



Record of bees and wasps (Insecta: Hymenoptera) during the dry season in a floodplain in the South Pantanal, Mato Grosso do Sul, Brazil

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Abstract. We reported the hymenopteran fauna (except Formicidae) in a floodable area in the South Pantanal, Mato Grosso do Sul, Brazil. The study was conducted in a riparian forest of the Miranda river, located in the Passo do Lontra region, Corumbá. The collection occurred in the dry season of August 2016 using different capture methods. A total of 137 individuals distributed in 18 families, 43 genera, and 64 morphospecies (10 nominal) were collected. The families with the greatest richness were Diapriidae and Ichneumonidae with 11 morphospecies each (17% of the total), followed by Platygasteridae and Braconidae with 10 and nine, respectively. Two species were newly recorded for Brazil: *Gryonoides pulchellus* Dodd, 1920 (Platygasteridae) and *Losada penai* Fritz, 1873 (Crabronidae), plus 22 new records for Mato Grosso do Sul. This study increases about 5.2% of the wasp fauna recorded in Mato Grosso do Sul, as well as for the Pantanal.

Keywords: Inventory; parasitoid; predators; riparian forest; tropical savanna.

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The Pantanal is the smallest Brazilian biome and the largest floodplain in the world with more than 110,000 km², formed by a mosaic of different phytogeographical domains and possessing great richness in terrestrial and aquatic biota (MMA 2007). A total of 65% of the Brazilian Pantanal is located in Mato Grosso do Sul, which is a hyperseasonal savanna periodically subjected to two stresses; one characterized by a dry season, and the other by prolonged floods (COSTA *et al.* 2010). This water process directly influences the availability of resources/habitats of the edaphic community, and consequently induces organisms, mainly terrestrial, to develop vertical or horizontal survival strategies (ADIS 1997; MARQUES *et al.* 2007). These processes may also indirectly influence other organisms such as bees, ants, and wasps (Hymenoptera), since species have different habits such as predators, phytophagous, pollinators, parasitoids, and galls (MELO *et al.* 2012), and therefore they are obliged to periodically explore other niches depending on the availability of resources (ADIS 1997).

Hymenoptera is a megadiverse order of insects with over 115,000 species with a worldwide distribution (SHARKEY 2007). There are approximately 10,505 species in 1,618 genera and 69 families of hymenopteran in Brazil (OLIVEIRA *et al.* 2022). Of this total, 2,464 species in 262 genera and eight families are Apoidea, with 70% of these species (1,796 in 171 genera) represented by bees (*sensu lato*) such as Andrenidae, Apidae, Colletidae, Halictidae, and Megachilidae. Wasps consequently constitute most of the known Hymenoptera for Brazil, with 6,663 species in 1,246 genera and 60 families (OLIVEIRA *et al.* 2022). However, most of these records are based on species descriptions and only a few inventories mainly performed in the Atlantic Forest and Cerrado (tropical savanna) biome in the Southeastern region (AZEVEDO *et al.* 2002, 2003, 2015; PÁDUA & ZAMPIERON 2012; PÁDUA *et al.* 2014; SILVESTRE *et al.* 2014), so there is still a great need to explore the Pantanal fauna.

The current knowledge of Hymenoptera in the state of Mato Grosso do Sul comprises about 386 species (260 nominal) in 107 genera of bees (MOURE *et al.* 2013; LIMA & SILVESTRE 2017), and at least 420 species in 286 genera of wasps (AUKO & SILVESTRE 2013; AUKO *et al.* 2017; LUZ *et al.* 2017; SHIMBORI *et al.* 2017; TRAD & SILVESTRE 2017). However, many of these records are generic identifications, and some of these are outside the Pantanal biome.

Thus, the distribution of many taxa is still unknown, and for this reason, inventories are important to establish regional fauna, as well as reveal the real distribution of species in the different phytogeographic domains (DINIZ & MORAIS 2007; OLIVEIRA *et al.* 2022). Examples of this are the Pantanal and Cerrado biomes, where inventories have significantly contributed to the Hymenoptera fauna (AUKO & SILVESTRE 2013; MOURE *et al.* 2013; AUKO *et al.* 2017; LIMA & SILVESTRE 2017; LUZ *et al.* 2017; SHIMBORI *et al.* 2017; TRAD & SILVESTRE 2017).

Both biomes are considered a “hotspot” of high biodiversity which needs conservation,

although it is one of the Brazilian biomes with the most unprotected areas by the government (MMA 2007; OLIVEIRA et al. 2017). All Brazilian biomes have been suffering from several anthropic actions which result in alterations to natural habitats and consequently in the loss of regional biodiversity (ICMBIO 2018). An example of this, the Pantanal biome has recently lost one fourth of its area due to fires, most of them caused by human actions.

This reality is already reaching the Hymenoptera diversity since five species of endemic bees are registered as being at some level of threat (ICMBIO 2018), of which *Melipona (Michmelia) rufiventris* Lepeletier, 1836 (Apidae) was recorded in Mato Grosso do Sul (LIMA & SILVESTRE 2017). Although, the Pantanal has been considered the Brazilian biome with the least species threatened with extinction, invertebrates, along with birds and continental fish, are the most worrisome (ICMBIO 2018).

These data indicate that the Pantanal has great unexplored biodiversity, therefore inventories may be important to establish the distribution limits of the species, as well as the potential focus of endemism (OLIVEIRA et al. 2017). Thus, the

objective of this study is to register the fauna of wasps and bees during the dry season in a floodable area in the South Pantanal, Mato Grosso do Sul State, Brazil.

MATERIAL AND METHODS

The study was performed in a foothold of the Universidade Federal do Mato Grosso do Sul (UFMS), located in the Passo do Lontra region (19°34'36" S, 57°01'08" W) to MS-184 road, between Corumbá and Miranda municipalities, west of Mato Grosso do Sul State, Brazil (Figure 1). This microregion is in the lower Pantanal (floodplain) at an average altitude of 90 m. It has a tropical savanna climate characterized by a drier season in winter (Aw) or summer (As), with the driest month having precipitation of less than 60 mm and is less than 4% of the total annual precipitation (KOTTEK et al. 2006). The floristic composition in the dry season is formed by grassland fields, Cerrado and Atlantic Forest vegetation, riparian forest, and some "Paradutal" which has *Tabebuia aurea* (Silva Manso) Benth. & Hook. f. ex. S. Moore (Bignoniaceae) as dominating arboreal species, but much of it periodically disappears (except part Atlantic Forest) with the floods beginning in October and ending with the ebbing in April (SOARES & OLIVEIRA

