UNIVERSIDADE ESTADUAL DE SANTA CRUZ - UESC

PROGRAMA DE PÓS-GRADUAÇÃO EM ECOLOGIA E CONSERVAÇÃO DA BIODIVERSIDADE - PPGECB

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# AVALIAÇÃO DA CONECTIVIDADE NATURAL DO DOSSEL SOBRE RIOS PARA MAMÍFEROS ARBORÍCOLAS NO MUNICÍPIO DE UNA, NO SUL DA BAHIA, BRASIL

ILHÉUS - BAHIA

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Dissertação apresentada ao Programa de Pós-graduação em Ecologia e Conservação da Biodiversidade da Universidade Estadual de Santa Cruz como parte dos requisitos para obtenção do título de Mestre em Ecologia e Conservação da Biodiversidade.

Linha de pesquisa: Ecologia e conservação de comunidades.

Orientador: Prof. Dr. Ricardo Siqueira Bovendorp

**ILHÉUS - BAHIA**

**2025**

S237 Santos, Stéfhanne Guimarães.
Avaliação da conectividade natural do dossel sobre rios para mamíferos arborícolas no município de Una, no sul da Bahia, Brasil / Stéfhanne Guimarães Santos. – Ilhéus, BA: UESC, 2025.
54 f. : il.

Orientador: Ricardo Siqueira Bovendorp.
Dissertação (mestrado) – Universidade Estadual de Santa Cruz. Programa de Pós-Graduação em Ecologia e Conservação da Biodiversidade.
Inclui referências.

1. Monitoramento florestal – Brasil. 2. Matas ripárias. 3. Armadilhas fotográficas. 4. Mamíferos. 5. Dossel florestal. I. Título.

CDD 577.30981

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Ilhéus, 25 de fevereiro de 2025.

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Universidade Estadual de Santa Cruz – UESC (Orientador)

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À minha mãe, que, com todo amor e incentivo, me ajudou a traçar este caminho.

## AGRADECIMENTOS

À minha família: minha irmã Thífanne, meu pai Erinaldo e minha mãe Dierdina, por todo apoio e por sempre fazerem o possível para que eu tivesse uma boa educação. Em especial, à minha mãe, que é minha base, a pessoa que mais admiro e que mais me incentiva. Não teria chegado até aqui sem vocês. Muito obrigada!

Ao meu companheiro, Breno, a pessoa que mais me ouviu durante esses dois anos de mestrado e que esteve ao meu lado em todos os momentos. Sou imensamente grata por tê-lo em minha vida.

Aos meus amigos, que se mantiveram presentes, apesar da distância, e me incentivaram, sempre arrumando um tempo para boas conversas e risadas. Um agradecimento especial à Thays, que compartilhou comigo a experiência do mestrado após cinco anos compartilhando a experiência da graduação. E à Laura, obrigada pelas sugestões, pelo apoio, pelas conversas, pelo carinho e pela cumplicidade.

A todas as pessoas que conheci durante esses dois anos de mestrado, sou eternamente grata. Obrigada à casa das oito mulheres – Laura, Thays, Júlia, Alejandra, Letícia, Victória e Nayla – minha turma do mestrado, que conseguiu tornar esses anos mais leves.

Ao meu orientador, Ricardo, por ter aceitado me orientar, por todas as contribuições ao trabalho, por esclarecer minhas dúvidas, pelo aprendizado, pelo apoio, pelo incentivo, pelas idas e vindas a campo e pela aventura de caiaque.

Aos membros da banca e suplentes, Dra. Fernanda Abra, Dr. Marcelo Magioli, Profa. Dra. Camila Cassano e Profa. Dra. Roberta Paolino, agradeço por aceitarem o convite para participar desta etapa, por dedicarem seu tempo e pelas contribuições e sugestões ao meu trabalho.

Aos amigos e colegas que me ajudaram em campo – Patrick Rodrigues, Bruno Fontes, Sumaya Freire e Breno Matos – sem vocês, o trabalho não seria possível. Ao Prof. Dr. Mirco Solé, pelo empréstimo do caiaque para os trabalhos de campo. E ao Wesley da Rocha, pelo serviço prestado como escalador e por permitir que realizássemos nossa pesquisa em sua propriedade.

Ao Laboratório de Ecologia Aplicada à Conservação (LEAC), pela infraestrutura e fornecimento de equipamentos, bem como aos professores e membros pelas contribuições científicas, pelos ensinamentos, auxílio estatístico e conversas. Um agradecimento especial aos professores Maíra Benchimol, Larissa Rocha e João Carlos Pires-Oliveira.

À Universidade Estadual de Santa Cruz (UESC), por fornecer a infraestrutura necessária para o desenvolvimento da pesquisa, e ao Programa de Pós-Graduação em Ecologia e Conservação da Biodiversidade (PPGECB), pela oportunidade de cursar o mestrado.

À Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) – Código de Financiamento 001, pelo apoio e concessão da bolsa de estudo de mestrado.

Esses dois anos passaram muito rápidos, mas tenho certeza de que tudo que aprendi me preparou para crescer profissionalmente e, um dia, me tornar a pesquisadora que almejo.

## SUMÁRIO

**RESUMO**

A Mata Atlântica é reconhecida como um bioma rico e diverso, classificado como um dos *hotspots* mundiais de biodiversidade, mas também figura entre os mais ameaçados do planeta. A expansão de cultivos agrícolas e o uso da terra para pastagens têm degradado os habitats remanescentes e reduzido a conectividade do dossel. As florestas ripárias atuam como corredores de dispersão e refúgios, promovendo o deslocamento de espécies e facilitando interações ecológicas. Em áreas florestais fragmentadas ou com barreiras naturais, pontes de dossel naturais funcionam com estruturas importantes, conectando habitats separados por rios. Neste estudo, avaliamos o uso de pontes de dossel naturais por mamíferos arborícolas ao longo das margens dos rios Una e Maruim, no município de Una, Bahia, Brasil, no bioma da Mata Atlântica. Registramos atividades de deslocamento e padrões de utilização por meio de armadilhas fotográficas ao longo de oito meses. No total, identificamos 12 espécies de mamíferos utilizando essas pontes, com 1.077 registros independentes. O sagui-de-wied (*Callithrix kuhlii*), espécie classificada como vulnerável pela IUCN, apresentou maior taxa de uso das pontes. A maioria das espécies apresentou um padrão de atividade noturno. Os resultados indicam que os descritores físicos das árvores, como diâmetro à altura do peito e pontos de conexão de galhos, além da largura do rio, são determinantes para o uso das pontes, influenciando na abundância de espécies. Observamos padrões distintos de utilização, refletindo preferências ecológicas e adaptações morfológicas. Este estudo destaca a importância de preservar e restaurar a conectividade em paisagens fragmentadas, fornecendo evidências para estratégias de conservação que priorizem a funcionalidade ecológica das florestas ripárias e estruturas similares.

**Palavras-chave:** Armadilhas fotográficas; Monitoramento de fauna, Passagem de fauna, Pontes de dossel natural; Mamíferos arborícolas; Floresta ripária.

**ABSTRACT**

The Atlantic Forest is recognized as a rich and diverse biome, classified as one of the world’s biodiversity hotspots, but also among the most threatened on the planet. The expansion of agricultural crops and land conversion to pastures have degraded the remaining habitats and reduced canopy connectivity. Riparian forests act as dispersal corridors and refuges, promoting species movement and facilitating ecological interactions. In fragmented forest areas or those with natural barriers, natural canopy bridges serve as critical structures, connecting habitats separated by rivers. In this study, we evaluated the use of natural canopy bridges by arboreal mammals along the banks of the Una and Maruim rivers, in the municipality of Una, Bahia, Brazil, within the Atlantic Forest biome. We recorded movement activities and usage patterns through camera traps over eight months. In total, we identified 12 mammal species using these bridges, with 1,077 independent records. The Wied's marmoset (*Callithrix kuhlii*), a species classified as vulnerable by the IUCN, showed the highest rate of use of the bridges. Most species exhibited nocturnal activity patterns. The results indicate that physical descriptors of trees, such as diameter at breast height and the branch connection points, as well as river width, are key determinants of bridge usage, influencing species abundance. We observed distinct usage patterns, reflecting ecological preferences and morphological adaptations. This study highlights the importance of preserving and restoring connectivity in fragmented landscapes, providing evidence for conservation strategies that prioritize the ecological functionality of riparian forests and similar structures.

**Keywords:** Camera traps; Wildlife monitoring; Wildlife crossings; Natural canopy bridges; Arboreal mammals; Riparian forest.

## INTRODUÇÃO GERAL

As florestas tropicais são habitats complexos e heterogêneos (AUGUST, 1983). Entre os continentes, a América do Sul se destaca por abrigar mais da metade das florestas tropicais do planeta (ACHARD *et al*., 2002). Nesse continente, o Brasil possui a maior extensão de cobertura florestal, predominantemente concentrada na Amazônia. Contudo, a Mata Atlântica, tão rica e diversa quanto a Amazônia, destaca-se como um dos biomas com maior riqueza de espécies de mamíferos (MACHADO *et al*., 2008). Dos 102 táxons de mamíferos oficialmente considerados ameaçados de extinção no Brasil, 53 ocorrem na Mata Atlântica, sendo 31 endêmicos (BRASIL, 2018a, 2018b, 2022). Além disso, a Mata Atlântica é classificada como um dos *hotspots* mundiais de biodiversidade (MITTERMEIER; RYLANDS, 2018), estando entre os biomas mais ameaçados do planeta, com apenas 22,27% de sua cobertura original remanescente (VANCINE *et al*., 2024).

