Forensic Entomology

New records of Sarcophagidae (Insecta: Diptera) collected in Cerrado fragments in the municipality of Campo Grande, Mato Grosso do Sul state, Brazil

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Abstract. Collections carried out for a period of 10 weeks from October to December 2013 in two fragments of Cerrado (experimental farm of Embrapa Gado de Corte and Private Reserve of Natural Heritage belong to the Universidade Federal de Mato Grosso do Sul (RPPN-UFMS)) located in the municipality of Campo Grande, state of Mato Grosso do Sul, Midwestern Brazil, with traps baited with decomposing beef liver, and collections conducted for a period of 15 days in January 2014 in the RPPN-UFMS, using Shannon traps baited with dog corpses, resulted in 32 flesh fly species of eight genera, with the first record of the genus Blaesoxipha and 15 new species records to Mato Grosso do Sul.

Keywords: Brazilian Savannah; Dogs’ Corpses; Flesh flies; Muscomorpha; Oestroidea.

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Sarcophagidae or flesh flies (Diptera) have worldwide distribution and about 3,100 described species (Pape et al. 2011). At least 800 species are known from Neotropical Region (Pape 1996; Mello-Patiu et al. 2014). Flesh flies are mainly attracted to decaying organic material, feces, carrion and corpses, and their larvae breed on these substrates (Dias et al. 1984a; D’Almeida & Lima 1994; Mello-Patiu et al. 2009). Many species are adapted to environments modified by human (D’Almeida 1983; Dias et al. 1984b) and are ecologically and forensically important as decomposers of decaying organic matter and as potential indicators of post-mortem interval (Oliveira-Costa et al. 2001). Some species are of medical and sanitary importance, either as vectors of human and animal diseases, or as producers of myiasis (Guimarães et al. 1983).

The Sarcophagidae are divided into three subfamilies: Miltogramminae, Paramacrorychini and Sarcophaginae. Miltogramminae are uncommon in South America, and most species are known as kleptoparasites of Hymenoptera. Most Paramacrorychini are distributed in the non-tropical part of the Northern Hemisphere, while few species occur in the Southern Hemisphere, and only one species is endemic to the Neotropical Region. Some members of this subfamily are parasitoids or predators of other insects, and there are records of species bred from pulmonate snails and rotting tortoise eggs. Sarcophaginae is the largest subfamily in number of genera and species in the Neotropical Region. This subfamily is biologically diverse and exhibits a wide variety of life habits, including species that are saprophagous, necrophagous, coprophagous, parasitoids of insects, and predators of invertebrates. Some species can cause myiasis (Pape 1996).

Sarcophagidae can usually be distinguished from all other Oestroidea by the following combination of characters: thorax with three longitudinal black stripes on the mesonotum, notopleuron with two or four bristles (two large and two small), meron with bristles, subscutellum weakly developed, abdomen checker, abdominal sternites 1 and 2 exposed and overlapping the sides of the respective tergites in males (Shewell 1987; Mello-Patiu et al. 2009). The external morphology of the Sarcophagidae is quite uniform or vary too much and few characters can be used safely for species identification. Identification is based mainly on the structures of the male terminalia (Carvalho & Mello-Patiu 2008; Mello-Patiu et al. 2009; Pape & Damle 2010; Vairo et al. 2011).

Despite the Sarcophagidae being the second family in number of species among the Oestroidea and presenting species of ecological, forensic, and medical-sanitary importance, the family is little studied worldwide, not excluding the Neotropical Region, where there are gaps in knowledge about aspects of its biology, taxonomy and
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systematics (Mello-Patiu et al. 2017). In the same way, works on checklist and inventory of flesh fly species, which could potentially contribute to forensic, biodiversity, biogeography, and conservation policies studies, are little performed in the Neotropical Region (Lopes & Tibana 1982; Mello-Patiu et al. 2017). Knowledge of the Sarcophagidae from the state of Mato Grosso do Sul is still scarce and only 35 species are recorded from this state (Pape & Mello-Patiu 2006; Mello-Patiu & Salazar-Souza 2016; Mulieri et al. 2017; Mello-Patiu et al. 2017; Toma et al. 2017; Santos & Mello-Patiu 2018), which demands more collections in this region.

