



ECOSYSTEMS

Phytoseiid mites (Acari: Mesostigmata: Phytoseiidae) from Mato Grosso State, Central-Western Brazil

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Abstract: The aim of the present study was to conduct a survey of mites of the family Phytoseiidae associated with plants of the natural vegetation and cultivated forests in sites of three biomes (Amazon Forest, Cerrado and Pantanal) in the Mato Grosso State. Twenty-one species of 11 genera, of the three phytoseiid subfamilies were registered. *Amblyseius* Berlese was the most diverse genus, with five species. *Iphiseiodes zuluagai* Denmark & Muma was the most common species, collected from 12 plant species in five collection sites. Eleven phytoseiid species were reported for the first time in the Mato Grosso State.

Key words: Diversity, faunistic survey, biological control, Parasitiformes, predator.

INTRODUCTION

Mato Grosso is a large state of the central-western region of Brazil, occupying an area of about 10% (903.207 km²) of the country's territory (IBGE 2020) and extending over parts of three biomes (Amazon Forest, Cerrado and Pantanal). Despite being one of the main agricultural producers in Brazil (Sousa et al. 2017), relatively few studies (Ferla & Moraes 2002, Moraes et al. 2006, Demite & Feres 2007, Demite et al. 2008a, 2009, Daud & Feres 2013) have been conducted to understand the local mite fauna. Most of these studies have been conducted in rubber tree plantations, except that of Demite et al. (2009), conducted in areas of natural vegetation of the Cerrado biome, neighboring plots of rubber trees. In these studies, only 25 phytoseiid species were reported, too few for a state about the size of the largest countries of western Europe. Knowledge regarding the mite fauna is of considerable

importance to establish effective programs for the biological control of pest organisms.

Phytoseiidae is considered the most important family of predatory mites, with several species being produced and used commercially for the biological control of arthropod pests, including small insects (thrips and whiteflies) and mites (McMurtry et al. 2013, 2015, Knapp et al. 2018). The aim of this study was to evaluate the phytoseiid species associated with plants both in the natural vegetation and cultivated forests in Mato Grosso State.

MATERIALS AND METHODS

Mites were collected from ten sites (Table I and Figure 1). Leaf and flower samples were obtained from the natural vegetation and cultivated forests from sites of the biomes found in the state between January 2015 and September 2016. They were put in plastic bags and transported

Table I. Geographic coordinates of the areas in which samples were taken for evaluation of phytoseiid fauna in Mato Grosso State, Brazil.

Code	Area	Geographic Coordinates	Vegetation Type/Biome
A	Cáceres	16° 01'S, 57° 43'W	Natural Vegetation / Pantanal Biome
B	Cotriguaçu	09° 51'S, 58° 14'W	Natural Vegetation / Amazon Forest Biome
C	Nobres	14° 32'S, 55° 22'W	Natural Vegetation / Cerrado Biome
D	Poconé - Area 1	16° 29'S, 56° 23'W	Natural Vegetation / Pantanal Biome
E	Poconé - Area 2	16° 30'S, 56° 24'W	Natural Vegetation / Pantanal Biome
F	Rondonópolis	16° 33'S, 54° 34'W	Natural Vegetation / Cerrado Biome
G	Sinop - Area 1	11° 50'S, 55° 29'W	Natural Vegetation / Amazon Forest Biome
H	Sinop - Area 2	11° 52'S, 55° 30'W	Cultivated Forest / Amazon Forest Biome
I	Sinop - Area 3	11° 51'S, 55° 28'W	Cultivated Forest / Amazon Forest Biome
J	Sinop - Area 4	11° 52'S, 55° 23'W	Natural Vegetation / Amazon Forest Biome

to the laboratory, where they were washed in a bucket containing 8L of 30% ethanol and then filtered through a 50 µm mesh screen, from which mites were collected as described by Rezende & Lofego (2011).

The samplings carried out in Nobres, Poconé (areas 1 and 2) and Sinop (areas 1, 2 and 3) were conducted by E.P.J. Britto, M.R. Barreto and T.T. Bukoski; the sampling carried out in Cáceres, Cotriguaçu, Rondonópolis and Sinop (area 4) were conducted by A.C. Lofego, F.S.R. Amaral and J.M. Rezende.