A conservação dos remanescentes florestais da Mata Atlântica depende de diferentes tipos de vegetação protegidos por leis ambientais, como o Código Florestal Brasileiro (FARIA *et al*., 2021). Entre essas áreas protegidas, destacam-se as florestas ripárias, também conhecidas como matas ciliares, que são reconhecidas como Áreas de Preservação Permanente (APP) (BRASIL, 2012). Essas formações vegetais estão associadas a cursos d'água, como córregos, rios e lagos, apresentando variações na estrutura e composição da vegetação (VALERA *et al*., 2019). Além disso, desempenham funções ecológicas vitais para a estabilidade e dinâmica dos ecossistemas (NAIMAN *et al*., 1998).

Dentre as funções das florestas ripárias, destacam-se a melhoria da qualidade da água, a proteção contra impactos antropogênicos na bacia hidrográfica e o fornecimento de habitat para espécies terrestres e aquáticas (ANGELSTAM; LAZDINIS, 2017; LI *et al*., 2018; SANTOS *et al*., 2015; VALLE JUNIOR *et al*., 2015). Além disso, essas florestas promovem a biodiversidade do solo, filtram sedimentos, controlam enchentes, estabilizam canais fluviais e contribuem para a recarga de aquíferos (CHOI *et al*., 1970; TOCKNER; WARD, 1999; POIANI *et al*., 2000; ARSCOTT e*t al*., 2002; MELEASON; QUINN, 2004; DWIRE; LOWRANCE, 2006; PHOEBUS; SEGELBACHER; STENHOUSE, 2017). Para os mamíferos, as florestas ripárias oferecem água, alimento e abrigo, especialmente durante períodos de seca, além de funcionarem como corredores ecológicos em áreas abertas e fragmentadas (RAMOS PEREIRA *et al*., 2013).

Os corredores ecológicos são essenciais ao conectar paisagens fragmentadas, permitindo a manutenção da biodiversidade (GREGORY *et al*., 2021). Nas paisagens antrópicas da Mata Atlântica, o uso de corredores ecológicos contribui significativamente para ampliação dos serviços de conservação (PERKL, 2016; SANTOS *et al*., 2018). A conectividade refere-se à facilidade ou restrição ao movimento de organismos entre fragmentos em uma paisagem (TAYLOR *et al*., 1993). Ela pode ser descrita de duas formas: conectividade estrutural, que avalia aspectos físicos, como distância entre fragmentos e a presença de corredores, baseando-se simplesmente nos padrões da paisagem e não está necessariamente associada ao comportamento de movimento de nenhum organismo em particular (LIU; HUANG; ZHENG, 2022; LOOKINGBILL; MINOR, 2017); e a conectividade funcional, que considera os hábitos e a percepção das espécies sobre os elementos da paisagem e suas respostas comportamentais (GOODWIND, 2003; LIU; HUANG; ZHENG, 2022). Os mamíferos, em especial os arborícolas, se beneficiam da conectividade. No Brasil, muitas espécies de mamíferos apresentam hábitos arborícolas, embora variem no grau de dependência do dossel (PAGLIA *et al*., 2012). Algumas espécies são estritamente arborícolas, como cuíca-lanosa (*Caluromys lanatus*), enquanto outras, classificadas como escansoriais, utilizam o solo ocasionalmente, como tamanduá-mirim (*Tamandua tetradactyla*) (TEIXEIRA *et al*., 2022).

O estrato vertical das florestas, mais especificamente o dossel, é um ambiente distinto do terrestre, caracterizado por representar não apenas uma área, mas um volume tridimensional de habitat (LORETTO, 2012). A vida no dossel exige adaptações específicas para locomoção, obtenção de recursos e manutenção fisiológica (MALCOLM; LOWMAN, 2004). Mamíferos que habitam o dossel desempenham importantes funções ecológicas e serviços ecossistêmicos, como dispersão de sementes e polinização (BUFALO *et al*., 2016; BOGONI *et al*., 2020; MAGIOLI *et al*., 2021, 2022), sendo muitas vezes dependentes de frutos, sementes, flores, néctar e outros compostos vegetais (LORETTO, 2012).

A conectividade, quase sempre está atrelada à gestão das matrizes na paisagem (PREVEDELLO; VIEIRA, 2010). Contudo, as pontes de dossel, naturais ou artificiais, também desempenham grande importância na promoção da conectividade. Nos últimos anos, o número de estudos e ações de mitigação envolvendo o uso dessas estruturas tem aumentado ao redor do mundo. Muitos trabalhos têm como foco a redução da mortalidade de mamíferos arborícolas, especialmente primatas, causada por atropelamentos, por meio da implementação de pontes artificiais em rodovias (GARCIA *et al*., 2022; MONTICELLI *et al.*, 2022; TEIXEIRA *et al*., 2013; TEIXEIRA *et al*., 2022; VALLADARES-PADUA *et al*., 1995). Além disso, a importância das pontes de dossel naturais também já foi relatada na mitigação dos efeitos da fragmentação causada por oleodutos na Amazônia peruana e equatoriana (BALBUENA *et al*., 2019; GREGORY *et al*., 2017; THURBER; AYARZA, 2005).

Este trabalho foca nas pontes naturais, formadas pelas interligações de galhos de árvores em lados opostos de margens de rios, permitindo uma rota natural no topo das árvores de um lado para o outro (GREGORY *et al*., 2017). As pontes naturais são mais propensas a serem utilizadas por todas as espécies de uma comunidade de mamíferos arborícolas do que as artificiais (BALBUENA *et al*., 2019; GREGORY *et al*., 2017, 2022a; LINDSHIELD, 2016; THURBER; AYARZA, 2005; WILLIAMS, 1999), desde que os ramos estejam bem conectados (GREGORY *et al*., 2014). Assim, as pontes de dossel são uma excelente fonte de informação relativamente imparcial sobre a atividade das espécies que vivem nesse estrato (GREGORY *et al*., 2022a).

O monitoramento das pontes de dossel naturais tem sido realizado, com maior frequência, por meio de armadilhas fotográficas, um método não invasivo e eficaz para detectar espécies raras e elusivas. Embora as armadilhas fotográficas no solo sejam utilizadas há décadas, sua popularidade nas copas das árvores aumentou consideravelmente na última década (MOORE *et al*., 2021). Nos últimos anos, também cresceu o uso de armadilhas fotográficas para monitorar a fauna nas pontes de dossel (GREGORY *et al*., 2017; HIDALGO-MIHART *et al*., 2022; NEKARIS *et al*., 2021), permitindo o registro de espécies em áreas remotas e em grandes escalas espaciais e temporais (KAIZER *et al*., 2022).

A obtenção de dados sobre o uso das pontes de dossel naturais é especialmente relevante no litoral sul da Bahia, que abriga uma das maiores porções remanescentes de Mata Atlântica e é considerada uma área prioritária para para conservação (AYRES; MARIGO, 2005; BRASIL, 2018b). Contudo, a expansão de cultivos agrícolas, como o café e o cacau, e o uso da terra para pastagens têm degradado os habitats remanescentes, reduzindo a conectividade do dossel

(CASSANO *et al*., 2017; LORETTO, 2012; MAGIOLI *et al*., 2022). Esses remanescentes desconexos dificultam a dispersão de espécies arborícolas, impactando a manutenção de suas populações (FERNANDEZ; PIRES 2006). As florestas ripárias, em particular, atuam como corredores de dispersão e refúgios, embora os rios possam representar barreiras para algumas espécies (AYRES; CLUTTIN-BROCK, 1992; RANZI, 2000). Dessa forma, a presença de pontes de dossel naturais em florestas ripárias, podem permitir a passagem de fauna de mamíferos arborícolas, fazendo com que eles se desloquem de um lado ao outro do rio. Apesar de estudos com pontes naturais no Brasil ainda serem escassos, pesquisas apontam que as pontes naturais são ferramentas eficazes para conservação e podem subsidiar a implementação de alternativas artificiais (GREGORY *et al*., 2022b; TEIXEIRA *et al*., 2022).

Diante disso, este estudo teve como objetivo investigar o uso de pontes de dossel naturais por mamíferos arborícolas ao longo das margens de rios e avaliar se essas pontes podem funcionar como passagem de fauna, promovendo conectividade entre as margens. Dessa forma, a presente dissertação está organizada em um capítulo único, apresentado em formato de artigo científico, seguindo as diretrizes da revista *Biodiversity and Conservation*.

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**Evaluation of natural canopy connectivity over rivers for arboreal mammals in the municipality of Una, in Southern Bahia, Brazil[1]**

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[1] Article in preparation for submission to the journal *Biodiversity and Conservation*

## Abstract

The Atlantic Forest is recognized as a rich and diverse biome, classified as one of the world's biodiversity hotspots, but also among the most threatened on the planet. The expansion of agricultural crops and land conversion to pastures have degraded the remaining habitats and reduced canopy connectivity. Riparian forests act as dispersal corridors and refuges, promoting species movement and facilitating ecological interactions. In fragmented forest areas or those with natural barriers, natural canopy bridges serve as critical structures, connecting habitats separated by rivers. In this study, we evaluated the use of natural canopy bridges by arboreal mammals along the banks of the Una and Maruim rivers, in the municipality of Una, Bahia, Brazil, within the Atlantic Forest biome. We recorded movement activities and usage patterns through camera traps over eight months. In total, we identified 12 mammal species using these bridges, with 1,077 independent records. Wied's marmoset (*Callithrix kuhlii*) was the species with the highest bridge usage rate. Most species exhibited nocturnal activity patterns. The results indicate that physical descriptors of trees, such as diameter at breast height and the branch connection points, as well as river width, are key determinants of bridge usage, influencing species abundance. We observed distinct usage patterns, reflecting ecological preferences and morphological adaptations. This study highlights the importance of preserving and restoring connectivity in fragmented landscapes, providing evidence for conservation strategies that prioritize the ecological functionality of riparian forests and similar structures.