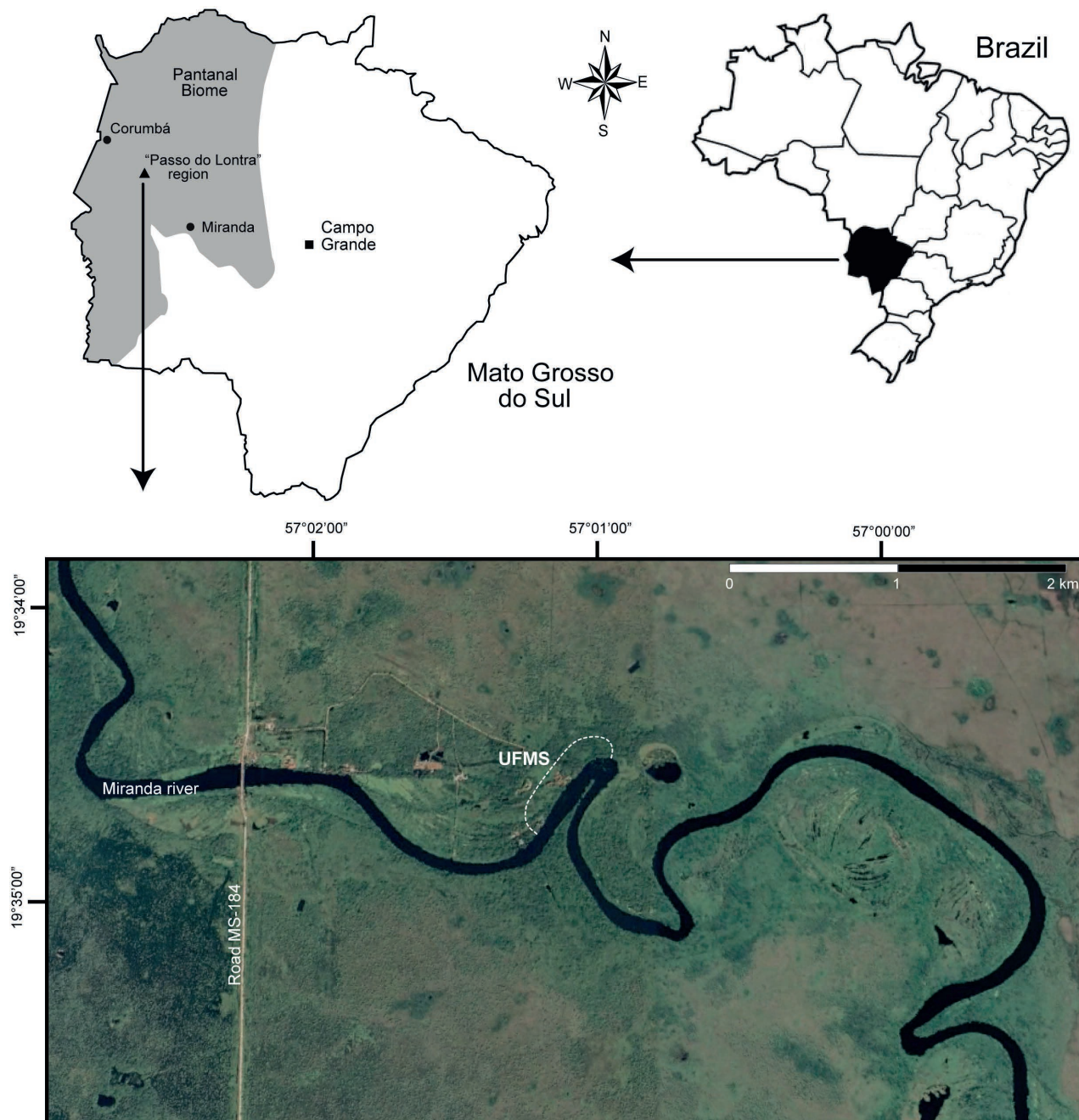


Figure 1. Geographic location where the hymenopteran specimens were collected, in foothold of the Universidade Federal do Mato Grosso do Sul - UFMS, "Passo do Lontra" region, state of Mato Grosso do Sul, Brazil. Source: Modified from Google Earth.

2009; COSTA *et al.* 2010).

The collection was made in around ("Paradutal" and riparian forest) of the Miranda river during four days in the dry season in August of 2016, using different traps: Light traps (1), Townes-style Malaise (1), Pitfall (9), and Color Plate (2 in each color: blue, green, red, yellow and white), in addition to an attractive trap using eugenol to capture bees (3), all specific methods for wasps and bees (e.g., AZEVEDO *et al.* 2003; PÁDUA & ZAMPIERON 2012; PÁDUA *et al.* 2014; SILVESTRE *et al.* 2014; LIMA & SILVESTRE 2017). The distance between the traps was about 10 m for pitfall traps, 20 m for color plates, and 50 m for attractive traps. Specimens were preserved in 70% alcohol along with the label for the collection method and then mounted on entomological pins for identification which were mostly performed by specialists (Permanent authorization of SISBIO: 23093, JAC Zequi). Specimens were photographed using a Leica M165C stereomicroscope attached to a DFC420 digital camera with a dome as shown in KAWADA & BUFFINGTON (2016). Photographs were digitally corrected using Leica Application Suite V3.4.1. Specimens are deposited at the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil, except for the specimens of Bethyliidae at Universidade Federal do Espírito Santo (UFES), Brazil; and Figitidae at the Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata (FCNyM/UNLP), Argentina. SHARKEY (2007) was consulted for the classification of wasps, and MICHENER (2007) for bees.

RESULTS

In total, 137 hymenopterans distributed in 18 families, 43 genera, and 64 morphospecies were collected, with 10 nominal species (Table 1). The families with the greatest richness were Diapriidae and Ichneumonidae with 11 morphospecies each (17% of the total), followed by Platygasteridae with 10 and Braconidae with nine species. These families together account for almost 70% (94 specimens) of the total collected in all methods, predominantly Diapriidae (30), Braconidae (24), Ichneumonidae (22), and Platygasteridae (18).

Two new records were obtained for Brazil: *Gryonoides pulchellus* Dodd, 1920 (Platygasteridae, Figure 5C) and *Losada penai* Fritz, 1973 (Crabronidae), plus 22 new records for Mato Grosso do Sul, 18 in generic level and four specifics: *Megalopta amoena* (Spinola, 1853), *Neotheronia lineata* (Fabricius, 1804), *Pimpla croceiventris* (Cresson, 1868) (Figure 4H), and *Auplopus comparatus* (Smith, 1873) (Figure 5D) (Table 1). The larger number of records were for Ichneumonidae (Figures 4C-H) with seven taxa (*Cryptanura* Brullé, 1846, *Diapetimorpha* Viereck, 1913, *Golbachella* Townes, 1970, *Lymeon* Förster, 1869, *N. lineata*, *Orthocentrus* Gravenhorst, 1829, and *P. croceiventris*), followed by Diapriidae (*Basalys* Westwood, 1883, *Daliopria* Kieffer, 1910, *Paramesius* Westwood, 1832), and Platygasteridae (*Calliscelio* Ashmead, 1893, *Calotelea* Westwood, 1837, *Duta* Nixon, 1933), both with three generic taxa. Previous records of parasitoid wasps in the state were Agaonidae (*Pegoscapus* Cameron, 1906) (Figure 2B),

Table 1. List of bees and wasps species including abundance, guilds, and different methods sampled in region of "Passo do Lontra", Pantanal South, Mato Grosso do Sul, Brazil.

Taxon	Abundance	Method	Status	Code	Guild
APOIDEA					
Apidae					
<i>Apis mellifera</i> Linnaeus, 1758	1♀	pitfall	(3, 4)	PS001/INPA	diurnal pollinators
<i>Eulaema (Apeulaema) nigrita</i> Lepeletier, 1841	1♀	attractive	(3, 4)	PS002/INPA	diurnal pollinators
<i>Trigona spinipes</i> (Fabricius, 1793)	1♀	pitfall	(3, 4)	PS003/INPA	diurnal pollinators
Halictidae					
<i>Megalopta amoena</i> (Spinola, 1853)	1♀	light trap	new record (MS)*	PS004/INPA	crepuscular pollinators
Crabronidae					
<i>Losada penai</i> Fritz, 1973	1(?)	malaise	new record (BR)*	PS005/INPA	hunters
CERAPHRONOIDEA					
Ceraphronidae					
<i>Aphanogmus</i> sp.1 (Fig. 2A)	2♀	white pan	(5)	PS006-7/INPA	endoparasitoids koinobiont or hyperparasite
<i>Aphanogmus</i> sp.2	1♀	yellow pan	(5)	PS008/INPA	endoparasitoids koinobiont or hyperparasite
<i>Ceraphron</i> sp.	1♀	white pan	new record (MS)*	PS009/INPA	koinobiont endoparasitoids or hyperparasite
CHALCIDOIDEA					
Agaonidae					
<i>Pegoscapus</i> sp. (Fig. 2B)	1♀	light trap	(1)	PS010/INPA	phytophagous
Chalcididae					
<i>Zavoya</i> sp. (Fig. 2C)	2♂	white pan	new record (MS)*	PS011-12/INPA	parasitoids (host unknown)
Encyrtidae					

to be continue...

Table 1. continue...

