Insect galls of the Brazilian Cerrado: associated fauna

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Abstract: Insect galls host a rich and diverse fauna of secondary dwellers, which compose the associated fauna. In Brazil, many inventories of insect galls in Cerrado areas have recorded secondary dwellers. These records were scattered in several papers. This study gathered literature data to provide an overview of the arthropod fauna associated with insect galls in the Brazilian Cerrado. We searched for scientific publications in online academic databases and retrieved 16 papers with data on the secondary dwellers. We limited our search to the period from 1988 to 2020. We updated the name of plant species and verified endemism and geographic distribution in Flora do Brasil 2020. We provided plant species uses based on the Tropical Useful Plants 2014. We found 163 gall morphotypes with secondary dwellers (16.8% of the total of gall morphotypes of the Brazilian Cerrado) on 94 plant species in 37 families. Asteraceae, Fabaceae, Myrtaceae, and Malpighiaceae exhibited the greatest number of records. These are the richest families in insect galls in the Brazilian Cerrado. Most arthropod fauna were recorded in galls of Cecidomyiidae (Diptera). Most records were in leaf galls, the predominant galled organ. Parasitoids were more frequent than successors, inquilines, and predators. Eulophidae and Eurytomidae were the most frequent parasitoid families. Inquilines were represented by Coleoptera, Diplopoda, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Psocoptera, and Thysanoptera; successors by Acari, Araneae, Cecidomyiidae (Diptera), Coleoptera, Collembola, and Formicidae (Hymenoptera), whereas predators by Pseudoscorpiones and Diptera. Most records were presented in suprageneric categories, showing that the taxonomic knowledge is very deficient. 29 plant species are endemic to Brazil and totaled 45 gall morphotypes with secondary dwellers; 46 plant species are useful and host secondary dwellers in 62 gall morphotypes. These data add ecological and economic importance to these arthropods.

Keywords: Parasitoids; inquilines; predators; successors; galling-insects.

Galhas de insetos do Cerrado Brasileiro: fauna associada

Resumo: As galhas de insetos abrigam uma fauna rica e diversificada de habitantes secundários que compõem a fauna associada. No Brasil, muitos inventários de galhas de insetos em áreas de Cerrado registram habitantes secundários. Estes registros, dispersos em vários artigos, foram reunidos para fornecer uma visão ampla da fauna de artrópodes associados às galhas de insetos no Cerrado brasileiro. Buscamos publicações científicas nas bases de dados acadêmicas virtuais e encontramos 16 artigos com informações de habitantes secundários. Limitamos nossa busca ao período de 1988 a 2020. Atualizamos o nome das espécies botânicas e verificamos sua distribuição geográfica e endemismo no site Flora do Brasil 2020. Fornecemos os usos das espécies vegetais com base no site Tropical Useful Plants 2014. Encontramos 163 morfotipos de galhas com habitantes secundários (16,8% do total de morfotipos de galhas do Cerrado brasileiro) em 94 espécies de plantas de 37 famílias. Asteraceae, Fabaceae, Myrtaceae e Malpighiaceae exibiram o maior número de registros. Estas são as famílias mais ricas em galhas de insetos no Cerrado brasileiro. A maioria da fauna de artrópodes foi assinalada em galhas de Cecidomyiidae (Diptera). A maioria dos registros foi em galhas foliares, órgão vegetal com maior riqueza de galhas. Os parasitoides foram mais frequentes que os sucessores, inquilinos e predadores. Eulophidae e Eurytomidae foram as famílias de parasitoides mais frequentes. Os inquilinos foram representados por Coleoptera, Diplopoda, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Psocoptera, e Thysanoptera; os sucessores por Acari, Araneae, Cecidomyiidae (Diptera), Coleoptera, Collembola e Formicidae (Hymenoptera); enquanto os predadores por Pseudoscorpiones e Diptera. Most records were presented in suprageneric categories, showing that the taxonomic knowledge is very deficient. 29 plant species are endemic to Brazil and totaled 45 gall morphotypes with secondary dwellers; 46 plant species are useful and host secondary dwellers in 62 gall morphotypes. These data add ecological and economic importance to these arthropods.

Palavras-chave: Parasitoides; inquilinos; predadores; sucessores; insetos galhadores.
Introduction

Galls are a classic example of niche construction (Gilbert 2009). They represent discrete microhabitats that support relatively closed communities of specialist inhabitants (Shorthouse & Rohfritsch 1992, Williams 1994, Crespi et al. 1997). Galls are abnormal plant growths induced by various parasitic organisms, mainly insects. Insect galls provide the inducers with food and shelter at the expense of the host plant (Tooker et al. 2008). Galls serve as “incubators” for the developing insects in which they gain nutrition and protection from both abiotic factors (e.g., sun irradiation, wind, rain and snow) and natural enemies such as pathogens, predators and parasitoids (Price et al. 1987, Stone & Schonrogge 2003). Galls act as a “nutrient sink” into which the plant translocates concentrated soluble nutrients for the growth of those cells. These nutrients, which are especially rich in amino acids, are then used by the gall-inducer for its own growth (White 2010).

Gall tissues are attractive for non-galling herbivores as food sources (Sugiura & Yamazaki 2009, Yamazaki & Sugiura 2016). There is a rich and diverse fauna of secondary dwellers of galls. They compose the associated fauna and include parasitoids, predators, cecidophages, successors, inquilines, kleptoparasites and symbionts (Luiz & Mendonça-Júnior 2019).

In Brazil, there are several inventories of insect galls in Cerrado areas, mainly in the states of Minas Gerais and Goiás (Araújo et al. 2014). The Cerrado is the second largest phytogeographical domain of Brazil, occupying an area of ca. 2 million km² (23% of the national territory) (Oliveira & Ratter 2014). The Cerrado is the second largest phytogeographical domain of Brazil, occupying mainly in the states of Minas Gerais and Goiás (Araújo et al. 2014). The associated fauna and include parasitoids, predators, cecidophages, successors, inquilines, kleptoparasites and symbionts (Luiz & Mendonça-Júnior 2019).

Material and Methods

We searched for papers in online academic databases: ISI Web of Knowledge, Google Scholar, Scopus and JSTor, using the terms “insect gall”, “galhas de insetos”, “inventories”, “inventários”, and “Brazilian Savanah” “Cerrado. We found 32 papers, 16 of them with data on the associated fauna. We used the Flora do Brasil 2020 website to verify botanical names and plant endemisms. We also looked for data on plant uses in the site Useful Tropical Plants 2014.

We organized tables, according to the level of plant identification: species – Table 1, genus – Table 2, and family – Table 3. These tables include the following data: host plant, galled organ, gall-inducer, associated fauna, food habit, locality and reference. Whenever the name of host plant species was updated, we presented the original name in brackets after the reference.

We counted the number of gall morphotypes only for host plant species. We compared morphotypes in the same plant species when recorded by different authors to avoid repeated counting. We adopted this procedure only when gall illustrations were available.

Concerning the guilds of the associated fauna, we kept the term “inquiline” as used in the original publications, although we recognize problems in its use, since it includes cecidophages, kleptoparasites, and inquilines. However, original data are insufficient to allow re-categorization.

Results

We found records of the associated fauna in 163 gall morphotypes, 94 plant species and 37 plant families. Fabaceae (N=52) (31.9%), Asteraceae (N=15) (9.2%), Myrtaceae, and Malpighiaceae (N=10 each) (6.1%) had the greatest number of gall morphotypes with records of the associated fauna (Table 4).

Most records (N=105) (64.4%) were in galls of Diptera, mainly Cecidomyiidae (N=102) (62.6%), but galls of Hemiptera, Lepidoptera, Hymenoptera, Coleoptera, and Thysanoptera also hosted secondary dwellers (Table 5). Hemiptera were the second most common gall-inducers, but with very low percentage (4.3% only). Leaf galls had the most records (N=117) (71.8%), followed by stem galls (N=43) (26.4%). Galls on buds, spines and reproductive structures also hosted secondary dwellers. Some galls were induced in two plant organs or more (Table 6).

Parasitoids were the most frequent guild, being reported in 147 gall morphotypes (90.2%). They were followed by successors, inquilines, and predators, reported in 13 (8.0%), 12 (7.4%) and three (1.8%) gall morphotypes, respectively, showing that these guilds were infrequent (Table 7).

