimentos nutricionais, assim como evitar problemas de desordens gastrointestinais e a mortalidade exacerbada (MATSUDA et al., 2018; CRISSEY; PRIBYL, 2000).

As preguiças-de-três-dedos, pertencentes ao gênero *Bradypus* (Pilosa: Bradypodidae), apresentam uma dieta majoritariamente baseada em folhas de árvores e lianas, as quais são pobres em energia prontamente disponível (carboidratos não-estruturados) e ricas em compostos secundários (CORK; FOLEY, 1991; GANZHORN et al., 2017). Além da pouca energia disponível em sua dieta, custos energéticos adicionais de digestão e desintoxicação tendem a fazer com que estes animais tenham um baixo orçamento energético para viver. Para lidar com a dieta folívora, as preguiças-de-três-dedos apresentam uma série de adaptações voltadas para a conservação e obtenção de energia, tais como: baixa taxa metabólica basal (PAULI et al., 2016); baixa capacidade de termorregulação por mecanismos termogênicos (CLIFFE et al., 2015; MCNAB, 1978); baixos níveis de atividade (CHIARELLO, 1998a; GINÉ et al., 2015) e adaptações anatômicas e fisiológicas do trato digestivo para aumentar a eficiência da fermentação (FOLEY et al., 1995; CLAUSS, 2004). Ainda, estes animais apresentam baixa taxa

reprodutiva, áreas de vida pequenas, movimentos lentos e deslocamentos curtos (FALCONI et al., 2015; RAMIREZ et al., 2011; PAULI et al., 2016). Estas últimas características, somadas ao hábito estritamente florestal, impõem limitações à dispersão por ambientes abertos e uma intrínseca vulnerabilidade à perda, degradação e fragmentação florestal (CASTRO-VÁSQUEZ et al., 2010; CHIARELLO; MORAES-BARROS, 2014; MORENO; PLESE, 2006).

Na natureza, as preguiças-de-três-dedos são consideradas generalistas em nível de população e espécie, uma vez que uma ampla variedade de espécies de plantas (árvores e lianas) compõe sua dieta; porém, os indivíduos são considerados especialistas, pois cada um se alimenta de um conjunto pequeno de espécies, que variam de indivíduo para indivíduo (CHIARELLO, 2008; CHIARELLO et al., 2018; MONTGOMERY; SUNQUIST, 1978). Este padrão é denominado especialização individual, no qual os indivíduos utilizam um pequeno subconjunto da base de recursos da população, sendo comumente encontrado em populações de vertebrados e invertebrados, embora haja poucos exemplos em mamíferos herbívoros (BOLNICK et al., 2003; ARAÚJO et al., 2011). De acordo com a teoria do forrageio ótimo, organismos tendem a consumir apenas um subconjunto dos recursos disponíveis, preferindo aqueles que possuem maior trade-off positivo entre a aquisição de energia (e nutrientes) por unidade de tempo e o custo energético para obtenção e processamento do alimento (incluindo busca, manuseio e digestão). Porém, quando os recursos preferidos disponíveis são escassos, os animais tendem a ampliar seu nicho para explorar recursos secundários (ARAÚJO et al., 2011). Neste cenário, se os indivíduos divergem no uso de tais recursos secundários, a especialização individual será maior. Outro fator que aumenta o grau da especialização individual são as variações fenotípicas, que causam naturalmente variações na dieta interindividual, uma vez que indivíduos podem ter diferentes habilidades em obter e digerir os recursos, comportamentos de forrageio e evitação de predadores, requerimentos nutricionais, status social, e podem conseqüentemente apresentar preferências e/ou uso de recursos diferenciadas (ARAÚJO et al., 2011). No entanto, é especialmente a maior diversidade de recursos no ambiente que tende a aumentar a especialização individual nas populações de espécies de vertebrados generalistas (DARIMONT et al., 2009; HERRERA et al., 2008; SEMMENS et al., 2009), e no sentido contrário, uma menor diversidade tende a tornar a dieta de indivíduos mais similares (LAYMAN et al., 2007). O entendimento da resposta da variação do nicho alimentar à diversidade de recursos no

ambiente é crucial, uma vez que sua redução pode levar a maior competição, predação e parasitismo (DARIMONT et al., 2007; DUFFY, 2010; JOHNSON et al., 2009), o que pode, por sua vez, afetar a dinâmica e o risco de extinção de populações locais, e a longo prazo pode afetar a evolução do nicho alimentar (ARAÚJO et al., 2011).

Apesar das evidências, a especialização individual em preguiças não foi testada até o momento, não sendo clara sua magnitude e se esta pode variar de acordo com o contexto ambiental por várias razões. Primeiro, um baixo tamanho amostral por indivíduo (pequeno número de registros de alimentação e curto período amostral) tende a artificialmente inflar estimativas de especialização individual, uma vez que tende a subestimar a similaridade entre dietas individuais (ARAÚJO et al., 2011). Ainda, os estudos realizados até o momento não avaliaram se os indivíduos compartilharam recursos em proporção menor que aquela que seria esperado ao acaso, considerando suas limitações de consumo e a similaridade florística de suas áreas de vida (hipótese nula), como também não analisaram se existe uma seleção alimentar diferenciada entre os indivíduos pelas espécies de plantas (contrastando a proporção usada versus a disponibilidade destas). Por fim, os estudos que possuem resultados que sugerem a especialização individual (dada a baixa sobreposição da dieta individual) foram conduzidos em florestas altamente diversas (MONTGOMERY; SUNQUIST, 1978; CHIARELLO, 2008), enquanto em ambientes menos diversos as populações parecem ter dieta menos diversa (ACEVEDO-QUINTERO et al., 2011; MENDOZA et al., 2015; OSCAR-RAMIREZ et al., 2011; URBANI; BOSQUE, 2007). Embora dietas individuais não tenham sido avaliadas nestas últimas condições, a baixa diversidade da dieta das populações sugere que indivíduos tendem a ter dietas mais similares nestas condições. Portanto, dada a escassez de estudos e limitações amostrais (número de populações, indivíduos e registros de alimentação individuais), há pouca informação sobre a magnitude da especialização individual de preguiças e quando ela é mais ou menos pronunciada, justificando a necessidade de um estudo dirigido para suprir tais lacunas.

A preguiça-de-coleira (*Bradypus torquatus*) é a única preguiça continental ameaçada de extinção. Esta é classificada como “vulnerável” pela lista nacional e internacional de espécies ameaçadas (CHIARELLO et al., 2018). A espécie é endêmica da Mata Atlântica, bioma que foi reduzido a menos de 13% da sua extensão original devido principalmente à conversão da floresta para atividade agropecuária (SOS MATA ATLÂNTICA, 2020), sendo a perda e a fragmentação de habitat as maiores ameaças em

potencial para suas populações (CHIARELLO et al., 2018). A espécie está distribuída entre a região central do estado do Rio de Janeiro e de Sergipe, em três regiões geográficas disjuntas (HIRSCH; CHIARELLO, 2011), habitadas por quatro sub linhagens: norte da Bahia + Sergipe, sul da Bahia, Espírito Santo e Rio de Janeiro. As linhagens do norte (norte da Bahia + Sergipe e sul da Bahia) e sul (Espírito Santo e Rio de Janeiro) estão separadas há aproximadamente 5,36 milhões de anos, enquanto as sub linhagens do sul estão separadas entre si há cerca de 390 mil anos, e as sub linhagens do norte, há cerca de 210 mil anos (SCHETINO et al., 2017). Apesar de seu estado de ameaça, a ecologia alimentar da preguiça-de-coleira foi pouco documentada na literatura científica. Sua dieta é conhecida por uma lista de espécies (dados qualitativos) de plantas consumidas por dez indivíduos no sul da Bahia e suas preferências individuais (CASSANO et al., 2011; GINÉ et al., 2022) e dados quantitativos da frequência de consumo de espécies de plantas por cinco animais no Espírito Santo (CHIARELLO, 1998b; CHIARELLO et al., 2004), sendo que não existem estudos sobre o tema para as sub linhagens do Rio de Janeiro e norte da Bahia, as quais devem ser tratadas como unidades de manejo distintas das demais (SCHETINO et al., 2017).

As preguiças do gênero *Bradypus* raramente sobrevivem por mais de cinco anos ou se reproduzem em cativeiro (DINIZ; OLIVEIRA, 1999). ARENALES et al. (2020), em investigação sobre as condições de saúde de preguiças provenientes de um centro de reabilitação no Brasil, encontraram que 24 das 25 preguiças-de-coleira necropsiadas apresentaram sinais de anorexia e decubência. Os autores notaram que os animais eram alimentados essencialmente com folhas de embaúba (*Cecropia* spp), um gênero de planta comumente associado a preguiças do gênero *Bradypus* (GARCÉS-RESTREPO et al., 2019; URBANI; BOSQUE, 2007; VAUGHAN et al., 2007). De modo similar, em estudo prévio, DINIZ & OLIVEIRA (1999) encontraram que 45,7% das preguiças *Bradypus* necropsiadas apresentavam sintomas de desnutrição. A oferta de uma dieta pouco diversa, que pode não atender às exigências alimentares diferenciadas dos indivíduos, e o pouco conhecimento acerca da ecologia alimentar são provavelmente as principais causas da alta mortalidade dessas espécies em cativeiro.

Além da manutenção temporária e adequada da preguiça-de-coleira em cativeiro, há uma premente necessidade de implementar ações de restauração florestal, principalmente no Rio de Janeiro e norte da Bahia, onde as condições de paisagem atualmente se encontram menos adequadas para a conservação de suas populações

(SOUTO, 2022). A atual escassez de informações sobre a ecologia alimentar da espécie, o número reduzido de indivíduos monitorados e populações amostradas, seu estado de ameaça e a necessidade de ações de conservação *in situ* e *ex situ*, indicam a necessidade de serem realizados mais estudos a fim de melhor descrever a ecologia alimentar desta espécie ameaçada. Logo, ampliar o conhecimento sobre a gama de espécies de plantas que consomem, sua flexibilidade alimentar e exigências individuais, assim como identificar padrões taxonômicos de plantas consumidas e entender como sua dieta responde a diversidade florística de seus ambientes, podem ajudar no desafio de sua conservação.