Taxon	Abundance	Method	Status	Code	Guild
<i>Adelencyrtus</i> sp. (Fig. 2G)	1♀	green pan	new (MS)* record	PS013/INPA	parasitoids of Diaspididae (Homoptera)
<i>Prochiloneurus</i> sp. (Fig. 2H)	1♀	malaise	new (MS)* record	PS014/INPA	parasitoids (host unknown)
Encyrtidae sp.1	1♀	red pan	-	PS015/INPA	koinobiont/idiobiont? endoparasitoid
Eulophidae					
<i>Aprostocetus</i> sp.1	1(?)	pitfall	(5)	PS016/INPA	koinobiont endoparasitoid
<i>Aprostocetus</i> sp.2 (Fig. 2E)	1♀	malaise	(5)	PS017/INPA	koinobiont endoparasitoid
<i>Horismenus</i> sp.	1(?)	pitfall	(5)	PS018/INPA	endoparasitoids presumably koinobiont
Mymaridae					
Gen.1 sp.1	1♀	malaise	-	PS019/INPA	idiobiont endoparasitoid
CHRYSIDOIDEA					
Bethylidae					
<i>Pseudisobrachium</i> sp.1 (Fig. 2F)	1♂	light trap	new (MS)* record	UFES	idiobiont ectoparasitoid
<i>Pseudisobrachium</i> sp.2	1♂	light trap	-	UFES	idiobiont ectoparasitoid
CYNIPOIDEA					
Figitidae					
<i>Leptopilina</i> sp. (Fig. 2D)	1♀	light trap	new (MS)* record	FCNyM/UNLP	koinobiont endoparasitoid
DIAPRIOIDEA					
Diapriidae					
<i>Basalys</i> sp.1	1♂	yellow pan	new (MS)* record	PS020/INPA	koinobiont endoparasitoid
<i>Basalys</i> sp.2 (Fig. 3A)	1♂, 6♀	malaise/ pitfall/ all pan	-	PS021-27/INPA	koinobiont endoparasitoid
<i>Coptera</i> sp. (Fig. 3B)	2♂	malaise/ red pan	(5)	PS028-29/INPA	idiobiont endoparasitoid
<i>Doliopria</i> sp.1 (Fig. 3C)	1♂, 1♀	malaise/ red pan	new (MS)* record	PS030-31/INPA	koinobiont endoparasitoid
<i>Doliopria</i> sp.2	3♀	pitfall/ green pan	-	PS032-34/INPA	koinobiont endoparasitoid
<i>Paramesius</i> sp. (Fig. 3D)	2♂, 4♀	malaise/ red and yellow pan	new (MS)* record	PS035-40/INPA	parasitoids (host unknown)
<i>Trichopria</i> sp.1	2♀	light trap, green pan	(5)	PS041-42/INPA	koinobiont endoparasitoid
<i>Trichopria</i> sp.2	3♀	pitfall/ yellow pan	(5)	PS043-45/INPA	koinobiont endoparasitoid
<i>Trichopria</i> sp.3	1♀	white pan	(5)	PS046/INPA	koinobiont endoparasitoid
<i>Trichopria</i> sp.4	2♀	yellow pan	(5)	PS047-48/INPA	koinobiont endoparasitoid
<i>Trichopria</i> sp.5	1♀	white pan	(5)	PS049/INPA	koinobiont endoparasitoid
ICHNEUMONOIDEA					
Braconidae					
<i>Aphaereta</i> sp.	1♀	pitfall trap	(5)	PS050/INPA	koinobiont endoparasitoid
<i>Glyptapanteles</i> sp.1 (Fig. 4A)	1♀	light trap	(5)	PS051/INPA	koinobiont endoparasitoid
<i>Glyptapanteles</i> sp.2	1♀	malaise	(5)	PS052/INPA	koinobiont endoparasitoid
<i>Heterospilus</i> sp.	1♀	white pan	(5)	PS053/INPA	idiobiont ectoparasitoid
<i>Hormius</i> sp.1	1♂	light trap	(5)	PS054/INPA	idiobiont ectoparasitoid
<i>Hormius</i> sp.2	1♀	light trap	(5)	PS055/INPA	idiobiont ectoparasitoid
<i>Peristenus</i> sp.	1♀	malaise	(5)	PS056/INPA	koinobiont endoparasitoid
<i>Phanerotoma</i> sp.	2♂, 3♀	light trap	(5)	PS057-61/INPA	koinobiont endoparasitoid
<i>Triaspis</i> sp. (Fig. 4B)	10♂	malaise/ white pan	(5)	PS062-71/INPA	koinobiont endoparasitoid
Microgastrinae unidentified	2♂	red and white pan	-	PS072-73/INPA	koinobiont endoparasitoid
Ichneumonidae					

to be continue...

Table 1. continue...

Taxon	Abundance	Method	Status	Code	Guild
<i>Cryptanura</i> sp. (Fig. 4C)	1♀	yellow pan	new (MS)* record	PS074/INPA	parasitoids (host unknown)
<i>Diapetimorpha</i> sp. (Fig. 4D)	1♂	malaise	new (MS)* record	PS075/INPA	idio- or koinobionts ectoparasitoid
<i>Golbachiella</i> sp. (Fig. 4E)	7♂	green, white and yellow pan	new (MS)* record	PS076-82/INPA	parasitoids (host unknown)
<i>Lymeon</i> sp.1	2♀	yellow pan	new (MS)* record	PS083-84/INPA	predators, idiobiont ento- and/or endoparasitoid
<i>Lymeon</i> sp.2 (Fig. 4F)	2♀	malaise/ red pan	-	PS085-86/INPA	predators, idiobiont ento- and/or endoparasitoid
<i>Neotheronia lineata</i> (Fabricius, 1804)	1♂	malaise	new (MS)** record	PS087/INPA	idiobiont ento- or ectoparasitoid
<i>Orthocentrus</i> sp.1	3♂	red and yellow pan	new (MS)* record	PS088-90/INPA	koinobiont endoparasitoid
<i>Orthocentrus</i> sp.2 (Fig. 4G)	1♀	yellow pan	-	PS091/INPA	koinobiont endoparasitoid
<i>Pimpla croceiventris</i> (Cresson, 1868) (Fig. 4H)	1♂	green pan	new (MS)** record	PS092/INPA	idiobiont endoparasitoid
<i>Ichneumoninae</i> sp.1	1♂	yellow pan	-	PS093/INPA	idio- or koinobiont endoparasitoid
<i>Ichneumoninae</i> sp.2	2♂	yellow pan	-	PS094-95/INPA	idio- or koinobiont endoparasitoid
PLATYGASTROIDEA					
Platygastridae					
<i>Calliscelio</i> sp.1	7♀	pitfall/ green and white pan	new (MS)* record	PS096-102/INPA	endoparasitoid
<i>Calliscelio</i> sp.2	1♀	white pan	-	PS103/INPA	idiobiont endoparasitoid
<i>Calotelea</i> sp. (Fig. 5A)	1♀	red pan	new (MS)* record	PS104/INPA	idiobiont endoparasitoid
<i>Duta</i> sp.1 (Fig. 5B)	2♀	blue and red pan	new (MS)* record	PS105-06/INPA	idiobiont endoparasitoid
<i>Duta</i> sp.2	1♀	pitfall	-	PS107/INPA	idiobiont endoparasitoid
<i>Gryonoides pulchellus</i> Dodd, 1920 (Fig. 5C)	1♀	white pan	new (BR)** record	PS108/INPA	idiobiont endoparasitoid
<i>Telenomus</i> sp.1	1♂, 1♀	pitfall/ yellow pan	(5)	PS109-10/INPA	idiobiont endoparasitoid
<i>Telenomus</i> sp.2	1♀	malaise	(5)	PS111/INPA	idiobiont endoparasitoid
<i>Telenomus</i> sp.3	1♀	light trap	(5)	PS112/INPA	idiobiont endoparasitoid
<i>Trissolcus</i> sp.	1♀	white pan	(5)	PS113/INPA	idiobiont endoparasitoid
POMPILOIDEA					
Pompilidae					
<i>Auplopus comparatus</i> (Smith, 1873) (Fig. 5D)	1♀	white pan	new (MS)* record	PS114/INPA	hunters
VESPOIDEA					
Vespidae					
<i>Agelaia pallipes</i> (Olivier, 1792)	4♀	light trap/ white pan/ pitfall	(2)	PS115-118/INPA	predators
TENTHREDINOIDEA					
Pergidae					
<i>Acordulecera</i> sp. (Fig. 5E)	16♂, 1♀	green, red and yellow pan	new (MS)* record	PS119-35/INPA	phytophagous

Records: ⁽¹⁾COSTA & GRACIOLI 2010; ⁽²⁾AUKO *et al.* 2017; ⁽³⁾MOURE *et al.* 2013; ⁽⁴⁾LIMA & SILVESTRE 2017; ⁽⁵⁾SHIMBORI *et al.* 2017, * new generic record, ** new specific record, (?) indeterminate sex.

Chalcididae (*Zavoya* Bouček, 1992) (Figure 2C), Eulophidae (*Aprostocetus* Westwood, 1833 (Figure 2E), *Horismenus* Walker, 1843), Figitidae (*Leptopilina* Förster, 1869) (Figure 2D), and one unidentified Mymaridae specimen. Other new records were also found for Bethylidae (*Pseudisobrachium* Kieffer, 1904) (Figure 2F), Ceraphronidae (*Ceraphron* Jurine, 1807), and Pompilidae (*Aplopus comparatus* (Smith, 1873)) (Figure 5D).

The species of registered bees were *Apis mellifera* Linnaeus, 1758, *Eulaema (Apeulaema) nigrita* Lepeletier, 1841, *Trigona spinipes* (Fabricius, 1793) (Apidae) and *Megalopta amoena* (Spinola, 1853) (Halictidae), with this last new record being for Mato Grosso do Sul.

New Records

APOIDEA

Crabronidae

Losada penai Fritz, 1973

Table 1

Material examined. BRAZIL - Mato Grosso do Sul • Corumbá, Passo do Lontra, base of the Universidade Federal do Mato Grosso do Sul; 19°34'36"S, 57°01'08"W; 92 m.; 21-25.VIII.2016; JAC Zequi & team leg.; malaise trap; 1 specimen (PS005/INPA).

Identification. *Losada penai* differs from the other species by having: 1) golden pubescence; 2) ocellar area few elevated; 3) clypeus without teeth; 4) last antennomeres slightly longer than preceding; 5) the acute tooth bearing on the posterolateral edge of the propodeum and the metascutellum teeth (FRITZ 1973).