Parasitoids were represented by 12 Hymenopteran families. Among them, Eulophidae, Eurytomidae, Torymidae, and Encyrtidae were the most frequent, with records in 41 gall morphotypes (29.7% of the parasitized morphotypes), 20 (13.6%), 14 (9.5%) and 12 (8.2%), respectively.

Successors included insects of three orders (Coleoptera, Diptera and Hymenoptera), as well as other arthropods (Acari, Araneae, and Collembola); inquilines included insects of seven orders (Coleoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera, Psocoptera, and Thysanoptera), and Diplodopa, whereas predators were the least diverse, being represented by Pseudoscorpiones and Diptera; all of these taxa were recorded in few gall morphotypes (from 5 to 1) (Table 8).

Concluding the taxonomic knowledge, only four species, Anthonomus vis Clark, 1992 (Coleoptera), Meunieriella spinosa Urso-Guimarães, 2019 (Diptera), Salina celebensis (Schäffer, 1898), and...
### Table 1. Data on arthropods associated with insect galls in the Brazilian Cerrado: host plant species, gall-inducer, host organ, secondary dweller, ecological guild, locality, and reference. Plant origin: (1) native to Brazil, (2) endemic to Brazil, (3) naturalized. Ecological guild: (Inq) inquiline, (Par) parasitoid, (Pre) predator, (Suc) successor, (Und) undetermined.

| Host plant | Gall-inducer | Host organ | Secondary dweller | Locality         | Reference |
|------------|--------------|------------|-------------------|------------------|-----------|
| **ANNONACEAE** |              |            |                   |                  |           |
| *Annona coriacea* Mart. (1) | Cecidomyiidae (Diptera) | Leaf | Eulophidae (Par) | Serra dos Pireneus (GO) | Araújo et al. 2011 |
| *Annona crassiflora* Mart. (1) | Sternorrhyncha (Hemiptera) | Leaf | Braconidae (Par) | Tiradentes (MG) | Maia & Fernandes 2004 |
| *Duguetia furfuracea* (A. St-Hil.) Saff. (1) | Undetermined | Leaf | Hymenoptera (Par) | Caetité (BA) | Nogueira et al. 2016 |
| **APOCYNACEAE** |              |            |                   |                  |           |
| *Aspidosperma australis* Müll.-Arg. (1) | Cecidomyiidae | Flower bud | Eurytomidae (Par) | Belo Horizonte (MG) | Fernandes et al. 1988 |
| *Duguetia furfuracea* (A. St-Hil.) Saff. (1) | Undetermined | Leaf | Hymenoptera (Par) | Belo Horizonte (MG) | Fernandes et al. 1988 |
| **ARALIACEAE** |              |            |                   |                  |           |
| *Didymopanax morototoni* (Aubl.) Decne. & Planch. (1) | Undetermined | Leaf | Eulophidae (Par) | Goiânia (GO) | Santos et al. 2010 (as Schefflera morototoni Aubl) |
| **ASTERACEAE** |              |            |                   |                  |           |
| *Baccharis microcephala* (Less.) DC (1) | Cecidomyiidae | Leaf | Eulophidae 1 (Par) | Tiradentes (MG) | Maia & Fernandes 2004 |
| *Baccharis reticularia* DC. (2) | Cecidomyiidae | Bud | Eulophidae 2 (Par) | Tiradentes (MG) | Maia & Fernandes 2004 |
| *Baccharis serrulata* (Lam.) (2) | Cecidomyiidae | Leaf | Hymenoptera (Par) | Tiradentes (MG) | Maia & Fernandes 2004 |
| *Eremanthus capitatus* (Spreng.) MacLeish (2) | Coleoptera | Stem | Formicidae (Suc) | Caetité (BA) | Nogueira et al. 2016 |
| *Eremanthus erythropappus* (DC.) MacLeish (2) | *Asphondylia serrata* Maia, 2004 (as Cecidomyiidae) | Leaf | Hymenoptera (Par) | Tiradentes (MG) | Maia 2004, Maia & Fernandes 2004 (as Vannilosmopsis erythropappus Schult) |
| *Moquiniastrum barrosoae* (Cabrera) G. Sancho (1) | Undetermined | Stem | Sciariidae (Diptera) | Silvânia (GO) | Bergamini et al. 2017 (as Gochnatia barrosi Cabrera) |
| *Mikania lindbergii* Baker (2) | Neolasioptera sp. (Cecidomyiidae) | Stem | Hymenoptera (Par) | Tiradentes (MG) | Maia & Fernandes 2004 |
| *Moquiniastrum paniculatum* (Less.) G. Sancho (2) | Cecidomyiidae | Leaf | Eulophidae (Par) | Belo Horizonte (MG) | Fernandes et al. 1988 (as Moquinia paniculata (Less) D.C.) |
| *Moquiniastrum pulchrum* (Cabrera) G. Sancho (1) | Cecidomyiidae | bud | Eulophidae (Par) | Altinópolis (SP) | Ribeiro et al. 2019 |
| *Porophyllum ruderale* (Jacq.) Cass. (1) | Cecidomyiidae | Stem | Hymenoptera (Par) | Belo Horizonte (MG) | Fernandes et al. 1988 |
| *Verbesina macrophylla* (Cass.) S.F.Blake (1) | Cecidomyiidae | Bud | Araneae (Suc) | Caetité (BA) | Silva et al. 2018a |

CONTINUE...
| Family                | Genus                  | Species                        | Stage | Taxa                                      | Location       | Reference                                                                 |
|----------------------|------------------------|--------------------------------|-------|-------------------------------------------|----------------|---------------------------------------------------------------------------|
| Bignoniaceae         | Vernonanthura          | polyanthes (Spreng.) Vega & Dematteis (1) | Stem/Bud | Braconidae (Par) Eulophidae (Par) Hymenoptera (Par) | Belo Horizonte | Fernandes et al. 1988 Maia & Fernandes Urso-Guimarães et al. 2003 (as Vernonia polyanthes Less.) |
|                      | Asphondylia sp.        | (Cecidomyiidae)                | Leaf/ Stem | Chalcididae (Par) Torymidae (Par)          | Belo Horizonte | Fernandes et al. 1988                                                    |
| Bignoniaceae         | Handroanthus           | ochraceus (Cham.) Mattos (1)    | Leaf   | Helconiae (Braconidae) (Par) Hemiptera (Inq) | Delfinópolis (MG) | Urso-Guimarães et al. 2003 (as Tabebuia ochracea (Cham.) Standl.) |
| Boraginaceae         | Cordia sellowiana      | Cham. (2)                      | Leaf   | Braconidae (Par) Eulophidae (Par)          | Belo Horizonte (MG) | Fernandes et al. 1988                                                    |
|                      |                        |                                | Leaf   | Hymenoptera (Par)                           | Belo Horizonte (MG) | Fernandes et al. 1988                                                    |
|                      |                        |                                | Leaf   | Hymenoptera (Par)                           | Belo Horizonte (MG) | Fernandes et al. 1988                                                    |
| Burseraceae          | Protium heptaphyllum   | (Aubl.) March. (1)              | Leaf/ Stem | Torymidae (Par)                            | Silvânia (GO) | Bergamini et al. 2017                                                    |
| Calophyllaceae       | Calophyllum            | brasiliense (1)                | Leaf   | Eulophidae (Par) Eurytomidae (Par) Pteromalidae (Par) | Tiradentes (MG) | Madeira et al. 2002, Maia & Fernandes 2004 (as Calophyllum sp.)          |
|                      |                        |                                | Leaf   | Hymenoptera (Par)                           | Tiradentes (MG) | Madeira et al. 2002, Maia & Fernandes 2004 (as Calophyllum sp.)          |
| Cannabaceae          | Celtis iguanea         | (Jacq.) Sarg. (1)               | Undetermined | Encyrtidae (Par)                       | Goiânia (GO) | Santos et al. 2010                                                       |
| Caryocaceae          | Caryocar brasiensis    | Cambess. (1)                   | Leaf   | Eulophidae (Par) Eurytomidae (Par) Pteromalidae (Par) | Hidrolândia (GO) | Silva et al. 2018b                                                       |
|                       |                        |                                | Leaf   | Hymenoptera (Par)                           | Hidrolândia (GO) | Ribeiro et al. 2019                                                      |
| Celastraceae         | Plenckia populnea      | Reissek (1)                    | Leaf   | Encyrtidae (Par)                           | Goiânia (GO) | Santos et al. 2010                                                       |
| Combretaceae         | Combretum leprosum     | Mart. (1)                      | Leaf   | Hymenoptera (Par) Lepidoptera (Inq)        | Caetité (BA) | Nogueira et al. 2016 Silva et al. 2018a Vieira et al. 2018              |
| Connaraceae          | Connarus suberosus     | Planch. (1)                    | Leaf   | Hymenoptera (Par)                           | Silvânia (GO) | Bergamini et al. 2017                                                    |
| Dilleniaceae         |                        |                                | Leaf   | Hymenoptera (Par)                           |                |                                                                            |