**Keywords:** Camera traps; Wildlife monitoring; Wildlife crossings; Riparian forest.

## Introduction

Tropical forests, complex environments rich in biodiversity, are under intense pressure from land use (August 1983; Davis et al. 2011). In South America, the Atlantic Forest is a major biodiversity hotspot, characterized by high degradation (Rezende et al. 2018), endemism, and species richness (Myers et al. 2000; Joly et al. 2014). However, its original cover has been reduced to just 22.27%, due to the conversion of native forest to anthropogenic land uses, mainly agriculture (Vancine et al. 2024), with 80% of remaining forest patches covering areas smaller than 50 ha (Ribeiro et al. 2009).

Brazil is home to 785 native mammal species, with high levels of endemism (Abreu et al. 2024). Among these species, more than 10% are considered threatened (Paglia et al., 2012). Specifically in the Atlantic Forest, 321 mammal species are found, 89 of which are endemic to this biome (Grapinel et al., 2017). Arboreal mammals, widespread in Brazilian territories (Paglia et al. 2012), perform various ecological functions and ecosystem services (Bogoni et al. 2020; Magioli et al. 2021; Magioli et al. 2022). These species vary in their level of dependence on the canopy, with strictly arboreal taxa like Brown-eared Woolly Opossum (*Caluromys lanatus*) and scansorial species like Southern Tamandua (*Tamandua tetradactyla*) that occasionally descend to the ground (Teixeira et al. 2022).

Arboreal mammals face increasing threats due to habitat loss and fragmentation, as well as pressures from hunting and road mortality, which reduce their populations and limit connectivity between forested areas (Cassano et al. 2017; Garcia et al. 2022; Praill et al. 2023). These species, adapted to the upper strata of highly connected tropical forests, rely on primary plant resources such as fruits, seeds, flowers, and nectar (Loretto 2012). However, habitat degradation restricts their movement, leading to population isolation and hampering dispersal and survival in areas with low connectivity (Loretto and Vieira 2011).

Natural canopy bridges can function as wildlife corridors between fragmented or geographically isolated habitats (Gregory et al. 2017). These structures enable the safe movement of arboreal animals, thus contributing to the long-term viability of their populations (Teixeira et al. 2022). Riparian forest, recognized as Permanent Preservation Area (APP) under the Brazilian Forest Code, play a crucial role along rivers, acting as dispersal corridors and biological refuges, especially in predominantly arboreal environments (Ranzi 2000). However, rivers can act as geographical barriers for mammals (Ayres and Clutton-Brock 1992), with riverbank and vegetation characteristics influencing species distribution (Ramos Pereira et al. 2013). Therefore, the presence of natural canopy bridges along rivers may offer structural and functional connectivity for arboreal species (Soanes et al. 2013; Soanes and van der Ree 2015; Franceschi et al. 2022; Teixeira et al. 2022). Studies on natural bridges in Brazil remain scarce, but research suggests that canopies and natural bridges are effective conservation solutions, providing data on usage patterns that can guide the implementation of artificial bridges (Gregory et al. 2017).

The southern coast of Bahia harbors one of the largest remaining portions of the Atlantic Forest and stands out for its biodiversity, making it a priority conservation area (Ayres and Marigo 2005; MMA 2018). However, this region is affected by disturbances to native forests resulting from the expansion of agricultural crops, such as coffee and cocoa, as well as land use for pasture. These disturbances result in tree removal, contributing to habitat degradation and loss (Cassano et al. 2017; Magioli et al. 2022). The fragmentation of contiguous habitat areas creates isolated habitat patches, leading to reduced canopy connectivity (Loretto 2012). This directly impacts the maintenance of arboreal mammal populations, as these species have greater difficulty crossing open areas and dispersing or migrating (Fernandez and Pires 2006).

This study aims to investigate the use of natural canopy bridges by arboreal mammals along riverbanks and assess whether these bridges can function as wildlife corridors, promoting connectivity between riverbanks. For this, we assessed richness, relative abundance, bridge use rate, and the activity period of arboreal mammals. We hypothesize that these bridges facilitate the movement and distribution of mammals, acting as environmental filters that select species based on structural characteristics (Cornwell et al. 2006). We expect to find more canopy bridges in areas with narrow riverbeds and preserved forests, with greater use of bridges formed by trees with larger diameter at breast height (DBH) and other structural attributes (Gregory et al. 2017). Thus, species with greater canopy mobility would tend to use these bridges more frequently, while others might avoid them.

## Methodology

### Study Area

The study was conducted in the municipality of Una (Fig. 1), located in the southern region of Bahia State, Brazil. This area covers a total of 11,400 ha, of which 7,059 ha are actively used (Coimbra-Filho et al. 1993). In Una, the proportional land use distribution consists of: forest formations (75%), including remnants of the Atlantic Forest in southern Bahia, interspersed with pastureland (12%), agricultural (9%), mangroves (1%), and water bodies like rivers, lakes, and the ocean (1%) (MapBiomas 2024). Inserted in the Brazilian phytogeographic formation of Dense Ombrophilous Forest, this forest is characterized by its tall structure, with different vegetation layers, including understory, tree canopy, and emergent trees, and is rich in lianas and epiphytes (Thomas et al. 1998). The rivers and streams in the area are part of the Una River watershed (Góes Neto 1996). The major rivers in this watershed within the municipality include the Una River (21.42%), Maruim River (15.78%), and Serra River (13.05%).

The monitoring of natural canopy bridges was conducted in two areas. The first, Una Wildlife Refuge (Revis), is a Brazilian strictly protected conservation unit that spans 23,262.09 ha and is crossed by the Maruim River, characterized by fast-flowing, deep waters, a rocky bed, and a width of approximately eight to ten meters (Napoli and Pimenta 2003). This area, located at 15°10'S - 39°3'W, was created as a buffer zone around the Una Biological Reserve (ReBio), which is also a strictly protected area (Sollberg et al. 2014). The second area is the Private Natural Heritage Reserve (RPPN) Fazenda Ararauna, a sustainable use conservation unit, covering 39 ha and crossed by the Una River, which originates to the west of the Anuri district in Arataca, at approximately 650 m altitude, and flows eastward into the municipality of Una after covering approximately one hundred kilometers (located at 15º18’32.5”S - 39º09’38.8”W). The region's climate is classified as Af, according to Köppen’s classification, characterized as hot and humid, with an average annual temperature of 25ºC and average annual precipitation between 1,200 and 1,800 mm (Alvares et al. 2013).

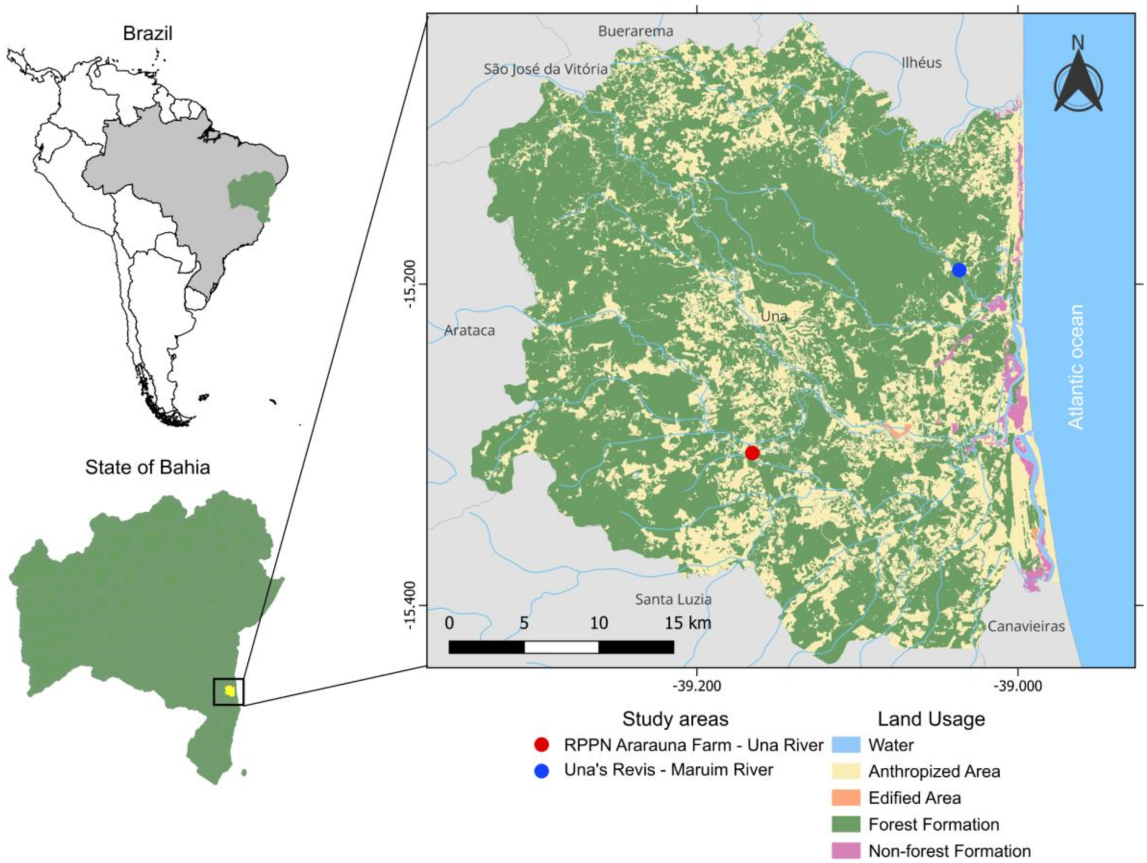


**Fig. 1** Location of the protected areas, Una's Revis and RPPN Fazenda Ararauna, in the municipality of Una, Bahia, Brazil, depicting the main land uses and rivers

