

Phytoseiidae (Acari: Mesostigmata) on native Cerrado plants in a fragment in Eastern Mato Grosso do Sul, Brazil

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Abstract. Phytoseiidae mites are key natural enemies in agricultural and natural ecosystems. However, their diversity in some areas of the Cerrado biome, particularly in the state of Mato Grosso do Sul (MS), Brazil, remains poorly documented. This study aimed to survey the Phytoseiidae species associated with native plants in a Cerrado fragment in the municipality of Aparecida do Taboado, MS. Sampling was conducted quarterly over one year (2023-2024) on ten selected native plant species. A total of 268 adult mites were collected, belonging to 12 species in two subfamilies (Amblyseinae and Phytoseiinae). The most abundant species were *Euseius citrifolius* Denmark & Muma (106 specimens), *Phytoseius nahuatlensis* De Leon (82), and *Iphiseiodes zuluagai* Denmark & Muma (36). *Xylopiia aromatica* (Lam.) Mart. (Annonaceae) and *Mabea fistulifera* Mart. (Euphorbiaceae) were the plant species harboring the highest mite abundance. This study provides the first records of *Amblydromalus zannoui* Sourassou, Sarmiento & Moraes and *Phytoseius kaapre* Demite, Lofego & Feres for the state of Mato Grosso do Sul. Furthermore, the findings suggest that plant – mite associations are influenced by leaf traits and food resources: *P. nahuatlensis* was dominant on the trichome-rich leaves of *X. aromatica*, *I. zuluagai* utilized leaf domatia on *Matayba guianensis* Aubl., and the abundant *E. citrifolius* was linked to *M. fistulifera*, likely utilizing its pollen. These data help fill a faunistic gap and highlight the role of native Cerrado vegetation as a reservoir of functional biodiversity, maintaining stable populations of natural enemies.

Keywords. Diversity; Ecosystem Services; Natural Enemies; Plant-Mite Interaction; Survey.

INTRODUCTION

Mites are extremely successful organisms, occurring in virtually all natural and modified ecosystems. In plant canopies, they are an important component (May, 1988) and exhibit high diversity (Walter & Proctor, 2013). Phytoseiidae is the most studied and representative family of predatory mites in Brazil, with more than 260 species recorded (Jacinavicius *et al.*, 2025). These mites have garnered considerable interest owing to their potential as natural enemies of phytophagous or-

ganisms (McMurtry *et al.*, 2015), as the majority exhibit predatory behavior with varying levels of specificity (Gerson *et al.*, 2003; McMurtry *et al.*, 2013). Several species have already demonstrated efficacy in the biological control of phytophagous mites and small insect pests in agricultural systems (McMurtry *et al.*, 2013).

Despite this ecological and applied relevance, knowledge of the phytoseiid fauna remains limited in several regions of Brazil. In the state of Mato Grosso do Sul, for example, there are few records from native Cerrado plants. Rezende & Lofego

Pap. Avulsos Zool., 2026; v.66: e202666026
<https://doi.org/10.11606/1807-0205/2026.66.026>
<https://revistas.usp.br/paz>
<https://www.scielo.br/paz>

Edited by: Carlos José Einicker Lamas

Received: 24/11/2025

Accepted: 08/04/2026

Published: 01/05/2026

ISSN On-Line: 1807-0205
ISSN: 0000-0004-0384-1825

(2011) reported four species from collections made in a Cerrado area in the state. Other surveys have been conducted in Pantanal areas (Mendonça *et al.*, 2019) or human-modified environments, such as roadsides and agricultural crops (Furtado *et al.*, 2014; Barroso *et al.*, 2019), reinforcing the scarcity of studies on native vegetation, particularly within the Cerrado biome from Mato Grosso do Sul.

Beyond the faunistic aspect, natural areas play a strategic role in the conservation and dispersal of natural enemies. These environments can act as sources of organisms that colonize cultivated areas (Altieri, 1994). Therefore, understanding their potential as predator reservoirs is an initial step for ecological pest management. Considering the scarcity of records for the state and the relevance of these environments as a source of natural enemies, this study aimed to provide new data on the occurrence of Phytoseiidae on native Cerrado plants in Mato Grosso do Sul, Brazil.