Neste contexto, além de avaliar a composição alimentar e a ocorrência de especialização individual, uma das questões do presente estudo é entender o efeito que diferenças na seleção individual e na composição florística de suas áreas de vida exercem sobre a dissimilaridade da dieta de indivíduos dentro de uma mesma população, e entre populações. Em outras palavras: as dietas de pares de indivíduos são diferentes porque os recursos disponíveis em suas áreas de vida são diferentes, ou porque os indivíduos possuem preferências distintas? Este é um ponto chave para o manejo, pois preferências individuais distintas podem dificultar a adequação do manejo alimentar em cativeiro, enquanto a flexibilidade de adequar a dieta conforme o recurso disponível pode facilitar tal manejo. Ainda, uma menor diversidade florística pode causar uma perda de diversidade na dieta da população e uma maior similaridade da dieta de indivíduos, ou seja, redução da especialização individual. Assim, a última pergunta do presente estudo é: existe um efeito da diversidade florística do ambiente sobre a similaridade das dietas individuais? Os resultados nos ajudam a entender se pode ocorrer redução na diversidade e similaridade das dietas individuais das preguiças diante da perda de diversidade florística das florestas tropicais, especialmente aquela ocorrida na Mata Atlântica, hábitat da preguiça-de-coleira.

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Figura 1. Preguiça-de-coleira se alimentando de folhas de cajueiro (*Anacardium occidentale*), na região de Praia do Forte, Mata de São João, Bahia.

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2 FLORISTIC DIVERSITY MEDIATES INDIVIDUAL DIET SPECIALIZATION OF THE MANED SLOTH

Abstract

Individual diet specialization is commonly found in generalist populations but has been little studied in folivore mammals. Empirical evidence shows that the diversity of food resources in the habitat affects the degree of this specialization, by influencing among-individual diet variation (diet dissimilarity) and individual niche breadth (diet diversity). Here, we aim to evaluate the diet composition and selection of maned sloths (*Bradypus torquatus*, Illiger 1811) in two distinct ecological contexts; test whether the diet similarity between individuals and populations is explained by changes in the local floristic compositions and/or by a differentiated selection of plant species, and evaluate the effect of floristic diversity on the diet diversity and similarity across individuals. We monitored 13 radio-tracked individuals, and assessed the tree species diversity and availability in each home range. We identified 67 tree species in the diet of the maned sloths, and the majority of them were selected by the animals. The diet dissimilarities were mostly explained by differences in the local floristic composition, but also by a differentiated feeding selection. We found a negative effect of the floristic diversity on diet similarity. Together, our results evidence that the maned sloth is specialist and selective at the individual level, and the lower tree diversity increases the similarity of individual diets, revealing tree species that are commonly preferred at the population level under such condition. Our results can be directly applied to feeding protocols of captive populations, and ecological restoration initiatives with focus on the conservation of this threatened species.

Keywords: Atlantic Forest; diet similarity; feeding ecology; folivory; three-toed sloth.

2.1 Introduction

Individual diet specialization - when the individuals' diet composition is a small subset of the population diet and varies considerably across individuals - has been commonly reported in many generalist populations of vertebrates and invertebrates (Araújo et al. 2011; Bolnick et al. 2003). Indices used to calculate its degree, consider the among-individual variation of the diet (i.e. diet dissimilarity), individual niche width (i.e. individual diet diversity), and total niche width (Araújo et al. 2011; Bolnick et al. 2002). The magnitude of Individual Specialization can be influenced by phenotypic variation, that naturally occurs within populations, by intraspecific competition, and especially by ecological context, more specifically the diversity of resources in the environment (Araújo et al. 2011; Darimont et al. 2009; Garcia et al. 2018; Semmens et al. 2009). A

higher diversity of food resources available for a generalist population may allow the individuals to expand their diets on more items, thus enhancing individual diet breadth (Bolnick & Ballare 2020), as favor the individual specialization through among-individual variation of the diet (Bolnick et al. 2010; Darimont et al. 2009; Herrera et al. 2008; Semmens et al. 2009; Svanbäck et al. 2011), once it increases the opportunity for individuals to feed on a unique subset of food resources used by the population (ecological opportunity; Araújo et al. 2011; Bolnick & Ballare 2020; Garcia et al. 2018). Understanding how the loss of resource diversity can affect Individual Specialization is crucial because reduced diet variation can lead to greater aggregation of individuals, intraspecific competition, predation, and parasitism risks, which can, in turn, affect population dynamics and the risk of extinction of local populations (Araújo et al. 2011).

While it has been little studied in folivore mammals, it apparently occurs in three-toed sloths (*Bradypus* spp) (Chiarello 1998b; Giné et al. 2022; Montgomery & Sunquist 1978). Although untested, the low overlap observed across individual diets has been explained as consequent of distinct preferences of the individuals for plant species associated with processes passed through generations (such as mother-infant learning and symbiotic gut microbiota sharing); or due to differences in the local floristic compositions of the home ranges of the animals, being related to the distinct availability of resources to each animal same when in the same forest fragment (Chiarello 1998b; Chiarello 2008; Montgomery & Sunquist 1978). The first explanation is possible, considering the long time (~10 months) that the young spend with their mother until weaning, during which they experience the plant species consumed by their mothers (Chiarello 2008; Montgomery & Sunquist 1978). The second explanation may also be feasible, especially when considering the energetic constraints and consequent sessile habits of these

mammals combined with the high changes in floristic compositions within and between forest fragments of Neotropical forests, where these animals inhabit (Chiarello 2008).

Despite the evidence of individual diet specialization in sloths, the magnitude and how it may vary according to the environmental context are unclear. A low sample size (number of individuals and feeding records per individual) tends to artificially inflate individual specialization estimates as it tends to underestimate the similarity between individual diets (Araújo et al. 2011), and this is the case of many studies. In addition, studies that suggest Individual Specialization have been conducted in highly diverse forests (Chiarello 2008; Montgomery & Sunkist 1978), while individual diets were not evaluated in less diverse forested environments (Acevedo-Quintero et al. 2011; Mendoza et al. 2015; Ramirez et al. 2011; Urbani & Bosque 2007). In addition, understanding whether individual diet specialization (i.e. low diet similarity across individuals) is a consequence of the variation in the resource availability between individual home ranges, or of differentiated individual preferences, is a key question for the suitable management of sloths. Different preferences for food resources among individuals can make the management in captivity difficult, while the flexibility to adapt the diet according to the available resources can facilitate such management.

The maned sloth (*Bradypus torquatus* Illiger, 1811) is an arboreal folivore mammal endemic to the Brazilian Atlantic Forest, currently threatened with extinction due to habitat loss and fragmentation caused by deforestation (Chiarello et al. 2018; Chiarello & Moraes-Barros 2014). They are separated into four sub-lineages, which are distributed in three disrupted geographic areas: Rio de Janeiro, Espírito Santo, and Bahia, where are located two sub-lineages (Northern Bahia and Southern Bahia; Schetino et al. 2017). Like other sloths and folivore mammals (Collins & Roberts 1978; Diniz & Oliveira 1999), the survival, rehabilitation, and reproduction in captivity of this species

is a challenge for the responsible institutions, and have been reported high mortality of captive animals by anorexia and decumbency mainly due to inadequate feeding management (Arenales et al. 2020). A better understanding of basic aspects of the maned sloth's feeding ecology, such as diet composition and feeding selection, can provide support to *ex situ* management, as well as to actions of forest restoration, which has been indicated as necessary to reduce the risk of local extinctions, mainly in the Rio de Janeiro and Northern Bahia (Souto 2022; Tourinho et al. 2022).

Considering the gap in the knowledge about the feeding ecology of the maned sloth, their threatened status, and high mortality in captivity, we studied and compared aspects of the diet of the maned sloths from Rio de Janeiro (RJ) and Northern Bahia (BA) at intrapopulation and interpopulation levels. Specifically, we aim: (1) to evaluate the diet composition and tree species selection by the maned sloths, at individual and population levels; (2) to test whether the diet similarity between individuals and populations is explained by changes in the local floristic compositions and/or by a differentiated selection of plant species; and (3) to evaluate the effect of the floristic diversity on the diversity and similarity of the diet of the individuals and populations. Taking into account the high floristic diversity of the Atlantic Forest, the necessity of energy conservation, and the supposed Individual Specialization of this species, we expect that changes in the floristic composition of home ranges (i.e. β -diversity of plant species) will explain most of the diet similarity across individuals. Considering that ecological opportunity provided by a more diverse habitat will promote both among-individual variation and enhance niche breadth of the individuals, we expect that the floristic diversity will have a positive effect on the diet diversity of the individuals and populations, and a negative effect on the diet similarity across individuals.

2.2 Material and methods

Study area

The study was developed in forested fragments located in the municipality of Silva Jardim, Rio de Janeiro (22° 39' 34" S, 42° 22' 57" W), and Sapiranga Reserve, a tourist municipal reserve of the municipality of Mata de São João, northern Bahia (12° 31' 50" S, 38° 17' 59" W; Fig.2). These municipalities are located in the southern and northern portion of the species range, respectively, which harbor distinct maned sloth sub-lineages separated by approximately 5.36 million years (Schetino et al. 2017).

The vegetation of both areas belongs to the Atlantic Forest biome but harbors different phytophysiognomies and climates. The predominant vegetation in Silva Jardim is the Submontane Rainforest (De Lima et al. 2006), composed of intermediate and late secondary forest, with canopy layer usually ranging between 10 and 20 m, and emergent trees that can reach 40 m. Such forests are situated about 200 m a.s.l. (IBGE 2010), and > 30 Km from shore. The region is influenced by tropical climatic regime with dry winter season (Aw, Köppen-Geiger 1918), with mean temperature of 23.2°C and annual precipitation of 1250 mm (TWC 2021). Forest restoration initiatives, like the implementation of ecological corridors connecting Federation Conservation Units, were conducted in the region, that belongs to the Environmental Protected Area (APA) of São João River Basin. In Sapiranga Reserve, the vegetation is composed of Rainforest tree species and herbaceous vegetation over sandy soil, known as Arboreal Restinga, with most trees ranging from 3 to 13 m tall and few trees reaching more than 20 m (Santos 2013). The area is inserted in a coastal plain and is more influenced by the sea, once is only 3 Km distant from the shore. The climate is tropical humid (Af, Köppen-Geiger 1918), with mean temperature of 24.8°C and annual precipitation superior to 1500 mm (TWC 2021).