## Bridge Selection and Mammals Monitoring

Initially, we reviewed high-resolution satellite images available on Google Earth Pro to identify potential crossing points over the rivers in the study areas. These crossing points consist of pairs of trees on opposite sides whose canopies have some connection. After selecting the points, we conducted on-site inspections to confirm the connections and georeference these locations. To map these canopy connection points, we used QGIS software (version 3.36 Maidenhead). We selected five natural canopy bridges in each area adjacent to the Una and Maruim Rivers, with a maximum distance of 100 m between each. However, due to the theft of two cameras, monitoring was conducted on only four bridges in each area. In the study areas, it was possible to identify some trees that formed the bridges such as *Casearia arborea*, *Cecropia* sp., *Elaeis* sp., *Ficus* sp., *Inga edulis*, *Inga* sp. and *Parinari* sp.

To understand which bridge characteristics might be associated with higher usage by mammals, we collected data on some basic physical descriptors of the trees, including diameter at breast height (DBH) of all trees forming each bridge, the height of branch connections (using a digital tape measure), and the number of branch connection points. Additionally, we evaluated canopy openness, measured by the amount of visible sky. For this purpose, hemispherical photographs were taken at a height of 1.5 m using a smartphone camera with a wide-angle lens mounted on a tripod. During image acquisition, the smartphone was leveled using the tripod's bubble level. Hemispherical photographs were taken under clouded skies to ensure better contrast and avoid overexposure (Reis et al. 2021). Whenever possible, we identified the tree species composing the canopy bridges. Finally, with the help of a digital tape measure, we measured the height of the camera traps and the width of the river adjacent to each monitored bridge.

Mammal monitoring was conducted with a camera trap on each bridge from November 2023 to June 2024. We installed four Bushnell Essential E3 and four UOVision UV557 cameras, attaching them to trunks or branches as needed (Fig. 2). The installation height varied depending on the most suitable branch, ranging from 3.3 m to 10.3 m, allowing the capture of animals across different forest strata. We checked the camera settings immediately after installation to ensure the crossing point was within the cameras' detection field. Camera settings were as follows: programmed to operate 24 hours a day, with hybrid mode activated for Bushnell cameras and video mode only for UOVision cameras; both with videos of 10 to 15 seconds and a trigger interval of five seconds, including date and time stamps for each recording. Both Bushnell and UOVision cameras were equipped with eight AA lithium batteries, with memory cards ranging from 16 GB to 64 GB, depending on the camera model. Camera maintenance was performed every two months, during which batteries were replaced, photos and videos were downloaded, and malfunctioning cameras were replaced. We then manually selected the photos and videos.

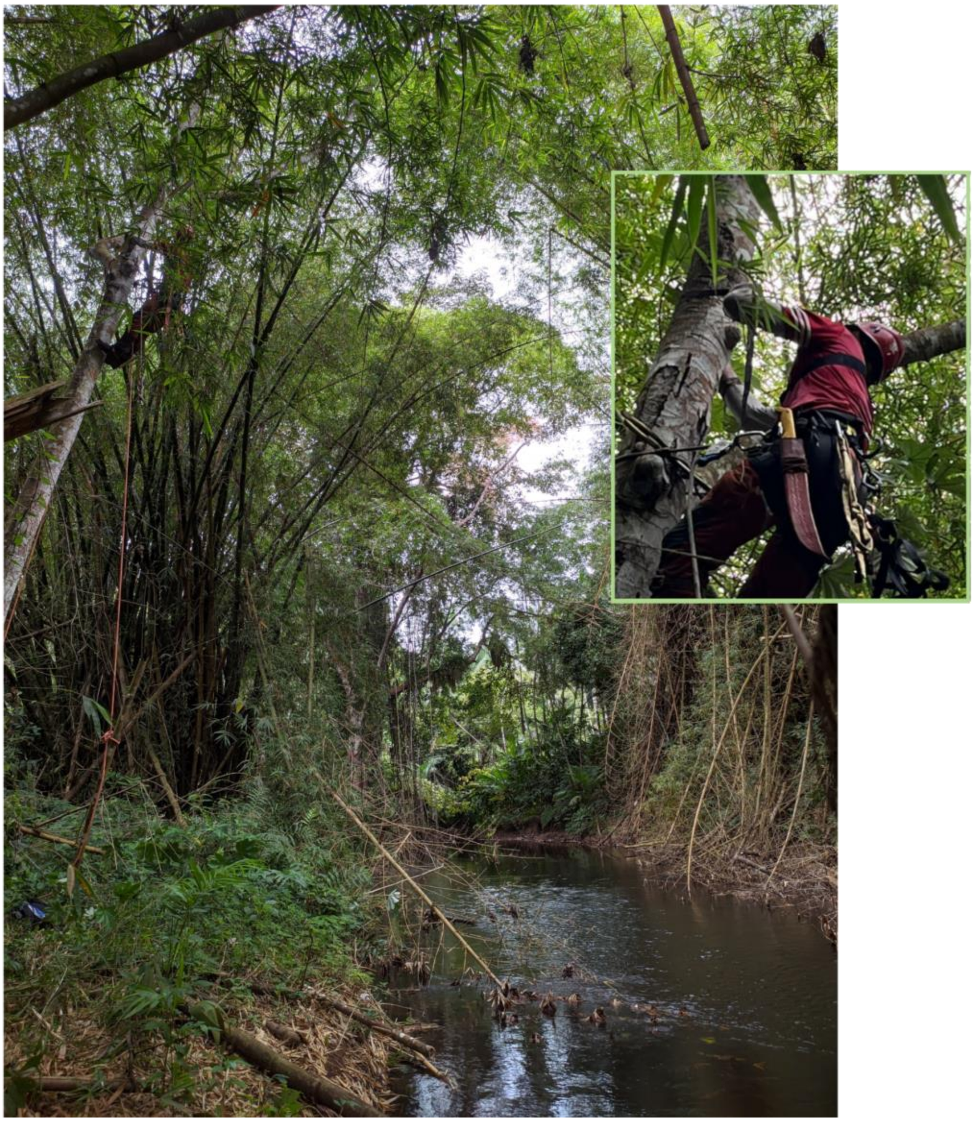

**Fig. 2** The climber ascending a natural canopy bridge over the river in the municipality of Una, Bahia, Brazil, to install the camera trap

## Data Analysis

The conservation status of the recorded species, their threat categories were indicated at global, national, and regional levels, according to the IUCN Red List (International Union for Conservation of Nature), MMA (Ministry of Environment and Climate Change, Brazil), and BA (Mammal Conservation Status of Bahia State, Brazil), respectively.

For canopy openness analysis in the collected images, we used the *photoanalyzer* function in R, which enables the analysis of square-format images with the assistance of the *devtools* (Wickham et al. 2022) and *ReadImages* (Loecher et al. 2011) packages packages in R, version 4.3.3 (R Core Team 2024). Independent events were considered whenever the same species was recorded on the same camera with a minimum interval of one hour between records (Oliveira-Santos et al. 2008). When a group of animals was recorded crossing the camera, this occurrence was counted as a single event. The rate of bridge usage by mammals was calculated based on the number of potential crossing events for each species. To obtain this rate, we divided the total number of events by the number of cameras operating in each study area. Additionally, we evaluated the degree of usage for each bridge, recording richness and relative abundance (calculated by dividing the number of individuals recorded on each bridge by the total number of individuals recorded in each study area).

The activity period was analyzed jointly for both areas and included only species with more than 26 activity records (Oliveira-Santos et al. 2008). Circular statistics in the ORIANA software, version 4.02, were used to analyze circadian activity patterns.

For statistical analyses, we used Generalized Additive Mixed Models (GAMM) with the *uGamm* function from the *mgcv* package (Wood 2004, 2011). This approach allowed us to analyze the relationship between response variables (richness and relative abundance) and predictor variables (DBH, branch connection height, camera trap height, number of branch connection points, canopy openness, and river width). Additionally, we considered the random effect related to the two sampled areas as part of the statistical model. We conducted a collinearity test among predictor variables, incorporating those with a variance inflation factor (VIF) < 3 in the model (Zuur et al. 2010). The included variables were: DAP, number of connection points between branches, and river width.

Model selection from a global model was performed using the *dredge* function in the *MuMIn* package (Bartoń 2024) (Supplementary Material Tables 1 and 2), and the optimal model was selected based on Akaike's Information Criterion (AICc) (Akaike 1998), by calculating ΔAICc and Akaike weight (w). The model with the lowest AICc, ΔAICc < 2, and the highest weight (w) was selected. For the richness-adjusted model, a Poisson distribution was used, while the Negative Binomial was adopted for the relative abundance model. The analyses were performed using R, version 4.3.3 (R Core Team 2024).