The mites were sorted under a stereomicroscope (40x), mounted in Hoyer's medium and examined under phase contrast microscopy (Zeiss Axio Imager M3). Identification to genus level was done mostly based on Chant & McMurtry (2007). Species identification was done initially with the use of the key for Brazilian phytoseiid species available in the unpublished MS thesis of A.C. Lofego, later confirmed using species descriptions and redescriptions available in the literature (references listed subsequently under each species) and comparison with voucher and type specimens

deposited in the mite collections of ESALQ-USP Piracicaba and UNESP São José do Rio Preto.

Voucher specimens were deposited at the mite reference collections of Departamento de Zoologia e Botânica, UNESP—Universidade Estadual Paulista, São José do Rio Preto and of Departamento de Entomologia e Acarologia, Escola Superior de Agricultura “Luiz de Queiroz”, Universidade de São Paulo (ESALQ-USP), Piracicaba, both in São Paulo State, Brazil.

RESULTS

Twenty-one species were found, belonging to 11 genera of three phytoseiid subfamilies, as subsequently specified.

Amblyseiinae

Amblydromalus insolitus Nuvoloni & Lofego

Amblydromalus insolitus Nuvoloni & Lofego, in Nuvoloni et al. 2015a: 262.

Specimens examined – Poconé (area 1): *Inga* sp. (Leguminosae – Fabaceae), IV-2016 (5 females).