Halictidae

Megalopta amoena (Spinola, 1853)

Table 1

Material examined. *Idem* previous labels, except light trap; 1 specimen (PS004/INPA).

Identification. According to SANTOS & SILVEIRA (2009), the female of *M. amoena* differs from all Halictidae female species by having: 1) lateral surface of metapostnotum polished, although sometimes minutely punctate; 2) posterior margin of metapostnotum straight, abruptly bending laterally toward metanotum; 3) disc of scutellum uniformly flat or very gently arcuate, dorsal surface of axilla and contiguous antero-lateral margin of scutellum on same or almost on the same plane as the disc of scutellum as seen posterior view; 4) metepisternal process, inconspicuous, narrow, without velvety pilosity; 5) longitudinal rugae of metapostnotum absent, ferruginous with metallic green hues restricted to lateral areas.

CERAPHRONOIDEA

Ceraphronidae

Ceraphron Jurine, 1807

Ceraphron sp.

Table 1

Material examined. *Idem* previous labels, except white pan trap; 1 specimen (PS009/INPA).

Identification. *Ceraphron* is a large ceraphronid genus that belongs to 186 species (ULMER et al. 2018). The genus has not been subject to taxonomic revision, so species identification is complicated (diagnostic features are dubious), it was not

possible to determine the specimen.

CHALCIDOIDEA

Chalcididae

Zavoya Bouček, 1992

Zavoya sp.

Figure 2C; Table 1

Material examined. *Idem* previous labels, except white pan trap; 2 specimens (PS011-12/INPA).

Identification. *Zavoya* is a small genus of chalcid with only three species from Neotropic (NOYES 2019). In Brazil, there are two species *Zavoya cooperi* Bouček, 1992 and *Zavoya parvula* Bouček, 1992 recorded (TAVARES 2022). It was not possible to have access to the type species of the genus and therefore it was not possible to determine the specimen.

Encyrtidae

Adelencyrtus Ashmead, 1900

Adelencyrtus sp.

Figure 2G; Table 1

Material examined. *Idem* previous labels, except green pan trap; 1 specimen (PS013/INPA).

Identification. *Adelencyrtus* are a cosmopolitan genus belongs to 45 species (NOYES 2019). In Brazil, only *A. odonaspidis* Fullaway, 1913 is recorded (COSTA & DALMOLIN 2022). The genus has not been subject to taxonomic revision in the Neotropical region, therefore the identification of this specimen is complicated.

Prochiloneurus Silvestri, 1915

Prochiloneurus sp.

Figure 2H; Table 1

Material examined. *Idem* previous labels, except malaise trap; 1 specimen (PS014/INPA).

Identification. *Prochiloneurus* belongs to 30 species in the world (NOYES 2019). In Brazil, there is only *Prochiloneurus dactylopii* (Howard, 1885) (COSTA & DALMOLIN 2022) from São Paulo state. The genus has not been subject to taxonomic revision, so species identification is complicated.

CHRYSIDOIDEA

Bethylidae

Pseudisobrachium Kieffer, 1904

Pseudisobrachium sp. 1

Figure 2F; Table 1

Material examined. *Idem* previous labels, except light trap; 1♂ (no number/UFES).

Identification. According to GOBBI & AZEVEDO (2010), this genus belongs to 141 species in Neotropical Region. These same authors made a taxonomic key to the species of the Atlantic Forest of Brazil, but this specimen differs from all steps of this key.

Pseudisobrachium sp. 2

Table 1

Material examined. *Idem* previous labels, except light trap; 1♂ (no number/UFES).

Identification. See comments above for *Pseudisobrachium* sp.1 as a whole.

CYNIPOIDEA

Figitidae

Leptopilina Förster, 1869

Leptopilina sp.

Figure 2D; Table 1

Material examined. *Idem* previous labels, except light trap; 1 specimen (no number/FCNyM/UNLP).

Identification. *Leptopilina* belongs to 32 species in the world (LUE *et al.* 2016). In Brazil, there is only *Leptopilina boulandi* (Barbotin, Carton & Kelner-Pillaut, 1979) (GALLARDO 2022) and an undetermined species (AZEVEDO *et al.* 2015). The genus has not been subject to taxonomic revision, so species identification is complicated.

DIAPRIOIDEA

Diapriidae

Basalys Westwood, 1833

Basalys sp.1

Material examined. *Idem* previous labels, except yellow pan trap; 1 specimen (PS020/INPA).

Identification. According to MASNER & GARCÍA (2002), the genus is well represented in New World and there are many undescribed species. In Brazil, the genus is recorded only to state of Espírito Santo (AZEVEDO *et al.* 2015). The genus has not been subject to taxonomic revision in the Neotropical region therefore, the identification of this specimen is complicated.

Basalys sp.2

Figure 3A; Table 1

Material examined. *Idem* previous labels, except malaise trap; 1 specimen (PS021/INPA); *idem*, except pitfall trap, 2 specimens (PS022-23/INPA); *idem*, except yellow pan trap, 2 specimens (PS024-25/INPA); *idem*, except white pan trap, 1 specimen (PS026/INPA); *idem*, except green pan trap (PS027/INPA).

Identification. See comments above for *Basalys* sp.1 as a whole.

Doliopria Kieffer, 1910

Doliopria sp.1

Figure 3C; Table 1

Material examined. *Idem* previous labels, except malaise trap; 1 specimen (PS030/INPA); *idem*, except red pan trap, 1 specimen (PS031/INPA).

Identification. *Doliopria* has a known distribution only for the New World, where eight species are known (seven in the Neotropical region) (ARIAS-PENNA 2003). In Brazil only *Doliopria collegii* Ferrière, 1929 is recorded (MARGARÍA 2022) and genus was collected in conilon coffee crops in Espírito Santo state (OLIVEIRA *et al.* 2020). This genus is little known and there is no

specific researcher to improve the identification.

Doliopria sp.2

Table 1

Material examined. *Idem* previous labels, except green pan trap; 2 specimens (PS032-33/INPA); *idem*, except pitfall trap, 1 specimen (PS034/INPA).

Identification. See comments above for *Doliopria* sp.1 as a whole.

Paramesius Westwood, 1832

Paramesius sp.

Figure 3D; Table 1

Material examined. *Idem* previous labels, except malaise trap; 3 specimens (PS035-37/INPA); *idem*, except yellow pan trap, 2 specimens (PS038-39/INPA); *idem*, except red pan trap, 1 specimen (PS040/INPA).

Identification. *Paramesius* belongs to 46 valid species in the world (CHEMYREVA & KOLYADA 2018). In Brazil only *Paramesius brasiliensis* Ferrière, 1929 is recorded (MARGARÍA 2022). There is no review of the genus to Neotropical Region, so species identification is complicated.

ICHNEUMONOIDEA

Ichneumonidae

Cryptanura Brullé, 1846

Cryptanura sp.

Figure 4C; Table 1

Material examined. *Idem* previous labels, except yellow pan trap; 1 specimen (PS074/INPA).

Identification. There are about 70 valid species in the *Cryptanura* in New World (Yu *et al.* 2016). The genus has not been subject to taxonomic revision for all species, only there is a revision from Mexican species (KASPARYAN & RUÍZ-CANCINO 2006), so species identification is complicated.

Diapetimorpha Viereck, 1913

Diapetimorpha sp.

Figure 4D; Table 1

Material examined. *Idem* previous labels, except malaise trap; 1 specimen (PS075/INPA).

Identification. According to Yu *et al.* (2016), this genus has 49 valid species in New World. There is only a taxonomic key to Mexican species (KASPARYAN & RUÍZ-CANCINO 2005), and this specimen differs from all steps of this key.

Golbachella Townes, 1970

Golbachella sp.

Figure 4E; Table 1

Material examined. *Idem* previous labels, except white pan trap; 4 specimens (PS076-79/INPA); *idem*, except yellow pan trap, 2 specimens (PS080-81/INPA); *idem*, except green pan trap, 1 specimen (PS082/INPA).