MATERIAL AND METHODS

The study was conducted in a Cerrado remnant in the municipality of Aparecida do Taboado, Eastern Mato Grosso do Sul (20°02'06"S, 51°14'25"W; 318 m a.s.l.; Fig. 1). Ten native plant species were selected for sampling, namely *Annona coriacea* Mart. (Annonaceae), *Byrsonima intermedia* A. Juss. (Malpighiaceae), *Caryocar brasiliense* Cambess. (Caryocaraceae), *Handroanthus* cf. *chrysotrichus* (Bignoniaceae), *Mabea fistulifera* Mart. (Euphorbiaceae), *Matayba guianensis* Aubl. (Sapindaceae), *Myrsine coriacea* (Sw.) R.Br. Ex Roem & Schult. (Primulaceae), *Qualea grandiflora* Mart. (Vochysiaceae), *Xylopia aromatica* (Lam.) Mart. (Annonaceae), and Anacardiaceae sp. Three individuals of each plant species were selected and marked for sampling mites. The selection considered different types of leaf architecture, such as the presence of trichomes, domatia, prominent veins, and extrafloral nectaries. The sampling effort was standardized into six levels, established based on the leaf dimensions (length and width) of

each plant species. Plant species with larger leaf surface areas (*Q. grandiflora* and *C. brasiliense*) were represented by samples of 15 and 20 leaves, respectively. Species with intermediate leaf sizes were sampled with 25 (*A. coriacea*) to 30 leaves (*H. cf. chrysotrichus*). For hosts with narrow or small leaves, the sampling effort consisted of 40 leaves (Anacardiaceae sp., *B. intermedia*, *M. fistulifera* and *X. aromatica*), reaching 50 leaves for species with the smallest leaf area (*M. guianensis* and *M. coriacea*). Four samplings were performed over the course of a year, in November 2023, February 2024, May 2024, and August 2024.

Leaves or leaflets were collected using pruning shears and placed in paper bags, which were subsequently sealed inside polyethylene bags and stored in insulated polystyrene boxes with ice. The phytoseiid specimens were mounted on slides in Hoyer's medium (Krantz & Walter, 2009) under a 40× stereomicroscope (Leica EZ4). Identification was performed based only on adults, under a phase-contrast optical microscope (Zeiss Axio Imager M3), using the bibliographies of Chant & McMurtry (2007), Lofego *et al.* (2024), and taxonomic description and revision works (Demite *et al.*, 2016; Cavalcante *et al.*, 2017; Sourassou *et al.*, 2017; Ferragut & Navia, 2022, 2024).

We assembled a species versus host abundance matrix (edges weighted by counts; zeros omitted) and visualized it in RAWGraphs 2.0 (*Bipartite Network*). The layout used bipartite + d3-force; edge width ∝ weight, and node size ∝ degree (species) or total abundance (hosts). The map of the fragment's location was created using SimpleMappr (Shorthouse, 2010). The voucher material is deposited in the mite collection of the Laboratório de Acarologia da UNESP, campus de São José do Rio Preto, São Paulo State, Brazil.

RESULTS

A total of 268 adult phytoseiids belonging to 12 species were recorded on the sampled plants (Table 1). The most abundant species in this study was *Euseius citrifolius*

