Fundación Miguel Lillo
Tucumán
Argentina

Mycophagous behavior by small mammals observed through camera traps in a riparian forest fragment in Southwestern São Paulo, Brazil

Comportamiento micofágico de pequeños mamíferos observado mediante cámaras trampa en un fragmento de bosque ribereño en el suroeste de São Paulo, Brasil

Baltazar, Juliano M.*; Thiago Ghiraldini Caetano; Larissa Trierveiler-Pereira

[1] Laboratório de Estudos Micológicos (LEMic-UFSCar), Centro de Ciências da Natureza, Universidade Federal de São Carlos, Rod. Lauri Simões de Barros, Km 12, Aracaçu, 18290-000 Buri, SP, Brazil.

* Corresponding author: <baltazar@ufscar.br>; R. Serafim Libaneo, 04, Centro, CEP: 18245-970, CP 64, Campina do Monte Alegre, SP, Brazil.

Abstract

Macrofungi play a crucial role in forest ecosystems by decomposing organic matter and influencing nutrient dynamics. They are characterized by the production of visible reproductive structures known as sporomes, commonly referred to as mushrooms, bracket fungi, among others. Macrofungi of various species are recognized as an important food resource for many animals. However, knowledge regarding the interactions between these fungi and native small mammals in the wild remains limited in Brazil. This study aimed to investigate the consumption of macrofungi by vertebrates in a riparian forest fragment along the Itapetininga River, in the southwestern region of São Paulo State, using camera traps. This study aimed to identify the vertebrate species that feed on macrofungi and to assess the efficacy of camera traps for this purpose. The images from the camera traps recorded the consumption of the coconut mushroom (*Oudemansiella cubensis*) by the white-eared opossum (*Didelphis albiventris*) and the Brazilian squirrel (*Guerlinguetus brasiliensis*). For the first time, this mycophagous behav-

➤ Ref. bibliográfica: Baltazar, J. M.; Caetano, T. G.; Trierveiler-Pereira, L. 2025. Mycophagous behavior by small mammals observed through camera traps in a riparian forest fragment in Southwestern São Paulo, Brazil. *Lilloa 62* – Suplemento N° 2: "Interacciones biológicas en un mundo cambiante": 247-262. doi: https://doi.org/10.30550/j.lil/2158
➤ Recibido: 31 de marzo 2025 – Aceptado: 21 de mayo 2025 – Publicado: 27 de junio 2025.
➤ URL de la revista: http://lilloa.lillo.org.ar

ior is recorded for the white-eared opossum. This study also confirmed the effectiveness of camera traps as a non-invasive tool for monitoring fauna and their interactions in ethological research. Furthermore, the data generated contribute to a deeper understanding of the ecological dynamics between fauna and fungi in the Neotropics.

Keywords: Agaricales; ecological interactions; mushrooms; mycophagy; small mammals.

Resumen

Los macrohongos desempeñan un papel crucial en los ecosistemas forestales al descomponer la materia orgánica e influir en la dinámica de los nutrientes. Se caracterizan por la producción de estructuras reproductivas visibles conocidas como esporomas, comúnmente denominadas setas, hongos de repisa, entre otros. Los macrohongos de diversas especies son reconocidos como un recurso alimenticio importante para muchos animales. Sin embargo, el conocimiento sobre la interacción entre estos hongos y pequeños mamíferos nativos en estado silvestre sigue siendo limitado en Brasil. Este estudio tuvo como objetivo investigar el consumo de macrohongos por vertebrados en un fragmento de bosque ribereño a lo largo del río Itapetininga, en la región suroeste del estado de São Paulo, mediante el uso de cámaras trampa. El estudio buscó identificar qué especies de vertebrados se alimentan de macrohongos y evaluar la eficacia de las cámaras trampa con este fin. Las imágenes obtenidas registraron el consumo del hongo *Oudemansiella cubensis* por parte de la comadreja overa (*Didelphis albiventris*) y la ardilla brasileña (*Guerlinguetus brasiliensis*). Por primera vez, se registra este comportamiento micófago en la comadreja overa. El estudio también corroboró la eficacia de las cámaras trampa como herramienta para el monitoreo no invasivo de la fauna y sus interacciones en investigaciones etológicas. Además, los datos generados contribuyen a una comprensión más profunda de las dinámicas ecológicas entre la fauna y los hongos en el Neotrópico.

Palabras clave: Agaricales; interaciones ecológicas; micofagia; pequeños mamíferos; setas.

INTRODUCTION

Fungi play a crucial role in terrestrial ecosystems by decomposing organic matter, thereby contributing significantly to nutrient cycling and the maintenance of life on Earth (Webster & Weber, 2007). In addition to these ecosystem services, several studies have demonstrated that fungi serve as an important nutrient source for various animal species (Fogel & Trappe, 1978; Wheeler & Blackwell, 1984; Elliott & Vernes, 2021; Elliott *et al*., 2019a, b, 2022; Santamaria *et al*., 2023).