**Results**

The camera traps recorded 26,082 photos and videos, capturing the use of canopy bridges by arboreal and/or scansorial mammals, birds and lizards, as well as a high occurrence of “false triggers” and tree movements, which accounted for 20,285 photos and videos in total. This resulted in a sampling effort of 1,944 trap-days. After screening, 5,210 photos and videos were identified with arboreal and/or scansorial mammals using natural canopy bridges.

In total, 12 small to medium-sized species, belonging to 9 families of arboreal and/or scansorial mammals, were recorded, totaling 1,077 independent records (Table 3). The area with the highest species richness and abundance was the Una’s Revis, adjacent to the Maruim River, with 12 species and 923 individuals records, where Wied's marmoset (*Callithrix kuhlii*) and Golden-headed lion tamarin (*Leontopithecus chrysomelas*) had the highest detection rates at 2.29% and 0.77% records per hour of sampling effort, respectively. In the RPPN Fazenda Araruna, adjacent to the Una River, 9 species and 154 individuals were recorded, where *Rhipidomys mastacalis* and Golden-headed lion tamarin (*L. chrysomelas*) having the most records and a detection rate of 0.33% and 0.24% records per hour of sampling effort, respectively.

The recorded threatened species were classified according to global (IUCN), national (MMA), and regional (BA) levels. According to the IUCN, the recorded threatened species were: the Bristle-spined rat (*Chaetomys subspinosus*), the Wied's marmoset (*C. kuhlii*), the Golden-headed lion tamarin (*L. chrysomelas*), and the Buff-headed capuchin (*Sapajus xanthosternos*), detected at heights between 6.5 m and 10.3 m. At the national (MMA) and regional (BA) levels, the same species were classified as threatened: the Margay (*L. wiedii*), the Golden-headed lion tamarin (*L. chrysomelas*), the Buff-headed capuchin (*S. xanthosternos*), and the Bristle-spined rat (*C. subspinosus*), detected at heights between 3.6 m and 10.3 m. (Table 3, Fig. 3).

**Table 3** Summary of mammal species recorded in the Maruim River area (Una's Revis) and Una River area (RPPN Fazenda Araruna) in the municipality of Una, Bahia, Brazil, indicating detection rates, camera heights, and threat categories at global, national, and regional levels

| Order - Family - Species | Body size | Area | Number of records | Detection rate | Camera height (m) | IUCN | MMA | BA |
|---|---|---|---|---|---|---|---|---|
| Carnivora | | | | | | | | |
| Felidae | | | | | | | | |
| *Leopardus wiedii* | Medium (>1 kg) | Maruim River<br>Una River | 3<br>- | 0,03<br>- | 3,6 - 6,45<br>- | NT | VU | EN |
| Mustelidae | | | | | | | | |
| *Eira barbara* | Medium (>1 kg) | Maruim River<br>Una River | 6<br>1 | 0,03<br>0,01 | 3,6 - 6,45<br>3,3 | LC | - | - |
| Procyonidae | | | | | | | | |
| *Nasua nasua* | Medium (>1 kg) | Maruim River<br>Una River | 44<br>- | 0,25<br>- | 3,6 - 9,8<br>- | LC | - | - |
| Didelphimorphia | | | | | | | | |
| Didelphidae | | | | | | | | |
| *Didelphis aurita* | Small (<1 kg) | Maruim River<br>Una River | 91<br>7 | 0,44<br>0,03 | 3,6 - 9,8<br>3,3 - 10,3 | LC | - | - |
| *Marmosa murina* | Small (<1 kg) | Maruim River<br>Una River | 149<br>7 | 0,70<br>0,05 | 3,6 - 9,8<br>3,3 - 6,5 | LC | - | - |
| *Metachirus nudicaudatus* | Small (<1 kg) | Maruim River<br>Una River | 3<br>- | 0,03<br>- | 3,6<br>- | LC | - | - |
| Pilosa | | | | | | | | |
| Myrmecophagidae | | | | | | | | |
| *Tamandua tetradactyla* | Medium (>1 kg) | Maruim River<br>Una River | 29<br>14 | 0,19<br>0,08 | 3,6 - 9,8<br>6,5 - 10,3 | LC | - | - |
| Primates | | | | | | | | |
| Callitrichidae | | | | | | | | |
| *Callithrix kuhlii* | Small (<1 kg) | Maruim River<br>Una River | 348<br>14 | 2,29<br>0,19 | 3,6 - 9,8<br>3,3 - 10,3 | VU | - | - |
| *Leontopithecus chrysomelas* | Small (<1 kg) | Maruim River<br>Una River | 118<br>32 | 0,77<br>0,24 | 6,45 - 9,8<br>6,5 - 10,3 | EN | EN | EN |
| Cebidae | | | | | | | | |
| *Sapajus xanthosternos* | Medium (>1 kg) | Maruim River<br>Una River | 20<br>1 | 0,13<br>0,13 | 6,45 - 9,8<br>6,5 | CR | EN | EN |
| Rodentia | | | | | | | | |
| Cricetidae | | | | | | | | |
| *Rhipidomys mastacalis* | Small (<1 kg) | Rio Maruim<br>Una River | 35<br>72 | 0,16<br>0,33 | 3,6 - 9,8<br>3,3 - 10,3 | LC | - | - |
| Erethizontidae | | | | | | | | |
| *Chaetomys subspinosus* | Medium (>1 kg) | Rio Maruim<br>Una River | 77<br>6 | 0,53<br>0,04 | 9,8<br>6,5 - 10,3 | VU | VU | VU |
| Total | | | 1077 | | | | | |

The table shows the total number of independent records for each species, detection rate (independent records/sampling effort x 100), and camera heights (m). Threat categories are indicated at global, national, and regional levels, according to the IUCN Red List (International Union for Conservation of Nature), MMA (Ministry of Environment and Climate Change, Brazil), and BA (Mammal Conservation Status of Bahia State, Brazil), respectively


**Fig. 3** The five threatened species recorded using natural canopy bridges over the rivers: (a) Wied's marmoset (*Callithrix kuhlii*), (b) Golden-headed lion tamarin (*Leontopithecus chrysomelas*), (c) Buff-headed capuchin (*Sapajus xanthosternos*), (d) Margay (*Leopardus wiedii*), and (e) Bristle-spined rat (*Chaetomys subspinosus*).

At the bridges in the Una’s Revis (Maruim River), the species with the highest number of potential crossing events were Wied's marmoset (*C. kuhlii*) (185) and Linnaeus's mouse opossum (*Marmosa murina*) (148), with usage rates of 46.25 and 37 events per camera, respectively. At the bridges in the RPPN Fazenda Ararauna (Una River), *R. mastacalis* (70) and Linnaeus's mouse opossum (*M. murina*) (40) stood out, usage rates of 17.5 and 10 events per camera, respectively (Fig. 4).