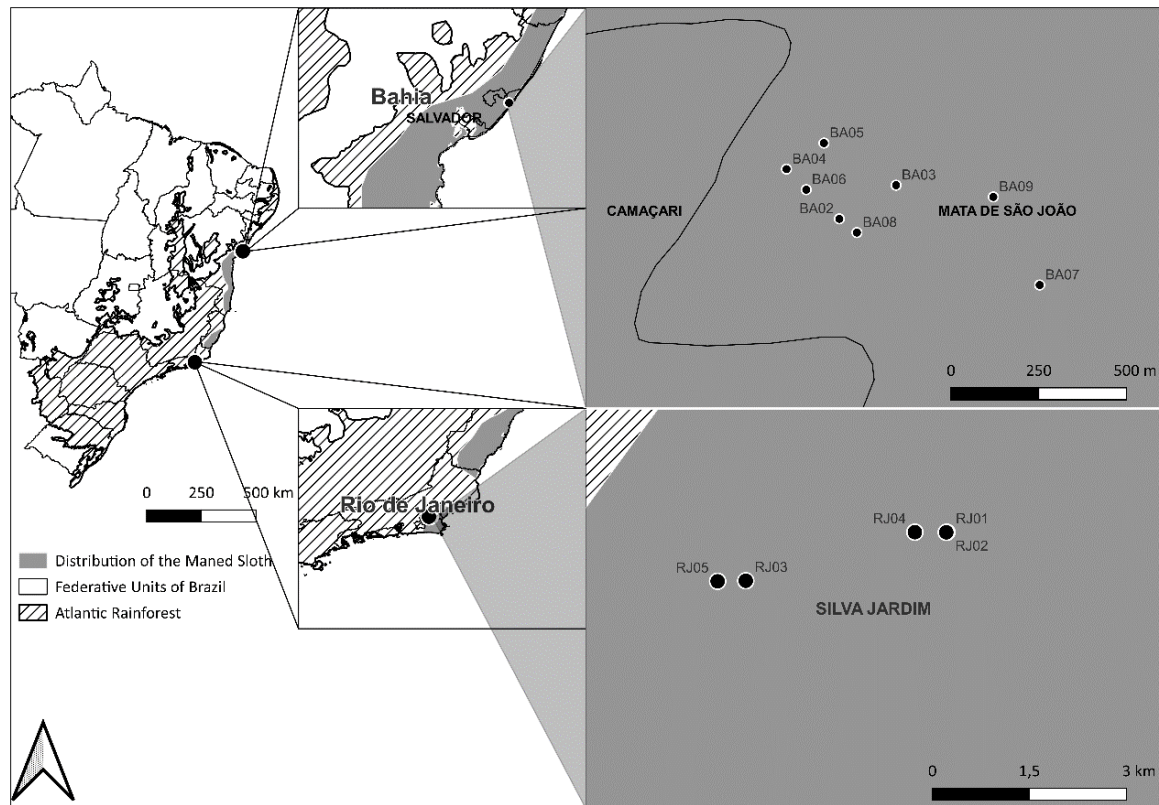


Figure 2. Map of the location of the study areas (left) within the geographical distribution of the maned sloth (according to IUCN, 2022) in the Atlantic Forest biome, Brazil. On the right, the locations where maned sloths were captured (black circles) in the Sapiroanga Reserve, northern Bahia (above), and in the municipality of Silva Jardim, Rio de Janeiro.

Capture, track, and feeding observations

We found through active search and captured five maned sloths (two males and three females, one subadult and four adults) in forest fragments from Silva Jardim municipality (RJ population), and eight individuals (two males and six females, two subadults and six adults) in Sapiroanga Reserve (BA population), during January 2019 and March 2020, respectively (Table 1). We captured each animal climbing the tree, physically immobilizing the animal, and carefully carrying it to the ground inside a previously disinfected permeable raffia bag. Then, we attached GPS/VHF backpacks (Telemetry Solutions, model 4000ER, Telenax, model TGB-325/311BF, and TGB-325/304BF) weighing between 77 and 90 g, which represent less than 2% of the animal's average body mass, within the limit ($\leq 5\%$) recommended by the American Society of

Animal Care (Sikes et al. 2016). After sexing and age classification (Lara-Ruiz & Chiarello 2005), we released the animals in the same tree where they were found.

We monitored each animal for 14 to 39 weeks, locating each sloth in the field at least once per week, following the VHF signal (homing in method; White & Garrott 1990) until visual detection of the animal or definition of the tree where the animal was situated (used tree) by triangulation. In addition, during 2 to 3 months, we located each animal one time per day, for approximately five consecutive days per week. After visual detection, we recorded the first behavior exhibited, marked the used tree, and verified during this procedure (which lasts approximately 10 minutes) if the animal was feeding on the tree. In total, we located each animal 52 to 66 times, marking 20 a 46 used trees per animal, totalizing 754 records and 413 marked trees, respectively (Table 1).

Table 1. Monitoring period, sampling effort, and individual characteristics of the monitored maned sloths (*Bradypus torquatus*) in forest fragments from Silva Jardim, Rio de Janeiro state (RJ) and Sapiranga Reserve, Mata de São João, Bahia (BA). F = female; M = male.

Animal (Id)	Sex	Age*	Number of records	Number of used trees	Monitoring period
BA02	M	Adult	56	39	Mar.–May/2020 and Aug.–Oct./2020
BA03	F	Subadult	53	32	Mar.–May/2020 and Aug.–Oct./2020
BA04	F	Adult	58	29	Mar.–May/2020 and Aug.–Oct./2020
BA05	F	Adult	65	20	Mar.–May/2020 and Aug.–Oct./2020
BA06	F	Adult	63	29	Mar.–May/2020 and Aug.–Oct./2020
BA07	F	Adult	59	25	Mar.–May/2020 and Aug.–Oct./2020
BA08	M	Adult	66	26	Mar.–May/2020 and Aug.–Oct./2020
BA09	F	Subadult	51	23	Mar.–May/2020 and Aug.–Oct./2020
RJ01	F	Subadult	59	39	Jan./2019–Apr./2020
RJ02	M	Adult	59	46	Jun./2019–May/2020 and Nov./2020–Mar./2021
RJ03	F	Adult	52	37	Jul./2019–May/2020 and Nov./2020–Mar./2021
RJ04	F	Adult	58	38	Jul./2019–May/2020 and Nov./2020–Mar./2021
RJ05	M	Adult	55	30	Dec./2019–May/2020 and Nov./2020–Mar./2021
Total			754	413	

*Age classification based on animal body mass following Lara-Ruiz & Chiarello (2005).

In the same period, a second researcher of our team monitored each animal through direct observation, for five non-consecutive days, in two time series (7h00 to 12h00 and 13h00 to 17h00), totalizing 41 to 45 hours of observation per animal. All feeding events detected were recorded, and the plant part (leaves, fruits, flower) and group (tree, liana) consumed were recorded when visible. Finally, GPS backpacks remotely recorded the animal locations every 4 hours, and these data were used to delimit the area used by the animals (home range) during the sampling period.

Plant species survey

At the end of the monitoring period, we collected botanical material from all the trees used by the tracked animals, and we performed botanical identifications to the lowest taxonomic level possible, with help of experienced botanists, according to the APG IV classification, and based on herbaria collections available, as UESC and virtual herbarium (INCT 2021). Additionally, we collected botanical material and identified all the trees with ≥ 10 cm of Diameter at Breast Height (DBH) within plots (20 x 20 m) randomly allocated in the home range of each monitored individual. The number of plots varied according to home range size, aiming to sample at least 10% of the area used by each sloth, and ranged from 3 to 15 plots. Home range was determined by the minimum convex polygon method (Mohr 1947) based on all GPS locations of each animal, using the software QGIS version 3.10 (QGIS Association 2020). We selected trees with DBH ≥ 10 cm because they represented more than 96% of the trees used by the maned sloths in Sapiranga Reserve and more than 98% of the trees used by the animals in Silva Jardim. Posteriorly, we calculated the Importance Value (IV; Mueller-Dombois & Ellenberg 1974) of the tree species found in each home range as a measure of relative availability. The IV of each plant species was calculated as the average of the plant species: (1) relative density – the number of individuals of the plant species in relation to the total of

individuals sampled in the area; (2) relative dominance – the contribution in basal area in relation to the total basal area sampled; and (3) relative frequency – the number of plots in which the species is found in relation to the total number of plots. The values were multiplied by 100 to be expressed as a percent. The IVs were later used in random simulations as the probability of consumption of a determined tree species, from a random perspective (i.e. feeding determined by the resource availability).

Diet composition and selection analysis

Given the low frequency with which maned sloths feed (6.7-12.3% of the time, Giné et al. 2015; Chiarello 1998a), we used three different approaches to list a tree species as part of maned sloths' diet: (1) feeding tree species confirmed by our observations; (2) repetitive usage of the individual tree for more than two consecutive days; and (3) repetitive usage of the tree species for more than three non-consecutive days. Then, we ranked the tree species listed in each sloth diet according to their relative usage frequency (RUF), which is the number of usage records for that tree species, divided by the total number of usage records of consumed trees, expressed in percentage. Similarly, we calculated the RUF of consumed plant genera and families.

We estimated the Ivlev's electivity index (E_i , Ivlev 1961) for each used tree species to evaluate the order of preference of these for the maned sloths. This index expresses the electivity of a food item by contrasting its use (r_i) with its availability in the habitat (n_i), through the formula $E_i = (r_i - n_i)/(r_i + n_i)$, and varies from -1 (total avoidance) to +1 (total preference). In our case, usage (r_i) is the RUF of each tree species, and the availability (n_i) is the IV of the respective tree species.