Considering the absences of studies in Mato Grosso do Sul and the importance of checklists and inventories as support for several research areas, the aim of this study is to present an updated checklist of the Sarcophagidae species from Mato Grosso do Sul, in order to broaden the knowledge of the regional fauna.

MATERIAL AND METHODS

The municipality of Campo Grande has a total area of 8,118.4 km² and is located geographically in the central region of the state of Mato Grosso do Sul, Brazil (Figure 1). According to the Köppen classification, the climate varies between Cfa (humid mesothermal subtype with no dry season) and the Aw (tropical wet and dry subtype with rainy summer and dry winter); most of the precipitation falls between October and April and low frequency of precipitation occur between June and August.

The present study was conducted in two fragments of Cerrado in the municipality of Campo Grande: a riparian forest remnant near the headquarters of the experimental farm of Embrapa Gado de Corte (20°27’S, 54°37’ W - 530 m) (Figure 2) and a Private Reserve of Natural Heritage belonging to the Universidade Federal de Mato Grosso do Sul (RPPN-UFMS) (20°30’S, 54°36’W - 600 m) (Figure 3). Samples were taken weekly for a period of 10 weeks from October to December 2013 in the two above-mentioned areas. Simultaneously in each area, three traps similar to those of Luiz et al. (2012) were used, baited with about 150 g of bovine liver decomposed outdoors for 48 hours (the baits were replaced weekly). The traps were installed in trees about 1.40 m above the ground and 100 m away from each other. Another part of the samples was carried out using Shannon traps baited with dog carcasses at two collection points in the RPPN-UFMS in 2014 (January 12th - 26th), collected by Rodrigues et al. (2019).

Flies were killed using ethyl acetate and then placed in 70% alcohol. Only males were identified. Male terminalia was exposed to facilitate identification up to the species level. Preliminary identification of the genera and of some species was carried out using keys provided by Carvalho & Mello-Patiu (2008), Buenaventura & Pape (2013), Vairo et al. (2011) e Vairo et al. (2014). Subsequently, samples of the material were sent to Dr. C Mello-Patiu (Museu Nacional/UFRJ), for confirmation and identification up to the species level.

Voucher specimens were deposited at the Zoological Collection of the Universidade Federal de Mato Grosso do Sul (ZUFMS) and at the Diptera Collection of the Museu Nacional/UFRJ (part of the deposited vouchers was lost in the fire of the Museu Nacional).

This checklist update follows classifications proposed by Pape (1996) and Buenaventura & Pape (2013). Species are listed according to Mello-Patiu et al. (2017), including information on type-locality and previous distribution. Additional information on substrate preference and synanthropy were mentioned, when available in the literature.

RESULTS AND DISCUSSION

A total of 8,580 individuals (3,626 males and 4,952 females) were collected using traps baited with bovine liver, and 319 individuals (157 males and 162 females) were collected...
Figure 1. Photo (satellite - Google Earth) Riparian forest remnant near the headquarters of the experimental farm of Embrapa Gado de Corte.