The term mycophagous refers to animals that incorporate fungi into their diet (Merritt, 2010). Mycophagy, defined as the consumption of fungi, has been documented in a wide range of animal groups, including invertebrates, birds, mammals, and reptiles. This behavior is ecologically relevant not only for the animals that consume fungi as a food resource but also for the fungi themselves, as ingestion by animals can aid in spore dispersal and influence various ecological processes, including ecological succession (Trappe *et al.*, 2009; Schickmann *et al.*, 2012; Trierveiler-Pereira *et al.*, 2016, 2024).

Fungal consumption by mammals in Brazil has been scarcely documented in literature. Peres (1993) reported the consumption of bracket fungi (Polyporaceae) by tamarins of the genus *Saguinus* Hoffmannsegg, 1807 in the Amazon. Later, Bordignon & Monteiro-Filho (1999) observed that mushrooms — identified only as fungi (Basidiomycota) — were consumed by the Brazilian squirrel [*Guerlinguetus brasiliensis* (Gmelin, 1788)], in secondary Araucaria forests, particularly during winter and spring. Correa *et al.* (2000) found that fungal consumption accounted for up to 19% of the foraging time of *Callithrix aurita* (É. Geoffroy, 1812), but the fungal species was not identified. Lopes & Rehg (2003) reported the consumption of *Auricularia* sp. by *Callimico goeldii* (O. Thomas, 1904) in the Amazon Rainforest of southeastern Acre. Vieira *et al.* (2006), analyzing fecal samples from three rodent species in Araucaria forests, concluded that fungi constitute an important component of their diet. Trierveiler-Pereira *et al.* (2016) reported the consumption of *Ascopolyporus* sp. by black-capped squirrel monkey (*Saimiri boliviensis* I. Geoffroy & Blainville, 1834) in the Amazon, as well as the ingestion of phalloid fungi (*Itajahya galericulata* Möller) by Azara's agouti (*Dasyprocta azarae* Lichtenstein, 1823) in Santa Catarina (Southern Brazil). Hilário and Ferrari (2010) observed that fungi accounted for 64.8% of all feeding records for the buff-headed marmoset (*Callithrix flaviceps* Thomas, 1903) in Augusto Ruschi Biological Reserve (Espirito Santo, Southeastern Brazil) during their study period, particularly two species of the genus *Mycocitrus* (Ascomycota). More recently, Simionatto *et al.* (2024) documented mushroom consumption (identified as Basidiomycota) by *Mazama rufa* (Illiger, 1815) in Iguaçu National Park (Paraná, southern Brazil), and Trierveiler-Pereira *et al*. (2024) reported the consumption of the coconut mushroom [*Oudemansiella cubensis* (Berk. & M.A. Curtis) R.H. Petersen] by the Brazilian squirrel (*G. brasiliensis*) on Ilhabela, an island off the Atlantic coast of São Paulo, Brazil.

Seeking to better understand mycophagy among Neotropical mammals, the present study investigated the occurrence of fungal consumption in the southwestern region of São Paulo (Brazil), with a particular focus on small mammals. Additionally, it evaluated the effectiveness of camera traps as a methodological tool for documenting and analyzing mycophagous behavior in natural environments.

MATERIAL AND METHODS

Study area

The study was conducted in a riparian forest fragment along the Itapetininga River in the municipality of Campina do Monte Alegre, located in the Southwestern São Paulo (Fig. 1). This region is characterized by the presence of both Atlantic Forest and Cerrado phytophysiognomies, making it an ecotone area, in addition to containing areas of livestock farming, agriculture, and forestry. The climate is classified as subtropical, categorized as Cfa according to the Köppen-Geiger classification system (Peel *et al.*, 2007). The Itapetininga River is part of the Alto Paranapanema River basin, a region where approximately one-fifth of the territory is covered by native vegetation and which possesses significant water resources (CBH-ALPA, 2018). Preliminary field visits were conducted to know the area, and two locations were selected for the installation of camera traps, here defined as: point 1 (23° 35' 58.5" S, 48° 28' 34.0" W) and point 2 (23° 35' 58.4" S, 48° 28' 32.7" W). These locations were chosen due to the presence of large decomposing logs containing a considerable number of mushroom specimens and potential evidence of mycophagy (Fig. 2).