CONTINUATION...
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**Davilla brasiliana** DC. (1)  
Cecidomyiidae Leaf  
*Clinodiplosis* sp.  
*Asphondylia* sp. (Cecidomyiidae)  
*Tiradentes* (MG)  
Maia & Fernandes 2004

**Davilla elliptica** A. St-Hil. (1)  
Cecidomyiidae Leaf  
*Eulophidae* (Par)  
*Serra dos Pireneus* (GO)/Serrânia (GO)  
Araújo et al. 2011

**EBENACEAE**

**Diospyros burchellii** DC. (1)  
Lepidoptera  
*Eulophidae* (Par)  
Serra dos Pireneus (GO)  
Araújo et al. 2011

**ERYTHROXYLACEAE**

**Erythroxylum frangulifolium** A. St-Hil.  
(Eurytomidae) Bud/Stem  
*Eulophidae* (Hymenoptera)  
Belo Horizonte (MG)  
Fernandes et al. 1988

**Erythroxylum suberosum** A. St-Hil. (1)  
Undetermined Stem  
*Eurytomidae* (Par)  
Serrânia (GO)  
Bergamini et al. 2017

**EUPHORBIACEAE**

**Croton floribundu** Spreng. (1)  
Cecidomyiidae Leaf  
*Clinodiplosis* sp. (Cecidomyiidae)  
*Tiradentes* (MG)  
Maia & Fernandes 2004

**Sapium glandulosum** (L.) Morong (1)  
Neolithus *fasciatus* Scott, 1882 (Triozidae, Hemiptera)  
Fruit/Inflorescence/Leaf/Stem  
Encyrtidae (Par)  
Pteromalidae (Par)  
Belo Horizonte (MG)  
Fernandes et al. 1988

**FABACEAE**

**Anadenanthera peregrina** (L.) Spreng. (1)  
Undetermined Leaf  
*Hymenoptera* (Par)  
Goiânia (GO)  
Santos et al. 2010

**Andira cuyabensis** Benth. (2)  
Undetermined Leaf  
*Acari* (Suc)  
Barreiras (BA)  
Lima & Calado 2018

**Andira fraxinifolia** Benth. (2)  
Undetermined Leaf/Stem  
*Hymenoptera* (Par)  
Belo Horizonte (MG)  
Fernandes et al. 1988 (as *Andira parvifolia* Mart. ex Benth.)

**Andira fraxinifolia** Benth. (2)  
Cecidomyiidae Leaf/Stem  
*Hymenoptera* (Par)  
Belo Horizonte (MG)  
Fernandes et al. 1988

**Andira fraxinifolia** Benth. (2)  
Cecidomyiidae Leaf/Stem  
*Hymenoptera* (Par)  
Belo Horizonte (MG)  
Fernandes et al. 1988 (as *Andira parvifolia* Mart. ex Benth.)

**Bauhinia brevipes** Vogel (1)  
Undetermined Leaf  
*Acari* (Suc)  
Barreiras (BA)  
Lima & Calado 2018

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CONTINUE...
| Species                          | Life Stage | Taxon Name                        | Location     |
|---------------------------------|------------|-----------------------------------|--------------|
| *Schizomyia macropillata*       | Leaf       | *Eulophidae (Par)*                | Barreiras (BA) |
| Maia, 2005 (Cecidomyiidae)      |            | *Collembola: Seira mendonacae*    |              |
|                                 |            | (Suc)                             |              |
|                                 |            | *Salina celebensis* (Suc)         |              |
|                                 |            |                                   | Maia & Fernandes 2005  |
|                                 |            |                                   | Lima & Calado 2018 |
|                                 | Stem       | *Acari (Suc)*                     | Barreiras (BA) |
|                                 |            | *Encyrtidae (Par)*                |              |
|                                 | Stem       | *Braconidae (Par)*                | Hidrolândia (GO) |
|                                 |            | *Eulophidae (Par)*                |              |
| *Bauhinia cupulata* Benth. (1)  | Leaf       |                                   | Barreiras (BA) |
|                                 |            | *Salina celebensis*               |              |
|                                 |            |                                   | Lima & Calado 2018 |
|                                 | Leaf       | *Rileynae*                        | Altinópolis (SP) |
| *Bauhinia holophylla* (Bong.) Steud. (2) | Leaf       | (Eurytomidae) (Par)               |              |
| Urso-Guimarães & Amorim, 2002  |            |                                   | Urso-Guimarães & Amorim 2002 |
|                                 |            |                                   | Ribeiro et al. 2019 |
| *Bauhinia rufa* (Bong.) Steud. (1) | Leaf       | *Eupelmidae (Par)*                | Silvânia (GO) |
|                                 |            | *Torymidae (Par)*                 |              |
|                                 | Leaf       | *Eulophidae (Par)*                | Silvânia (GO) |
|                                 |            | *Torymidae (Par)*                 |              |
|                                 | Stem       | *Eupelmidae (Par)*                | Silvânia (GO) |
|                                 |            | *Tetracampidae (Par)*             |              |
| *Bauhinia ungulata* L. (1)      | Leaf       | *Eulophidae (Par)*                | Goiânia (GO) |
|                                 |            | *Hymenoptera*                     |              |
| *Calliandra macrocalyx* Harms (2) | Leaf       |                                   | Santos et al. 2010 |
|                                 |            | *Hymenoptera*                     | Silva et al. 2018a |
| *Copaifera depilis* Dwyer (2)   | Undetermined Bud | *Hymenoptera* (Par)              | Barreiras (BA) |
|                                 |            | *Caetité (BA)*                    |              |
|                                 | Undetermined Stem | *Hymenoptera* (Par)              | Barreiras (BA) |
|                                 |            | *Hymenoptera* (Par)               |              |
| *Copaifera langsdorffii* Desf. (1) | Bud/ Leaf/ Stem | *Encyrtidae (Par)*              | Belo Horizonte (MG) |
|                                 | Hymenoptera | *Eurytomidae (Par)*               |              |
|                                 |            | *Pteromalidae (Par)*              |              |
|                                 | Cecidomyiidae Leaf/ Stem | *Hymenoptera* (Par)              | Belo Horizonte (MG) |
|                                 |            |                                   |              |
|                                 | Cecidomyiidae Leaf | *Hymenoptera* (Par)              | Belo Horizonte (MG) |
|                                 |            |                                   |              |
|                                 | Contarinia sp. (Cecidomyiidae) | *Platygastridera* (Par)             | Belo Horizonte (MG) |
|                                 |            |                                   |              |
|                                 | Cecidomyiidae Leaf | *Hymenoptera* (Par)              | Tiradentes (MG) |
|                                 |            |                                   |              |
|                                 | Cecidomyiidae Stem | *Hymenoptera* (Par)              | Caetité (BA) |
|                                 |            |                                   | Nogueira et al. 2016 |
|                                 | Cecidomyiidae Stem | *Hymenoptera* (Par)              | Caetité (BA) |
|                                 |            |                                   | Nogueira et al. 2016 |
|                                 | Undetermined Leaf | *Hymenoptera* (Par)              | Caetité (BA) |
|                                 |            |                                   | Nogueira et al. 2016 |
| *Copaifera luetzelburgii* Harms (2) | Undetermined Leaf | *Hymenoptera* (Par)              | Barreiras (BA) |
|                                 |            |                                   | Santos et al. 2018 |
|                                 | Undetermined Leaf | *Hymenoptera* (Par)              | Barreiras (BA) |
|                                 |            |                                   | Santos et al. 2018 |
|                                 | Undetermined Leaf | *Hymenoptera* (Par)              | Barreiras (BA) |
|                                 |            |                                   | Santos et al. 2018 |
| *Copaifera sabulicola* J. Costa & L.P. Queiroz (2) | Undetermined Stem | *Hymenoptera* (Par)              | Barreiras (BA) |
|                                 |            | *Acarai (Suc)*                     | Santos et al. 2018 |
|                                 | Undetermined Stem | *Formicicidae (Suc)               | Barreiras (BA) |
|                                 |            |                                   | Santos et al. 2018 |
|                                 | Undetermined Leaf | *Coleoptera (Suc)*               | Barreiras (BA) |
|                                 |            |                                   | Santos et al. 2018 |