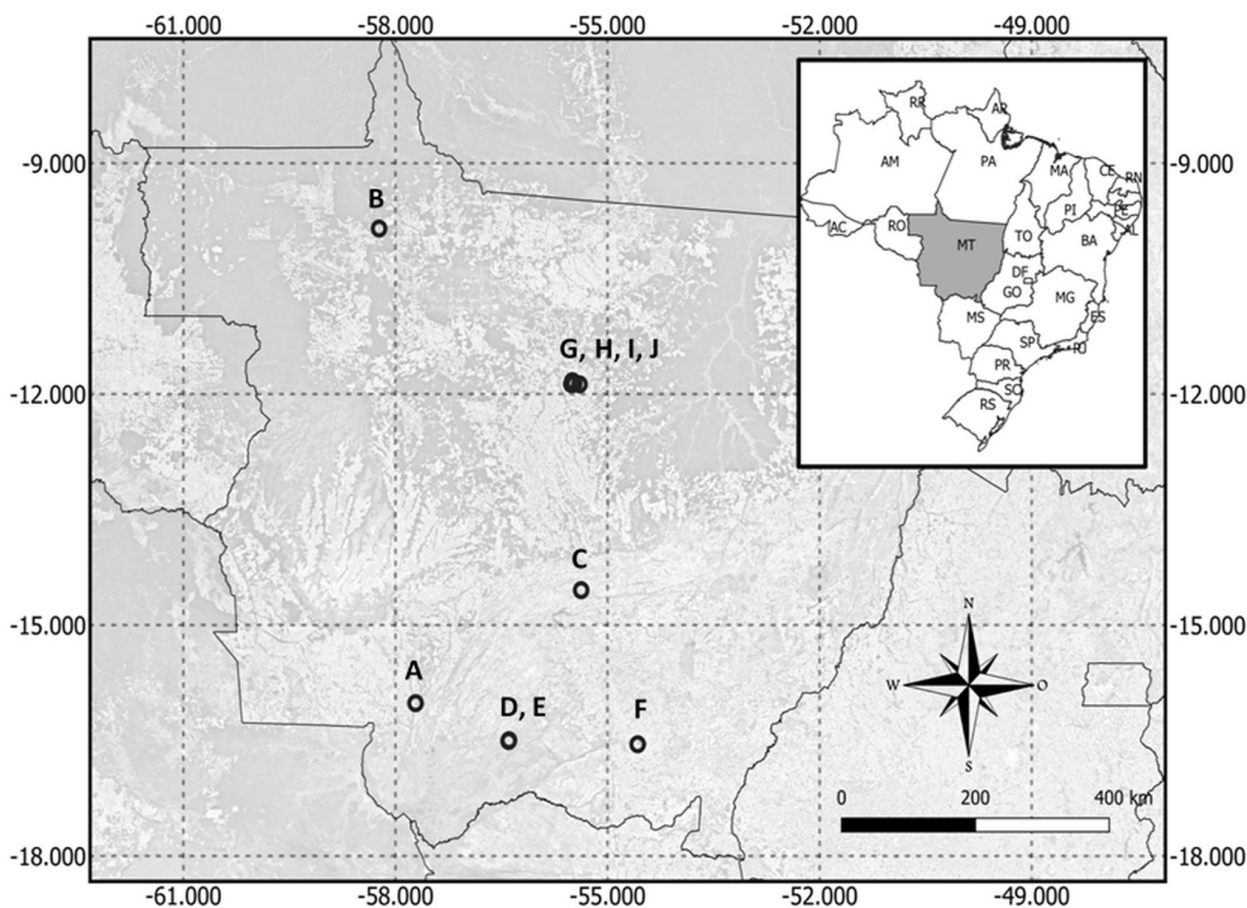


Figure 1. Sampling areas in Mato Grosso State, Brazil. Codes: A: Cáceres; B: Cotriguaçu; C: Nobres; D: Poconé – Area 1; E: Poconé– Area 2; F: Rondonópolis; G: Sinop – Area 1; H: Sinop – Area 2; I: Sinop – Area 3; J: Sinop – Area 4.

Remarks: The specimens collected in this study have seven setae on the genu III (1 2/1 2/0 1), differently from what was originally reported for the type specimens (eight setae: 1 2/2 2/0 1). An examination of the type specimens (holotype and six paratypes; all from Igrapiúna, Bahia State, Brazil) showed that the actual number is seven, not eight setae. This is the first record of this species for Mato Grosso State, Brazil.

Amblyseius acalyphus Denmark & Muma

Amblyseius acalyphus Denmark & Muma, 1973: 243.

Specimens examined – Cáceres: *Byrsonima* sp. (Malpighiaceae), I-2015 (6 females); **Cotriguaçu:** *Tabernamontana* sp. (Apocynaceae),

I-2015 (1 female); **Poconé:** *Inga* sp. IX-2016 (1 female).

Amblyseius aeralis (Muma)

Amblyseiopsis aeralis Muma, 1955: 264.

Amblyseius aeralis.— Athias-Henriot 1957: 338.

Typhlodromus (Amblyseius) aeralis.— Chant 1959: 88.

Amblyseius (Amblyseius) aeralis. — Denmark & Muma 1989: 15.

Specimens examined – Cáceres: *Byrsonima* sp., I-2015 (2 females), *Erythroxyton* sp. (Erythroxyllaceae), I-2015 (2 females and 1 male); **Cotriguaçu:** unidentified Bignoniaceae, I-2015 (1 female), *Soloea guilleminiana* Gaudich.

(Moraceae), I-2015 (1 female) unidentified Melastomataceae, I-2015 (1 female), unidentified Rubiaceae, I-2015 (1 female); **Rondonópolis:** *Psidium guajava* L. (Myrtaceae), I-2015 (1 female); **Sinop (area 4):** unidentified Heliconiaceae, I-2015 (3 females).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

***Amblyseius chiapensis* De Leon**

Amblyseius chiapensis De Leon, 1961: 85.

Amblyseius triplaris De Leon, 1967: 25 (synonymy according to Denmark & Muma 1989).

Specimens examined – Cotriguaçu: unidentified Annonaceae, I-2015 (1 female), *Inga* sp., I-2015 (1 female).

***Amblyseius chicomendesi* Nuvoloni, Lofego, Rezende & Feres**

Amblyseius chicomendesi Nuvoloni et al. 2015b: 189.

Specimens examined – Sinop (area 4): unidentified plant, I-2015 (1 female).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

***Amblyseius operculatus* De Leon**

Amblyseius operculatus De Leon, 1967: 26.

Amblyseius (Amblyseius) operculatus.— Denmark & Muma 1989: 47.

Specimens examined – Cotriguaçu: *Socratea exorrhiza* (Mart.) H.Wendl. (Arecaceae), I-2015 (9 females), *Attalea speciosa* Mart. (Arecaceae), I-2015 (1 female).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

***Euseius alatus* De Leon**

Euseius alatus De Leon, 1966: 87.