Figure 1. Photo (satellite - Google Earth) Private Reserve of Natural Heritage of the Universidade Federal de Mato Grosso do Sul (RPPN-UFMS).
Thirty-two species belonging to eight genera of Sarcophagidae were identified based only on the male (Table 1). Fifteen species are recorded for the first time from Mato Grosso do Sul: *Blaesoxipha (Acanthodotheca) brazil*, *Blaesoxipha e-ISSN 1983-0572
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with Shannon traps containing dog carcasses. Prior to the present study, 35 species were recorded from Mato Grosso do Sul. Except for *Metopia paucicerta* Dodge belonging to the subfamily Miltogramminae, all other recorded species belong to the subfamily Sarcophaginae: *Dexosarcophaga amphullula* (Engel), *Dexosarcophaga globolosa* Lopes, *Engelmiyia inops* (Walker), *Helicobia marionella* (Aldrich), *Helicobia pilifera* (Lopes), *Lepidodexia (Asilidodexia) elegans* (Lopes), *Lepidodexia (Asilidodexia) matrogrossensis* (Lopes), *Lipoptilocnema crispula* (Lopes), *Lipoptilocnema salobrensis* Lopes, *Oxysarcodexia amorosa* (Schiner), *Oxysarcodexia angrensis* (Lopes), *Oxysarcodexia avuncula* (Lopes), *Oxysarcodexia confusa* Lopes, *Oxysarcodexia fringidea* (Curran & Walley), *Oxysarcodexia parva* Lopes, *Oxysarcodexia thornax* (Walker), *Oxyvinia excisa* (Lopes), *Peckia (Euboettcheria) collusor* (Curran & Walley), *Peckia (Pattonella) intermutans* (Walker), *Peckia (Peckia) enderleini* (Engel), *Peckia (Sarcodexia) lambens* (Wiedemann), *Peckia (Squamodotes) ingens* (Walker), *Ravinia advena* (Walker), *Ravinia almeidai* (Lopes), *Retrocitomyia fluminensis* Lopes, *Retrocitomyia retrocita* (Hall), *Retrocitomyia mizuguchiana* Tibana & Xerez, *Retrocitomyia sibiota* Mello-Patiu & Salazar-Souza, *Titanogrypa cryptopyga* (Lopes), *Tricharaea canuta* (Wulp), *Tricharaea indonata* (Lopes), *Tricharaea occidua* (Fabricius), *Udamopyga percita* (Lopes), and *Udamopyga setigena* (Enderlein) (Pape & Mello-Patiu 2006; Mello-Patiu & Salazar-Souza 2016; Mulieri et al. 2017; Mello-Patiu et al. 2017; Toma et al. 2017; Santos & Mello-Patiu 2018).

### Table 1. Absolute and relative frequencies of each species of Sarcophagidae collected with traps baited with bovine liver in the experimental farm of Embrapa Gado de Corte and Private Reserve of Natural Heritage of the Universidade Federal de Mato Grosso do Sul (RPPN-UFMS), Campo Grande, Brazil, and with dog carcass in the RPPN-UFMS, and new records from Mato Grosso do Sul state, Brazil.

| Espécies                          | Absolute Freq. Bovine liver | Relative Freq. Bovine liver | Absolute Freq. Dog carcass | Relative Freq. Dog carcass | New records from Mato Grosso do Sul |
|----------------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|-----------------------------------|
| *Blaesoxipha (Tephromyia) convena* | 0                           | 0                          | 1                           | 0.64                       | X                                 |
| *Blaesoxipha (Acanthodotheca) brazil* | 1                           | 0.03                      | 0                           | 0                          | X                                 |
| *Engelmiyia inops*               | 1                           | 0.03                      | 0                           | 0                          |                                   |
| *Helicobia aurescens*            | 2                           | 0.06                      | 1                           | 0.64                       | X                                 |
| *Helicobia pilifera*             | 1                           | 0.03                      | 0                           | 0                          |                                   |
| *Lipoptilocnema crispula*        | 3                           | 0.08                      | 0                           | 0                          |                                   |
| *Lipoptilocnema salobrensis*     | 3                           | 0.08                      | 0                           | 0                          |                                   |
| *Oxysarcodexia admixta*          | 43                          | 1.18                      | 14                          | 8.91                       | X                                 |
| *Oxysarcodexia angrensis*         | 79                          | 2.18                      | 0                           | 0                          |                                   |
| *Oxysarcodexia amorosa*          | 13                          | 0.36                      | 3                           | 1.91                       |                                   |
| *Oxysarcodexia avuncula*         | 15                          | 0.41                      | 1                           | 0.64                       |                                   |
| *Oxysarcodexia carvalhoi*        | 24                          | 0.66                      | 2                           | 1.27                       | X                                 |
| *Oxysarcodexia diana*            | 34                          | 0.93                      | 3                           | 1.91                       | X                                 |
| *Oxysarcodexia meridionalis*      | 26                          | 0.72                      | 0                           | 0                          | X                                 |
| *Oxysarcodexia mineirensis*       | 5                            | 0.14                      | 0                           | 0                          | X                                 |
| *Oxysarcodexia occulta*          | 1                            | 0.03                      | 0                           | 0                          | X                                 |
| *Oxysarcodexia parva*            | 0                            | 0                         | 2                           | 1.27                       |                                   |
| *Oxysarcodexia thornax*          | 2,575                       | 70.98                     | 73                          | 46.50                      |                                   |
| *Oxysarcodexia xanthosoma*        | 9                            | 0.25                      | 0                           | 0                          | X                                 |
| *Peckia (Euboettcheria) anguilla* | 12                          | 0.33                      | 0                           | 0                          | X                                 |
| *Peckia (Euboettcheria) collusor* | 89                          | 2.45                      | 2                           | 1.27                       |                                   |
| *Peckia (Pattonella) intermutans* | 29                          | 0.80                      | 0                           | 0                          |                                   |
| *Peckia (Peckia) chrysostoma*     | 348                         | 9.59                      | 0                           | 0                          | X                                 |
| *Peckia (Peckia) enderleini*      | 73                          | 2.01                      | 0                           | 0                          | X                                 |
| *Peckia (Peckia) pexata*          | 67                           | 1.85                      | 0                           | 0                          | X                                 |
| *Peckia (Sarcodexia) florencioi*  | 2                            | 0.06                      | 0                           | 0                          | X                                 |
| *Peckia (Sarcodexia) lambens*     | 114                         | 3.14                      | 30                          | 19.11                      |                                   |
| *Peckia (Squamodotes) ingens*     | 25                           | 0.69                      | 1                           | 0.64                       |                                   |
| *Ravinia advena*                 | 1                            | 0.03                      | 1                           | 0.64                       |                                   |
| *Ravinia belforti*               | 28                           | 0.77                      | 23                          | 14.65                      | X                                 |
| *Udamopyga percita*              | 1                            | 0.03                      | 0                           | 0                          |                                   |
| *Udamopyga setigena*             | 1                            | 0.03                      | 0                           | 0                          |                                   |