CONTINUE...
| Taxon                                      | Family               | Type   | Genus                  | Order       | Host                                             | Location              | Authors            |
|--------------------------------------------|----------------------|--------|------------------------|-------------|-------------------------------------------------|------------------------|--------------------|
| *Hymenaea courbaril* L. (1)                | Cecidomyiidae        | Leaf   | Eurytomidae (Par)      | Barreiras (BA) | Lima & Calado 2018                               |                       |                    |
| *Inga bahiensis* Benth. (1)                | Undetermined         | Leaf   | Eurytomidae (Par)      | Barreiras (BA) | Silva et al. 2018a                               |                       |                    |
| *Inga cylindrica* (Vell.) Mart. (1)        | Cecidomyiidae        | Leaf   | Eurytomidae (Par)      | Goiânia (GO) | Santos et al. 2010                               |                       |                    |
| *Inga ingoides* (Rich.) Willd. (1)        | Cecidomyiidae        | Leaf/ Stem | Eurytomidae (Par)   | Belo Horizonte (MG) | Santos et al. 1988                               |                       |                    |
| *Inga edulis* Mart. (1)                    | Neolasioptera sp. (Cecidomyiidae) | Leaf   | Hymenoptera (Par)       | Belo Horizonte (MG) | Urso-Guimarães et al., 2003                       |                      |                    |
| *Lonchocarpus cultratus* (Vell.) A.M.G. Azevedo & H.C. Lima (1) | Euphaleurus sp. (Psyllidae, Hemiptera) | Leaf   | Hymenoptera (Par)       | Belo Horizonte (MG) | Urso-Guimarães et al., 2003                       |                      |                    |
| *Machaerium aculeatum* Raddi (2)          | Anadiplossis sp. (Cecidomyiidae) | Leaf   | Eurytomidae (Par)      | Belo Horizonte (MG) | Fernandes et al. 1988 |                                 |                    |
| *Mimosa gemmulata* Barneby (1)             | Undetermined         | Stem   | Hymenoptera (Par)       | Caetité (BA) | Nogueira et al. 2016 |                                 | Silva et al. 2018a |
| **LAMIACEAE**                              |                      |        |                        |             |                                                 |                       |                    |
| *Leonotis nepetifolia* (3)                 | Asphondyliaceae canasta Urso-Guimarães & Amorim, 2002 (Cecidomyiidae) | Inflorescence | Toryminae (Torymidae) (Par) | Delfinópolis (MG) | Urso-Guimarães & Amorim 2002 |                      |                    |
| **LAURACEAE**                              |                      |        |                        |             |                                                 |                       |                    |
| *Nectandra cuspidata* Nees (1)             | Cecidomyiidae        | Leaf   | Eurytomidae (Par)      | Hidrolândia (GO) | Silva et al. 2018b                               |                       |                    |
| *Byrsonima verbascifolia* (L.) DC. (1)     | Cecidomyiidae        | Leaf   | Eurytomidae (Par)      | Silvânia (GO)/ Tiradentes (MG) | Bergamini et al. 2017 |                                 |                    |
| *Byrsonima variabilis* A. Juss. (2)        | Undetermined         | Stem   | Eurytomidae (Par)      | Tiradentes (MG) | Maia & Fernandes 2004 |                                 |                    |

CONTINUE...
| Plant Species                  | Order/Insect Family   | Host Part      | Family/Insect Family   | Host Part   |
|-------------------------------|----------------------|----------------|------------------------|-------------|
| *Diplopterys pubipetala*      | *Cecidomyiidae*      | Leaf           | Eulophidae (Par)       | Altinópolis SP |
| *Clinodiplosis bellum*        |                      |                | *Entedoninae* (Par)    |             |
| *Urso-Guimarães & Garcia-Neto*, 2015 |                     |                | *Torymidae* (Par)      |             |
| *Dasineura sp.*               |                      | Leaf           | *Eulophidae* (Par)     | Hidrolândia (GO) |
| *Urso-Guimarães & Garcia-Neto*, 2015 |                     |                | *Altinópolis* (SP)     |             |
| *Phlaeothripidae*             |                      | Leaf           | Hidrolândia            |             |
| *Peixotoa goiana*             | Undetermined         | Leaf           | *Hymenoptera* (Par)    | Silvânia (GO) |
| *Cecidomyiidae*               |                      | Leaf           | *Torymidae* (Par)      | Silvânia (GO) |
| *Phlaeothripidae*             |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Altinópolis* (SP)            |                      |                | *Silvânia* (GO)        |             |
| *Ribeiro et al. 2019*         |                      |                |                         |             |
| *Dasineura sp.*               |                      | Leaf           | *Eulophidae* (Par)     | Hidrolândia |
| *Silva et al. 2018b*          |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Phlaeothripidae*             |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Altinópolis* (SP)            |                      |                | *Silvânia* (GO)        |             |
| *Ribeiro et al. 2019*         |                      |                |                         |             |
| *Dasineura sp.*               |                      | Leaf           | *Eulophidae* (Par)     | Hidrolândia |
| *Urso-Guimarães & Garcia-Neto*, 2015 |                     |                | *Altinópolis* (SP)     |             |
| *Phlaeothripidae*             |                      | Leaf           | Hidrolândia            |             |
| *Ribeiro et al. 2019*         |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Silva et al. 2018b*          |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Phlaeothripidae*             |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Altinópolis* (SP)            |                      |                | *Silvânia* (GO)        |             |
| *Ribeiro et al. 2019*         |                      |                |                         |             |
| *Dasineura sp.*               |                      | Leaf           | *Eulophidae* (Par)     | Hidrolândia |
| *Urso-Guimarães & Garcia-Neto*, 2015 |                     |                | *Altinópolis* (SP)     |             |
| *Phlaeothripidae*             |                      | Leaf           | Hidrolândia            |             |
| *Ribeiro et al. 2019*         |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Silva et al. 2018b*          |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Phlaeothripidae*             |                      | Leaf           | *Hymenoptera* (Par)    |             |
| *Altinópolis* (SP)            |                      |                | *Silvânia* (GO)        |             |
| *Ribeiro et al. 2019*         |                      |                |                         |             |

**MALVACEAE**

| Plant Species                  | Order/Insect Family   | Host Part      | Family/Insect Family   | Host Part   |
|-------------------------------|----------------------|----------------|------------------------|-------------|
| *Luehea divaricata* Mart. (1)  | Coleoptera           | Leaf           | *Hymenoptera* (Par)    | Belo Horizonte (MG) |
| *Luehea cf. divaricata* Mart. | Cecidomyiidae        | Leaf/Stem      | *Hymenoptera* (Par)    | *Tiradentes* (MG) |
| *Siderolobes longiflorum* (Mart. & Zucc.) A. Robyns (1) | Lepidoptera | Leaf           | *Hymenoptera* (Par)    | *Serra dos Pireneus* (GO) |
| *Sida micrantha* A.St.-Hil. (1) | Cecidomyiidae        | Leaf/Stem      | *Hymenoptera* (Par)    | *Serra dos Pireneus* (GO) |
| *MELASTOMATACEAE*              |                      |                |                         |             |
| *Leandra aurea* (Cham.) Cogn. (1) | Lepidoptera         | Bud            | *Anthonomus vis Clark, 1992* (Curculionidae) (Inq) | *Tiradentes* (MG) |
|                               |                      |                | *Fiebrigella* sp. (Chloropidae) (Pre) |             |
|                               |                      |                | *Lestodiplosis* sp. (Cecidomyiidae) (Pre) |             |
|                               |                      |                | *Eulophidae* (Par)    |             |
|                               |                      |                | *Phlaeothripidae* (Thysanoptera) |             |
| *Miconia theaezans* (Bonpl.) Cogn. (1) | Cecidomyiidae       | Bud            | *Hymenoptera* (Par)    | *Tiradentes* (MG) |
| *Pleroma candolleanum* (Mart. ex DC.) Triana (2) | Cecidomyiidae | Leaf           | *Hymenoptera* (Par)    | *Tiradentes* (MG) |
| *MELASTOMATACEAE*              |                      |                |                         |             |
| *Macairea radula* (Bonpl.) DC. (1) | Gelechiidae (Lepidoptera) | Leaf           | *Chalcididae* (Par)    | *Serra dos Pireneus* (GO) |
|                               | Undetermined         | Leaf           | *Microgastrinae* (Braconidae) (Par) | *Delfinópolis* (MG) |
| *Miconia theaezans* (Bonpl.) Cogn. (1) | Cecidomyiidae       | Bud            | *Hymenoptera* (Par)    | *Tiradentes* (MG) |
|                               |                      |                |                         |             |
| *MYRTACEAE*                    |                      |                |                         |             |
| *Eugenia punicifolia* (Kunth) DC. (2) | Undetermined | Leaf           | *Hymenoptera* (Par)    | *Serra dos Pireneus* (GO) |
|                               |                      |                |                         |             |
### CONTINUATION...