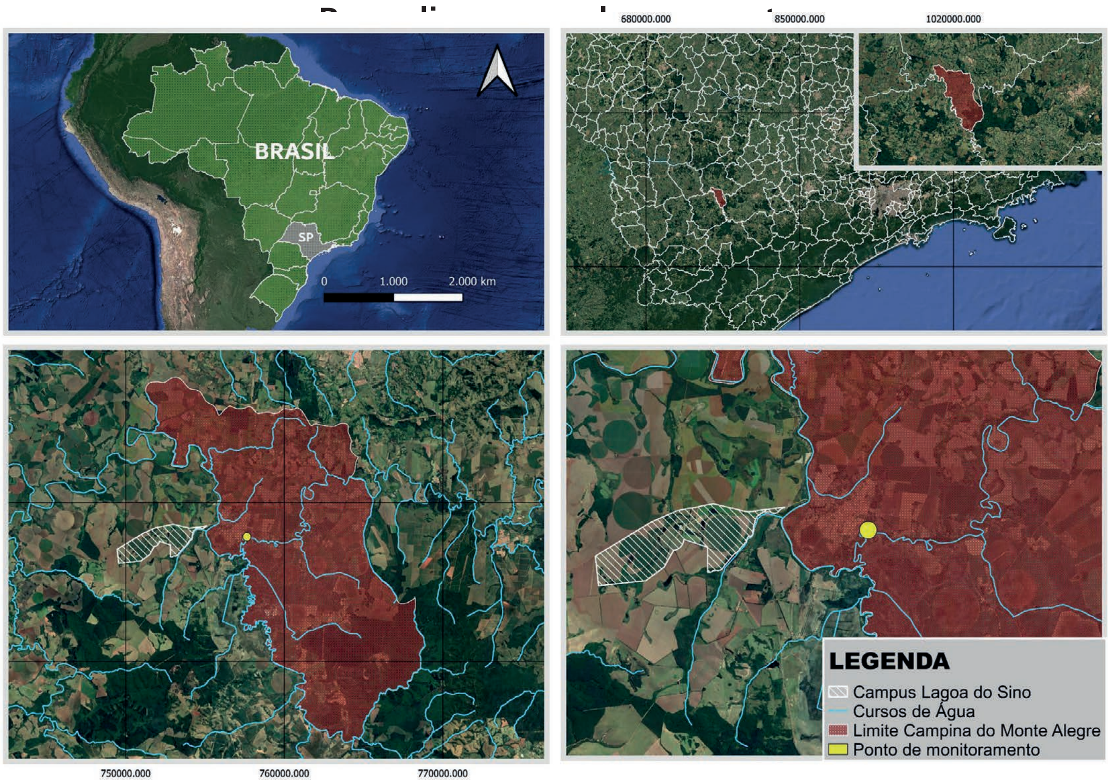

Fig. 1. Maps showing the study area in the municipality of Campina do Monte Alegre, State of São Paulo, Brazil.

Fig. 1. Mapas que muestran el área de estudio en el municipio de Campina do Monte Alegre, Estado de São Paulo, Brasil.

Fig. 2. Coconut mushroom (*Oudemansiella cubensis*) in the study area. A. Basidiomes on a decaying log *in situ*. B. Basidiomes showing signs of mycophagy.

Fig. 2. El hongo *Oudemansiella cubensis* en el área de estudio. A. Basidiomas sobre un tronco en descomposición *in situ*. B. Basidiomas con indicios de micofagia.

Two camera traps (Bushnell Trophy Cam) were installed in two points in the study area from October 2021 to April 2023. The camera traps were installed facing large fallen logs where researchers had previously observed the recurring and spontaneous emergence of mushrooms, primarily from the genera *Oudemansiella* and *Auricularia*. These devices were configured to capture images and record videos of up to 30 seconds. The camera traps were checked at intervals of no more than 30 days, during which images were copied, batteries were replaced, and the equipment was inspected for proper functionality. The total sampling effort amounted to 16,128 hours, with point 1 accounting for 12,936 hours from October 2021 to April 2023. Meanwhile, point 2 was monitored for a total of 3,192 hours, from October 2021 until its removal in February 2022. The difference in sampling effort between the two locations was due to the availability of camera trap equipment.

Collection and identification of mushrooms

Basidiomes were collected to confirm species identity following the standard methodology for macrofungi analysis (Vargas-Isla *et al.*, 2014). Specimens were carefully collected from the substrate using a pocketknife and subsequently analyzed macroscopically and microscopically. Microscopic analysis included the examination of fungal microstructures such as basidia, basidiospores, cystidia, and hyphae, among other essential elements for species identification and classification. The specimens were then dehydrated using a food dehydrator set to a temperature below 40°C to preserve structural integrity and prevent damage to the fungus (Wu *et al.*, 2004). Species identification followed the description proposed by Meijer (2008). Dried specimens are kept at the Fungal Collection of Herbarium SPSC (Federal University of São Carlos, Brazil).

Identification of recorded animal species

Animal species identification was based on literature (Patton *et al.*, 2015; Graipel *et al.*, 2017, Verdade, 2018) and confirmed, when needed, by specialists. The study was conducted solely using images captured by camera traps, and no animals were captured or handled during this research.

Data analysis

The collected data were analyzed qualitatively to document and observe all relevant information for the study. After reviewing the equipment and copying image files, images of interest were selected while discarding those without relevant content.

A spreadsheet was created to document data on recorded animal species, including their scientific and common names, the date and time of capture (daytime, nighttime, or both), and whether interactions with fungi were observed (Table 1).