Diet similarity analysis

We calculated the observed similarity of diet for all possible pairs of individuals, within and between populations (RJ and BA), using the Morisita-Horn index (R_o , Horn

1966). This index varies from 0 (total dissimilarity) to 1 (total similarity), and the calculation was based on the RUF of tree species by each sloth. We compared the similarity of diet (Ro values) of the pairs of individuals from the RJ and BA, using t-Student test. We then tested if the diet similarity between individuals was higher, lower, or equal to the expected when considering random consumption of plant species available in the home ranges. To estimate the expected diet similarity across each pair of individuals on a random use, we firstly performed 1000 simulated diets per individual using Monte Carlo simulations (Halton 1970). For each simulated diet, we sorted one tree species for each feeding tree used by the individual, considering the IV value as the probability of the plant species being sorted. During each repetition, the simulated diets were used to calculate the similarity indexes for each pair of sloths, resulting in 1000 values of similarity for each pair of sloths. Then, we used the Confidence Interval (CI) of 95% of these values to test if the observed diet similarity differed significantly from the simulated one; observed values below and above the CI indicate, respectively, a differentiated and shared feeding selection between the individuals in a pair (Fig.3). We tested these hypotheses for individuals within (intrapopulation similarity) and between study areas (interpopulation similarity). For the latter, we used the availability of tree genera, instead of tree species, as differences in the floristic compositions (especially at species level) occur due to the geographic distance between the areas.

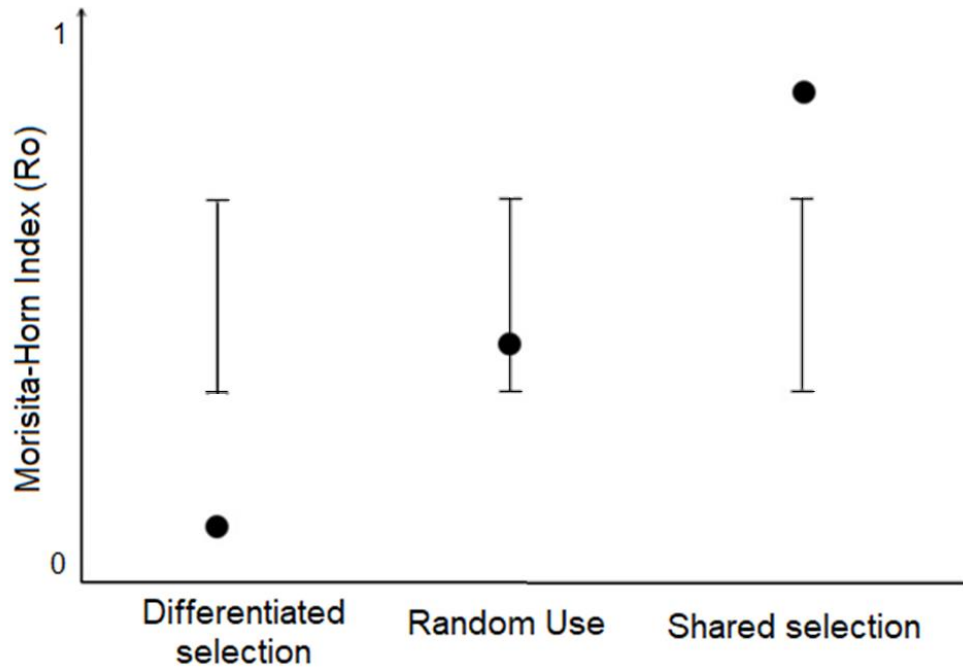


Figure 3. Hypotheses tested about the influence of feeding selection on diet similarity of the maned sloth. Differentiated selection (left) is evidenced when the observed diet similarity (dark dots) is lower than the 95% confidence interval (bars) of the expected similarity simulated in the scenario of random consumption of tree species, considering the relative availability of plant species in the home ranges. Random use (center) is evidenced when the observed diet similarity does not differ from the simulated similarity, and shared selection (right) is evidenced when the observed diet similarity is higher than the CI of the simulated similarity.

Effect of floristic diversity on diet diversity and similarity

We calculated the observed richness (S) and estimated the diversity of plant species in the diet and home range of each sloth using the natural logarithm-based Shannon-Weaver Index (H' ; Shannon & Weaver 1949). We performed t-Student test to compare the diversity and richness of sloth's diet and arboreal community between the two study areas. Finally, we performed linear regressions to test if the diet diversities and similarities (Ro index of the intrapopulation pairs) were influenced by the mean floristic diversity and richness contained in the home ranges of the animals.

2.3 Results

Diet composition and selection

Maned sloths consumed only tree leaves during the sampling period, and no consumption of other plant parts or water was seen. We spent approximately 15.5 hours of continuous sampling to observe each feeding event. We recorded 67 feeding tree species used by the maned sloths that had their consumption confirmed (76.1%) or inferred by repeated use (23.9%) during our sampling, 32 tree species in the RJ and 35 in the BA (Supplementary Tables 1 and 2). Each sloth used five to 11 feeding tree species during the sampling period, on average 8.46 ± 1.98 (mean \pm sd) tree species per individual (8.4 ± 2.6 in RJ, and 8.6 ± 1.5 in BA). We recorded 228 feeding trees used, 13 to 23 trees per individual. The animals repeated each used tree, on average, $1.94 (\pm 0.56)$ times.

The five most consumed species accounted for 38.6% of the diet of the population from RJ, while the five top species accounted for 68.2% of the diet in BA (Table 2). In descending order, the most consumed species by the population from RJ were: *Cupania racemosa*, *Trichilia lepidota schumanniana*, *Toulicia laevigata*, *Plathymenia reticulata*, and *Sapium glandulosum*. Among these, *Cupania racemosa*, *Toulicia laevigata*, and *Plathymenia reticulata* were the most preferred ($E_i \geq 0.2$) and shared by the sloths (at least by 40% of the individuals) in this study area. We highlight the species *Cupania racemosa*, once it was consumed almost twice as often as the others by population, and was among the two most consumed by two of five individuals (Supplementary Table 1). The five species most consumed in the BA were: *Ficus clusiifolia*, *Bowdichia virgilioides*, *Tapirira guianensis*, *Trema micrantha*, and *Artocarpus heterophyllus*. Among these, *Ficus clusiifolia*, *Bowdichia virgilioides*, and *Trema micrantha* were the most preferred ($E_i \geq 0.2$) and shared by the sloths (at least by 62.5% of the individuals). Highlighted, *Ficus clusiifolia* was consumed by all studied sloths and among the two most used by six of the eight individuals (Supplementary Table 2). *Tapirira guianensis* was also highly consumed and shared by the individuals, but due to its high Importance Value was less

preferred ($E_i = -0.2$). The genera most consumed, preferred, and shared by sloths in RJ were *Brosimum* and *Cordia*, while the families were Annonaceae, Moraceae, Boraginaceae, Fabaceae, and Euphorbiaceae (Fig.4). In the BA, the genera most consumed, preferred, and shared by animals were *Ficus*, *Bowdichia*, *Trema*, and *Ocotea*, while the families were: Moraceae, Fabaceae, Cannabaceae, and Lauraceae. The species *Brosimum guianense*, the genera *Cupania*, *Cecropia*, and *Brosimum*, and the families Urticaceae, Annonaceae, Moraceae, Fabaceae, Sapindaceae, Myrtaceae, and Lauraceae, were consumed by individuals from both populations.

Positive values of E_i were estimated for 30 species in RJ (93.8% of consumed species), and 21 species in BA (65.6% of consumed species analyzed), indicating that these species were used in a higher proportion than their availability in the environment, i.e. were selected. Among the 32 most consumed species by both populations, 21 (65.6%) presented values of $E_i \geq 0.7$, suggesting that, in general, the populations were highly selective in the choice of the most consumed tree species. At individual levels, among the 95 estimated values of E_i (Supplementary Tables 1 and 2), 81 (85.2%) were > 0.0 , and 50 (52.6%) were ≥ 0.7 , indicating that the individuals were also selective.

Table 2. Diet composition and feeding selection of maned sloths (*Bradypus torquatus*) from the municipality of Silva Jardim, Rio de Janeiro (RJ), and Sapiranga Reserve, Bahia (BA). The 16 most consumed plant species are shown, ranked accordingly to relative usage frequency (RUF), Ivlev's electivity Index (E_i), and the number of animals that fed on the species is presented. Individual diet compositions and preferences are shown in Supplementary Tables 1 and 2 of Appendix.

Silva Jardim (RJ)				Sapiranga Reserve (BA)			
Species (Family)	RUF (%)	E_i	Number of animals	Species (Family)	RUF (%)	E_i	Number of animals
1. <i>Cupania racemosa</i> (Sapindaceae)	12.4	0.2	2 (40%)	1. <i>Ficus clusiifolia</i> (Moraceae)	23.8	0.9	8 (100%)
2. <i>Trichilia lepidota schumanniana</i> (Meliaceae)	6.9	0.5	1 (20%)	2. <i>Bowdichia virgilioides</i> (Fabaceae)	17.6	0.8	7 (87.5%)
3. <i>Toulicia laevigata</i> (Sapindaceae)	6.9	~1	2 (40%)	3. <i>Tapirira guianensis</i> (Anacardiaceae)	17.3	-0.2	7 (87.5%)
4. <i>Plathymenia reticulata</i> (Fabaceae)*	6.2	0.8	2 (40%)	4. <i>Trema micrantha</i> (Cannabaceae)	4.9	0.7	5 (62.5%)