Identification. Only one species of this genus é known *Golbachella hilaris* Townes, 1970 from Paraguay, where the

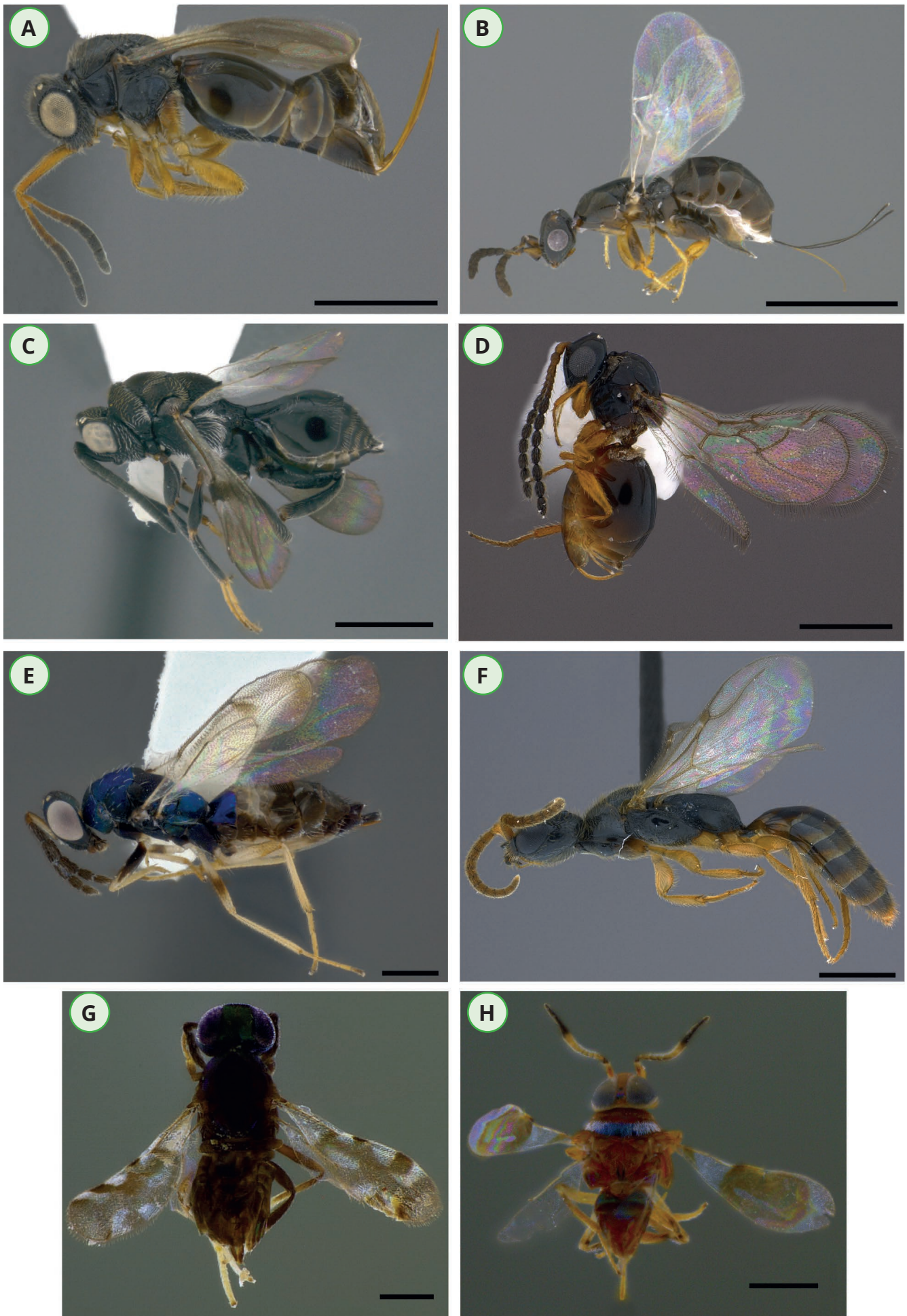


Figure 2. Specimens from different wasp's families recorded in the state of Mato Grosso do Sul. **A.** *Aphanogmus* sp.1 (Ceraphronidae), ♀. **B.** *Pegoscapus* sp. (Agaonidae), ♀. **C.** *Zavoya* sp. (Chalcididae), ♂. **D.** *Leptopilina* sp. (Figitidae), ♀. **E.** *Aprostocetus* sp.2 (Eulophidae), ♀. **F.** *Pseudisobrachium* sp.1 (Bethyliidae), ♂. **G.** *Adelencyrtus* sp. (Encyrtidae), ♀. **H.** *Prochiloneurus* sp. (Encyrtidae), ♀. Scale bars: Figs. A-C and F = 1 mm, D-E and H = 0.5 mm, G = 0.2 mm. Source: Cipola, N.G.



Figure 3. Species of Diapriidae recorded in the state of Mato Grosso do Sul. **A.** *Basalys* sp.2, ♀. **B.** *Coptera* sp., ♂. **C.** *Doliopria* sp.1, ♂. **D.** *Paramesius* sp., ♀. Scale bars: 0.5 mm. Source: Cipola, N.G.

description is based on females (Yu *et al.* 2016). The specimen in this study is a male and the color pattern is different from the original description (see TOWNES 1970).

Lymeon Förster, 1869

Lymeon sp.1

Material examined. *Idem* previous labels, except yellow pan trap; 2 specimens (PS083-84/INPA).

Identification. *Lymeon* is a large cryptine genus of generalized morphology that includes 86 species distributed in the New World (Yu *et al.* 2016). The genus has not been subject to taxonomic revision, so species identification is complicated and has to rely to direct comparison with type material.

Lymeon sp.2

Figure 4F; Table 1

Material examined. *Idem* previous labels, except red pan trap; 1 specimen (PS085/INPA); *idem*, except malaise trap, 1 specimen (PS086/INPA).

Identification. See comments above for *Lymeon* sp.1 as a whole.

Neotheronia lineata (Fabricius, 1804)

Material examined. *Idem* previous labels, except malaise trap; 1 specimen (PS087/INPA).

Identification. According to GAULD (1991), *N. lineata* differs from the other *Neotheronia* Krieger, 1899 species by having 1) body black and yellow, with a black stripe joining the lateral ocellus to the eye; 2) a ventrally rather weak epomia; 3) strongly dipped occipital carina; 4) strong median notch in the occiput; 5) female with ovipositor long and cylindrical, 1.4-1.5 times length of hind tibia.

Orthocentrus Gravenhorst, 1829

Orthocentrus sp.1

Material examined. *Idem* previous labels, except yellow pan trap; 2 specimens (PS088-89/INPA); *idem*, except red pan trap; 1 specimen (PS090/INPA).

Identification. *Orthocentrus* belongs to 48 valid species in New World (Yu *et al.* 2016). There is a taxonomic key to Neotropical species (VEIJALAINEN *et al.* 2014) and this specimen differs from all steps of this key.

Orthocentrus sp.2

Figure 4G; Table 1

Material examined. *Idem* previous labels, except yellow pan trap; 1 specimen (PS091/INPA);

Identification. See comments above for *Orthocentrus* sp.1 as a whole.

Pimpla croceiventris (Cresson, 1868)

Figure 4H; Table 1

Material examined. *Idem* previous labels, except green pan trap; 1 specimen (PS092/INPA).

Identification. This species differs mainly from other *Pimpla* species by 1) body black, except subalar prominence, tegula, scape, clypeus, palpus, and legs yellowish-white, and metasoma reddish-brown; 2) malar space 0.5-0.7 times as long as the basal mandibular width; 3) clypeal margin weakly convex; 4) laterotergites II-V narrow and inconspicuous, less than 0.2 times as long as wide; 5) female with ovipositor slightly depressed, upper valve bearing weak lateral denticles and with the valve not expanded laterally (PORTER 1970; as *Coccygomimus*).

PLATYGASTROIDEA

Platygastridae

Calliscelio Ashmead, 1893

Calliscelio sp.1

Material examined. *Idem* previous labels, except pitfall trap; 5 specimens (PS096-100/INPA); *idem*, except white pan trap, 1 specimen (PS101/INPA); *idem*, except green pan trap, 1 specimen (PS102/INPA).

Identification. There are 42 valid species of *Calliscelio* in New World included in a taxonomic key (see CHEN et al. 2017), and this specimen differs from all steps of this key.

Calliscelio sp.2

Material examined. *Idem* previous labels, except white pan trap, 1 specimen (PS103/INPA).

Identification. See comments above for *Calliscelio* sp.1 as a whole.

Calotelea Westwood 1837

Calotelea sp.

Figure 5A; Table 1

Material examined. *Idem* previous labels, except red pan trap, 1 specimen (PS104/INPA).

Identification. *Calotelea* belongs to more than 30 species globally (POPOVICI et al. 2013). The genus has not been subject to taxonomic revision in the Neotropical region, and in Brazil, there are some undetermined species (see AZEVEDO et al. 2015), and therefore, the identification of this specimen is complicated.

Duta Nixon, 1933

Duta sp.1

Figure 5B; Table 1

Material examined. *Idem* previous labels, except red pan

trap, 1 specimen (PS105/INPA); *idem*, except blue pan trap, 1 specimen (PS106/INPA).

Identification. *Duta* is a small scelionid genus with 13 species reported in the world (RAJMOHANA 2007). The genus has not been subject to taxonomic revision and in Brazil, there are some undetermined species (see AZEVEDO et al. 2015), so species identification is complicated.

Duta sp.2

Material examined. *Idem* previous labels, except pitfall trap, 1 specimen (PS107/INPA).

Identification. See comments above for *Duta* sp.1 as a whole.