RESULTS AND DISCUSSION

Animals and fungi recorded during the study

A total of 301 animal records were obtained, with 253 from point 1 and 48 from point 2. Forty species of animals were recorded, representing three major groups: birds (25 species), mammals (14 species), and reptiles (one species). Five species could not be identified at species level, including four birds and one mammal (rodent). All species are listed in Table 1. The most frequently recorded groups were birds and mammals, with the most commonly observed species being the white-eared opossum (*Didelphis albiventris* Lund, 1840) with 76 records, the pale-breasted thrush (*Turdus leucomelas* Vieillot, 1818) with 42 records, the white-tipped dove (*Leptotila verreauxi* Bonaparte, 1855) with 33 records, the domestic cat (*Felis silvestris catus* Linnaeus, 1758) with 26 records, the rufous-bellied thrush (*Turdus rufiventris* Vieillot, 1818) with 22 records, and the South American coati (*Nasua nasua* Linnaeus, 1766) with 17 records.

Table 1. Animals recorded during the study, their activity periods, and their interactions with fungi.

Tabla 1. Animales registrados durante el estudio, sus períodos de actividad e interacciones con hongos.

Taxa / Sampling site	Animal species	Common name in English	Common name in Portuguese	Period of activity	Presence of mushrooms	Mushroom consumption
Birds						
1	*Athene cunicularia* (Molina, 1782)	Burrowing Owl	coruja-buraqueira	night	no	no
1	*Campephilus melanoleucos* (Gmelin, 1788)	Crimson-crested Woodpecker	pica-pau-de-topete-vermelho	day	no	no
1	*Campylorhamphus falcularius* (Vieillot, 1822)	Black-billed Scythebill	arapaçu-de-bico-torto	day	no	no
1	*Cathartes aura* (Linnaeus, 1758)	Turkey Vulture	urubu-de-cabeça-vermelha	day	no	no
1	*Celeus* cf. *flavescens* (Gmelin, 1788)	Blond-crested Woodpecker	pica-pau-de-cabeça-amarela	day	no	no
2	*Colaptes melanochloros* (Gmelin, 1788)	Green-barred Woodpecker	pica-pau-verde-barrado	day	no	no
1	*Coragyps atratus* (Bechstein, 1793)	Black Vulture	urubu-preto	day	no	no
1	*Coryphospingus cucullatus* (Statius Muller, 1776)	Red-crested Finch	tico-tico-rei	day	no	no
1 and 2	*Cyanocorax chrysops* (Vieillot, 1818)	Plush-crested Jay	gralha-picaça	day	no	no
1	*Furnarius rufus* (Gmelin, 1788)	Rufous Hornero	joão-de-barro	day	no	no
1 and 2	*Leptotila verreauxi* Bonaparte, 1855	White-tipped Dove	juriti-pupu	day	yes	no
1 and 2	*Mesembrinibis cayennensis* (Gmelin, 1789)	Green Ibis	coró-coró	day	no	no
1	unidentified bird 1	unknown	unknown	day	no	no
2	unidentified bird 2	unknown	unknown	day	no	no
1	unidentified bird 3	unknown	unknown	day	no	no
2	unidentified bird 4	unknown	unknown	day	no	no
1	*Penelope obscura* Temminck, 1815	Dusky-legged Guan	jacuguaçu	day	yes	no
1	*Pitangus sulphuratus* (Linnaeus, 1766)	Great Kiskadee	bem-te-vi	day	no	no
1	*Stilpnia cayana* (Linnaeus, 1766)	Burnished-buff Tanager	saíra-amarela	day	no	no
1	*Tigrisoma lineatum* (Boddaert, 1783)	Rufescent Tiger-Heron	socó-boi	day	no	no
1	*Turdus amaurochalinus* Cabanis, 1850	Creamy-bellied Thrush	sabiá-poca	day	no	no
1 and 2	*Turdus leucomelas* Vieillot, 1818	Pale-breasted Thrush	sabiá-barranco	day	yes	no
1 and 2	*Turdus rufiventris* Vieillot, 1818	Rufous-bellied Thrush	sabiá-laranjeira	day	yes	no
1	*Tyrannus melancholicus* Vieillot, 1819	Tropical Kingbird	suiriri	day	no	no
1	*Volatinia jacarina* (Linnaeus, 1766)	Blue-black Grassquit	tiziu	day	no	no
Mammals						
1	*Canis lupus familiaris* Linnaeus, 1758	Domestic dog	cachorro-doméstico	both	no	no
1	*Chrysocyon brachyurus* (Illiger, 1815)	Maned wolf	lobo-guará	night	no	no
1	*Dasypus* cf. *septemcinctus* Linnaeus, 1758	Seven-banded armadillo	tatuí	night	no	no
1 and 2	*Didelphis albiventris* P. W. Lund, 1840	White-eared opossum	gambá-de-orelha-branca	night	yes	yes
1 and 2	*Felis catus* Linnaeus, 1758	Domestic cat	gato-doméstico	night	yes	no
1 and 2	*Guerlinguetus brasiliensis* (Gmelin, 1788)	Brazilian squirrel	serelepe	day	yes	yes
1	*Leopardus guttulus* (Hensel, 1872)	Atlantic Forest oncilla	gato-do-mato-pequeno	night	no	no
1	*Lepus* cf. *europaeus* Pallas, 1778	European hare	lebre-europeia	night	no	no
1	*Lycalopex* cf. *vetula* (Lund, 1842)	Hoary fox	raposa-do-campo	night	no	no
1	*Myrmecophaga tridactyla* Linnaeus, 1758	Giant anteater	tamanduá-bandeira	night	no	no
1 and 2	*Nasua nasua* Linnaeus, 1766	South American coati	quati-de-cauda-anelada	day	no	no
1	unidentified rodent	unknown	unknown	night	no	no
1	*Sapajus* sp.	Capuchin monkey	macaco-prego	day	no	no
1	*Tamandua tetradactyla* (Linnaeus, 1758)	Southern tamandua	tamanduá-mirim	night	no	no
Reptiles						
1	*Salvator merianae* Duméril & Bibron, 1839	Black and white tegu	teiú	day	yes	no