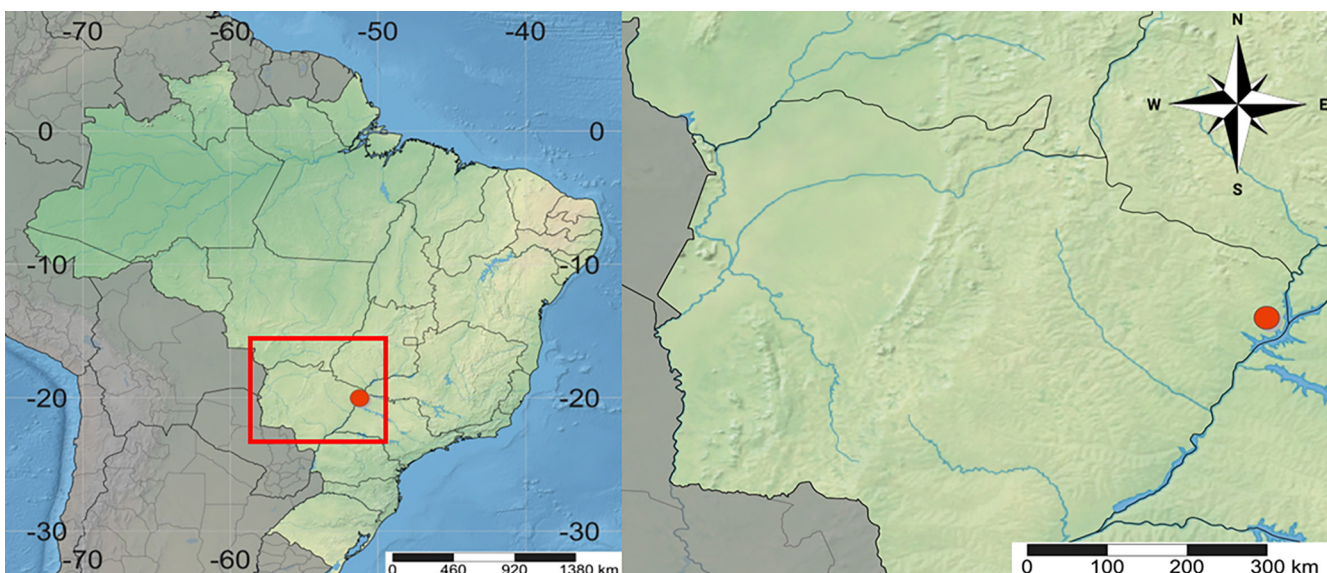


Figure 1. Location of the Cerrado remnant in Aparecida do Taboado, Mato Grosso do Sul, Brazil.

Table 1. Phytoseiidae species associated with plants in a Cerrado fragment in Aparecida do Taboado, Mato Grosso do Sul, Brazil, collected between November 2023 and August 2024.

Species	*Host Plant										
	Cbra	Mgui	Xaro	Mcor	Bint	Qgra	Mfis	Ansp	Acor	Hchr	Total
Amblyseiinae											
<i>Amblydromalus zannoui</i> Sourassou, Sarmento & Moraes		3									3
<i>Amblyseius acalyphus</i> Denmark & Muma		3		8	5		2				18
<i>Amblyseius aerialis</i> (Muma)		1									1
<i>Amblyseius chiapensis</i> De Leon	3	1									4
<i>Euseius citrifolius</i> Denmark & Muma					2	32	52	2	18		106
<i>Euseius sibelius</i> (De Leon)	1		2					9		1	13
<i>Iphiseiodes zuluagai</i> Denmark & Muma		20		5		6	2	1	2		36
<i>Neoseiulus tunus</i> (De Leon)	1										1
<i>Proprioseiopsis ovatus</i> (Garman)			1								1
<i>Transeius bellottii</i> (Moraes & Mesa)							1				1
Phytoseiinae											
<i>Phytoseius kaapre</i> Demite, Lofego & Feres	1										1
<i>Phytoseius nahuatlensis</i> De Leon	2		78					2			82
Abundance	9	28	81	13	7	38	57	14	20	1	268

*Codes: Cbra: *Caryocar brasiliense* Cambess. (Caryocaraceae); Mgui: *Matayba guianensis* Aubl. (Sapindaceae); Xaro: *Xylopia aromatica* (Lam.) Mart. (Annonaceae); Mcor: *Myrsine coriacea* (Sw.) R.Br. Ex Roem & Schult. (Primulaceae); Bint: *Byrsonima intermedia* A. Juss. (Malpighiaceae); Qgra: *Qualea grandiflora* Mart. (Vochysiaceae); Mfis: *Mabea fistulifera* Mart. (Euphorbiaceae); Ansp: *Anacardium* sp.; Acor: *Annona coriacea* Mart. (Annonaceae); Hchr: *Handroanthus* cf. *chrysotrichus* (Bignoniaceae).

Denmark & Muma, with 106 specimens, followed by *Phytoseius nahuatlensis* De Leon (82) and *Iphiseiodes zuluagai* Denmark & Muma (36). Among the host plants, *Xylopia aromatica* (Lam.) Mart. (Annonaceae) and *Mabea fistulifera* Mart. (Euphorbiaceae) harbored the highest abundance of phytoseiids, with 81 and 57 specimens, respectively (Table 1, Fig. 2).

The bipartite network (Fig. 2) illustrates the associations between phytoseiid species and host plants. *Phytoseius nahuatlensis* showed a strong association with *Xylopia aromatica*, with approximately 95% of the specimens collected on this host. *Iphiseiodes zuluagai* was recorded on the largest number of host plants (six species), whereas *E. citrifolius* occurred on five plant species, being particularly abundant on *M. fistulifera*. Most specimens of *I. zuluagai* collected on *Matayba guianensis* were found inside leaf domatia.