**Sarcophagidade total (machos)** | **3,628** | **100.00** | **157** | **100.00** |
(Tephromyia) convena, Helicobia aurescens (Townsend), Oxysarcodexia admixta (Lopes), Oxysarcodexia carvalhoi Lopes, Oxysarcodexia diana (Lopes), Oxysarcodexia mineirensis Souza & Paseto, Oxysarcodexia meridonialis (Engel), Oxysarcodexia occulta Lopes, Oxysarcodexia xanthosoma (Aldrich), Peckia (Euboeotrichia) anguilla (Curran & Walley), Peckia (Pecki) chrysostoma (Wiedemann), Peckia (Pecki) pexata (Wulp), Peckia (Sarcodexia) florencioi (Prado & Fonseca), and Ravinina belforti (Prado & Fonseca). The new records increased the number of known species to 50 in Mato Grosso do Sul.

Oxysarcodexia showed the highest number of species collected with traps baited with bovine liver and dog carcass, with 11 and seven species respectively, followed by Peckia, with nine and three species, resulting in seven and four new records respectively for each genus from Mato Grosso do Sul. Prior to the present work, these genera were the most diverse in this state, with seven and five species respectively (Mello-Patiú et al. 2017; Tomá et al. 2017). Mello-Patiú et al. (2017) assumed that Oxysarcodexia and Peckia were undersampled in Mato Grosso do Sul, since 23 and 14 species were recorded, respectively, for each genus from other areas of the Brazilian Cerrado. Oxysarcodexia thornax was the most abundant species, with 2,575 and 73 specimens collected with traps baited with bovine liver and dog carcass, corresponding to 70.98% and 46.50%, respectively, of the collected males. These results agreed with those showed by Barros et al. (2008) and Rosa et al. (2011), who studied the entomofauna associated with the domestic pig carcasses in Cerrado areas of the Distrito Federal and the state of Minas Gerais, respectively, in which Oxysarcodexia showed the highest number of species among the Sarcophagidae and O. thornax was the most abundant species. This may be related to the large size of this genus and the attraction of its species to different types of baits (Mello-Patiú et al. 2017).

Among the new records from Mato Grosso do Sul, H. aurescens, O. admixta, O. diana e P. (E.) anguilla, P. (P.) chrysostoma, P. florencioi, P. pexata, and R. belforti have already been collected from domestic pig carcasses in the Cerrado areas of the Distrito Federal and the state of Minas Gerais (Barros et al. 2008; Rosa et al. 2011; Mello-Patiú et al. 2014; Faria et al. 2017), and O. carvalhoi, O. meridonialis, O. mineirensis, O. occulta, O. xanthosoma, and P. florencioi, in Cerrado areas of Minas Gerais (Rosa et al. 2011; Mello-Patiú et al. 2014; Souza & Paseto 2015; Faria et al. 2017).