The most frequently occurring fungal species in the study area was the coconut mushroom [*Oudemansiella cubensis* (Berk. & M.A. Curtis) R.H. Petersen], which was frequently present on the monitored logs. Another common fungal species in the monitored logs was the jelly fungi *Auricularia cornea* Ehrenb.

Of the 40 animal species recorded in this study, eight had occurrences coinciding with the presence of the coconut mushroom. Among these eight species, two were documented eating the mushroom *in situ*: the white-eared opossum (*D. albiventris*), a nocturnal animal, and the Brazilian squirrel (*G. brasiliensis*), a diurnal animal (Fig. 3 and 4). These findings highlight the potential ecological role of fungi as a food resource and suggest that fungal consumption by native Brazilian mammals may be more common than previously recognized.

Fig. 3. White-eared opossum (*Didelphis albiventris*) consuming the coconut mushroom (*Oudemansiella cubensis*).

Fig. 3. Comadreja overa (*Didelphis albiventris*) consumiendo el hongo *Oudemansiella cubensis*.

Fig. 4. Brazilian squirrel (*Guerlinguetus brasiliensis*) consuming the coconut mushroom (*Oudemansiella cubensis*).

Fig. 4. Ardilla brasilera (*Guerlinguetus brasiliensis*) consumiendo el hongo *Oudemansiella cubensis*.

Mycophagous behavior of the squirrel (*Guerlinguetus brasiliensis*)

The first recorded contact between the Brazilian squirrel and *Oudemansiella cubensis* occurred on November 7, 2021; however, mushroom consumption was not observed at that time. The second record was on August 14, 2022, when mushroom consumption was documented for the first time. In total, 15 records of *G. brasiliensis* were obtained, 14 at point 1 and one at point 2. In three of these 15 records, the squirrel was eating the mushroom. The frequency of these observations suggests that fungi might be an occasional but relevant food source for this species.

This is the third documented case of mycophagy by this squirrel species and the second involving the consumption of the coconut mushroom (*O. cubensis*) (Bordignon & Monteiro-Filho, 1999; Trierveiler-Pereira *et al.*, 2024). The latter authors recorded this mushroom being consumed by the squirrel in Ilhabela in 2019, an island on the coast of São Paulo, approximately 320 km from the present study area. These records emphasize the importance of fungi in the diet of *G. brasiliensis*, and their potential role in dispersing fungal spores. The consumption of fungi by squirrels of the family Sciuridae is well documented in the literature. In their comprehensive global review on mammalian mycophagy, Elliott *et al.* (2022) reported a total of 57 mycophagous squirrel species. Considering all Rodentia species, these authors documented fungal consumption in 220 species.

Mycophagous behavior of the white-eared opossum (*Didelphis albiventris*)

The first record of the white-eared opossum (*D. albiventris*) occurred on October 19, 2021, followed by a second record two days later, on October 21, 2021. Periodic visits were observed at different intervals, sometimes daily, weekly, or biweekly. Based on these observations, it is believed that the coconut mushroom (*O. cubensis*) serves as a consistent food resource for the white-eared opossum.

Throughout the study, 76 photographic records of the white-eared opossum were obtained, ten of which coincided with the presence of the mushroom. In nine of these instances, fungal consumption was observed, confirming mycophagy. The frequency and regularity of these observations suggest that fungi may play a more significant role in the diet of *D. albiventris* than previously thought. This is the first documented case of the white-eared opossum consuming mushrooms, contributing valuable knowledge to the ecological interactions of this species and reinforcing its omnivorous diet (Silva *et al.*, 2014). On the other hand, mycophagy is well documented for another species of the genus, the Virginia opossum (*Didelphis virginiana* Kerr, 1792), with at least six studies reporting this behavior. Additionally, two species of *Marmosops* Matschie, 1916, also belonging to the family Didelphidae, are known to be mycophagous. Across all Metatheria (= Marsupialia), mycophagy has been reported in 54 species, according to Elliott *et al.* (2022).