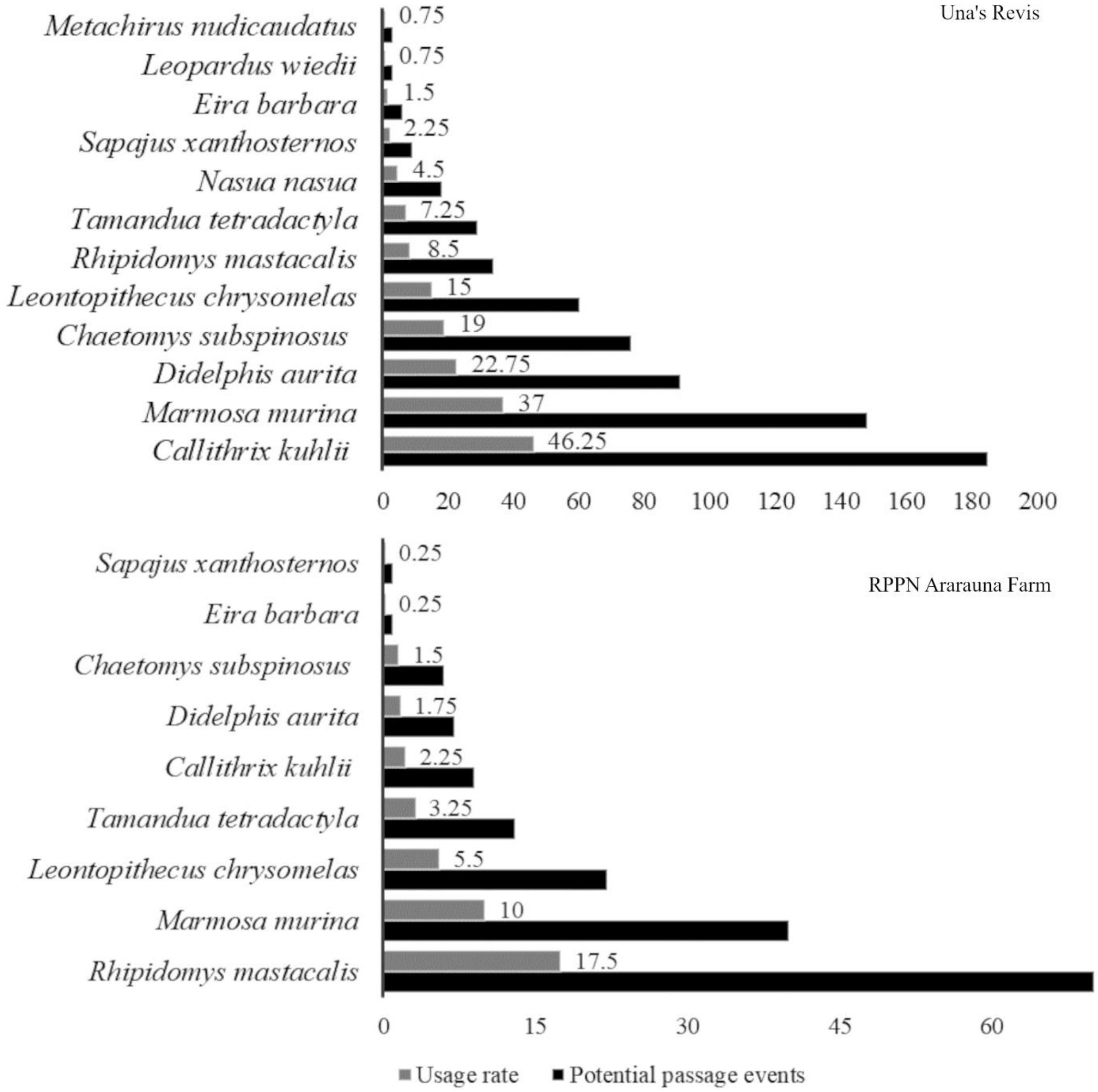


**Fig. 4** Use rate (events per camera) and potential crossing events for each species in the study areas, Una’s Revis (Maruim River) and RPPN Fazenda Araruna (Una River) in the municipality of Una, Bahia, Brazil. The use rate was calculated by dividing the total number of independent events for each species by the number of cameras operating in each study area

The circadian activity analyses revealed differences in activity patterns among species, with higher activity during the nighttime. Diurnally active, Wied's marmoset (*C. kuhlii*) had activity concentrated between 6:00 a.m. and 5:00 p.m. Similarly, Golden-headed lion tamarin (*L. chrysomelas*) (5:00 a.m. to 4:45 p.m.) and South American coati (*N. nasua*) (6:00 a.m. to 4:00 p.m.) were predominantly active during the day, although South American coati (*N. nasua*) registered a single event at 1:39 a.m. In contrast, species such as Bristle-spined rat (*C. subspinosus*), Brazilian common opossum (*D. aurita*), Linnaeus's mouse opossum (*M. murina*), *R. mastacalis*, and Southern tamandua (*T. tetradactyla*) exhibited nocturnal patterns. *C. subspinosus* and *D. aurita* concentrated their activities between 5:30 p.m. and 4:00 a.m., while *M. murina* and *R. mastacalis* were active between 5:45 p.m. and 4:00 a.m. *T. tetradactyla* was most active between 6:50 p.m. and 5:00 a.m. (Fig. 5; Supplementary Material Table 3).

None of the predictor variables showed a significant relationship with richness (Supplementary Material Table 4). However, significant relationships were observed between all predictors and abundance (Table 4). Tree diameter at breast height (DBH) had a positive effect on abundance, indicating that species abundance increased as DBH increased ($F = 89.13$, $p < 0.001$) (Table 4, Fig. 6). In contrast, river width ($F = 86.17$, $p < 0.001$) and connection points ($F = 163.71$, $p < 0.001$) had negative effects on abundance, with species abundance increasing as river width and the connection points decreased (Table 4, Fig. 6).

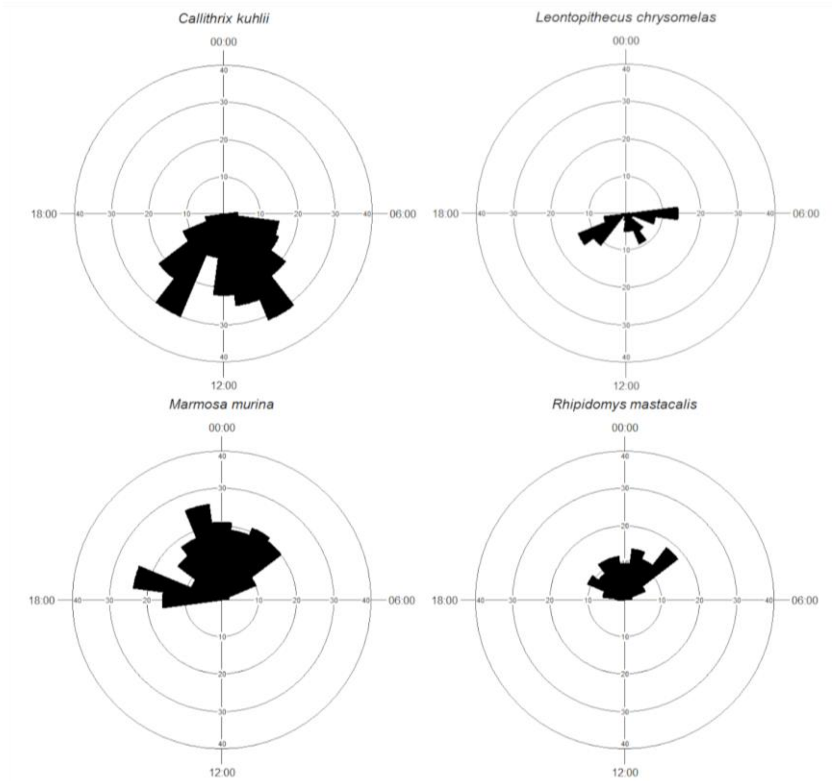


**Fig. 5** Activity patterns of arboreal and/or scansorial mammals in the canopy. The bars represent the proportion of records (%) obtained at each hour of the day. The time format is in 24-hour notation

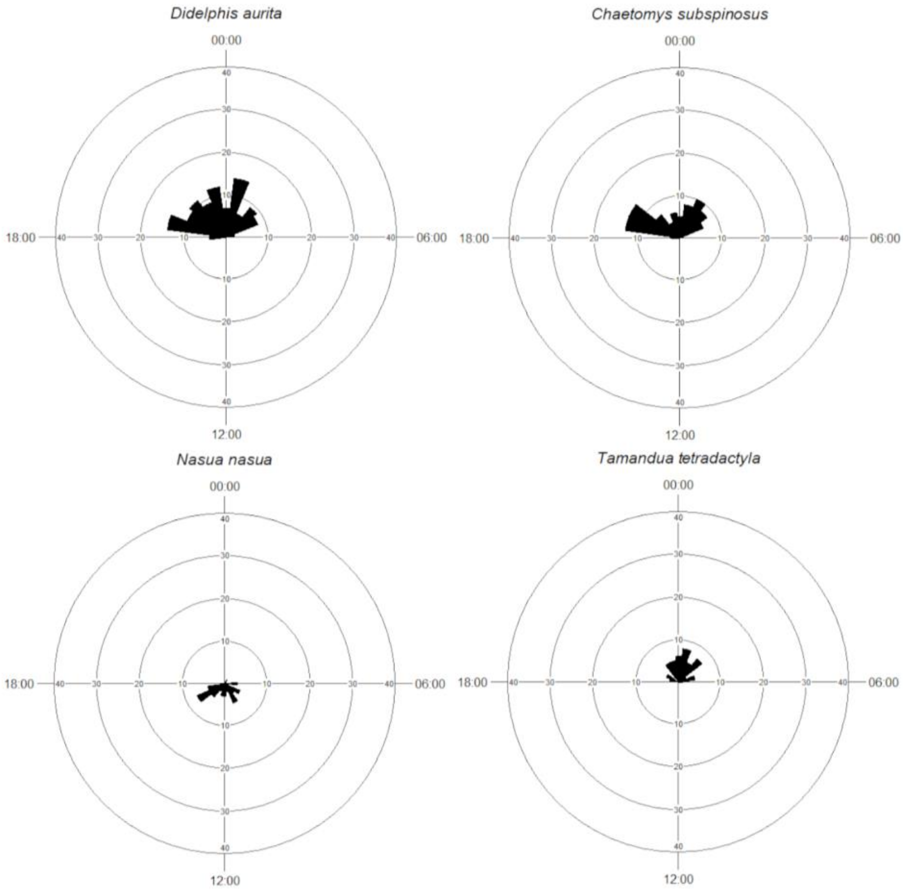


**Fig. 5** (Continued)

**Table 4** Coefficients of the best GAMM model for relative abundance

| Response variable | Preditor | Intercept | | Smooth term | | |
|---|---|---|---|---|---|---|
| | | Value (SE) | *p value* | edf | F | *p value* |
| Abundance | DBH | -1.702 (0.441) | <0.05* | 1.646 | 89.13 | <0.01** |
| | River Widht | | | 1 | 86.17 | <0.01** |
| | Connection Points | | | 1 | 163.71 | <0.01** |

The table presents estimates, standard errors, and p-values for the intercept. Smoothed terms for predictor variables include degrees of freedom (edf), F-value, and significance (*p*). Significant variables in the model are indicated by: ***$p$ <0.001, **$p$<0.01, *$p$<0.05