Euseius paraguayensis Denmark & Muma, 1970: 224 (synonymy according to Moraes & McMurtry 1983).

Specimens examined – Nobres: *Handroanthus* sp. (Bignoniaceae), IV-2016 (2

females); **Sinop (area 1):** *Dypterix odorata* (Aubl.) Willd. (Leguminosae – Fabaceae), II-2016 (2 females); **Sinop (area 2):** *Hymenaea courbaril* L. (Leguminosae – Fabaceae), IX-2016 (2 females); **Sinop (area 3):** *Khaya ivorensis* A. Chev. (Meliaceae), II-2016 (1 female).

***Euseius citrifolius* Denmark & Muma**

Euseius citrifolius Denmark & Muma, 1970: 222.

Specimens examined – Nobres: *D. odorata*, IV-2016 (6 females and 1 male); **Rondonópolis:** *P. guajava*, I-2015 (2 females); **Sinop (area 1):** *D. odorata*, II-2016 (2 males), *Bertholletia excelsa* Bonpl. (Lecythidaceae), IX-2016 (1 female); **Sinop (area 2):** *B. excelsa*, II-2016 (7 females and 2 males), IX-2016 (3 females and 2 males), *H. courbaril*, II-2016 (3 females and 2 males), IX-2016 (1 male), *Swietenia macrophylla* King (Meliaceae), II-2016 (3 females and 1 male), IX-2016 (2 females); **Sinop (area 3):** *K. ivorensis*, II-2016 (8 females).

***Euseius concordis* (Chant)**

Typhlodromus (Amblyseius) concordis Chant, 1959: 69.

Amblyseius (Iphiseius) concordis.— Muma 1961: 288.

Amblyseius concordis.— Chant & Baker 1965: 22.

Euseius concordis.— Denmark & Muma 1973: 264.

Euseius flechtmani Denmark & Muma, 1970: 223 (synonymy according to Moraes et al. 1982).

Specimens examined – Nobres: *Handroanthus* sp., IV-2016 (1 female); **Rondonópolis:** *P. guajava*, I-2015 (1 female and 1 male); **Sinop (area 2):** *B. excelsa*, II-2016 (1 female and 1 male); **Sinop (area 3):** *K. ivorensis*, II-2016 (1 female and 1 male).

***Euseius sibelius* (De Leon)**

Amblyseius (Typhlodromalus) sibelius De Leon, 1962: 21.

Euseius sibelius.— Muma & Denmark 1970: 98.

Euseius subalatus De Leon, 1965: 127 (synonymy according to Muma & Denmark 1970).

Specimens examined – Nobres: *Caryocar brasiliense* A.St.-Hil. (Caryocaraceae), IV-2016 (3 females and 3 males).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

***Iphiseiodes rauculara* Nuvoloni, Lofego, Rezende & Feres**

Iphiseiodes rauculara Nuvoloni et al. 2015b: 195.

Specimens examined – Cotriguaçu: Sapindaceae sp., I-2015 (1 female), Sapotaceae sp., I-2015 (1 female), *Genipa americana* L. (Rubiaceae), I-2015 (1 female).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

***Iphiseiodes zuluagai* Denmark & Muma**

Iphiseiodes zuluagai Denmark & Muma, 1972: 23.

Amblyseius zuluagai.— Moraes & Mesa 1988: 79.

Specimens examined – Cáceres: *Alchornea* sp. (Euphorbiaceae), I-2015 (1 male), *Annona* sp. (Annonaceae), I-2015 (1 male), *Byrsonima* sp., I-2015 (2 males), *Erythroxylum* sp., I-2015 (3 females and 3 males), *Handroanthus* sp., I-2015 (2 females and 1 male), Rubiaceae sp.2, I-2015 (2 males); **Cotriguaçu:** *Hymenaea* sp. (Leguminosae – Fabaceae), I-2015 (2 males); **Poconé (area 1):** *Handroanthus* sp., IV-2016 (1 female); **Sinop (area 3):** *B. excelsa*, II-2016 (6 females and 3 males), *K. ivorensis*, II-2016 (1 male); **Sinop (area 4):** *B. excelsa*, I-2015 (14 females and 3 males), *Erismia* sp. (Vochysiaceae), I-2015 (4 females), Myristicaceae sp., I-2015 (1 female and 1 male), *Olfersia* cf. *cervina* (L.) Kunze (Dryopteridaceae), I-2015 (2 females).