In addition to the dominant species, other phytoseiids were recorded in lower abundances, including *Amblydromalus zannoui* Sourassou, Sarmento & Moraes, *Amblyseius acalyphus* Denmark & Muma, *Amblyseius aerialis* (Muma), *Amblyseius chiapensis* De Leon, *Euseius sibelius* (De Leon), *Neoseiulus tunus* (De Leon), *Proprioseiopsis ovatus* (Garman), *Transeius bellottii* (Moraes & Mesa), and *Phytoseius kaapre* Demite, Lofego & Feres. Two species, *A. zannoui* and *P. kaapre*, represent new records for the state of Mato Grosso do Sul.

DISCUSSION

The results of this study provide new insights into diversity and distribution of phytoseiid mites associated with native Cerrado vegetation in Mato Grosso do Sul. Rezende & Lofego (2011) reported four species from collections made in a Cerrado area in the state. Other surveys have been conducted in Pantanal areas (Mendonça

et al., 2019) or in human-modified environments, such as roadsides and agricultural crops (Cardoso et al., 2010; Furtado et al., 2014; Barroso et al., 2019), highlighting the limited ecological understanding of phytoseiid communities in native Cerrado vegetation, particularly in Mato Grosso do Sul.

The occurrence of species with a wide distribution in other biomes, such as *E. citrifolius*, *P. nahuatlensis*, and *I. zuluagai*, suggests that part of the Cerrado phytoseiid fauna has a wide distribution but remains poorly documented in the state. In the Central-West region, the three most abundant species had already been mentioned in surveys in the Distrito Federal (Duarte et al., 2021; Rezende & Lofego, 2011), Goiás (Demite et al., 2017; Teixeira et al., 2017; Moraes et al., 2022; Rossetti et al., 2025), and Mato Grosso (Demitte et al., 2009, 2021; Conceição et al., 2021). In Mato Grosso do Sul, however, only *E. citrifolius* had been recorded on native vegetation. Species such as *Neoseiulus tunus* and *Proprioseiopsis ovatus* were previously reported in the state's Cerrado (Rezende & Lofego, 2011). Most previous records for Mato Grosso do Sul occurred in agricultural areas (Barroso et al., 2019), roadsides (Furtado et al., 2014), and Pantanal areas (Mendonça et al., 2019).

Host plants with the highest abundance of phytoseiids, especially *M. fistulifera* and *X. aromatica*, have already been identified as important sources of predators in other studies conducted in São Paulo (Daud & Feres, 2005; Demite et al., 2011; Nuvoloni et al., 2011). In the study by Daud & Feres (2005), which reported six Phytoseiidae species, *E. citrifolius* was the most abundant species associated with *M. fistulifera*. These authors correlated the abundance of this phytoseiid with the greater availability of pollen produced by the plant. In addition, Daud & Feres (2004) demonstrated that populations of *E. citrifolius* develop better when fed pollen of *M. fistulifera* than pollen from other plant species, reinforcing the importance of