Two species herein collected [Peckia chrysostoma (Wiedemann) and R. belforti] have already been registered on human corpses in Brazil, and have potential importance as forensic indicators, like other species previously recorded from Mato Grosso do Sul, such as O. angrensis, O. thorax, P. (P.) intermutans, and P. (S.) lombens (Carvalho et al. 2000; Oliveira-Costa et al. 2001; Oliveira & Vascconcelos 2010; Vasconcelos et al. 2014).

Mello-Patiú et al. (2017), in their checklist of the Sarcophagidae from Mato Grosso do Sul, could not confirm the records of seven species from this state [H. morionella; O. confusa; P. (E.) collutor; P. (P.) intermutans; P. (P.) enderleini; P. (S.) ingens; R. advena], due to the lack of collection and publication data prior to the separation of the states of Mato Grosso and Mato Grosso do Sul. Among the species mentioned above, the last five are confirmed here to Mato Grosso do Sul.

**List of new records from Mato Grosso do Sul**

**SARCOPHAGINAE**

**Blaesoxipha Loew, 1861**

The genus Blaesoxipha comprises about 245 species worldwide (Pape & Dahlem 2010), of which approximately 77 species are known from Neotropical Region (Pape 1996). Prior to this study, there was no record of species of this genus from Mato Grosso do Sul. Blaesoxipha (A.) brazil and Blaesoxipha (T.) convena are the first recorded from this state. This genus has numerous parasitoid species, especially of Acrididae grasshoppers, Tenebrionidae beetles, but also of Mantidae, cockroaches and other Coleoptera and Saltatoria (Pape & Dahlem 2010). Some species of the subgenus Gigantotheca seem to breed in vertebrate and invertebrate carrions (Pape 1996; Pape & Dahlem 2010). Blaesoxipha species can be recognized by the following combination of characters (Pape 1996): postalar wall setose, trochanter of hind leg with posteromedian row of spines present in both sexes; male mid femur with ctenidium with normal spines; male terminalia with cercus bent backwards with cercal prong with spines dorsally, lateral styli fused to each other through a median plate-like structure proximal to the stylus, lateral styli collapsed with no outlet from sperm duct, and phallic vesica reduced or undeveloped.

**Blaesoxipha (Anathotheca) Townsend, 1918**

Blaesoxipha brazil Pape. Type locality: Brazil [state?]. Chapada. Previous distribution (Pape 1994, 1996): Neotropical: Argentina (Entre Ríos, Tucumán), Brazil (Santa Catarina). The biology of this species is little known.

**Blaesoxipha (Tephromyia) Brauer & Bergenstamm, 1891**

Blaesoxipha convena (Reinhard). Type locality: United States, Texas, Brazos Co., College Station. Previous distribution (Pape 1994, 1996); Nearctic: United States (Florida, North Carolina, Oklahoma, Texas). Neotropical: Costa Rica, El Salvador. This is the first record of this species from Brazil. Its biology is little known.

**Helicobia Coquillett, 1895**

There are about 35 species of this genus worldwide, most of them recorded from Neotropical Region (Pape 1996). Helicobia aurescens is the third species of this genus recorded from Mato Grosso do Sul, in addition to H. morionella and H. pilifera (Mello-Patiú et al. 2017). Species of this genus are recognized by their small size, large bristles mainly on thorax, ocellar and vertical bristles very strong, recline orbital bristles in both sexes, parafacial bristled, wing with vein R5 setose and third costal sector bare, and male mid femur without ctenidium (Pape 1996). These three species can be identified using redescriptions provided by Lopes (1939) and Tibana & Mello-Patiú (1992).

**Helicobia aurescens (Townsend).** Type-locality: Brazil, São Paulo, Itaquaquecetuba. Previous distribution (Pape 1996; Barros et al. 2008; Rosa et al. 2011; Souza et al. 2015): Neotropical: Argentina, Brazil (Distrito Federal, Maranhão, Minas Gerais, Paraná, Rio de Janeiro, São Paulo). Helicobia aurescens has already been caught in traps baited with animal tissues (decomposing bovine liver and lung), dog feces, and domestic pig and rodent carcasses (Moura 2004; Mulleri et al. 2008; Barros et al. 2008; Mulleri et al. 2010; Mello-Patiú et al. 2014; Souza et al. 2015). In Curitiba, Paraná state, this species showed a preference for inhabited areas (Ferreira 1979).