| Family                  | Species                          | Location                  | Host Plant                     | Remarks                                      |
|-------------------------|----------------------------------|---------------------------|--------------------------------|----------------------------------------------|
| **Stephomyia sp.**      | (Cecidomyiidae)                  | Leaf                      | Hymenoptera (Par)              | Maia & Fernandes 2004 (as Eugenia cfr. ovalifolia) |
| **Undetermined**        | Stem                             | Hymenoptera (Par)         | Caetité (BA)                   | Vieira et al. 2018a                           |
| **Dasineura sp.**       | (Cecidomyiidae)                  | Leaf                      | Eulophidae (Par)               | Fernandes et al. 1988 (as Myrcia itambensis O. Berg.) |
| **Triozoida sp.**       | (Psyllidae, Hemiptera)           | Leaf                      | Encyrtidae (Par)               | Fernandes et al. 1988                         |
| **Cecidomyiidae**       |                                  |                           |                                |                                              |
| **Myrciaria tenella**   | (DC.) O. Berg. (1)               | Leaf                      | Hymenoptera (Par)              | Maia & Fernandes 2004                          |
| **Psidium brownianum**  | Mart. ex DC. (2)                 | Undetermined Leaf         | Pseudoscorpiones (Pre)         | Silva et al. 2018a                            |
| **Psidium salutare var. pohlianum** | (O. Berg.) Laundrum (2)       | Psyllidae (Hemiptera)     | Eulophidae (Par)               | Araújo et al. 2011                            |
| **Nyctaginaceae**       |                                  |                           |                                |                                              |
| **Guapira opposita**    | (Vell.) Reitz (1)                | Cecidomyiidae             | Hymenoptera (Par)              | Vieira et al. 2018                            |
| **Neea theifera**       | Oerst. (1)                       | Cecidomyiidae             | Hymenoptera (Par)              | Santos et al. 2012                            |
| **Ochnaceae**           |                                   |                           |                                |                                              |
| **Ouratea floribunda**  | (A. St-Hil.) Engl. (2)           | Cecidomyiidae             | Hymenoptera (Par)              | Fernandes et al. 1988                         |
| **Piperaceae**          |                                   |                           |                                |                                              |
| **Piper arboreum**      | Aubl. (1)                        | Undetermined Leaf         | Eulophidae (Par)               | Araújo et al. 2011                            |
| **Proteaceae**          |                                   |                           |                                |                                              |
| **Roupala montana**     | Aubl. (1)                        | Cecidomyiidae             | Eulophidae (Par)               | Silva et al. 2018b                            |
| **Rubiaceae**           |                                   |                           |                                |                                              |
| **Borreria cfr. brachystemonoides** | Cham. & Schltdl. (1)       | Cecidomyiidae             | Encyrtidae (Par)               | Maia & Fernandes 2004                          |
| **Chomelia pohliana**   | Müll.Arg (2)                     | Undetermined Spine base   | Lygaeidae (Hemiptera) (Inq)    | Urso-Guimarães et al. 2003                     |
| **Salicaceae**          |                                   |                           |                                |                                              |
| **Casearia sylvestris** | Sw. (1)                          | Undetermined Stem         | Hymenoptera (Par)              | Bergamini et al. 2017                         |
| **Sapindaceae**         |                                   |                           |                                |                                              |
| **Serjania obtusidentata** | Radlk. (2)                 | Cecidomyiidae             | Eulophidae (Par)               | Santos et al. 2010                            |
| **Siparuna guianensis** | Aubl. (1)                        | Undetermined Stem         | Torymidae (Par)                | Bergamini et al. 2017                         |
| **Cecidomyiidae**       |                                  |                           |                                | Silva et al. 2018b                            |
| **Cecidomyiidae**       |                                  |                           |                                | Bergamini et al. 2017                         |
| **Undetermined**        | Stem                             | Torymidae (Par)           | Silvânia (GO)                  | Silva et al. 2018b                            |
| **Smilacaceae**         |                                   |                           |                                |                                               |
| **CONTINUE...**
| Plant Species                  | Family          | Morphological Stage | Parasitoid Taxa                | Location          |
|-------------------------------|-----------------|---------------------|--------------------------------|------------------|
| Smilax oblongifolia Pohl ex Griseb. (2) | Cecidomyiidae | Leaf                | Hymenoptera (Par): Polyxenus (Diptera) (Inq): Eulophidae (Par): Camptoneuromyia sp. (Cecidomyiidae) (Inq) | Delfinópolis (MG): Altinópolis (SP) |
| STYRACACEAE                  |                 |                     |                                |                  |
| Styrax pohlii A.DC. (1)       | Cecidomyiidae  | Leaf                | Eulophidae (Par): Goiânia (GO)  | Santos et al. 2010 |
| TRIGONIACEAE                 |                 |                     |                                |                  |
| Trigonia nivea Cambess.       | Lantana fucata Lindl. (1) | Neolasioptera sp | Hymenoptera (Par): Tiradentes (MG) | Maia & Fernandes 2004 (as Lantana lilicina Desf.) |
| VERBENACEAE                  |                 |                     |                                |                  |
| Lippia alba (Mill.) N. E. Br. ex Britton & P. Wilson (1) | Lippia alba (Mill.) N. E. Br. ex Britton & P. Wilson (1) | Neolasioptera sp | Hymenoptera (Par): Tiradentes (MG) | Maia & Fernandes 2004 (as Lantana lilicina Desf.) |
| Vochysiaceae                 | Qualea grandiflora Mart. (1) | Undetermined       | Hymenoptera (Par): Collembola (Suc): Barreiras (BA) | Araújo et al. 2011 |
|                             | Qualea multiflora Mart. (1) | Undetermined       | Hymenoptera (Par): Caldas Novas (GO) | Santos et al. 2012 |
|                             | Qualea parviflora Mart. (1) | Undetermined       | Hymenoptera (Par): Serra dos Pireneus (GO) | Araújo et al. 2011 |

Seira mendoncae Bellini & Zeppelini, 2008 (Collembola); and five genera, Camptoneuromyia Felt, 1908, Clinodiplosis Kieffer, 1895, Lestodiplosis Kieffer, 1894 (Cecidomyiidae), and Fiebrigella Duda, 1921 (Chloropidae), and Polyxenus Latreille, 1802 were identified. All other records were at suprageneric levels.