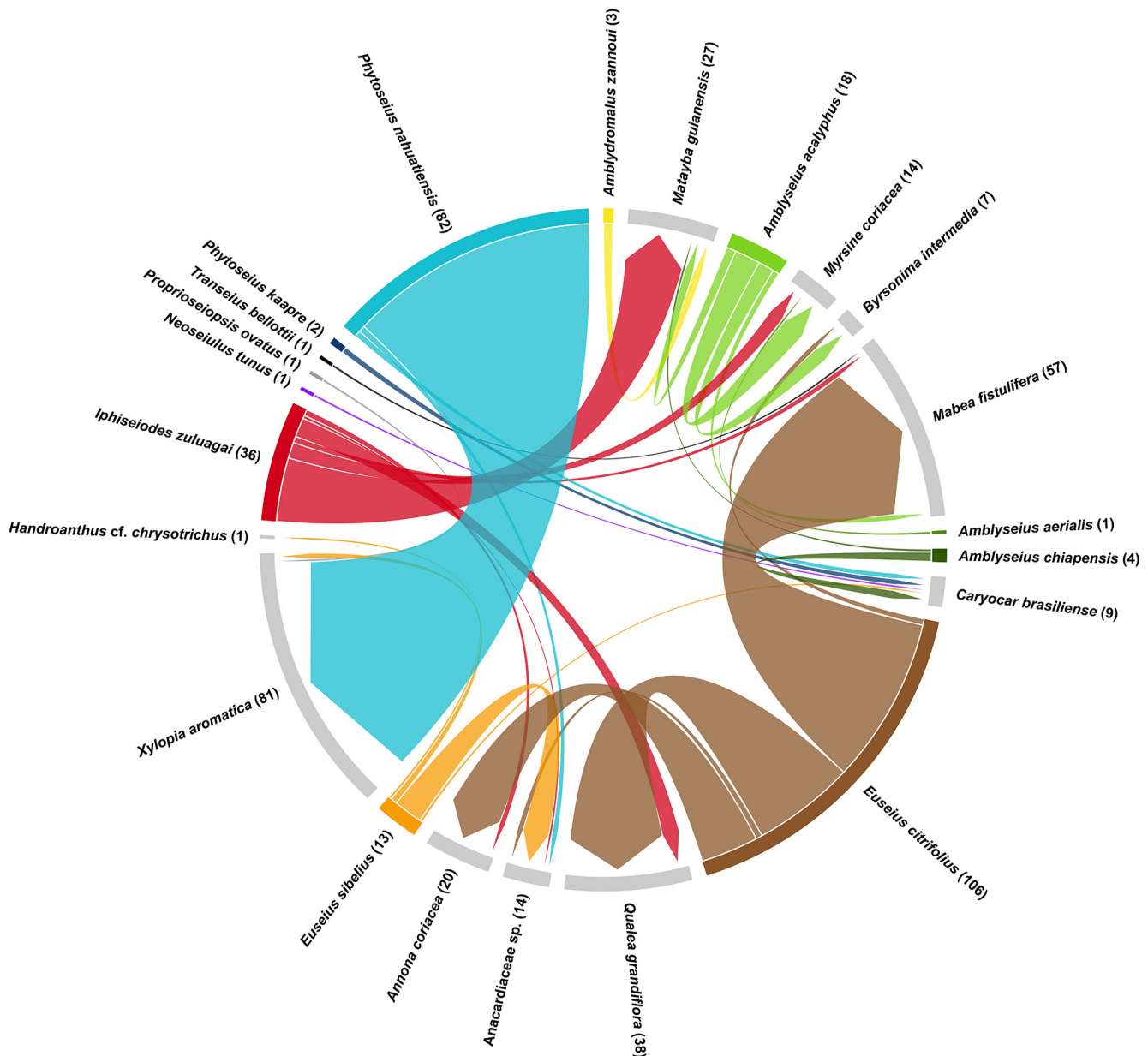


Figure 2. Bipartite network illustrating associations between Phytoseiidae species and host plants in Cerrado vegetation, Aparecida do Taboado, Mato Grosso do Sul, Brazil. Line thickness indicates relative abundance of mites.

this host as a food resource for predatory mites. *Euseius* species are known as Type IV generalist predators, able to feed on pollen and nectar (McMurtry et al., 2013).

Nuvoloni et al. (2011) surveyed the mite fauna associated with *X. aromatica*, reporting six Phytoseiidae species, with *P. nahuatlensis* (mainly), *E. sibelius*, and *P. guianensis* being the most abundant. *Phytoseius nahuatlensis* was also the most abundant species, with 95% of the specimens associated with this host. *Xylopiia aromatica* has leaves with trichomes on their lower surface (Simioni et al., 2018), which may favor the occurrence of phytoseiids possessing a more suitable morphology, such as a narrower idiosoma and erect setae, characteristics of *Phytoseius* (Walter, 1992). Thus, leaf structures and alternative food sources, such as pollen and nectar, may foster specific associations.

This information reinforces the role of host plants in maintaining local diversity. Furthermore, the occurrence

of *I. zuluagai* on six plant species and *E. citrifolius* on five species highlights their generalist habits and ecological potential as opportunistic predators in natural environments. *Euseius citrifolius* and *I. zuluagai* are species reported in all regions of Brazil, occurring in both natural and agricultural environments (Lofego et al., 2024; Demite et al., 2025).

Additionally, most specimens of *I. zuluagai* collected on *M. guianensis* were found inside leaf domatia. These structures are known to provide shelter and favorable microhabitats for predatory mites, protecting them from desiccation (Rowles & O'Dowd, 2009) and natural enemies (Faraji et al., 2002a, b; Ferreira et al., 2008). The presence of domatia has been associated with higher densities of phytoseiid mites on several plant species, as these structures may function as refuges and oviposition sites (e.g., Walter & O'Dowd, 1992; Grostal & O'Dowd, 1994; Matos et al., 2006a, b). Experimental

studies have also shown that domatia can increase the survivorship and oviposition of *I. zuluagai*, with females preferentially depositing eggs inside these structures (Matos et al., 2004). Thus, the occurrence of *I. zuluagai* inside domatia suggests that this plant trait may help maintain predatory mite populations in Cerrado vegetation.