**Oxysarcodexia Townsend, 1917**

This is one of the largest genera of Sarcophaginiae with 86 known species, broadly distributed in the Neotropical Region, and with a small number of species recorded from Nearctic, Australasia and Oceania Regions (Pape 1996; Soares & Mello-Patiú 2010; Souza & Buenaventura 2016). Prior to this study, seven species were recorded from Mato Grosso do Sul (Mello-Patiú et al. 2017), here the number of species was increased to 14. Species of Oxysarcodexia can be recognized by the following combination of characters (Pape 1996): postalar wall...
haired, male mid femur with ctenidium of flattened spines, tegula blackish, contrasting from orangish basicosta, male sternite 5 deeply cleft and usually with almost parallel sides, vesica elongated, phallos with lateral and medium styli. The identification of the *Oxysarcodexia* species is difficult, the species of this genus are mostly separate from each other by differences in the male terminalia, which in some cases have very similar morphology. Except for *O. mineirensis*, most of the species recorded from Mato Grosso do Sul can be identified using identification key to the species of *Oxysarcodexia* provided by *Lopes & Tibana* (1987), and a taxonomic synopsis provided by Souza 2014.

**Oxysarcodexia admixta** (Lopes). Type-locality: Brazil, Rio de Janeiro, Angras dos Reis. Previous distribution (PaPe 1996; Barros et al. 2008; Vairo et al. 2011; Souza et al. 2015). Neotropical: Argentina, Brazil (Districto Federal, Goiás, Mato Grosso, Maranhão, Minas Gerais, Pará, Rio de Janeiro, Santa Catarina, São Paulo). *Oxysarcodexia admixta* has already been captured in traps baited with bovine lung and liver, human feces, fish, and domestic pig carcass (D’Almeida & Lima 1994; Oliveira et al. 2002; Barros et al. 2008; Rosa et al. 2011; Vairo et al. 2011; Souza et al. 2015).

**Oxysarcodexia carvalhoi** Lopes. Type-locality: Brazil, Minas Gerais, Cordisburgo. Previous distribution (PaPe 1996; Couri et al. 2000; Vairo et al. 2014): Neotropical: Brazil (Amapá, Amazonas, Ceará, Mato Grosso, Minas Gerais, Pará, Rio de Janeiro, São Paulo), Ecuador, Guyana. *Oxysarcodexia carvalhoi* has already been collected with traps baited with chicken viscera, human feces, mouse and domestic pig carcasses. This species was mostly attracted to chicken viscera (Dias et al. 1984b). *Lopes* (1973) collected this species with a trap containing powdered milk and agar. *Oxysarcodexia carvalhoi* was regarded as one of the most asynanthropic species in Belo Horizonte, Minas Gerais state (Dias et al. 1984a).

**Oxysarcodexia diana** (Lopes). Type-locality: Brazil, Rio de Janeiro. Previous distribution (Lopes & Tibana 1991; PaPe 1996; Marchiori et al. 2001; Barros et al. 2008; YePez-Gaurisas et al. 2013; Lopes et al. 2018): Nearctic: Mexico (Morelos, San Luis de Potosí); Neotropical: Argentina, Brazil (Bahia, Distrito Federal, Ceará, Goiás, Mato Grosso, Minas Gerais, Paraná, Rio de Janeiro, Roraima, Santa Catarina, São Paulo), Colombia, Ecuador, El Salvador, Mexico (Chiapas), Paraguay, Trinidad and Tobago (Trinidad). *Oxysarcodexia diana* has already been collected with traps baited with fish, chicken viscera, human and bovine feces, domestic pig and rodent carcases, and fruits. This species showed mostly coprophagous and scavenger habits (Lopes 1973; D’Almeida 1983; Dias et al. 1984b; D’Almeida & Lima 1994; Marchiori et al. 2001; Barros et al. 2008), and was correlated to the rural area in Guajira (Valverde-Castro et al. 2017).