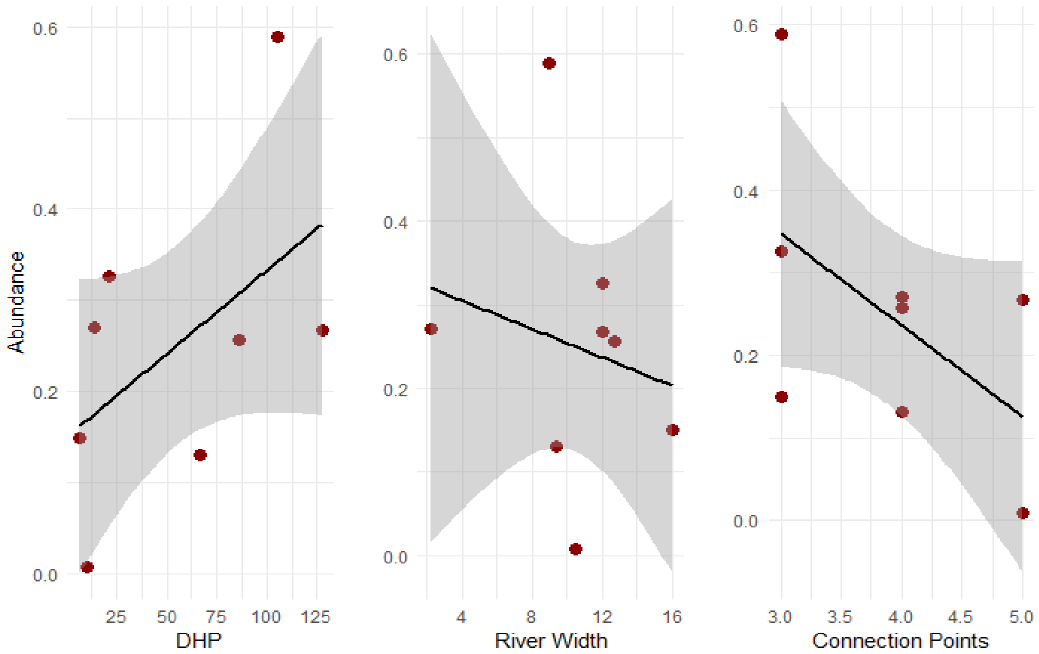


**Fig. 6** Effect of tree physical descriptors and river width on species relative abundance models

## Discussion

This study assessed the use of natural canopy bridges by arboreal mammals along riverbanks in the Atlantic Forest, providing new insights into the patterns of use of these structures. For the first time in the region, we recorded the continuous use of these bridges by several species, including regionally threatened species such as Bristle-spined Rat (*Chaetomys subspinosus*), Golden-headed lion tamarin (*Leontopithecus chrysomelas*), Buff-headed capuchin (*Sapajus xanthosternos*) and Margay (*Leopardus wiedii*). Circadian activity analyses revealed that most species used the bridges predominantly during the nighttime, with activities concentrated between 5:30 p.m. and 5:00 a.m. Our results partially support our hypothesis that natural canopy bridges facilitate connectivity between riverbanks for arboreal mammals, promoting their movement and distribution in geographically isolated areas. However, we identified variations in bridge use across species and sites. Although we did not find a significant relationship between the analyzed predictors and species richness, significant associations with relative abundance underscore the importance of specific physical descriptors of the bridges.

We observed a significant discrepancy in individual abundance between the studied areas. In the RPPN Fazenda Ararauna, 154 individuals were recorded, representing only 16.7% of the total individuals registered in the Una's Revis (923 individuals). Although both areas share a partially overlapping species composition, the landscape matrix surrounding the RPPN Fazenda Ararauna, composed of organic agriculture and other rural properties, may negatively impact the persistence of mammals, birds, and other organisms (Mazerolle and Villard 1999; Galetti et al. 2021). In the Brazilian Atlantic Forest, mammal diversity and abundance are influenced by factors such as altitude, precipitation, and forest productivity, but hunting pressure and fragment size are the primary determinants (Galetti et al. 2009). The Una's Revis, acting as a buffer zone for the Una's ReBio (Sollberg et al. 2014), presents greater forest cover and better conservation conditions, which may explain the observed differences.

Among the recorded species, Wied's marmoset (*C. kuhlii*) showed the highest bridge usage rate. This species, endemic to the Atlantic Forest and restricted to southern Bahia and northeastern Minas Gerais (Oliveira et al. 2017), is classified as vulnerable by the IUCN. According to Guy et al. (2016), the Una Wildlife Refuge provides a large amount of suitable habitat for Wied's marmoset, which may explain its high abundance in the area. This species, like other species of the *Callithrix* genus, exhibits a remarkable ability to adapt to marginal habitats, including forest fragments, urban parks, and squares (Ruiz-Miranda et al. 2006; Rodrigues and Martinez 2014). Small mammals, such as the marsupial Linnaeus's mouse opossum (*Marmosa murina*) and the rodent *Rhipidomys mastacalis*, also stood out in their use of the bridges. In a previous study, Buss (2022) recorded the use of artificial bridges by *M. murina*.

We observed a predominantly nocturnal activity pattern among arboreal mammals, consistent with other studies (Azcarraga et al. 2020; Gregory et al. 2022). An isolated nocturnal activity event was recorded for South American coati (*Nasua nasua*), a typically diurnal species (Barreto et al. 2024). We expected to observe interactions between Golden-headed lion tamarin (*L. chrysomelas*) and Wied's marmoset (*C. kuhlii*), especially considering that both species exhibit activity peaks during similar periods (between 6:00 a.m. and 5:00 p.m.) and have been reported interacting in different habitats (Rylands 1989; Raboy 2002; Oliveira and Dietz 2011; Oliveira et al. 2017). Although no direct interactions were recorded, the temporal proximity of the records suggests a possible association, potentially related to foraging benefits in native forests (Raboy 2002; Oliveira et al. 2017). We recorded Margay (*Leopardus wiedii*), one of the small Neotropical felid species that most frequently use the arboreal stratum, as also documented in a previous study by Azcarraga et al. (2020) in natural canopy bridges.

Although the physical predictors of the trees did not significantly affect species richness, diameter at breast height (DBH) positively influenced relative abundance, indicating that larger trees offer more resources and connectivity (Loretto and Vieira 2011). In contrast, river width had a negative effect on relative abundance, as wider rivers hinder the formation of natural bridges, limiting the crossing of some species. A similar pattern was observed for the number of connection points between branches; however, we expected a higher number of individuals as the number of connected branches increased. Previous studies have shown that bridges are used more frequently and by a greater variety of species when they are connected to multiple points, facilitating access for both jumping animals and those that rely on adjacent forest connections and canopy cover to minimize predator exposure (Gregory et al. 2017). However, aware of our methodological limitations, we recognize that using only one camera per bridge may have underestimated the actual use of these structures. Additionally, the presence of thinner branches in some tree species may have made these bridges unsuitable for heavier or non-jumping species, which may have contributed to a lower abundance of individuals as the number of connected branches increased.

In this study, the detection rate was notably low, with only Wied's marmoset (*C. kuhlii*) exhibiting a 2.29% of detection rate, a result consistent with findings by Azcarraga et al. (2020). Several methodological factors likely contributed to this low detection rate. The placement of camera traps in the canopy was constrained to scalable locations, limiting the maximum camera height to 10.3 meters. This restriction may have reduced the likelihood of detecting species that utilize different vertical strata of the forest (Bowler et al. 2017). Furthermore, in terrestrial surveys, variability in camera angle and vegetation density has been shown to affect detection probability (Meek et al. 2014), and this effect is amplified in the canopy due to the structural complexity of tree crowns.

Tree crowns exhibit significant heterogeneity, characterized by variations in branch size, curvature, and angle, as well as the presence of epiphytes and vines (Bowler et al. 2017).

This structural diversity may lead mammals to prefer specific trees, meaning that the optimal positioning of cameras may vary depending on the species. Additionally, the study recorded a high occurrence of “false triggers,” with 77.77% of the total records (20,285 photos and videos) lacking animal presence. These false triggers often result from branch movement or displacement of cameras by animals, which can deplete battery life and memory card capacity (Bowler et al. 2017; Gregory et al. 2017). Environmental factors such as high humidity and damage from ants and termites also undermined camera functionality (Gregory et al. 2017).

These methodological challenges underscore the importance of understanding the ecological context of riparian forests, which are often designated as Permanent Preservation Areas (APP) under Brazilian law (Brasil 2012). Protected from deforestation, riparian forests play a critical role in maintaining freshwater quality and buffering ecosystems from anthropogenic pressures (Valle Junior et al. 2015; Santos et al. 2015; Angelstam and Lazdinis 2017; Li et al. 2018; Valera et al. 2019). Their proximity to watercourses provides natural movement corridors for animals (Ranzi 2000) and fosters habitat heterogeneity, which is essential for supporting high species diversity (MacArthur and MacArthur 1961; Pianka 1966). The structural complexity of riparian areas, much like the heterogeneity of tree crowns, contributes to the creation of diverse microhabitats that benefit both flora and fauna (Salo et al. 1986; Suazo-Ortuño et al. 2011; Ramos Pereira et al. 2013).

Within this context, natural bridges provide a substrate and structure requiring minimal habituation by arboreal mammals (Gregory et al. 2017). Our findings reinforce the value of natural bridges in maintaining canopy connectivity in tropical forest reserves and other fragmented landscapes, such as road-crossing points. Their low implementation cost, when well-planned, makes them an effective tool for conservation. However, the establishment of natural bridges may take decades (Lindshield 2016), highlighting the potential role of artificial bridges as a viable short-term alternative. While artificial bridges may incur higher costs depending on the materials used (Balbuena 2019), they can provide immediate connectivity, addressing the urgent needs of arboreal species in fragmented habitats.