We found 36 host plant genera with records of the associated fauna on undetermined species. They included 24 plant families and totaled at most 55 gall morphotypes (Table 2). Among plant families, five were represented only by undetermined species, namely: Chrysobalanaceae, Loranthaceae, Lythraceae, Meliaceae, and Metteniusiaceae. Therefore, they were not included in the Table 1. Adding them, the number of host plant families with records of associated fauna rises to 42. Concerning genera data, Arrabidaeae DC. (Bignoniaceae), Hirtella L. (Chrysobalanaceae), Doliocarpus Rol. (Dilleniaceae), Manihot Mill. and Sebastiania Spreng. (Euphorbiaceae), Emmotum Dsv. ex Ham. (Metteniusiaceae), Struthanthus Mart. (Loranthaceae), Diplosodon Pohl. (Lythraceae), Heteropterys Kuth. and Thyrralis L. (Malpighiaceae), Tibouchina Aubl. (Melastomataceae), Guarea F. Allam ex L. and Trichilia P. Browne (Meliaceae), Campanonasus Ruiz et Pav. (Myrtaceae), and Paullinia L. (Sapindaceae) are added, increasing the number of host genera to 108. The following arthropod taxa were recorded as secondary dwellers: Hymenoptera: Braconidae, Chalcididae, Elasmidae, Encyrtidae, Eulophidae, Eurytomidae, Formicidae, Pseudoscorpiones, Collembola: Salina celebensis, Salina sp. and Seria mendonca, Araneae; and Pseudoscorpiones. Among them, Elasmidae, Perilampidae, Tanaostigmatidae, Tomyridae, and Trichogrammatidae; Diptera: Sciariidae and Brachycera; Thysanoptera; Collembola: Salina celebensis, Salina sp. and Seria mendonca; Acari; Araneae; and Pseudoscorpiones. Among them, Elasmidae, Perilampidae, Tanaostigmatidae, Trichogrammatidae, and Brachycera are added, increasing the richness of parasitoid families from 12 to 16, and including Brachycera in the “inquilines” guild. Records at family level (Table 3) added Acanthaceae, Solanaceae, Tiliaceae and Turneraceae, increasing from 42 to 46 the number of host families with associated fauna.

Multiparasitism was recorded in 23 gall morphotypes (15.6% of the total of parasitized gall morphotypes). The number of parasitoid taxa in the same gall morphotype varied from two to five. The highest numbers were recorded in galls on Byrsonima variabilis (Malpighiaceae),
### Table 2. Data on arthropods associated with insect galls in the Brazilian Cerrado: host plant (identification at genus level), gall-inducer, host organ, secondary dweller, ecological guild, locality, and reference. Ecological guild: (Inq) inquiline, (Par) parasitoid, (Suc) successor.

| Host plant       | Gall-inducer | Host organ | Secondary dwellers | Locality        | Reference                  |
|------------------|--------------|------------|--------------------|------------------|----------------------------|
| **Apocynaceae**  |              |            |                    |                  |                            |
| Aspidosperma sp. | Cecidomyiidae| Leaf       | Pteromalidae (Par) | Hidrolândia (GO) | Silva et al. 2018          |
| **Asteraceae**   |              |            |                    |                  |                            |
| Moquiniastrum sp.| Cecidomyiidae| Leaf       | Hymenoptera (Par)  | Caetité (BA)     | Silva et al. 2018          |
| **Bignoniaceae** |              |            |                    |                  |                            |
| Arrabidaea sp.   | Cecidomyiidae| Leaf       | Torymidae (Par)    | Goiânia (GO)     | Santos et al. 2010         |
| **Boraginaceae** |              |            |                    |                  |                            |
| Cordia sp.       | Hymenoptera  | Leaf       | Acari (Suc)        | Barreiras (BA)   | Lima & Calado 2018         |
| **Chrysobalanaceae** |            |            |                    |                  |                            |
| Hirtella sp.     | Cecidomyiidae| Leaf       | Torymidae (Par)    | Silvânia (GO)    | Bergamini et al. 2017      |
| **Combretaceae** |              |            |                    |                  |                            |
| **Connaraceae**  |              |            |                    |                  |                            |
| Connarus sp.     | Undetermined | Stem       | Eulophidae (Par)   | Hidrolândia (GO) | Silva et al. 2018          |
| **Dilleniaceae** |              |            |                    |                  |                            |
| Doliocarpus sp.  | Cecidomyiidae| Stem       | Eulophidae (Par)   | Silvânia (GO)    | Bergamini et al. 2017      |
| **Erythroxylaceae** |            |            |                    |                  |                            |
| Erythroxylum sp. | Cecidomyiidae| Leaf       | Eulophidae (Par)   | Hidrolândia (GO) | Silva et al. 2018          |
| **Euphorbiaceae**|              |            |                    |                  |                            |
| Croton sp.       | Undetermined | Leaf       | Hymenoptera (Par)  | Caetité (BA)     | Vieira et al. 2018         |
| Manihot sp.      | Undetermined | Leaf       | Eulophidae (Par)   | Serra dos Pireneus (GO) | Araújo et al. 2011 |
| **Fabaceae**     |              |            |                    |                  |                            |
| Sebastiana sp.   | Cecidomyiidae| Leaf       | Eulophidae (Par)   | Hidrolândia (GO) | Silva et al. 2018          |
| **Fagaceae**     |              |            |                    |                  |                            |
| Andira sp.       | Cecidomyiidae| Stem       | Eulophidae (Par)   | Tiradentes (MG)  | Maia & Fernandes 2004      |
| Bauhinia sp.     | Cecidomyiidae| Leaf       | Eulophidae (Par)   | Serra dos Pireneus (GO) | Araújo et al. 2011 |
| **Guttiferae**   |              |            |                    |                  |                            |
| Inga sp.         | Cecidomyiidae| Leaf       | Hymenoptera (Par)  | Tiradentes (MG)  | Maia & Fernandes 2004      |
| **Loranthaceae** |              |            |                    |                  |                            |
| Struthanthus sp. | Undetermined | Leaf       | Hymenoptera (Par)  | Serra dos Pireneus (GO) | Araújo et al. 2011 |
| **Lythraceae**   |              |            |                    |                  |                            |
| Diploxodon sp.   | Undetermined | Stem       | Brachycera (Diptera) (Inq) | Silvânia (GO) | Bergamini et al. 2017      |

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http://www.scielo.br/bn
| Genus          | Family                | Organ | Genus                  | Order              | Location                  | Reference                                      |
|---------------|-----------------------|-------|------------------------|--------------------|----------------------------|------------------------------------------------|
| *Byronima*    | Cecidomyiidae         | Leaf  | *Trichogrammatidae*    | (Par)              | Serra dos Pireneus (GO)   | Araújo et al. 2011                           |
| *Heteropterys*| Undetermined          | Leaf  | *Eulophidae* (Par)     |                    | Hidrolândia (GO)           | Silva et al. 2018                            |
| *Peixotoa*    | Cecidomyiidae         | Leaf  | *Eulophidae* (Par)     |                    | Hidrolândia (GO)           | Silva et al. 2018                            |
| *Thryallis*   | Undetermined          | Leaf  | *Hymenoptera* (Par)    |                    | Caetité (BA)               | Nogueira et al. 2016                         |
| Malvaceae     |                       |       |                        |                    |                            |                                                |
| *Luehea*      | Cecidomyiidae         | Leaf  | *Salina celebensis* (Suc) | *Salina* sp. (Suc) | Barreiras (BA)             | Lima & Calado 2018                           |
| Melastomataceae|                      |       |                        |                    |                            |                                                |
| *Miconia*     | Cecidomyiidae         | Leaf  | *Hymenoptera* (Par)    |                    | Tiradentes (MG)            | Maia & Fernandes 2004                        |
| *Miconia*     | Undetermined          | Stem  | *Hymenoptera* (Par)    |                    | Goiânia (GO)               | Silva et al. 2015                            |
| *Tibouchina*  | Cecidomyiidae         | Leaf  | *Perilampidae* (Par)   |                    | Altinópolis (SP)           | Ribeiro et al. 2019                          |
| Meliaceae     |                       |       |                        |                    |                            |                                                |
| *Guarea*      | Cecidomyiidae         | Leaf  | *Thysanoptera* (Inq)   |                    | Caetité (BA)               | Silva et al. 2018                            |
| *Trichilia*   | Undetermined          | Stem  | *Eulophidae* (Par)     |                    | Tiradentes (MG)            | Maia & Fernandes 2004                        |
| Metteniusaceae|                       |       |                        |                    | Hidrolândia (GO)           | Silva et al. 2018                            |
| *Emmetum*     | Undetermined          | Stem  | *Hymenoptera* (Par)    |                    | Caetité (BA)               | Nogueira et al. 2016                         |
| Myrtaceae     |                       |       |                        |                    |                            |                                                |
| *Campomanesia*| Undetermined          | Leaf  | *Hymenoptera* (Par)    |                    | Caetité (BA)               | Vieira et al. 2018                           |
| *Eugenia*     | Undetermined          | Leaf  | *Hymenoptera* (Par)    |                    | Caetité (BA)               | Vieira et al. 2018                           |
| *Myrcia*      | Cecidomyiidae         | Bud   | *Hymenoptera* (Par)    |                    | Serra dos Pireneus (GO)    | Araújo et al. 2011                           |
| Nyctaginaceae |                       |       |                        |                    |                            |                                                |
| *Lopesia*     | *Guapira*             | Leaf  | *Hymenoptera* (Par)    |                    | Tiradentes (MG)            | Maia 2004                                    |
| *Myrtaceae*   | *Eugenia*             | Leaf  | *Hymenoptera* (Par)    |                    | Caetité (BA)               | Vieira et al. 2018                           |
| *Myrcia*      | *Asphondyliini* (Cecidomyiidae) | Stem | *Hymenoptera* (Par)    |                    | Tiradentes (MG)            | Maia & Fernandes 2004                        |
| *Nyctaginaceae*|                       |       |                        |                    |                            |                                                |
| *Guapira*     | R. Lopesia bilobata   | Leaf  | *Hymenoptera* (Par)    |                    | Tiradentes (MG)            | Maia 2004                                    |
| *Piper*       | *Parametaspachyphylla*| Leaf/ stem | *Hymenoptera* (Par) |                    | Tiradentes (MG)            | Maia & Fernandes 2004                        |
| *Piper*       | Maia & Santos, 2007   |       |                        |                    |                            | Maia & Santos 2007                           |
| *Sapindaceae* | *Pauhlinia*           | Stem  | *Hymenoptera* (Par)    |                    | Tiradentes (MG)            | Maia & Fernandes 2004                        |
| *Serjania*    | Cecidomyiidae         | Leaf  | *Eulophidae* (Par)     |                    | Tiradentes (MG)            | Maia & Fernandes 2004                        |
| *Smilax*      | Undetermined          | Leaf  | *Eulophidae* (Par)     |                    | Hidrolândia (GO)           | Silva et al. 2018                            |
| *Styrax*      | Undetermined          | Leaf  | *Eupelmidae* (Par)     |                    | Serra dos Pireneus (GO)    | Araújo et al. 2011                           |