The records obtained in this study expand the knowledge of the distribution of phytoseiid mites in the Cerrado biome and in the state of Mato Grosso do Sul. All species recorded here had previously been reported in association with native Cerrado plants (e.g., Lofego et al., 2004; Demite et al., 2009, 2017, 2021; Rezende & Lofego, 2011; Teixeira et al., 2017; Sourassou et al., 2017; Conceição et al., 2021; Ferragut & Navia, 2022; Rossetti et al., 2025). However, *Amblydromalus zannoui* and *Phytoseius kaapre* are recorded for the first time in Mato Grosso do Sul. *Amblydromalus zannoui* has been previously reported in the states of Tocantins (Sourassou et al., 2017; Miranda et al., 2021) and Amazonas (Cruz et al., 2019), and *P. kaapre* in the states of Goiás (Rossetti et al., 2025), Mato Grosso (Conceição et al., 2021; Demite et al., 2021) and São Paulo (Demite et al., 2008, 2011; Lofego et al., 2017; Moraes et al., 2013).

Among the species previously known from the state, different patterns of occurrence across environments have been reported. *Amblyseius acalyphus* and *A. aerialis* had previously been recorded only from the Pantanal biome (Mendonça et al., 2019). *Amblyseius chiapensis*, *E. sibelius*, *P. nahuatlensis*, and *T. bellottii* were known only from the Pantanal (Mendonça et al., 2019) and roadside vegetation (Furtado et al., 2014). *Euseius citrifolius* and *P. ovatus* have been reported in a wider range of environments, including the Cerrado (Rezende & Lofego, 2011) and Pantanal (Mendonça et al., 2019) biomes, as well as agroecosystems (Cardoso et al., 2010; Barroso et al., 2019) and roadside plants (Furtado et al., 2014). *Iphiseiodes zuluagai* had previously been recorded from the Pantanal (Mendonça et al., 2019), agroecosystems (Barroso et al., 2019), and roadside vegetation (Furtado et al., 2014), whereas *Neoseiulus tunus* had only been reported from the Cerrado in Mato Grosso do Sul (Rezende & Lofego, 2011).

The observed patterns reinforce the importance of Cerrado fragments as reservoirs of natural enemies, capable of maintaining stable populations and acting as sources for adjacent cultivated areas. These environments contribute to the conservation of functional biodiversity and may favor biological control through ecosystem services provided by predatory mites.

In conclusion, this study advances the knowledge of Phytoseiidae diversity in the Cerrado of Mato Grosso do Sul, recording twelve species, including two new occurrences for the state. Native vegetation, particularly hosts such as *M. fistulifera* and *X. aromatica*, supports abundant and diverse mite populations, likely driven by leaf structural traits and the availability of alternative food resources such as pollen and nectar. These findings highlight the ecological value of Cerrado remnants as reservoirs of predatory mites that can naturally regulate pest

populations in surrounding crops, reinforcing the importance of conserving native vegetation for biodiversity maintenance and ecosystem services related to biological control.

Authors' Contributions: ACL, LAN, PRD: Conceptualization; VMRC, NMAC, DVAC, AHMS, MFSX, LAN, PRD: Investigation, Data-curation, Formal analysis; VMRC, NMAC, DVAC, AHMS, MFSX, ACL, PRD: Writing-review & editing. All authors actively participated in the discussion of the results, and they reviewed and approved the final version of the paper.

Conflicts of Interest: Authors declare there are no conflicts of interest.

Ethics Statement: Voucher specimens of the species reported in this study are deposited in public biological collection.

AI Use: No AI tools were used in this manuscript.

Data Availability: The authors confirm that the data supporting the findings of this study are available within the article.

Funding: This work was supported by the Foundation for the Support of Teaching, Science, and Technology Development of the State of Mato Grosso do Sul (Fundação de Apoio ao Desenvolvimento do Ensino, Ciência e Tecnologia do Estado de Mato Grosso do Sul – FUNDECT) (Proc. Nº 83/045.355/2023).

Acknowledgments: We thank Fabio D.B. Evangelista, Manoel A.M. Neto, Shaysa da C. Bezerra, Mayane Ferreira and Fernando Machado (Escola Estadual Ernesto Rodrigues, Aparecida do Taboado, Mato Grosso do Sul) for their assistance with the collections carried out in the fragment.

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