**Oxysarcodexia meridionalis** (Engel). Type-locality: Argentina, Chaco, San José. Previous distribution (PaPe 1996; Mello-Patui et al. 2014): Neotropical: Argentina, Bolivia, Brazil (Goiás, Minas Gerais, São Paulo). The biology of this species remains unknown.

**Oxysarcodexia mineirensis** Souza & Paseto. Type-locality: Brazil, Minas Gerais, Uberlândia. Previous distribution (Souza & Paseto 2015): Neotropical: Brazil (Minas Gerais). This species was collected with traps containing domestic pig carcasses in a semi-deciduous forest area in the Cerrado (Souza & Paseto 2015; Faria et al. 2017).

**Oxysarcodexia occulta** Lopes. Type-locality: Brazil, Rio de Janeiro, Guanabara. Previous distribution (Lopes & Tibana 1991; PaPe 1996; Mello-Patui et al. 2014): Neotropical: Brazil (Ceará, Minas Gerais, Rio de Janeiro, Roraima), Colombia, Ecuador, Panama. In previous works, *Oxysarcodexia occulta* was collected with traps containing powdered milk and agar, fish, rotten banana with brown sugar, human feces, and domestic pig carcass (Lopes 1973; Lopes 1975; Mello-Patui et al. 2014; Valverde-Castro et al. 2017). This species was captured exclusively in a forest area in Colombia, being attracted to fish bait, however that study involved only two specimens (Valverde-Castro et al. 2017).

**Oxysarcodexia xanthosoma** (Aldrich). Type-locality: Guatemala, Los Amates. Previous distribution (Lopes & Tibana 1991; PaPe 1996; Vairo et al. 2011): Nearctic: Mexico (San Luis Potosí, Sonora); Neotropical: Argentina, Brazil (Amazonas, Ceará, Espirito Santo, Mato Grosso, Minas Gerais, Pará, Roraima, Rio de Janeiro, Roraima, São Paulo), Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Mexico (Jalisco, Veracruz), Panama, Peru. *Oxysarcodexia xanthosoma* has already been captured in traps baited with sardine, human feces, wild pig viscera, domestic pig carcass, and palm (Curran & Walley 1934; Lopes 1973; Oliveira et al. 2002; Leandro & D’Almeida 2005; Bárbara et al. 2009). In previous studies, this species was collected in a urban environment (Bárbara et al. 2009), Cerrado area in Minas Gerais (Rosa et al. 2011), remnant of Mixed Ombrophilous Forest in Paraná (Vairo et al. 2011), Humid Tropical Forest in Amazonas (Vairo et al. 2014), and Atlantic Forest fragment in Rio de Janeiro (Leandro & D’Almeida 2005).

**Peckia Robinie-Desvoidy, 1830**

There are 67 New World species of this genus, mainly Neotropical (Buenaventura & PaPe 2015). Nine species are known from Mato Grosso do Sul, including the four new records from this study. The monophyly and systematic position of this genus remain controversial issues. PaPe (1996) listed a combination of characters for recognition of Peckia: lower calypter with fringe of long hair along the outer margin extending to its posterior corner, lateral styli filiform, female tergite 6 divided into two lateral plates door-like closing the terminalia. Species recorded from Mato Grosso do Sul can be identified using the taxonomic revision work of the Peckia species by Buenaventura & PaPe (2013), which provides good redescriptions and illustrations mostly of the male terminalia.

**Peckia (Euboettcheria) Townsend, 1927**

**Peckia anguilla** (Curran & Walley). Type locality: Guyana, Cartabo. Previous distribution (PaPe 1996; Barros et al. 2008; Buenaventura & PaPe 2013; Souza et al. 2015): Nearctic: Mexico (San Luis Potosí); Neotropical: Argentina, Bolivia, Brazil (Amazonas, Ceará, Distrito Federal, Maranhão, Mato Grosso, Rio de Janeiro, São Paulo), Costa Rica, Guyana, Nicaragua, Panama, Peru, Trinidad & Tobago. This species has already been collected with traps baited with fish, chicken viscera, bovine lung, human feces, and domestic pig carcass (Yepez-Gaurisas et al. 2013; Mello-Patui et al. 2014; Souza et al. 2015); Peckia (E.) anguilla was considered asynanthropic in a study carried out in Belo Horizonte (Dias et al. 1984a), but in Colombia, this species was more abundant in rural area than in urban and forest areas. In the last two areas it showed the same proportion of collected specimens and showed attraction to fish (Yepez-Gaurisas et al. 2013).