Silva Jardim (RJ)				Sapiranga Reserve (BA)			
Species (Family)	RUF (%)	Ei	Number of animals	Species (Family)	RUF (%)	Ei	Number of animals
5. <i>Sapium glandulosum</i> (Euphorbiaceae)*	6.2	0.8	1 (20%)	5. <i>Artocarpus heterophyllum</i> (Moraceae) ψ	4.6	0.9	2 (25%)
6. <i>Brosimum lactescens</i> (Moraceae)*	4.8	0.8	1 (20%)	6. <i>Protium heptaphyllum</i> (Burseraceae)	4.3	-0.5	5 (62.5%)
7. <i>Guatteria ferruginea</i> (Annonaceae) ψ	4.8	~1	1 (20%)	7. <i>Heisteria blanchetiana</i> (Olacaceae)*	3.5	0.8	2 (25%)
8. <i>Cordia trichoclada</i> (Boraginaceae)	4.1	0.9	3 (60%)	8. <i>Campomanesia guazumifolia</i> (Myrtaceae)	2.2	-0.2	2 (25%)
9. Euphorbiaceae sp	4.1	0.5	1 (20%)	9. <i>Swartzia flaemingii</i> (Fabaceae)	2.2	-0.3	3 (37.5%)
10. <i>Xylopia sericea</i> (Annonaceae)	4.1	0.5	1 (20%)	10. <i>Ficus hirsuta</i> (Moraceae)*	1.9	0.8	2 (25%)
11. <i>Cecropia pachystachya</i> (Urticaceae)	3.5	0.8	2 (40%)	11. <i>Ocotea nitida</i> (Lauraceae)	1.9	0.8	1 (12.5%)
12. <i>Meriania glabra</i> (Melastomataceae)* ψ	3.5	0.9	1 (20%)	12. <i>Ficus americana guianensis</i> (Moraceae)	1.6	0.5	1 (12.5%)
13. <i>Sorocea guilleminiana</i> (Moraceae)	3.5	0.9	1 (20%)	13. <i>Ficus pulchella</i> (Moraceae) ψ	1.6	0.8	1 (12.5%)
14. <i>Couratari pyramidata</i> (Lecythidaceae)	2.8	0.6	2 (40%)	14. <i>Ocotea velutina</i> (Lauraceae)*	1.4	-0.4	2 (25%)
15. <i>Endlicheria paniculata</i> (Lauraceae) ψ	2.8	0.9	1 (20%)	15. <i>Cupania rugosa</i> (Sapindaceae)	1.1	0.8	1 (12.5%)
16. <i>Eugenia prasina</i> (Myrtaceae)*	2.8	0.7	1 (20%)	16. <i>Ficus obtusiuscula</i> (Moraceae) ψ	1.1	0.7	1 (12.5%)
The other 16 species accounted for 20.6% of the diet				The other 16 species accounted for 9% of the diet			

Asterisk (*) indicates the plant species not confirmed visually to be eaten by the maned sloths.

The symbol (ψ) indicates the plant species not found in the sampling plots – the minimum IV found was used for the Ei calculation.

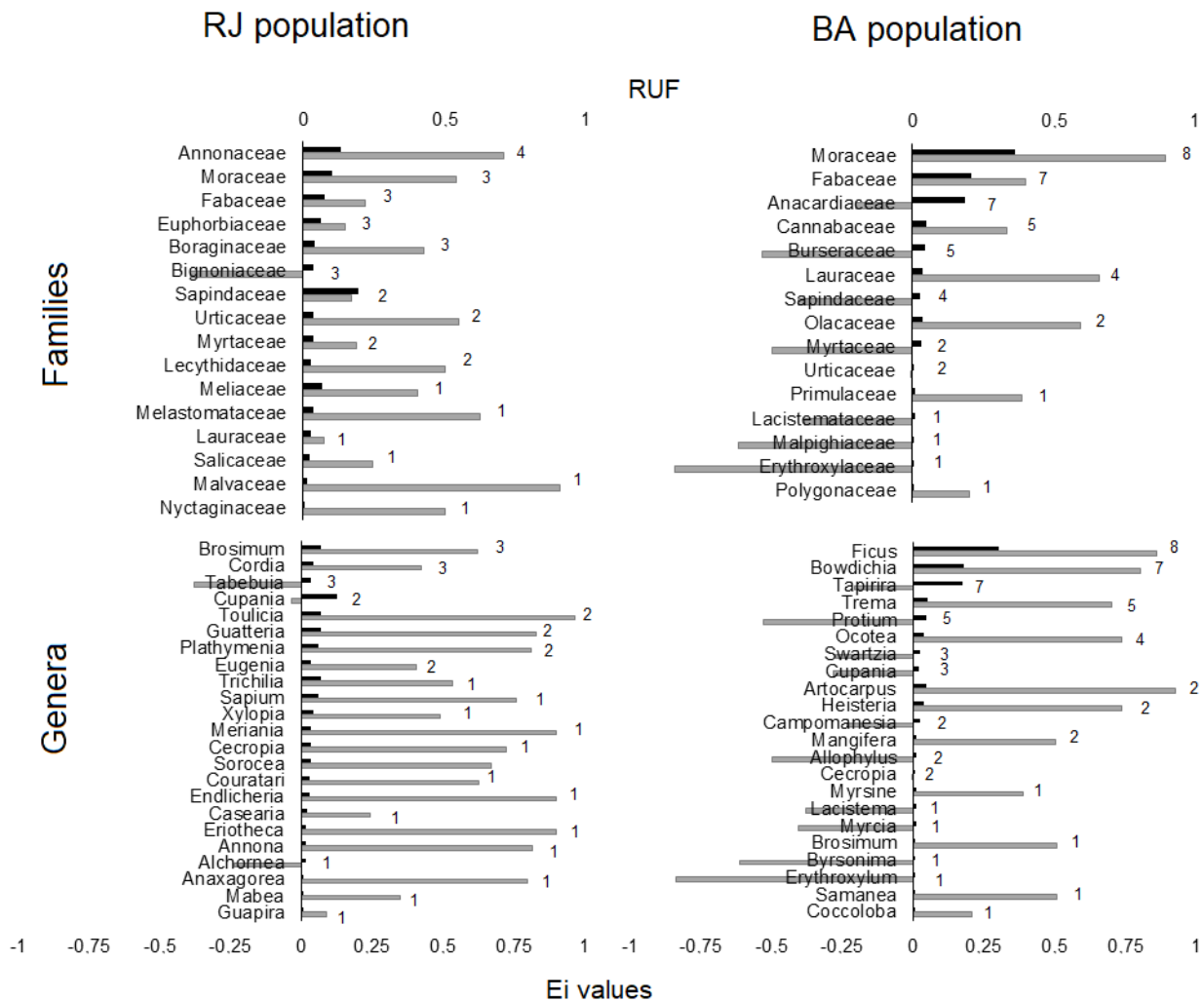


Figure 4. Importance of the plant families (above) and genera (below) in the diet of maned sloths (*Bradypus torquatus*) from Rio de Janeiro (left) and northern Bahia (right). The taxa were ordered according to the number of individuals foraging (number reported beside each bar), relative usage frequency (RUF; black bars), and Ivlev's electivity Index (Ei; gray bars). Species of greatest importance are assumed to be those that combined had the highest number of animals sharing, the highest frequency of use, and highest preference.

Diet similarity

The individual diet composition and preferences varied in both populations (Supplementary Tables 1 and 2). The mean diet similarity across the 38 intrapopulation pairs analyzed was 0.40 ± 0.25 (mean \pm sd), presenting a wide range from 0 (total dissimilarity) to 0.9 (almost total similarity). However, the diet similarity across the

individuals from the RJ population (0.08 ± 0.13 ; range: 0 to 0.44) was statistically lower than those observed between individuals from the BA population (0.51 ± 0.17 ; range: 0.19 to 0.90; t-Student test: $t = -8.3$; $df = 20.4$; $p < 0.001$).

Contrasting the observed diet similarity of all the 38 intrapopulation pairs of individuals and the respective confidence interval of the similarity expected by random use (Fig.4A and 4B), the observed diet similarity of 17 pairs (44.7%) did not differ from those expected by random use, indicating that the β -diversity of plant species in the home ranges better explained the diet dissimilarity found in almost half of the cases. Eleven pairs (29%) presented lower observed similarities than those expected on a random use, which indicates the existence of a differentiated feeding selection by these individuals, while ten pairs (26.3%) presented higher observed similarities than expected, indicating a shared feeding selection.

Among the ten pairs of individuals evaluated from the RJ state (Fig.5A), 70% exhibited diet similarity statistically equal to expected (indicating the effect of β -diversity) and 30% lower than expected (indicating differentiated individual selection). Among the 28 pairs from northern Bahia (Fig.5B), 35.7% exhibited diet similarity statistically equal to expected, 35.7% higher than the expected (indicating shared individual selection), and 28.5% lower than the expected. Comparing populations, the diet similarity across the individuals from the RJ and BA states ranged from 0 to 0.06 (0.015 ± 0.039). Among the 40 pairs of individuals evaluated (Fig.5C), 75% presented diet similarity statistically equal to expected, while 25% were lower than expected.

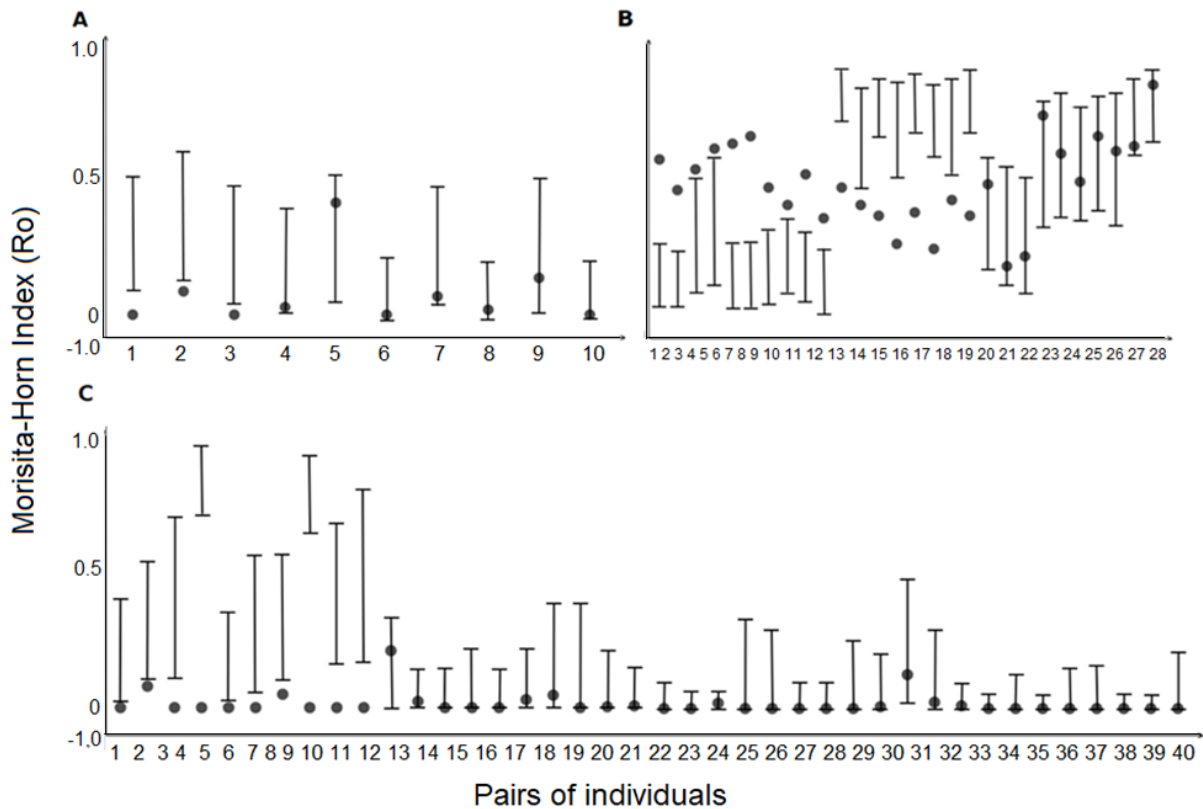


Figure 5. Observed (dark dots) and expected (95% confidence intervals) diet similarity across the pairs of maned sloths studied in Rio de Janeiro (A), northern Bahia (B), and interpopulation pairs (C). The expected diet similarity values were produced by 1,000 Monte Carlo simulations, representing the expected similarities in a scenario of random use of tree species, following the plant species availability in the sloths' home range. Differentiated, random, or shared selection of plant species occurs when observed diet similarity is lower, equal, or higher than simulated diet similarity, respectively (i.e. below, within, or above the 95% confidence intervals). The animals that composed each pair are shown in Supplementary Table 3 of Appendix.