Other relevant observations

As stated above, the Brazilian squirrel and the white-eared opossum were the only two species recorded consuming the coconut mushroom. It is worth highlighting that these interactions occurred during distinct periods — all records of the Brazilian squirrel were made during the day, while all records of the white-eared opossum were made at night. Although these findings were expected, as these are the typical activity periods for each species, it is interesting to note that they can share the same food resource — the same mushroom species on the same log — by taking turns. Mycophagy among co-occurring vertebrates was also reported by Elliott and Vernes (2021), who observed eleven species consuming *Amanita* sp. mushrooms at the same time and location. Interestingly, that study also employed camera traps as a methodological tool.

During this study, the jelly fungus *Auricularia cornea* was recorded on the monitored logs but no evidence of mycophagy involving this fungus was observed. The genus *Auricularia* Bull. includes at least five species known to be consumed by various animal species, notably primates such as the golden bamboo lemur (*Hapalemur aureus* Meier, Albignac, Peyriéras, Rumpler, & P. Wright, 1987), Goeldi's monkey [*Callimico goeldii* (O. Thomas, 1904)], and the Japanese macaque (*Macaca fuscata* E. Blyth, 1875) (Hanson *et al*., 2003, 2006; Porter, 2001). Capuchin monkeys (*Sapajus* sp.) were recorded during the study; however, in all instances, the presence of fungi could not be confirmed. These findings suggest several possibilities: (1) jelly fungi may be consumed in other parts of the study area that were not monitored; (2) animals may exhibit specific food preferences within their habitat, potentially influenced by factors such as the availability of alternative resources; or (3) *Auricularia* species may not be part of their natural diet.

Another noteworthy observation was the frequent presence of different animals on a decomposing log at one of the monitored sites. As previously mentioned, certain species, such as the white-tipped dove (*Leptotila verreauxi* Bonaparte, 1855), pale-breasted thrush (*Turdus leucomelas* Vieillot, 1818), rufous-bellied thrush (*Turdus rufiventris* Vieillot, 1818), and South American coati (*Nasua nasua* Linnaeus, 1766), were frequently recorded. It is believed that these animals were attracted to the log in search of other food resources, such as various invertebrates present in the decomposing wood, as they are all omnivorous species. Costa *et al.* (2022) investigated the consumption of *Macrolepiota bonaerensis* (Speg.) Singer mushrooms by the shiny cowbird (*Molothrus bonariensis* Swainson, 1832), a passerine bird similar to the pale-breasted thrush and the rufous-bellied thrush. However, these species were not observed consuming mushrooms in the present study.

While this study provides important insights into mycophagy, it is necessary to acknowledge potential methodological biases. Camera traps are an effective non-invasive technique, but their use in mycophagy research appears to be relatively recent. According to the review by Elliott *et al.* (2022), the first study to employ this method was conducted by Vernes *et al.* (2014), and only five studies have used camera traps for this purpose. Prior to the present study, the only research in Brazil to apply this technique was that of Simionatto *et al.* (2024), who reported mushroom consumption by the red brocket deer (*Mazama rufa* Illiger, 1815). Despite the potential of camera traps for mycophagy studies, their use also presents limitations, such as a restricted field of view, potential misidentifications, and environmental factors — such as lighting conditions — that may affect image quality. Additionally, the mere presence of a camera trap could influence animal interactions with macrofungi. Future studies should incorporate complementary methods, including direct observation, fecal analysis for fungal spores, molecular sequencing techniques to detect fungal DNA in animal feces, and controlled experiments such as cafeteria trials, to achieve a more comprehensive understanding of fungal consumption by animals. These additional approaches could help determine whether fungi serve as an occasional or staple food source for certain species and clarify their role in forest ecosystems.

CONCLUSIONS

Camera trap monitoring resulted in the first recorded case of mycophagy by the white-eared opossum (*D. albiventris*) and the third documented instance of mycophagy by the Brazilian squirrel (*G. brasiliensis*) in Brazil. These findings contribute to a better understanding of fungus-animal interactions, a topic often overlooked in vertebrate dietary studies, where fungi are typically omitted or reported only in broad taxonomic categories, such as at the phylum level. The observed mycophagous behavior suggests that small mammals may contribute to fungal spore dispersal, in a manner analogous to seed dispersal by frugivores—an ecological process potentially important for fungal population dynamics and forest regeneration.

Documenting animal–fungi interactions in underexplored regions, such as southwestern São Paulo, contributes valuable data to biodiversity assessments and enhances our understanding of ecosystem functioning. These insights are particularly relevant for informing conservation strategies in ecotones and fragmented landscapes, where species interactions may be more vulnerable to environmental change and habitat loss.

This research reinforces the importance of mycophagy studies for a more comprehensive understanding of the ecological role of fungi and the dietary habits of Brazilian fauna. However, further long-term studies integrating multiple methodologies are necessary to refine our knowledge of mycophagous behavior across different animal species.