Five (Eulophidae, Eupelmidae, Eurytomidae, Ichneumonidae, and Platygasteridae) in stem galls and four (Eulophidae, Eurytomidae, Torymidae, and Signiphoridae) in leaf galls. Four taxa of parasitoids (Elasmidae, Eurytomidae, Eulophidae, and Torymidae) were also reported in galls on Doliocarpus sp. (Dilleniaceae). Different inquilines – Clinidiplosis sp. (Cecidomyiiidae) and Lepidoptera were found in a bud gall on Davilla brasiliana DC. (Dilleniaceae), as well as Polyxenus sp. (Diplopoda) and Psocoptera in a leaf gall on Smilax oblongifolia Pohl ex Griseb (Smilacaceae). Two successors – Seria mendonca and Salina celebensis (Collembola).
Table 3. Data on arthropods associated with insect galls in the Brazilian Cerrado: host plant (identification at family level), gall-inducer, host organ, secondary dweller, ecological guild, locality, and reference. Ecological guild: (Inq) inquiline, (Par) parasitoid, (Suc) successor.

| Host plant | Gall-inducer | Host organ | Secondary dweller | Locality       | Reference                  |
|------------|--------------|------------|-------------------|----------------|----------------------------|
| Acanthaceae| Undetermined | Leaf midvein| Chalcididae (Par)  | Silvânia (GO) | Bergamini et al. 2017      |
| Anacardiaceae| Undetermined | Leaf       | Eurytomidae (Par) | Silvânia (GO) | Bergamini et al. 2017      |
| Asteraceae | Cecidomyiidae| Leaf       | Encyrtidae (Par)  | Serra dos Pireneus (GO) | Araújo et al. 2011 |
|            | Undetermined | Leaf       | Eulophidae (Par)  | Silvânia (GO) | Bergamini et al. 2017      |
|            | Undetermined | Stem       | Torymidae (Par)   | Silvânia (GO) | Bergamini et al. 2017      |
|            | Undetermined | Stem       | Sciaridae (Diptera) (Inq) | Silvânia (GO) | Bergamini et al. 2017      |
| Celastraceae| Undetermined | Leaf       | Eulophidae (Par)  | Silvânia (GO) | Bergamini et al. 2017      |
| Connaraceae| Cecidomyiidae| Inflorescence| Eurytomidae (Par) | Hidrolândia (GO) | Silva et al. 2018 |
| Erythroxylaceae| Undetermined | Leaf       | Araneae (Suc) Hemiptera (Inq) | Caetité (BA) | Silva et al. 2018 |
| Euphorbiaceae| Undetermined | Leaf/ Stem | Eulophidae (Par)  | Hidrolândia (GO) | Silva et al. 2018 |
| Fabaceae    | Cecidomyiidae| Bud        | Hymenoptera (Par) | Tíradentes (MG) | Maia & Fernandes 2004 |
| Meliaceae   | Undetermined | Leaf       | Eulophidae (Par)  | Serra dos Pireneus (GO) | Araújo et al. 2011 |
| Malpighiaceae| Cecidomyiidae| Leaf       | Eulophidae (Par)  | Caetité (BA) | Nogueira et al. 2016      |
|            | Undetermined | Stem       | Pseudoscorpiones (Pre) | Caetité (BA) | Nogueira et al. 2016      |
| Phlaeothripidae (Thysanoptera) | Leaf       | Eulophidae (Par)  | Hidrolândia (GO) | Silva et al. 2018  |
|            | Undetermined | Stem       | Hymenoptera (Par) | Caetité (BA) | Vieira et al. 2018        |
|            | Cecidomyiidae| Leaf       | Hymenoptera (Par) | Caetité (BA) | Vieira et al. 2018        |
|            | Undetermined | Leaf       | Eurytomidae (Par) | Sílvânia (GO) | Bergamini et al. 2017     |
| Malvaceae  | Undetermined | Leaf       | Hymenoptera (Par) | Serra dos Pireneus (GO) | Araújo et al. 2011       |
| Melastomataceae| Undetermined | Leaf       | Hymenoptera (Par) | Sílvânia (GO) | Bergamini et al. 2017     |
|            | Undetermined | Stem       | Sciaridae (Inq)   | Sílvânia (GO) | Bergamini et al. 2017     |
|            | Undetermined | Stem       | Torymidae (Par)   | Sílvânia (GO) | Silva et al. 2018         |
| Meliaceae | Undetermined | Leaf       | Eulophidae (Par)  | Sílvânia (GO) | Bergamini et al. 2017     |
| Moraceae   | Undetermined | Stem       | Araneae (Suc)     | Caetité (BA) | Silva et al. 2018         |
| Myrtaceae  | Undetermined | Leaf       | Eulophidae (Par)  | Sílvânia (GO) | Bergamini et al. 2017     |
| Cecidomyiidae| Undetermined | Leaf       | Hymenoptera (Par) | Sílvânia (GO) | Bergamini et al. 2017     |
|            | Undetermined | Leaf       | Eurytomidae (Par) | Sílvânia (GO) | Bergamini et al. 2017     |
| Phlaeothripidae (Thysanoptera) | Leaf       | Collembola (Suc) | Barreiras (BA) | Lima & Calado 2018        |
were recorded in a leaf gall on Bauhinia brevipes Vogel (Fabaceae); and two predators in a bud gall on Leandra aurea (Cham.) Cogn. (Melastomataceae). Furthermore, 17 gall morphotypes hosted more than one ecological guild: successors + inquilines (N=2), parasitoids + inquilines (N=7), parasitoids + successors (N=5), predators + parasitoids (N=2) and parasitoids + predictors + inquilines (N=1).

Almost all recorded plant species are native to Brazil, except Leonotis nepetifolia (L.) R.Br which is naturalized. Among the native species, 29 are endemic to Brazil (30.8%) (Table 1). The endemic plants host secondary dwellers in 50 gall morphotypes. Nine hosts are restricted to the Cerrado: Bauhinia holophylla (Bong.) Steud., Copaifera depilis Dwyer, C. luetzelburgii Harms, C. sabulicola J. Costa & L.P. Queiroz (Fabaceae), Ouratea var. pohlianum (O. Berg.) Laundrum (Myrtaceae) and Byrsonima crassifolia (A. St-Hil.) Engl. (Ochnaceae), whereas Calliandra macrocalyx Harms (Fabaceae) is restricted to the Caatinga. Nevertheless, this plant species is cited in the present paper, because it was recorded in a transition area between the Cerrado and the Caatinga. The endemic plants host four different ecological guilds: 1) parasitoids of seven Hymenopteran families (Braconidae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae, Ichneumonidae, and Platygasteridae), 2) predators (Formicidae, Acari, and Coleoptera), 3) parasitoids (Pseudoscorpiones), and 4) inquilines (Lygaeidae: Hemiptera, and Camptoneuromyia sp.: Cecidomyiidae).