***Neoseiulus tunus* (De Leon)**

Typhlodromips tunus De Leon, 1967: 29.

Amblyseius tunus.— McMurtry & Moraes 1989: 181.

Neoseiulus tunus.— Ferla & Moraes 2002: 872;

Typhlodromips neotunus Denmark & Muma 1973: 255 (synonym according Cavalcante et al. 2017: 593).

Amblyseius neotunus.—Moraes & Mesa 1988: 155.

Neoseiulus neotunus.—Chant & McMurtry 2003.

Specimens examined – Nobres: *Handroanthus* sp., IV-2016 (3 females).

***Paraamblyseius multicircularis* Gondim Jr. & Moraes**

Paraamblyseius multicircularis Gondim Jr. & Moraes, 2001: 79.

Specimens examined – Cotriguaçu: unidentified Sapindaceae, I-2015 (1 female), unidentified plant 2, I-2015 (1 female).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

***Proprioseiopsis ovatus* (Garman)**

Amblyseiopsis ovatus Garman, 1958: 78.

Typhlodromus (Amblyseius) ovatus.— Chant 1959: 90.

Amblyseiulus cannaensis Muma, 1962: 4 (synonymy according to Denmark & Evans 2011).

Proprioseiopsis ovatus.— Muma & Denmark 1970: 38.

Proprioseiopsis (Proprioseiopsis) cannaensis.— Karg 1989: 116.

Amblyseiulus judsonianus Chant & Hansell, 1971: 723 (synonym according to Denmark & Evans 2011).

Amblyseius parapeltatus Wu & Chou, 1981: 274 (synonym according to Tseng 1983).

Amblyseius peltatus Van der Merwe, 1968: 119 (synonym according to Tseng 1983).

Amblyseius (*Proprioseiopsis*) *peltatus*.— Blommers 1976: 100.

Iphiseius punicae Gupta, 1980: 2013 (synonym according to Gupta 1985).

Proprioseiopsis punicae.— Moraes et al. 1986: 122.

Specimens examined – Cotriguaçu: *Annona* sp., I-2015 (1 female), *Handroanthus* sp., I-2015 (1 female), unidentified plant (1 female).

Remarks: *Proprioseiopsis cannaensis* was considered junior synonym of *P. ovatus* by Denmark & Evans (2011). However, Moraes & McMurtry (1983) measured and illustrated the spermathecae of holotypes of both species, reporting the following differences: *P. cannaensis* having calyx short (13 µm) and progressively increasing in diameter towards the base, and *P. ovatus* having calyx long (22 µm) and somewhat constricted medially. The specimens collected the shape of the calyx is most similar to the illustration provided by Moraes & McMurtry (1983) for *P. cannaensis*, 15 µm long. In our experience along the years, mites of this group collected in the American continent most often have calyx of the *P. cannaensis* type. Hence, studies to confirm or not that proposed synonymy should be conducted. Ideally, priority should be given to collect new specimens from the respective type localities. There would be no problem in this regard concerning *P. cannaensis*, whose type locality is Winter Haven, Florida, USA. However, the type locality of *P. ovatus* is not adequately known, as it was described from a single specimen intercepted in quarantine at Brownsville, Texas, USA, on plants imported from Ecuador. Hence, an effort should be made to determine more precisely the source of that specimen. This is the first record of this species for Mato Grosso State, Brazil.

***Proprioseiopsis neotropicus* (Ehara)**

Amblyseius neotropicus Ehara, 1966: 133.

Proprioseiopsis neotropicus.— Moraes et al. 1986: 119.

Specimens examined – Cotriguaçu: *Byrsonima* sp., I-2015 (1 female).

***Typhlodromalus aripo* De Leon**

Typhlodromalus aripo De Leon, 1967: 21.

Amblyseius aripo.— Moraes & McMurtry 1983: 132.

Specimens examined – Cotriguaçu: *Inga* sp., I-2015 (1 female).