ACKNOWLEDGMENTS

We would like to thank Emily dos Santos Silva for helping in some field trips and Guilherme Renzo Rocha Brito, Hugo B. Mozerle, Vinícius de Avelar São Pedro and Vítor de Queiroz Piacentini and for helping with identification of some animal species. We also thank the two anonymous reviewers for their valuable suggestions, which improved the quality of the manuscript. Many thanks are due to Centro de Ciências da Natureza (UFSCar Campus Lagoa do Sino) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (Chamada Universal CNPq/2016, Processo 422514/2016-0) for providing equipment and financial support.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

Bordignon, M. & Monteiro-Filho, E. L. (1999). Seasonal food resources of the squirrel *Sciurus ingrami* in a secondary Araucaria Forest in southern Brazil. *Studies on Neotropical Fauna and Environment* 34: 137-140.

CBH-ALPA (Comitê da Bacia Hidrográfica do Alto Paranapanema). (2018). *Relatório II – Plano de Bacia. Plano da Bacia Hidrográfica do Alto Paranapanema* (UGRHI 14) – 2016-2027. Retrieved from https://sigrh.sp.gov.br/public/uploads/documents/CBH-ALPA/13699/pbh-alpa_relatorioii_final.pdf

Correa, H. K. M., Coutinho, P. E. G. & Ferrari, S. F. (2000). Between-year differences in the feeding ecology of highland marmosets (*Callithrix aurita* and *Callithrix aviceps*) in southeastern Brazil. *Journal of Zoology* 252: 421-427. https://doi.org/10.1111/j.1469-7998.2000.tb01224.x

Costa, A. L., Furlan-Lopes, C., Heberle, M. A. & Putzke, J. (2022). The bird shiny cowbirds (*Molothrus bonariensis*) in a relationship interesting of mycophagy with the mushroom *Macrolepiota bonaerensis* in the brazilian pampa biome. *Studies in Multidisciplinary Review* 3 (2): 153-167. https://doi.org/10.55034/smrv3n2-011

Elliott, T. F., Bower, D. S. & Vernes, K. (2019a). Reptilian mycophagy: A global review of mutually beneficial associations between reptiles and macrofungi. *Mycosphere* 10 (1): 776-797. https://doi.org/10.5943/mycosphere/10/1/18

Elliott, T. F., Jusino, M. A., Trappe, J. M., Lepp, H., Ballard, G. A., Bruhl, J. J. & Vernes, K. (2019b). A global review of the ecological significance of symbiotic associations between birds and fungi. *Fungal Diversity* 98: 161-194. https://doi.org/10.1007/s13225-019-00436-3

Elliott, T. F. & Vernes, K. (2021). Camera trap detection of mycophagy among co-occurring vertebrates. *Austral Ecology* 46 (4): 496-500. https://doi.org/10.1111/aec.12988

Elliott, T. F., Truong, C., Jackson, S. M., Zúñiga, C. L., Trappe, J. M. & Vernes, K. (2022). Mammalian mycophagy: A global review of ecosystem interactions between mammals and fungi. *Fungal Systematics and Evolution* 9: 99-159. https://doi.org/10.3114/fuse.2022.09.07

Fogel, R. D. & Trappe, J. M. (1978). Fungus consumption (mycophagy) by small mammals. *Northwest Science* 52: 1-31. Retrieved from: https://andrewsforest.oregonstate.edu/publications/1757

Graipel, M. E., Cherem, J. J., Monteiro-Filho, E. L. A. & Carmignotto, A. P. (2017). Mamíferos da Mata Atlântica. In: Monteiro-Filho, E. L. A. & Conte, C. E. (Org.). *Revisões em Zoologia: Mata Atlântica*. Curitiba, Brasil: Ed. UFPR.

Hanson, A., Hall, M., Porter, L. & Lintzenich, B. (2006). Composition and nutritional characteristics of fungi consumed by *Callimico goeldii* in Pando, Bolivia. *International Journal of Primatology* 27 (1): 323-346. https://doi.org/10.1007/s10764-005-9014-z

Hanson, A. M., Hodge, K. T. & Porter, L. M. (2003). Mycophagy among primates. *Mycologist* 17 (1): 6-10. https://doi.org/10.1017/S0269-915X(03)00106-X

Hilário, R. R. & Ferrari, S. F. (2010). Feeding ecology of a group of buffy-headed marmosets (*Callithrix flaviceps*): fungi as a preferred resource. *American Journal of Primatology* 72 (6): 515-521. https://doi.org/10.1002/ajp.20804

Lopes, M. A. D. O. A. & Rehg, J. A. (2003). Observations of *Callimico goeldii* with *Saguinus imperator* in the Serrado Divisor National Park, Acre, Brazil. *Neotropical Primates* 11: 181-183. https://doi.org/10.62015/np.2003.v11.557

Meijer, A. A. R. (2008). *Macrofungos notáveis das Florestas de Pinheiro-do-Paraná*. Colombo, Brasil: EMBRAPA.

Merritt, J. F. (2010). *The biology of small mammals*. Baltimore, USA: The Johns Hopkins University Press.

Patton, J. L., Pardiñas, U. F. J. & D'Elía, G. (2015). *Mammals of South America, Volume 2. Rodents*. Chicago and London: The University of Chicago Press.