Gryonoides pulchellus Dodd, 1920

Figure 5C; Table 1

Material examined. *Idem* previous labels, except white pan trap, 1 specimen (PS108/INPA).

Identification. According to MIKÓ et al. (2021), *G. pulchellus* is most similar to *Gryonoides paraguayensis* Masner & Mikó, 2021 mainly by having the glabrous medial area of lateral propodeal area and dorsal metapleural area; the long posterior propodeal projection, and the dorsally closed torular triangle. But differs from this species in the glabrous tergite III.

POMPILOIDEA

Pompilidae

Auplopus comparatus (Smith, 1873)

Figure 5D; Table 1

Material examined. *Idem* previous labels, except white pan trap, 1 specimen (PS114/INPA).

Identification. This species differs mainly from other *Auplopus* species by having: 1) body mainly blackish (except apical segments testaceous) with whitish hairiness, apical segments of antennae brownish, and hind femur reddish; 2) head and mesonotum finely punctured and metasoma shining impunctate; 3) base of propodeum with a finely striated band; 4) pygidial area polished and shining (DREIBACH 1963).

TENTHREDINOIDEA

Pergidae

Acordulecera Say, 1836

Acordulecera sp.

Figure 5E; Table 1

Material examined. *Idem* previous labels, except yellow pan trap, 12 specimens (PS119-30/INPA); *idem*, except green pan trap, 3 specimens (PS131-33/INPA); *idem*, except red pan trap, 2 specimens (PS134-35/INPA).

Identification. *Acordulecera* belongs to 60 species in New World (SCHMIDT & SMITH 2021). The genus has not been subject to taxonomic revision, so species identification is complicated.

DISCUSSION

Parasitoid wasps are the most diverse group among the Hymenoptera (MELO et al. 2012), and this probably justifies the greatest diversity recorded herein, with 52 morphospecies in

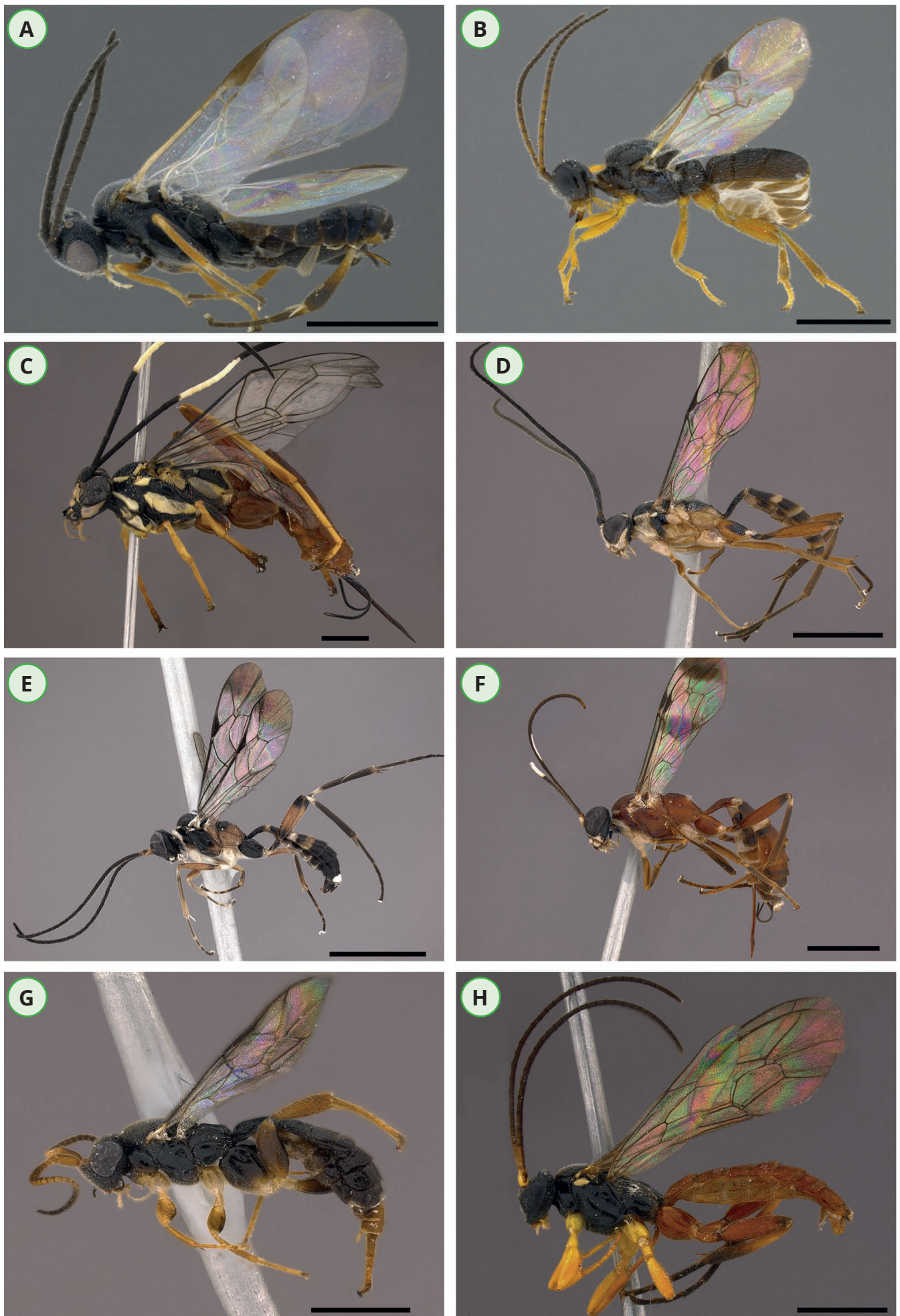


Figure 4. Species of Ichneumonoidea recorded in the state of Mato Grosso do Sul. **A.** *Glyptapanteles* sp.1. **B.** *Triaspis* sp. (Braconidae). **C.** *Cryptanura* sp. **D.** *Diapetimorpha* sp. **E.** *Golbachiella* sp. **F.** *Lyneon* sp.2. **G.** *Orthocentrus* sp.2. **H.** *Pimpla croceiventris* (Ichneumonidae). Scale bars: Figs. A-B and G = 1 mm, C-F and H = 2 mm. Source: Cipola, N.G.