Phytoseiinae

***Phytoseius intermedius* Evans & MacFarlane**

Phytoseius (*Dubininellus*) *intermedius* Evans & MacFarlane, 1962: 588.

Phytoseius (*Phytoseius*) *intermedius*.— Ehara 1972: 170.

Phytoseius intermedius.— Moraes et al. 2004: 242.

Phytoseius (*Phytoseius*) *yira* Pritchard & Baker 1962: 227 (synonymy according to Denmark 1966).

Specimens examined – Sinop (area 2): *B. excelsa*, IX-2016 (3 females).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

***Phytoseius kaapre* Demite, Lofego & Feres**

Phytoseius kaapre Demite et al. 2008b: 22.

Specimens examined – Cãceres: *Alchornea* sp., I-2015 (26 females and 14 males), *Handroanthus* sp., I-2015 (4 females and 2 males); **Cotriguaçu:** unidentified Annonaceae, I-2015 (1 female), unidentified Myrtaceae, I-2015 (2 females and 1 male), *G. americana*, I-2015 (3 females).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

Typhlodrominae

Galendromus (Galendromus) annectens (De Leon)

Typhlodromus annectens De Leon, 1958: 75.
Galendromus annectens.— Muma 1961: 298.
Galendromus (Galendromus) annectens.—
 Muma 1963: 30.

Specimens examined – Nobres: *C. brasiliense*, IV-2016 (1 female), *D. odorata*, IV-2016 (1 female).

Leonseius regularis (De Leon)

Typhloseiopsis regularis regularis De Leon, 1965: 122.

Diadromus regularis. — De Leon 1966: 100.
Chanteius regularis. — De Leon 1967: 16.
Typhlodromus regularis. — Chant & Yoshida-Shaul 1983: 1034.

Specimens examined – Cotriguaçu: *Matayba* sp. (Sapindaceae), I-2015 (9 females), *Siparuna guianensis* Aubl. (Siparunaceae), I-2015 (2 females), *S. guilleminiana*, I-2015 (6 females and 2 males), *Bauhinia* sp. (Leguminosae – Fabaceae), I-2015 (2 females), *Tabernaemontana* sp., I-2015 (1 female), *G. americana*, I-2015 (1 female); **Sinop (area 4):** unidentified plant 4, I-2015 (1 female).

Remarks: This is the first record of this species for Mato Grosso State, Brazil.

DISCUSSION

Iphiseiodes zuluagai was the most common species in this study, being recorded from 12 plant species and in five collection sites, two from the Amazon Forest biome, two from the Pantanal and one from cultivated forest grown in a region where the original vegetation was Amazon Forest. Three other species also occurred both on plants of the natural vegetation and on plants of cultivated forests: *Euseius alatus*, *E. citrifolius* and *E. concordis*. These four species

have been frequently found in Brazil, both on cultivated plants (e.g. Mineiro et al. 2004, 2009, Hernandez & Feres 2006, Rezende & Lofego 2012, Silva et al. 2012, Lofego et al. 2013, Domingos et al. 2014, Baldo et al. 2018) and on plants of the Amazon Forest (Nuvoloni et al. 2015b), Cerrado (Lofego et al. 2004, Demite et al. 2009, 2017, Rezende & Lofego 2011), and Pantanal (Mendonça et al. 2019). In Mato Grosso State, *E. alatus* was previously reported from rubber trees (Ferla & Moraes 2002), while *E. citrifolius*, *E. concordis* and *I. zuluagai* were reported from rubber trees (Feres 2000, Feres et al. 2002, Demite & Feres 2007, Daud & Feres 2013) and from plants of the Cerrado vegetation (Demite et al. 2009). *Amblyseius aerialis* was the only species reported on plants of the three biomes. *Amblyseius chicomendesi* and *I. raucara* were previously reported only from the original descriptions, from the Amazonian region, in Acre State, northwest of Mato Grosso (Nuvoloni et al. 2015b). In the present study, they were collected only in the Amazon Forest area, in Cotriguaçu (*I. raucara*) and Sinop (*A. chicomendesi*). In addition to these two, nine other species are reported for the first time in Mato Grosso. These new records of species and genera demonstrate the importance of conducting surveys to better understand the diversity of this important group of predatory mites in Central-Western region of Brazil.

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