Peel, M. C., Finlayson, B. L. & McMahon, T. A. (2007). Updated world map of the Köppen-Geiger climate classification. *Hydrology and Earth System Sciences* 11 (5): 1633-1644. https://doi.org/10.5194/hess-11-1633-2007

Peres, C. A. (1993). Diet and feeding ecology of saddle-back (*Saguinus fuscicollis*) and moustached (*S. mystax*) tamarins in an Amazonian terra firme forest. *Journal of Zoology* 230: 567-592. https://doi.org/10.1111/j.1469-7998.1993.tb02707.x

Porter, L. (2001). Dietary differences among sympatric Callitrichinae in Northern Bolivia: *Callimico goeldii*, *Saguinus fuscicollis* and *S. labiatus*. *International Journal of Primatology* 22 (6): 961-992. https://doi.org/10.1023/A:1012013621258

Santamaria, B., Verbeken, A. & Haelewaters, D. (2023). Mycophagy: A global review of interactions between invertebrates and fungi. *Journal of Fungi* 9 (2): 163. https://doi.org/10.3390/jof9020163

Schickmann, S., Urban, A., Kräutler, K., Nopp-Mayr, U. & Hackländer, K. (2012). The interrelationship of mycophagous small mammals and ectomycorrhizal fungi in primeval, disturbed and managed Central European mountainous forests. *Oecologia* 170: 395-409. https://doi.org/10.1007/s00442-012-2303-2

Silva, A. R. da, Forneck, E. D., Bordignon, S. A. de L. & Cademartori, C. V. (2014). Diet of *Didelphis albiventris* Lund, 1840 (Didelphimorphia, Didelphidae) in two periurban areas in southern Brazil. *Acta Scientiarum. Biological Sciences* 36 (2): 241-247. https://doi.org/10.4025/actascibiolsci.v36i2.20444

Simionatto, T., Prasniewski, V. M., Szinwelski, N. & Brocardo, C. R. (2024). Consumo de cogumelos por *Mazama rufa* (Illiger, 1815) na Mata Atlântica subtropical. *Notas Sobre Mamíferos Sudamericanos* 6: e24.11.3. https://doi.org/10.31687/SaremNMS24.11.3

Trappe, J. M., Molina, R., Luoma, D. L., Cázares, E., Pilz, D., Smith, J. E., Castellano, M. A., Miller, S. L. & Trappe, M. J. (2009). *Diversity, ecology, and conservation of truffle fungi in forests of the Pacific Northwest*. General Technical Report PNW-GTR-772. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland. 10.2737/PNW-GTR-772

Trierveiler-Pereira, L., Silva, H. C. S., Funez, L. A. & Baltazar, J. M. (2016). Mycophagy by small mammals: new and interesting observations from Brazil. *Mycosphere* 7 (3): 297-304. https://doi.org/10.5943/mycosphere/7/3/5

Trierveiler-Pereira, L., Francisco, A. & Baltazar, J. M. (2024). New observation on mycophagy: consumption of coconut mushroom (*Oudemansiella cubensis*) by the Brazilian squirrel (*Guerlinguetus brasiliensis*). *Steviana* 16 (2): 5-11. https://doi.org/10.56152/StevianaFacenV16N2A1_2024

Vargas-Isla, R., Cabral, T. S. & Ishikawa, N. K. (2014). *Instruções de coletas de macrofungos. Agaricales e gasteroides*. Manaus, Brasil: Editora INPA. Retrieved from: https://repositorio.inpa.gov.br/handle/1/36179

Verdade, L. M. (Coord.). (2018). *Mamíferos da região de Angatuba*. São Paulo: Author's edition.

Vernes, K., Smith, M. & Jarman, P. (2014). A novel camera-based approach to understanding the foraging behaviour of mycophagous mammals. In: Meek, P., Fleming, P., Ballard, G., Banks, P., Claridge, A., Sanderson, J. & Swann D. (Eds.). *Camera Trapping in Wildlife Management and Research.* Melbourne, Australia: CSIRO Publishing. https://doi.org/10.1071/9781486300402 28.215.224.2014.28

Vieira, E. M., Paise, G. & Machado, P. H. (2006). Feeding of small rodents on seeds and fruits: a comparative analysis of three species of rodents of the Araucaria forest, southern Brazil. *Acta Theriologica* 51: 311-318. https://doi.org/10.1007/BF03192683

Webster, J. & Weber, R. (2007). *Introduction to fungi* (3ª ed.). Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/CBO9780511809026

Wheeler, Q. D. & Blackwell, M. (Eds.). (1984). *Fungus-insect relationships: Perspectives in ecology and evolution*. New York, USA: Columbia University Press. https://doi.org/10.1086/414669

Wu, Q., Thiers, B. M. & Pfister, D. H. (2004). Preparation, preservation, and use of fungal specimens in herbaria. In: Mueller, G. M., Bills, G. F. & Foster, M. S. (Eds.). *Biodiversity of fungi: Inventory and monitoring methods*. Boston, USA: Elsevier Academic Press. https://doi.org/10.1016/B978-012509551-8/50031-3