Effect of the floristic diversity on the diet diversity and similarity

The floristic diversity within home ranges in RJ ($H' = 3.8 \pm 0.3$) were significantly higher than those of the home ranges in BA ($H' = 2.9 \pm 0.3$; $t = 4.6$, $df = 10.2$, $p < 0.001$), as well as the floristic richness (RJ: $S = 68 \pm 23.9$; BA: $S = 29.5 \pm 10.3$; $t = 3.4$, $df = 4.9$, $p = 0.02$). We did not find any significant difference between the diet diversity (RJ: $H' = 1.9 \pm 0.3$; BA: $H' = 1.8 \pm 0.2$; $t = 0.5$, $df = 6.1$, $p = 0.65$) and richness (RJ: $S = 8.4 \pm 2.6$; BA: $S = 8.4 \pm 1.8$; $t = 0.2$, $df = 5.7$, $p = 0.87$) of the animals from the two areas. Also, the floristic diversity and richness in the individual home ranges have no significant effect on the individual diet diversity ($R^2 = 0.13$, $p = 0.23$.) and richness ($R^2 = 0.004$, $p = 0.83$). However, the diet similarity across the individuals from the RJ population (0.08 ± 0.13 ;

range: 0 to 0.44) was statistically lower than those observed between individuals from the BA population (0.51 ± 0.17 ; range: 0.19 to 0.90; t-Student test: $t = -8.3$; $df = 20.4$; $p < 0.001$), as well as the floristic diversity and richness in the home ranges influenced negatively the diet similarity across the individuals ($R^2 = 0.61$, $p < 0.001$; $R^2 = 0.57$, $p < 0.001$, respectively; Fig.6). In other words, the pairs of individuals exposed to less diverse environment presented higher diet overlaps.

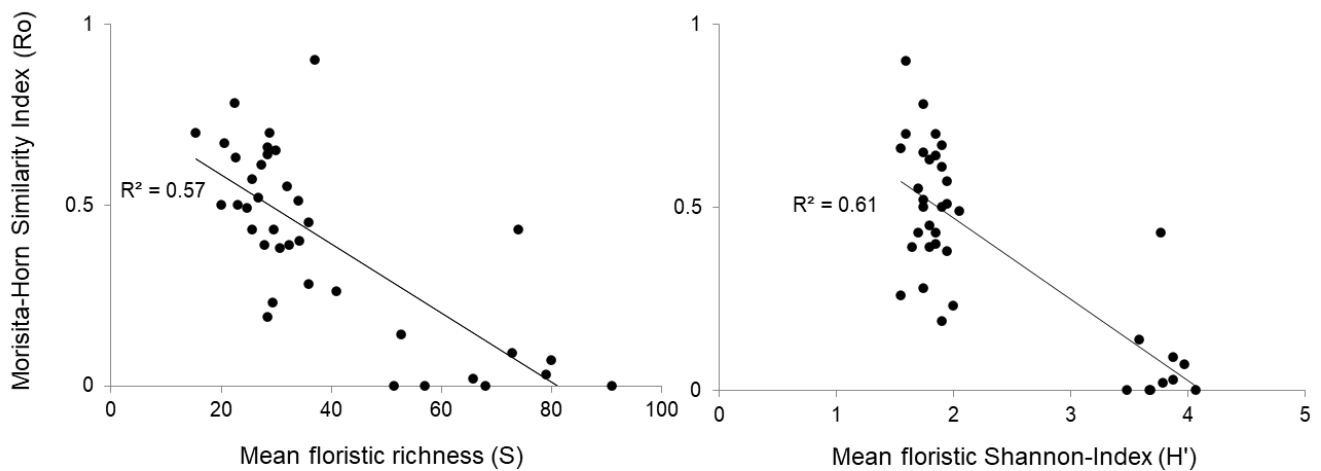


Figure 6. Relationship between diet similarities (Morisita-Horn Index – Ro) of the 38 intrapopulation pairs of maned sloths evaluated, from Silva Jardim – RJ and Sapiranga Reserve – BA, and the mean floristic richness (left) and diversity (Shannon index – H') of the animals' home ranges.

2.4 Discussion

We carried out the first diet study on the maned sloths from Rio de Janeiro and Northern Bahia sub lineages, and nearly doubled the number of known plant species consumed by maned sloths, adding 60 new species to their diet, considering the published data to date (Giné et al. 2022 – 68 species). We also carried out the largest sampling in terms of number of animals and populations to date, accessing two populations and 13 individuals. The studied populations presented a broader diet in terms of tree species composition, and individuals presented a narrower and more varied diet, in accordance with the occurrence of Individual Specialization described previously for other

populations and sloth species (Chiarello 1998b, 2008; Giné et al. 2022; Montgomery & Sunquist 1978). The diet dissimilarity across individuals within and between populations was explained more by the β -diversity of the animals' home ranges than by a differentiated selection of the individuals for plant species, although the latter also contribute to a relevant part of this dissimilarity. Furthermore, we show that in a less diverse forest, there is also a shared individual selection for plant species that makes the diets of individuals more similar, reducing the Individual Specialization. The floristic diversity influenced negatively the diet similarity (as we predicted), but did not change the diet diversity and richness, indicating that the loss of floristic diversity may make individuals share more resources, but did not change the individual diet breadth. Although selective, the diet of individuals and population vary widely according to the local floristic composition, suggesting certain plasticity of the species in dealing with different floristic conditions. The apparent cause of the diet dissimilarity is a mix between the dissimilarity of their environments (home ranges and forests) and the differentiated individual selection.

The extensive list of tree species that composed the diet of the maned sloths in this and previous studies (Cassano 2011; Chiarello et al. 1998b; Chiarello 2004; Giné et al. 2022) indicate that this species is generalist and able to consume a wide variety of tree species from Atlantic Forest. Comparing our results about diet composition with those reported in other regions, we observed that some taxa are present in the diet of two or more sub-lineages. Plant taxa shared among the studied population of Northern Bahia and others previously studied (Southern Bahia – Cassano et al. 2011, Giné et al. 2022; Espírito Santo – Chiarello 1998b) were the species *Ficus clusiifolia*, *Tapirira guianensis*, *Protium heptaphyllum*, and the genera *Ficus*, *Myrcia*, and *Swartzia*. It is interesting to note that *Tapirira guianensis* was one of the most consumed species by another threatened folivore mammal endemic to the Atlantic Forest, the thin-spined porcupine (*Chaetomys*

subspinosus), which inhabited Restinga and forests within the maned sloth range (Giné et al. 2010, 2020; Souto-Lima et al. 2010). Plant taxa shared between the studied population of the Rio de Janeiro and others previously studied were the species *Cecropia pachystachya* and *Guapira opposita*, and the genera *Brosimum*, and *Eriotheca*. The genera *Cecropia*, *Cupania*, and *Ocotea*, and the species *Brosimum guianense* were recorded for all sublineages. The family Moraceae was representative in the diet of *Bradypus torquatus* of all sub-lineages studied (Cassano et al. 2011; Chiarello 1998b; Giné et al. 2022; this study). Interestingly, we also demonstrated that both populations here studied exhibited a preference for this family, consuming it in higher proportion than available in the habitat. The preference for Moraceae family and *Ficus* spp. by this and other three-toed sloth species, in general, has been previously explained by the higher digestibility of their leaves compared to other species, wide distribution in South America, and asynchronous production of young leaves (Chiarello 2008; Montgomery and Sunquist, 1978; Queiroz 1995). Then, *Ficus* spp. may be a strong candidate to be considered as a key resource in management actions, while the other taxa here highlighted may be potential candidates.

Unlike another sympatric arboreal folivore mammal (*Chaetomys subspinosus*) that reduces the diversity of their diets in less diverse environments (Giné et al. 2020), the diet diversity (niche breadth) of maned sloth individuals and populations were not affected by the reduction in the diversity of available trees. This indicates a great ability of the individuals to adapt their diet to the arboreal availability of their respective habitats, finding a diversity of food resources regardless of the conditions of tree species diversity, which corroborates the previous generalist habit described for this and other sloth species (Chiarello 2008, Giné et al. 2022; Montgomery & Sunquist 1978). Furthermore, there may be an optimal diversity in individual diets that should be maintained, which may be

limited to some tree species known by the individuals, while maintaining a varied diet may bring advantages concerning nutritional complementarity (Westoby 1978) and avoidance of secondary compound overload (Freeland & Janzen 1974; Iason & Villalba 2006).

Despite the high number of plant species recorded in the diet of the maned sloth, each animal fed on a smaller set of tree species, disregarding the floristic diversity, and exhibiting individual specialization. The dissimilarity among individual diets was mainly explained by the change in tree composition in their home ranges, even for individuals of the same population. The heterogeneous nature of tree communities in highly diverse Neotropical forests combined with the small home range of maned sloths (Cassano et al. 2011; Falconi et al. 2015) may make different tree species available to each individual (Chiarello 2008), as observed in large part of the pairs here analyzed. Considering the Optimal Foraging Theory precepts (Stephens & Krebs 1986) and the necessity of energy conservation that folivore mammals present, may be advantageous for the individuals to adapt their diet to the arboreal availability of their respective habitats instead of searching for particular plant species, since this last strategy may require longer displacement if performed on less abundant plant species, as is the case of the majority of the plant species comprising the diet of the maned sloths (Chiarello et al. 2008).