## Conclusions

Natural canopy bridges play a crucial role in maintaining habitat connectivity for arboreal mammals in riparian forest areas of the Atlantic Forest. The influence of physical descriptors of trees, as well as river width, underscores the importance of the structural connectivity provided by these bridges, facilitating the movement of mammals across geographically separated areas and being essential for ecological processes such as dispersal, foraging, and gene flow. Our results also suggest that areas with greater forest cover and better conservation status provide more resources and connectivity for arboreal species, highlighting the critical importance of conserving riparian forest, especially in regions where anthropogenic pressures threaten natural connectivity. We present information on the temporal activity patterns of arboreal mammals, contributing to the understanding of natural canopy bridge use. Thus, we believe that these data can serve as a valuable foundation for predicting the use of artificial bridges not only in riparian forests but also in anthropized areas. Since natural bridges show higher nocturnal than diurnal activity for arboreal mammals, we recommend that future studies consider both diurnal and nocturnal fauna. Finally, we believe that efforts to conserve and restore riparian corridors in the Atlantic Forest should be intensified, prioritizing the preservation of large, well-connected trees that can function as natural canopy bridges. In this way, these trees can serve as a refuge for various species, as riparian forests provide a safer habitat option, reducing the need for risky crossings, such as road crossings, which increase the risk of roadkill. The maintenance and planning of natural or artificial bridges should be considered in conservation projects, especially in regions with a high degree of fragmentation.

**Acknowledgements** We would like to thank Patrick Rodrigues, Bruno Fontes, Sumaya Freire, and Breno Matos for their assistance during the fieldwork. We are grateful to Maíra Benchimol and Laura Torezan for their suggestions in the development of the project. We also thank Larissa Rocha for her help in the identification of the trees. We appreciate Wesley da Rocha for his services as a climber and for allowing us to conduct the study on his property. We are also thankful to the members of the Applied Ecology & Conservation Laboratory for their scientific contributions. Additionally, we appreciate the valuable support from PROPP (073.6764.2021.0003010-94).

**Author contributions** Conceptualization: S. G. Santos and R. S. Bovendorp; methodology, S. G. Santos and R. S. Bovendorp; formal analysis, S. G. Santos and J. C. Pires-Oliveira; investigation, S. G. Santos; resources, R. S. Bovendorp; data curation, S. G. Santos; writing-original draft preparation, S. G. Santos; writing-review and editing, J. C. Pires-Oliveira and R. S. Bovendorp; visualization, S. G. Santos; supervision, R. S. Bovendorp; project administration, S. G. Santos and R. S. Bovendorp; funding acquisition, R. S. Bovendorp. All authors have read and agree to the publication of the manuscript.

**Funding** This research was funded by the Programa de Apoio à Pós-Graduação (SEI: 073.6764.2021.0003010-94) - Postgraduate Program in Ecology and Biodiversity Conservation (PPGECB) of the State University of Santa Cruz (UESC). The CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) scholarship was awarded to SGS. Logistical support during fieldwork and the provision of camera traps were provided by the Applied Ecology & Conservation Laboratory of UESC.

**Data availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Declarations**

**Competing interests** The authors declare no competing interests.

**Supplementary Material**

**Table 1** Set of models tested for species richness

| Model | Model Structure |
|---|---|
| mod0 | Richness ~ Null Model |
| mod1 | Richness ~ s(DBH) + s(River Width) + s(Connection Points) + s(Area, bs = "re") |
| mod2 | Richness ~ s(Connection Points) + s(Area, bs = "re") |
| mod3 | Richness ~ s(DBH) + s(Area, bs = "re") |
| mod4 | Richness ~ s(River Width) + s(Connection Points) + s(Area, bs = "re") |
| mod5 | Richness ~ s(DBH) + s(River Width) + s(Area, bs = "re") |
| mod6 | Richness ~ s(DBH) + s(Connection Points) + s(Area, bs = "re") |

**Table 2** Set of models tested for relative abundance

| Model | Model Structure |
|---|---|
| mod0 | Abundance ~ Null Model |
| mod1 | Abundance ~ s(DBH) + s(River Width) + s(Connection Points) + s(Area, bs = "re") |
| mod3 | Abundance ~ s(Connection Points) + s(Area, bs = "re") |

**Table 3**. Statistical parameters of activity patterns for arboreal and/or scansorial mammals

| Variables | *Marmosa murina* | *Rhipidomys mastacalis* | *Callithrix kuhlii* | *Leontopithecus chrysomelas* | *Chaetomys subspinosus* | *Tamandua tetradactyla* | *Didelphis aurita* | *Nasua nasua* |
|---|---|---|---|---|---|---|---|---|
| Observations (n) | 201 | 114 | 215 | 84 | 82 | 48 | 106 | 43 |
| Mean Vector ($\alpha$) | 23:07 (346,823°) | 23:52 (358,036°) | 11:29 (172,391°) | 11:23 (170,855°) | 22:51 (342,881°) | 00:44 (11,08°) | 23:01 (345,424°) | 12:24 (186,18°) |
| Length of mean vector (r) | 0,715 | 0,759 | 0,745 | 0,529 | 0,68 | 0,779 | 0,716 | 0,578 |
| Circular Standard Deviation (SD) | 03:07 (46,929°) | 02:50 (42,579°) | 02:55 (43,948°) | 04:18 (64,692°) | 03:21 (50,3°) | 02:42 (40,544°) | 03:07 (46,882°) | 03:59 (59,982°) |
| Rayleigh Test ($z$) | 102,764 | 65,623 | 119,377 | 23,476 | 37,94 | 29,092 | 54,267 | 14,372 |
| Rayleigh test of uniformity ($p$) | < 1e-12 | < 1e-12 | < 1e-12 | 6,37E-11 | < 1e-12 | < 1e-12 | < 1e-12 | 1,80E-07 |

For each species, we have the number of observations (n), the mean activity vector ($\alpha$), the length of the mean vector (r), the circular standard deviation (SD), the Rayleigh test value, and the $p$ value for the Rayleigh uniformity test. The $p$ values indicate whether the activity patterns differ from a uniform distribution over 24 hours.

**Table 4** Coefficients of the best GAMM model for richeness

| Response variable | Preditor | Intercept | | Smooth term | | |
|---|---|---|---|---|---|---|
| | | Value (SE) | *p value* | edf | F | *p value* |
| Richeness | DBH | 1.9083 (0.1469) | <0.025* | 1 | 176 | 696 |
| | River Widht | | | 1 | 1.666 | 266 |
| | Connection Points | | | 1 | 578 | 490 |

The table presents estimates, standard errors, and p-values for the intercept. Smoothed terms for predictor variables include degrees of freedom (edf), F-value, and significance (*p*). Significant variables in the model are indicated by: ****p* <0.001, ***p*<0.01, **p*<0.05

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## CONCLUSÃO GERAL

Podemos observar que as pontes de dossel naturais desempenham um papel fundamental na manutenção da conectividade de habitat para mamíferos estritamente arborícolas e escansoriais em áreas de florestas ripárias da Mata Atlântica. Os descritores físicos das árvores, como o diâmetro à altura do peito (DAP) e o número de pontos de conexão, juntamente com a largura do rio, influenciam significativamente a abundância de espécies que utilizam essas estruturas. Esses resultados reforçam a importância da conectividade estrutural proporcionada pelas pontes de dossel naturais na viabilização do movimento da fauna em áreas isoladas, sendo essencial para processos ecológicos como dispersão, forrageamento e fluxo gênico.

A diferença na abundância de indivíduos entre as áreas estudadas evidencia a influência da matriz da paisagem. A maior cobertura florestal na Revis de Una, próxima ao Rio Maruim, contribuiu para uma maior abundância e diversidade de espécies em comparação com a RPPN Fazenda Ararauna, onde a paisagem adjacente consiste em propriedades rurais. Esses resultados sugerem que áreas com maior cobertura florestal e melhor estado de conservação oferecem mais recursos e conectividade para as espécies arborícolas.

Fornecemos informações sobre padrões temporais de atividade para mamíferos arborícolas, confirmando tendências previamente descritas para as espécies registradas. Os padrões de atividade que observamos nessas pontes não são limitados por possíveis vieses no uso por mamíferos arborícolas, que podem ocorrer em pontes artificiais. Dessa forma, acreditamos que esses dados podem informar expectativas de uso de pontes artificiais não somente em florestas ripárias, mas também em áreas antropizadas, mitigando os impactos de infraestruturas lineares. Como as pontes naturais apresentam maior atividade noturna do que diurna por mamíferos arborícolas, é recomendado que estudos futuros deem atenção não apenas à fauna diurna, mas também à noturna.

Por fim, acreditamos que os esforços para conservar e restaurar corredores ripários na Mata Atlântica devem ser intensificados, priorizando a preservação de árvores grandes e bem conectadas que possam atuar como pontes naturais de dossel. Dessa forma, essas árvores podem servir de refúgio para diversas espécies, uma vez que as florestas ripárias oferecem uma opção mais segura de habitat, reduzindo a necessidade de travessias arriscadas, como o cruzamento de estradas, que aumenta o risco de atropelamento. A manutenção e o planejamento de pontes naturais ou artificiais devem ser consideradas em projetos de conservação, especialmente em regiões com alto grau de fragmentação. Através desses esforços, será possível preservar a biodiversidade de florestas tropicais, garantindo a continuidade das funções ecossistêmicas desempenhadas pelos mamíferos arborícolas.