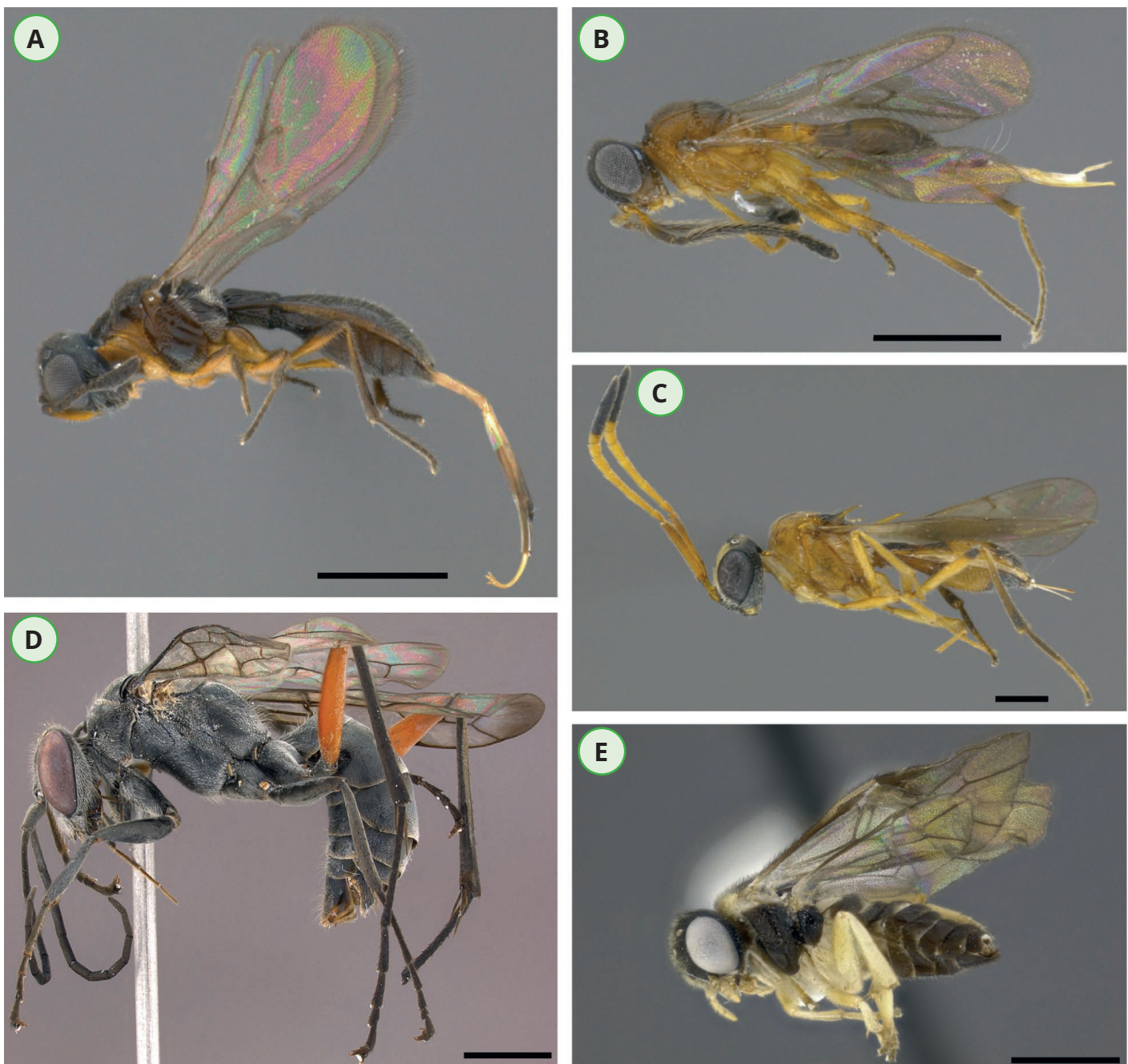


Figure 5. Species from different wasp families recorded in the state of Mato Grosso do Sul. **A.** *Calotelea* sp. (Platygastridae). **B.** *Duta* sp.1 (Platygastridae). **C.** *Gryonoides pulchellus* (Platygastridae). **D.** *Auplopus comparatus* (Pompilidae). **E.** *Acordulecera* sp. (Pergidae). Scale bars: Figs. A-C = 0.5 mm, E = 1 mm, D = 2 mm. Source: Cipola, N.G.

32 genera and 10 families distributed among Ceraphronoidea, Chalcidoidea (except Agaonidae), Cynipoidea, Diaprioidea, Ichneumonoidea, and Platygastroidea. SHIMBORI *et al.* (2017) gathered data from at least 20 locations (including collections made by the authors and published data) in Mato Grosso do Sul, and recorded 105 species in 64 genera and 18 families of parasitoid wasps, which represents double the present work. In addition, SHIMBORI *et al.* (2017) recorded 153 genera of parasitoid wasps without specific identification, of which 85% were new records for the state, while herein 52% of the genera (17 genera) were recorded for the first time. These differences are small considering the number of locations between the two studies (20 in SHIMBORI *et al.* (2017) versus a punctual collection), as well as lower sample numbers in the present study (21 samples in total).

About other Brazilian regions, PÁDUA *et al.* (2014) carried out a study in the Brazilian Cerrado in the Serra da Canastra National Park (Minas Gerais state) and collected 24 families of parasitoid wasps with a sweep net, of which the most frequent among them were Platygastridae (n= 1026), Eulophidae (n= 1209), Braconidae (n= 1203) and Encyrtidae

(n= 638). These results are similar to the present study, except for Eulophidae and Encyrtidae. Similar results to the present study were obtained in Atlantic Forest areas from Espírito Santo State with the frequency of Braconidae, Diapriidae, and Platygastridae families (AZEVEDO *et al.* 2002, 2003; ALENCAR *et al.* 2007), even with different sample standardizations between these studies. Although, the specific richness for each family was not performed in these studies cited for a proper comparison, it is evident that parasitoid wasps predominate, regardless of vegetal physiognomy. In addition, it is necessary to consider that the specific richness of many Hymenoptera groups is still unknown, especially in the Neotropical region (MASNER & GARCIA 2002; MELO *et al.* 2012), so it can still be difficult to make accurate comparisons with unidentified taxa.

Nevertheless, part of our results can be attributed to the different types of taxa guilds, which allows for different survival strategies (Table 1), and/or the seasonal period, since many hymenopteran groups can occupy all environments in drought (MELO *et al.* 2012), which is consistent with the methods used herein in soil undergrowth. In addition, Hymenoptera may have high abundance in this period,

regardless of stratification, as observed by MARQUES *et al.* (2007) in studying the arthropod fauna on treetops in Poconé Pantanal (Mato Grosso state); as well as LOPES *et al.* (2017) with malaise traps in different physiognomies of the Corumbá Pantanal (about 70 km from the present study), in which they recorded hymenopterans as one of the most representative orders in both seasons (dry and flooded), but with strong abundance in the dry season.

This season still favors resources for most of the groups sampled here, especially parasitic wasps. Chalcidoidea have a range of animal hosts including 13 orders of insects, spiders, ticks, mites, pseudoscorpions, and even nematode worms (HERATY *et al.* 2012), with most of them being well sampled in the dry season in the Poconé Pantanal (BATTIROLA *et al.* 2016, 2017). Chalcidoid wasps collected were *Aprostocetus* (Figure 2E), *Horismenus* (Eulophidae), and *Encyrtus* Latreille, 1809 (Encyrtidae) (Figure 2D), all widely distributed in Brazil (NOYES 2019). *Zavoya* (Chalcididae) (Figure 2C) is a new record, since only two species had previously been registered in Brazil; *Zavoya cooperi* Bouček, 1992, for Bahia and Minas Gerais States; *Zavoya parvula* Bouček, 1992, for São Paulo State (NOYES 2019; OLIVEIRA *et al.* 2022); and a non-nominal record from Espírito Santo State (TAVARES & ARAUJO 2007).

Some wasp groups sampled herein are parasitoids of Diptera larvae, which are common taxa in Pantanal studies (MARQUES *et al.* 2007; LOPES *et al.* 2017). These wasps are *Aphanogmus* Thomson, 1858 (Figure 2A), *Ceraphron* (Ceraphronidae), and *Leptopilina* (Figitidae) (GUIMARÃES *et al.* 2004; JOHNSON & MUSETTI 2004). *Aphanogmus* has three nominal species with occurrence for the Neotropics, but none recorded in Brazil (JOHNSON & MUSETTI 2004), although *Aphanogmus* specimens are often not identified (LOIÁCONO & MARGARÍA 2002). *Ceraphron* corresponds to a new record for Mato Grosso do Sul, and is of extreme importance, since only *Ceraphron sylviae* Dessart, 1981, has been recorded in Brazil for Mato Grosso and Amazonas States (DESSART 1981; LOIÁCONO & MARGARÍA 2002). *Leptopilina* also only previously had one nominal species registered in Brazil, so it is also a new record (OLIVEIRA *et al.* 2022).

The presence of *Pseudisobrachium* (Bethyidae) (Figure 2F) sampled herein can be explained because it is an abundant genus and diverse in Atlantic Forest areas (AZEVEDO *et al.* 2006; MUGRABI *et al.* 2008). It currently has 60 species recorded in Brazil (AZEVEDO & LANES 2010; OLIVEIRA *et al.* 2022), but this scenario is certainly present in the other Brazilian biomes such as the Pantanal. The other is because bethyid larvae are primary idiobiont ectoparasitoids, so females attack different hosts such as larvae from different Coleoptera and Lepidoptera families, with both groups being frequent in the Pantanal regardless of the season and vegetal domains (MARQUES *et al.* 2007; LOPES *et al.* 2017).

In this same sense, many Ichneumonoidea taxa (Braconidae and Ichneumonidae) are parasitoids from different Lepidoptera families (e.g., Gelechiidae, Noctuidae, Psychidae) and Coleoptera (TOWNES & TOWNES 1966; SHARKEY 1997; BISOTTO-DE-OLIVEIRA *et al.* 2007; YU *et al.* 2012; QUICKE 2015; BROAD *et al.* 2018) or even Diptera (VEIJALAINEN *et al.* 2014), all constituting frequent groups in a study carried out in a flooded region of the Pantanal (MARQUES *et al.* 2007); however, it is necessary to consider that Ichneumonoidea has the greatest diversity within Hymenoptera with more than 44,000 valid species (YU *et al.* 2012).

Braconidae has about 900 species in more than 200 genera in Brazil (OLIVEIRA *et al.* 2022), of which 85 genera were recorded in Mato Grosso do Sul (SHIMBORI *et al.* 2017). Thus, the five genera recorded herein (Table 1) have already been reported for the Pantanal region. Among them, *Triaspis* Haliday, 1835 (Figure

4B) and *Phanerotoma* Wesm., 1838 are the most abundant genera obtained in this work, with 10 and five specimens respectively. *Triaspis* is a very common and speciose genus with more than a hundred species described, and it is known to parasitize Bruchinae (Chrysomelidae) and Curculionidae beetles (SHARKEY 1997), both frequent groups in a study carried out in a flooded Pantanal region (MARQUES *et al.* 2007), and therefore its presence may be related. *Phanerotoma* has about 200 species described (YU *et al.* 2012) and is commonly more abundant during dry seasons (SHAW 1997), which were when the samples of this work were taken.