The differentiated individual preference by tree species also was a relevant factor influencing the low similarity among individual diets, and it was also the apparent source of the dissimilarity found in Espírito Santo (Chiarello 1998b). In addition, we confirmed that the differentiated individual preferences were a source of Individual Specialization in both conditions of floristic diversity. The resource selection differences among individuals may be explained by one or more reasons (Araújo et al. 2011), such as: (1) differentiated physiological and nutritional requirements of the individuals; (2)

differentiated optimization criteria to perform their foraging behavior (e.g. more or less predator avoidance); (3) differential social status (e.g. dominant vs subordinated animals) and/or (4) genealogy-conserved diet compositions, as the preference for each set of tree species may be passed across generations. In particular, a “diet transference” across generations can be made through maternal learning, once the infant sloths learn what plant species to eat from the mother during the weaning phase (Montgomery and Sunquist 1978), and/or through sharing symbiotic gut microbiota (Blyton et al. 2021), which may enable each individual to perform better in digesting and detoxifying the leaves of a particular subset of plant species. However, whether differentiated feeding selection is associated or not with learning, differentiated gut microbiota across individuals, and/or other phenotypic differences is an open question that needs further investigation.

Although the individual diet diversity did not change, the higher tree diversity in the environment promoted the individual specialization (with higher individual diet dissimilarity), which evidences a niche expansion of the population through among-individual variation, instead of enhancing individual niche width (Bolnick & Ballare 2020). Thus, our results support the hypothesis that higher resource diversity favors individual specialization. Similar to our results, there is evidence from other animal groups that there is a positive effect of the food resource diversity on the individual specialization, with individuals more prone to feeding on unique sets of items when in environments with higher resource diversity (Balme et al. 2019; Cloyed & Eason 2016; Darimont et al. 2009, Herrera et al. 2008). In the opposite direction, the lower floristic diversity led to a more pronounced interindividual sharing of resources by the maned sloth, explained both by the higher similarity between the floristic composition of home ranges and a shared individual selection for plant species. Whether this resource sharing is due to a fewer abundance of adequate tree species for consumption or is because there

is a high abundance of tree species adequate for consumption in this area (such as *Ficus clusiifolia*), is an open question. Anyway, in both study sites, the preference index (Ei) indicated that the maned sloths were highly selective on most of the plant species consumed, using in higher proportion than their availability in the environment. Few exceptions were observed, such as *Tapirira guianensis*, which was the third most consumed species and shared by the majority of sloths in the less diverse study site, but given its high abundance, was considered avoided. In other low-diversity habitats, like flooded vegetations of the Amazon Forest (Queiroz 1995), mangroves (Anderson & Handley 2002), and cacao-shade plantations used by maned sloths in Southern Bahia (Cassano et al. 2011), three-toed sloths usually consume the most abundant species in the habitat, different of sites with higher diversity (Chiarello 1998b; Chiarello 2008; Montgomery and Sunquist 1978), maybe because some dominant species are appreciated by sloths or there are no better options that compensate for the energy expenditure in reaching them.

Our results suggest that the loss of plant diversity due to human disturbance may lead individuals to share feeding tree species with higher frequency, reducing the individual specialization (individual diet variation). Consequently, more frequent simultaneous occupancy of trees by more than one individual may be expected, as we empirically observed in northern Bahia. These findings are relevant because such behavioral changes can affect population dynamics in different ways (Araújo et al. 2011), as it can bring about an increase in intraspecific competition, depression of food resources, nutritional deficiencies, genetic variation reduction, spread of diseases, antagonistic interactions (e.g. fights) and detection by predators (including humans), as well as positive effects may also be expected such as higher rate of mate encounters. From an evolutionary point of view, the reduction of interindividual variation in the diet, if heritable, may affect niche

evolution, or even make a local population more susceptible to the loss of a key food resource and extinction risk (Duffy 2010; Johnson et al. 2009). Our recommendation and expectation for future studies on sloths are that it be evaluated how the reduction in floristic diversity and consequent reduction in the variation of individual diets affect the population dynamics.

The tree species *Ficus clusiifolia*, *Bowdichia virgilioides*, and *Trema micrantha*, and the genera *Ocotea* may be important resources at least for the studied population from northern Bahia, as *Cupania racemosa*, *Toulicia laevigata*, and *Plathymentia reticulata*, and the genera *Brosimum* and *Cordia* for the studied population from Rio de Janeiro, because they were the most shared, consumed and preferred across individuals. Members of the families Annonaceae, Fabaceae, Sapindaceae, and Lauraceae were consumed by both populations studied, which denotes the importance of these taxa, while the family Moraceae (especially *Ficus* spp.) seems to be a key resource for three-toed sloths in general. In *ex situ* food management and restoration projects, we recommend including these most important tree species consumed by maned sloths and of as many species listed as possible (see Giné et al. 2022 for complementary list), respecting their region of origin and giving the opportunity to exercise their selective behavior, mainly to satisfy their individual preferences.

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Legal permit: All procedures taken to enable this work: capture, marking, monitoring, and collection of living material and behavior registers were authorized by the Brazilian responsible organ ICMBio (licenses no: 64635-5; 67274-4) and by the Ethics Committee of University of Santa Cruz (certificate no 009/20).

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3 CONSIDERAÇÕES FINAIS

Pela primeira vez, a ecologia alimentar da preguiça-de-coleira das populações do Rio de Janeiro e do Norte da Bahia foi estudada, assim como um número maior de indivíduos foi amostrado e novos aspectos foram investigados – seletividade, relação entre disponibilidade de recursos e diversidade e similaridade da dieta. Em Silva Jardim, foi encontrada uma sobreposição baixa da dieta entre os indivíduos, porém esta sobreposição foi mais explicada por diferenças na composição florística entre as áreas de vida de cada indivíduo, embora uma seleção diferenciada entre os indivíduos também tenha contribuído para esta baixa similaridade. Na Reserva Sapiranga, uma área com menor diversidade florística, as similaridades da dieta encontradas foram mais altas, também explicadas em sua maior parte por mudanças na composição florística local, mas com contribuição de uma seleção diferenciada por alguns pares de indivíduos, e de uma seleção comum exercida por outros pares. Foi encontrada uma relação negativa entre diversidade florística do ambiente e similaridade da dieta, o que indica que a similaridade da dieta é influenciada por características do ambiente, mais especificamente pela diversidade florística, ou de recursos alimentares. O pequeno conjunto de espécies na dieta de cada indivíduo, e a não alteração da diversidade da dieta com o aumento da diversidade de recursos no ambiente, evidenciam que a preguiça-de-coleira é especialista em nível individual e generalista em nível de espécie. A grande habilidade dos indivíduos em ajustarem sua dieta à disponibilidade de árvores em seus respectivos habitats sugerem uma alta flexibilidade da espécie, o que pode ter evoluído dada a necessidade deste animal folívoro reduzir gastos energéticos na busca por alimento. A perda de diversidade florística devido a fatores antropogênicos pode acarretar um aumento no uso de recursos alimentares compartilhados entre os indivíduos desta espécie, o que por sua vez pode aumentar a propagação de doenças, interações agonísticas e competição. Mais estudos são necessários para avaliar este risco, que investiguem, por exemplo, o sucesso reprodutivo de animais destes dois ambientes. É recomendado que as instituições de populações cativas ofereçam a animais provenientes da sub linhagem do Norte da Bahia, mais especificamente de regiões de Restinga Arbórea, folhas dos gêneros *Ficus*, *Bowdichia*, *Trema* e *Ocotea*. Para animais provenientes de florestas altamente diversas, é recomendado que se ofereça folhas da maior quantidade de espécies listadas por este e outros trabalhos, com foco em membros das famílias Annonaceae, Moraceae, Fabaceae, Sapindaceae e Lauraceae, que foram consumidas por animais de ambas áreas de estudo.

Por fim, é recomendado que projetos de restauração florestal nas áreas de distribuição da preguiça-de-coleira utilizem as espécies de planta aqui listadas como mais importantes na dieta, como ação de conservação a esta espécie ameaçada.

APÊNDICE

Supplementary Table 1. Diet composition and feeding selection of maned sloths (*Bradypus torquatus*) from the municipality of Silva Jardim, Rio de Janeiro, Brazil (RJ). Plant species were ranked accordingly to relative usage frequency (RUF), expressed in percentage (%). The individual (RJ01 to RJ05) preference (Ivlev's electivity Index - Ei) is presented.

Species (Family)	Individuals				
	RJ01	RJ02	RJ03	RJ04	RJ05
	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)
1. <i>Cupania racemosa</i> (Sapindaceae)	34.4 (0.7)			18.9 (0)	
2. <i>Trichilia lepidota schumanniana</i> (Meliaceae)					34.5 (0.5)
3. <i>Toulicia laevigata</i> (Sapindaceae)	6.3 (0.8)			21.6 (0.9)	
4. <i>Plathymenia reticulata</i> (Fabaceae)*			11.1 (0.5)		20.7 (0.9)
5. <i>Sapium glandulosum</i> (Euphorbiaceae)*					31 (0.9)
6. <i>Brosimum lactescens</i> (Moraceae)*	21.9 (0.9)				
7. <i>Guatteria ferruginea</i> (Annonaceae) ψ				16.2 (0.9)	
8. <i>Cordia trichoclada</i> (Boraginaceae)		5 (0.9)	11.1 (0.9)		6.9 (0.4)
9. Euphorbiaceae sp1			22.2 (0.9)		
10. <i>Xylopia sericea</i> (Annonaceae)				16.2 (0.4)	
11. <i>Cecropia pachystachya</i> (Urticaceae)		5 (0.9)		10.8 (0.9)	
12. <i>Meriania glabra</i> (Melastomataceae)* ψ				13.5 (0.9)	
13. <i>Sorocea guillemianiana</i> (Moraceae)		25 (~1)			
14. <i>Couratari pyramidata</i> (Lecythidaceae)	9.4 (0.7)		3.7 (0.6)		
15. <i>Endlicheria paniculata</i> (Lauraceae) ψ			14.8 (0.9)		
16. <i>Eugenia prasina</i> (Myrtaceae)*			14.8 (0.8)		