**Peckia (Peckia) Robinie-Desvoidy, 1830**

**Peckia chrysostoma** (Wiedemann). Type locality: US Virgin Islands, St. Thomas. Previous distribution (PaPe 1996; Buenaventura & PaPe 2013; Yepez-Gaurisas et al. 2013): Nearctic: Mexico (Baja California Sur, Morelos, Sonora), United States (Florida, Texas); Neotropical: American Virgin Islands, Argentina, Bahamas, Belize, Bolivia (Ceará, Espírito Santo, Distrito Federal, Pernambuco, Rio de Janeiro, Santa Catarina, São Paulo), Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Islands Galapagos, Guatemala, Guyana, Jamaica, Mexico (Chiapas, Jalisco, Tabasco, Yucatán),
Nicaragua, Panama, Peru. Australasia-Oceania - Cook Islands, French Polynesia (Society Is.). *Peckia (P.) chrysostoma* has already been bred or collected with traps baited with fish, crab, squid, shrimp, gastropod, mouse, bovine liver, human feces, domestic pig carcass, and human corpse (Lopes 1973; D’Almeida 1988, 1989; D’Almeida & Lima 1994; Vasconcelos et al. 2014). This species was breed more frequently in fish in a study of Calyptratae trophic niche (D’Almeida & D’Almeida 1998). *Peckia (P.) chrysostoma* showed strong preference for inhabited areas in Rio de Janeiro (D’Almeida 1983) and slight preference for the urban environment in Colombia (Valverde-Castro et al. 2017), however, in Belo Horizonte, it was more frequent in uninhabited areas (Dias et al. 1984a).

**Peckia (Sarcodexia) Townsend, 1892**

*Peckia florencioi* (Prado & Fonseca). Type-locality: Brazil, São Paulo. Previous distribution (Ferreira 1979; Pepe 1996; Buenaventura & Pepe 2013; Mello-Patiu et al. 2014; Souza et al. 2015): Neártico: Mexico (Morelos), United States (Texas); Neotropical: Barbados, Bolivia, Brazil (Amapá, Amazonas, Bahia, Ceará, Distrito Federal, Espírito Santo, Maranhão, Minas Gerais, Piauí, Rio de Janeiro, Rondônia, Roraima), Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Mexico (Guerrero, Jalisco, Sinaloa, Tamaulipas, Veracruz, Yucatán), Nicaragua, Saint Lucia, Saint Vincent & the Grenadines, Trinidad & Tobago (Trinidad), Venezuela. *Peckia (P.) pexata* has already been collected with traps baited with fish, chicken viscerca, feces, bananas, rodents and pig carcasses (Dias et al. 1984b; Barros et al. 2008; Rosa et al. 2011; Valverde-Castro et al. 2017). Its behavior has indicated necrophagous habits (Dias et al. 1984b; Valverde-Castro et al. 2017). This species was found in urban, rural and forest areas in Colombia, but was highly associated with the last two areas (Valverde-Castro et al. 2017), agreeing with the studies carried out by Dias et al. (1984a) in Belo Horizonte.

**Ravinia Robineau-Desvoidy, 1863**

*Ravinia* has 34 described species and is a predominantly New World genus, except for one Paleartic species (Pepe 1996; Pepe & Dahlem 2010). Prior to this study, two species were known from Mato Grosso do Sul, *R. advena* and *R. almeidai* (Mello-Patiu & et al. 2017). This genus can usually be recognized by the following combination of characters (Pepe 1996): postalar wall setose, tegula usually yellowish or orangish and the same color as basiconcha, male mid femur with ctenidium with flattened spines, male sternite 5 deeply cleft and parallel-sided, and aedeagus with hindle. *Ravinia* species are difficult to identify (Lopes 1947), and no identification keys are currently available to New World species. However, species recorded from Mato Grosso do Sul can be recognized using the redescriptions based on male terminalia provided by Lopes & Leite (1991) and Guimarães (2004).
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