Ichneumonidae is among the more diverse families in Brazil with 952 species in 227 genera, of which only 11 species in six genera were recorded in Mato Grosso do Sul State (SHIMBORI *et al.* 2017; OLIVEIRA *et al.* 2022). Nominal ichneumonids sampled herein such as *Neotheronia lineata* (Fabricius, 1804) and *Pimpla croceiventris* (Cresson, 1868) (Figure 4H) are widespread and frequently found from tropical Mexico southwards to Uruguay (GAULD 1991; OLIVEIRA *et al.* 2022). Both species are known from the south and southeast regions in Brazil, except *P. croceiventris* which includes Pará State (OLIVEIRA *et al.* 2022). According to observations in a seasonally dry forest site from Costa Rica (GAULD 1991), *P. croceiventris* is active throughout much of the dry season and was only not found at the very end of this period.

Orthocentrus (Orthocentrinae) (Figure 4G), as well as all Cryptinae genera (*Cryptanura*, *Diapetimorpha*, *Golbachella*, *Lymeon*), recorded herein for the first time in Mato Grosso do Sul, are predominant in the Neotropical region (VEIJALAINEN *et al.* 2014; BROAD *et al.* 2018). *Orthocentrus* has 28 species in Neotropics (VEIJALAINEN *et al.* 2014), but there are only two records of the species for Santa Catarina State, Brazil (OLIVEIRA *et al.* 2022). *Cryptanura* and *Lymeon* (Figures 4C, F) has about 80 valid species (YU *et al.* 2012), of which 15 were widely recorded in eight Brazilian States (OLIVEIRA *et al.* 2022). *Cryptanura* species occur in woods and shrubby places (TOWNES 1970; KASPARYAN & RUIZ-CANCINO 2006), while *Lymeon* females attack small cocoons of various insects and egg sacs of spiders (TOWNES 1970), which was the typical and favorable environment (i.e., BATTIROLA *et al.* 2016; MARQUES *et al.* 2007) for both taxa in the present study. *Diapetimorpha* (Figure 4D) has 50 valid species (YU *et al.* 2012), of which nine are registered in Amazonas, Rio de Janeiro, and Santa Catarina States (OLIVEIRA *et al.* 2022). *Golbachella* (Figure 4E) is a monotypic genus from Paraguay (YU *et al.* 2012) and also recorded in Espírito Santo State (AZEVEDO *et al.* 2015), so this species probably has wide distribution in Capricorn Tropics in South America.

The new generic records of Diapriidae (*Basalys*, *Doliopria*, and *Paramesius*) and Platygastriidae (*Calliscelio*, *Calotelea*, and *Duta*) exactly characterize the scarcity in the distribution knowledge of many family taxa in Brazil. *Basalys* (Figure 3A) have 154 described species in America (JOHNSON 1992), considered parasitoids of Diptera, and there are some individuals collected in ant nests (NOTTON 1991), as well as *Paramesius* (Figure 3D) (hosting *Eciton* Latreille, 1804 ants) and *Doliopria* (FERRIÈRE 1929; LOIÁCONO & MARGARÍA 2002). Other diapriids such as *Coptera* Say, 1836 and *Trichopria* Ashmead, 1893 are also parasitoids of Diptera and have great tropical richness (MASNER 2006), both with few species registered in Brazil (JOHNSON 1992; OLIVEIRA *et al.* 2022).

Other Platygastriidae such as *Telenomus* Haliday, 1833 and *Trissolcus* Ashmead, 1893 species can parasitize eggs of Hemiptera and Noctuidae lepidopterans (NARENDHAN 2001; FARIAS *et al.* 2012; BARLOGGIO *et al.* 2019; TOGNON *et al.* 2019), as well as *Calliscelio* in cricket eggs (Orthoptera, Gryllidae) (HILL 1983), all generally abundant in the dry season (MARQUES *et al.* 2007; LOPES *et al.* 2017). In contrast, there is no information on the biology of *G. pulchellus*, whose species certainly has wide

Neotropical distribution, previously collected in Mexico (type locality), Nicaragua, Venezuela (Dodd 1920; Masner 1995; Van Noort 2020), and now in Brazil.

The availability of soil during the dry season may also be indicative of the records of predators, hunters, and phytophagous wasps in the present study, with most being collected with pan traps. The predator wasp is *Agelaia pallipes* (Olivier, 1792) (Vespididae), and hunting wasps are *L. penai* (Crabronidae) and *A. comparatus* (Pompilidae, Figure 5D).

Trad & Silvestre (2017) used different collection methods in 22 sites (three in the Pantanal biome) of Mato Grosso do Sul (including Miranda river) and recorded 372 individuals distributed in 85 species and 38 genera of Crabronidae, but none species of *Losada* Pate, 1940 was collected in this study, so this diverse little genus with three species is probably rare (Amarante 2002). Thus, *L. penai* (until then only known by the type locality of Paraguay) now happens to be the second species of the genus registered in the country (Bohart & Menke 1976; Amarante 2002; Oliveira et al. 2022). The habitat of *Losada* species is still little known, but crabronid species build their nests with mud where they usually store several relatively small spiders which will be consumed later by her brood (Gonzaga 2010), and until now apparently having only been found in preserved environments of the Amazon and Pantanal biomes (Amarante 2002). Furthermore, the *Agelaia pallipes* social wasp has the habit of making its nests in soil cavities (Somavilla et al. 2012) and was also previously registered in the Pantanal dry season (Auko et al. 2017), as well as in the larger part of Brazil (Oliveira et al. 2022). *Auplopus comparatus* is exclusively a hunter of spiders, generally of species associated with the ground (e.g., Ctenizidae, Lycosidae, Teraphosidae). These wasps also nest and provide their prey for their larvae if they feed (Gonzaga 2007). However, the new record of *A. comparatus* may be because this species is widely distributed, present in Costa Rica, Guyana, and Trinidad (Fernández 2000; Oliveira et al. 2022).

Acordulecera (Pergidae) (Figure 5E) and *Pegoscopus* (Agaonidae) (Figure 2B) were two species of phytophagous wasps (Heraty et al. 2012; Schmidt & Smith 2021) sampled herein. The presence of *Acordulecera* may be explained because the sampling in the present study occurred during the dry period of the Pantanal, exactly when shrub vegetation is more exposed and propitiates the oviposition, fixation, and feeding of the larvae, as well as soil availability, because the larvae are buried after the final molting (Schmidt & Smith 2021). However, it is necessary to consider that this genus is exclusive and widely distributed in the Neotropical region, currently with 59 species (but estimated to exceed 100 species), of which 30 were recorded in Brazil (Schmidt & Smith 2021; Oliveira et al. 2022). *Pegoscopus* is one native Neotropical genus specialized in the pollination of *Ficus* (Bouček 1993). A total of 3,617 specimens of *Pegoscopus* associated with syconia of *Ficus citrifolia* Miller, were collected in Mato Grosso do Sul, with this being the first study with this type of association for the region (Costa & Gracioli 2010).

Although the diversity of wasps is certainly higher and more sampled in the present study, the number of bee species known to Mato Grosso do Sul indicates that this group is best studied at this moment (Auko & Silvestre 2013; Moure et al. 2013; Auko et al. 2017; Lima & Silvestre 2017; Luz et al. 2017; Shimbori et al. 2017; Trad & Silvestre 2017).

Lima & Silvestre (2017) gathered data of 38 locations (including collections made by the author and published data) in Mato Grosso do Sul and recorded 180 species in 64 genera of Apinae, and 58 species in 17 genera of Halictinae. Therefore, the bee fauna recorded herein is not drastically lower considering the punctual collection of the present study,

although this number could have been higher if the sampling effort had been more intense in number of days and/or traps. In addition, Brazilian bee fauna is generally well known, and therefore the three Apidae species collected herein were previously registered for Mato Grosso do Sul (Lima & Silvestre 2017). On the other hand, *Megalopta amoena* (Spinola, 1853) (Halictidae) was registered for the first time in the state. This species probably should not be common in Mato Grosso do Sul (and probably in the Pantanal), since it was not found among the 58 species of Halictidae present in the state (Lima & Silvestre 2017), although it is widely distributed with records in seven Neotropical countries, now including 11 Brazilian states (Moure et al. 2013).

Despite these differences related to the number of locations, methods, and sample effort, inventories such as these are important to increase the knowledge of generic diversity at least on a regional scale, precisely because several groups of hymenopterans predominate in the lower environments of the soil undergrowth.

The present study demonstrated that small hymenopteran inventories may reveal unknown regional diversity since the study increased slightly more than 5% of wasp fauna for Mato Grosso do Sul, as well as for the Pantanal phytogeographical domain. Thus, these data favor the distribution of some unknown species until now for this region of Brazil, although many taxa still need to be determined/described at a specific level so that the local fauna is properly revealed, and consequently used in future comparisons, diversity analyzes, and possible endemic studies.

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