Species (Family)	Individuals				
	RJ01	RJ02	RJ03	RJ04	RJ05
	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)
17. <i>Brosimum guianense</i> (Moraceae)		10 (0.7)	3.7 (0.4)		
18. <i>Casearia sylvestris</i> (Salicaceae)*	9.4 (0.9)				
19. <i>Guatteria australis</i> (Annonaceae)*		15 (0.9)			
20. <i>Tabebuia elliptica</i> (Bignoniaceae)	6.3 (0.8)		3.7 (0.7)		
21. <i>Alchornea triplinervia</i> (Euphorbiaceae)			7.4 (-0.2)		
22. <i>Annona</i> sp1 (Annonaceae) ψ	6.3 (0.8)				
23. <i>Eriotheca</i> sp1 (Malvaceae) ψ		10 (0.9)			
24. Fabaceae sp1		10 (0.9)			
25. Sp1* ψ	6.3 (0.8)				
26. <i>Tabebuia cassinoides</i> (Bignoniaceae)*					6.9 (-0.6)
27. <i>Anaxagorea dolichocarpa</i> (Annonaceae) ψ		5 (0.9)			
28. <i>Eugenia speciosa</i> (Myrtaceae)		5 (0.9)			
29. <i>Guapira opposita</i> (Nyctaginaceae)			3.7 (0.7)		
30. <i>Mabea piriri</i> (Euphorbiaceae)		5 (0.7)			
31. Sp6 ψ				2.7 (0.6)	
32. Sp9 ψ			3.7 (0.7)		

Asterisk (*) indicates the plant species not confirmed visually to be eaten by the maned sloths.

The symbol (ψ) indicates the plant species not found in the sampling plots – the minimum IV found was used for the Ei calculation

Supplementary Table 2. Diet composition and feeding selection of maned sloths (*Bradypus torquatus*) from Sapiranga Reserve, in the municipality of Mata de São João, Bahia, Brazil (BA). Plant species were ranked accordingly to relative usage frequency (RUF), expressed in percentage (%). The individual (BA02 to BA09) preference (Ivlev's electivity Index - Ei) is presented.

Species (Family)	Individuals							
	BA02	BA03	BA04	BA05	BA06	BA07	BA08	BA09
	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)
1. <i>Ficus clusiifolia</i> (Moraceae)	24.3 (0.9)	25.7 (0.9)	47.9 (0.9)	26.4 (0.5)	15.1 (0.8)	13 (0.9)	29.8 (0.9)	4.9 (0.5)
2. <i>Bowdichia virgilioides</i> (Fabaceae)	13.5 (0.3)	14.3 (0.8)	6.3 (0.4)	7.5 (0.4)	37.7 (0.9)		43.9 (0.9)	7.3 (0.4)
3. <i>Tapirira guianensis</i> (Anacardiaceae)		25.7 (0)	16.7 (-0.5)	13.2 (0.6)	11.3 (-0.5)	21.7 (-0.2)	12.3 (-0.5)	41.5 (-0.1)
4. <i>Trema micrantha</i> (Cannabaceae)		8.6 (0.8)	4.2 (0.2)	3.8 (-0.4)	11.3 (0.8)	10.9 (0.8)		
5. <i>Artocarpus heterophyllus</i> (Moraceae) ψ				3.8 (0.1)		32.6 (~1)		
6. <i>Protium heptaphyllum</i> (Burseraceae)	10.8 (0.2)		2.1 (-0.2)		9.4 (0.6)		7 (-0.1)	4.9 (0.2)
7. <i>Heisteria blanchetiana</i> (Olacaceae)*				22.6 (0.7)	1.9 (0.2)			
8. <i>Campomanesia guazumifolia</i> (Myrtaceae)	13.5 (0.6)							7.3 (0.3)
9. <i>Swartzia flaemingii</i> (Fabaceae)	10.8 (0.8)						3.5 (0.6)	4.9 (0.5)
10. <i>Ficus hirsuta</i> (Moraceae)*			6.3 (0.4)	7.5 (0.4)				
11. <i>Ocotea nitida</i> (Lauraceae)								17.1 (0.8)
12. <i>Ficus americana guianensis</i> (Moraceae)						13 (0.7)		
13. <i>Ficus pulchella</i> (Moraceae) ψ				11.3 (0.5)				
14. <i>Ocotea velutina</i> (Lauraceae)*				1.9 (-0.3)	7.5 (0.7)			
15. <i>Cupania rugosa</i> (Sapindaceae)		11.4 (0.3)						
16. <i>Ficus obtusiuscula</i> (Moraceae) ψ			8.3 (0.5)					
17. <i>Mangifera indica</i> (Anacardiaceae)		2.9 (0.6)				6.5 (0.8)		

Species (Family)	Individuals							
	BA02	BA03	BA04	BA05	BA06	BA07	BA08	BA09
	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)	RUF (Ei)
18. <i>Allophylus puberulus</i> (Sapindaceae)		2.9 (-0.4)			3.8 (0.3)			
19. <i>Lacistema robustum</i> (Lacistemataceae)	8.1 (0.5)							
20. <i>Myrcia splendens</i> (Myrtaceae)*	8.1 (0.6)							
21. <i>Myrsine umbellata</i> (Primulaceae)*		8.6 (0.8)						
22. <i>Brosimum guianense</i> (Moraceae)							3.5 (0.6)	
23. <i>Byrsonima sericea</i> (Malpighiaceae)*			4.2 (0.1)					
24. <i>Cecropia glaziovii</i> (Urticaceae) ψ			2.1 (-0.2)	1.9 (-0.3)				
25. <i>Cupania rigida</i> (Sapindaceae)								4.9 (0.5)
26. <i>Erythroxylum passerinum</i> (Erythroxylaceae)	5.4 (0.2)							
27. Fabaceae sp2	5.4 (0)							
28. <i>Samanea tubulosa</i> (Fabaceae) ψ								4.9 (0.5)
29. <i>Coccoloba striata</i> (Polygonaceae) ψ					1.9 (0.2)			
30. <i>Cupania impressinervia</i> (Sapindaceae) ψ			2.1 (-0.2)					
31. <i>Ficus</i> sp (Moraceae) ψ								2.4 (0.2)
32. <i>Ocotea notata</i> (Lauraceae)						2.2 (0.4)		
<i>Cecropia</i> sp (Urticaceae)**								
<i>Clusia nemorosa</i> (Clusiaceae)**								
<i>Pseudoxandra bahiensis</i> (Annonaceae)**								

Asterisk (*) indicates the plant species not confirmed visually to be eaten by the maned sloths.

Doble Asterisk (**) indicates plant species observed opportunistically being eaten by non-monitored maned sloths in the study area and were not included in usage frequency estimates and selection analysis.

The symbol (ψ) indicates the plant species not found in the sampling plots – the minimum IV found was used for the Ei calculation.

Supplementary Table 3. Demonstrated pairs of individuals in Figure 4, with their respective numbers.

A (RJ pairs)		C (Interpopulation pairs)	
1	RJ01-RJ02	1	RJ01-BA02
2	RJ02-RJ04	2	RJ01-BA09
3	RJ03-RJ04	3	RJ02-BA09
4	RJ01-RJ03	4	RJ03-BA07
5	RJ01-RJ04	5	RJ03-BA09
6	RJ01-RJ05	6	RJ04-BA02
7	RJ02-RJ03	7	RJ04-BA09
8	RJ02-RJ05	8	RJ05-BA06
9	RJ03-RJ05	9	RJ05-BA08
10	RJ04-RJ05	10	RJ05-BA09
B (BA pairs)		11	RJ01-BA03
1	BA02-BA04	12	RJ01-BA04
2	BA02-BA05	13	RJ01-BA05
3	BA02-BA06	14	RJ01-BA06
4	BA02-BA07	15	RJ01-BA07
5	BA03-BA05	16	RJ01-BA08
6	BA04-BA05	17	RJ02-BA02
7	BA05-BA06	18	RJ02-BA03
8	BA05-BA07	19	RJ02-BA04
9	BA05-BA08	20	RJ02-BA05
10	BA05-BA09	21	RJ02-BA06
11	BA04-BA06	22	RJ02-BA07
12	BA04-BA07	23	RJ02-BA08
13	BA04-BA09	24	RJ03-BA02
14	BA06-BA07	25	RJ03-BA03
15	BA06-BA09	26	RJ03-BA04
16	BA07-BA08	27	RJ03-BA05
17	BA07-BA09	28	RJ03-BA06
18	BA08-BA09	29	RJ03-BA08
19	BA02-BA03	30	RJ04-BA03
20	BA02-BA07	31	RJ04-BA04
21	BA02-BA09	32	RJ04-BA05
22	BA03-BA04	33	RJ04-BA06
23	BA03-BA06	34	RJ04-BA07
24	BA03-BA07	35	RJ04-BA08
25	BA03-BA08	36	RJ05-BA02
26	BA03-BA09	37	RJ05-BA03
27	BA04-BA08	38	RJ05-BA04
28	BA06-BA08	39	RJ05-BA05
		40	RJ05-BA07

Supplementary Table 4. Diet diversity - Shannon Index (H') and richness (S) of the 13 maned sloths monitored in the study, from Silva Jardim (RJ individuals) and Sapiranga Reserve (BA individuals). The floristic diversity of the home ranges of each individual is also shown.

Animal (ID)	Diet diversity (H')	Floristic diversity (H')	Diet Richness (S)	Floristic Richness (S)
RJ01	1.8	4.0	8	77
RJ02	2.2	4.2	11	105
RJ03	2.2	3.8	11	55
RJ04	1.8	3.6	7	59
RJ05	1.4	3.4	5	44
Mean±SD	1.9±0.3	3.8±0.3	8.4±2.6	68±23.9
BA02	2.1	3.3	9	37
BA03	1.8	3.0	8	31
BA04	1.7	2.1	10	14
BA05	2.0	2.7	10	17
BA06	1.8	2.9	9	29
BA07	1.7	3.3	7	43
BA08	1.4	3.1	6	39
BA09	1.9	2.7	10	26
Mean±SD	1.8±0.2	2.9±0.3	8.4±1.8	30.8±10.4