Forty-six host plant species are useful and host secondary dwellers in 62 gall morphotypes. Several species have multiple uses, but most (33) (71.7%) are used in carpentry and/or cabinet making, 27 (58.7%) are medicinal and 15 (32.6%) are edible (Table 9). The useful plants host parasitoids of eight families (Braconidae, Encyrtidae, Eulophidae, Eurytomidae, Ichneumonidae, Platygasteridae, Pteromalidae, Signiphoridae, and Torymidae), inquilinous Lepidoptera, Hemiptera, and Camptoneuromyia sp. (Cecidomyiidae); and successors (Acari and Collembola).

Data on the associated fauna are distributed in 12 localities of four Brazilian states: Minas Gerais – Tiradentes (Serra de São José – 21°04'08"W) with records in 33 gall morphotypes, Belo Horizonte (Campus Pampulha – 19°48'0"S and 43°57'W) with 26, Delfinópolis – 20°15'0"S and 46°45'W with seven, and Serra do Cipó – 19°12'34"S and 43°27'38"W) with one; Goiás – Silvânia (16°38'0"S and 48°39'W) with 18, Serra dos Pireneus (15°48'0"S and 48°52'0"W) with 14, Goiânia (16°36'0"S and 49°16'0"W) with 13, Hidrolândia (17°00'0"S and 49°12'0"W) with 13, and Caldas Novas (17°42'0"S and 48°38'0"W) with 4; Bahia – Barreiras (11°37'0"S and 44°34'0"W) with 19 and Caetité (14°05'0"S and 42°29'0"W) with 19; and São Paulo (Altinópolis – 21°00'0"S and 47°23'0"W) with 16.

### Discussion

Cintra et al. (2020) recorded a total 968 gall morphotypes in the Brazilian Cerrado. In the present paper, we reported the associated fauna in 163 gall morphotypes, which corresponds to only 16.8% of the total. This low value appears to suggest that the presence of secondary dwellers is not frequent, but we have to consider that from 32 papers, only 50% addressed the associated fauna. The plant families with the greatest richness of secondary dwellers were the same ones pointed out by Cintra et al. (2020) as those with the highest gall richness.

The associated fauna was reported in all known orders of gall-inducing insects: Diptera Hemiptera, Lepidoptera, Hymenoptera, Coleoptera, and Thysanoptera. The majority was found in galls of Cecidomyiidae, the most frequent inducers in the Brazilian Cerrado. Leaf and stem galls supported most records as they are the most galled plant organs. Some galls hosted more than one ecological guild, which emphasizes the importance of gall-inducers as ecosystem engineers.

Parasitoids were the most frequent secondary dwellers, being represented by 12 Hymenopteran families. Among them, Eulophidae, Eurytomidae, Torrymidae, and Encyrtidae predominated. In restinga areas of the Atlantic Forest, Maia & Azevedo (2009) recorded 15 families, almost all represented in the Brazilian Cerrado, except Aphelinidae, Bethylidae, Mymaridae and Scelionidae. On the other hand, Ichneumonidae and Tetracampidae were not recorded by Maia.
Table 4. Richness of host plant species and gall morphotypes with records of the associated fauna per plant family in the Brazilian Cerrado. Families with the greatest number of gall morphotypes are highlighted in bold.

| Host plant-family | Number of host species | Number of gall morphotypes |
|-------------------|------------------------|----------------------------|
| Annonaceae        | 3                      | 3                          |
| Apocynaceae       | 1                      | 2                          |
| Araliaceae        | 1                      | 1                          |
| **Asteraceae**    | **12**                 | **15**                     |
| Bignoniaceae      | 1                      | 1                          |
| Boraginaceae      | 1                      | 3                          |
| Burseraceae       | 1                      | 2                          |
| Calophyllaceae    | 1                      | 3                          |
| Cannabaceae       | 1                      | 1                          |
| Caryocaraceae     | 1                      | 2                          |
| Celastraceae      | 1                      | 1                          |
| Combretaceae      | 1                      | 1                          |
| Connaraceae       | 1                      | 1                          |
| Dilleniaceae      | 2                      | 3                          |
| Ebenaceae         | 1                      | 1                          |
| Erythroxylaceae   | 2                      | 3                          |
| Euphorbiaceae     | 2                      | 5                          |
| **Fabaceae**      | **23**                 | **52**                     |
| Lamiaceae         | 1                      | 1                          |
| Lauraceae         | 1                      | 3                          |
| Malpighiaceae     | 6                      | 10                         |
| Malvaceae         | 3                      | 4                          |
| Melastomataceae   | 4                      | 6                          |
| **Myrtaceae**     | **5**                  | **10**                     |
| Nyctaginaceae     | 2                      | 2                          |
| Ochnaceae         | 1                      | 1                          |
| Piperaceae        | 1                      | 2                          |
| Proteaceae        | 1                      | 1                          |
| Rubiaceae         | 2                      | 2                          |
| Salicaceae        | 1                      | 1                          |
| Sapindaceae       | 1                      | 1                          |
| Siparunaceae      | 1                      | 3                          |
| Smilacaceae       | 1                      | 1                          |
| Styracaceae       | 1                      | 3                          |
| Trigoniacae       | 1                      | 1                          |
| Verbenaceae       | 2                      | 3                          |
| Vochysiaceae      | 3                      | 8                          |
| Total             | 35                     | 163                        |

Table 5. Richness of gall morphotypes with records of the associated fauna per gall-inducing insect in the Brazilian Cerrado.

| Gall-inducing insect | Number of gall morphotypes |
|----------------------|----------------------------|
| Diptera (Cecidomyiidae: 103) | 105                       |
| Hemiptera            | 7                          |
| Lepidoptera          | 6                          |
| Hymenoptera          | 3                          |
| Coleoptera           | 2                          |
| Thysanoptera         | 2                          |
| Undetermined         | 38                         |
| Total                | 163                        |

Table 6. Richness of gall morphotypes with records of the associated fauna per host plant organ in the Brazilian Cerrado.

| Host plant organ | Number of gall morphotypes |
|------------------|----------------------------|
| Leaves           | 109                        |
| Stems            | 32                         |
| Bud              | 8                          |
| Flower bud/inflorescence | 2                |
| Spine            | 1                          |
| Stem and bud     | 2                          |
| Leaf and stem    | 7                          |
| Bud, leaf and stem | 1                   |
| Fruit, inflorescence, leaf and stem | 1 |

Table 7. Richness of gall morphotypes with records of the associated fauna per ecological guild in the Brazilian Cerrado.

| Guild          | Number of gall morphotypes |
|----------------|----------------------------|
| Parasitoids    | 147 (90.2%)                |
| Successors     | 13 (8.0%)                  |
| Inquilines     | 12 (7.4%)                  |
| Predators      | 3 (1.8%)                   |
| Undetermined   | 1 (0.6%)                   |

&Azevedo (2009). Parasitoids were also reported in other biomes, as in Pantanal (Urso-Guimarães et al. 2016, Ascendino & Maia 2018), Amazon (Carvalho & Mota 2018), and Caatinga (Costa et al. 2014, Brito et al. 2018), however as a not so diverse guild.

The frequency of successors was similar to that of inquilines, differing from some inventories in Atlantic Forest areas, where inquilines were more frequent than successors (e.g. Maia et al. 2008, Maia & Mascarenhas 2017, Maia & Siqueira 2020). However, other inventories showed similar frequencies between both guilds as in Maia & Carvalho-Fernandes 2016, Flor et al. 2018. The taxa of inquilines ubiquitous were the same as that reported in the Atlantic Forest (Maia et al. 2008, Maia & Mascarenhas 2017, Maia & Siqueira 2020), except Diplopoda, observed until this moment only in galls from Cerrado areas. Coleoptera, Diptera, and Thysanoptera have been recorded in galls from the Amazon Forest (Maia 2011), whereas Trotteria and Camptoneuromyia (Cecidomyiidae), Phoridae, Lepidoptera, Coleoptera, Hemiptera, and Hymenoptera in galls from Pantanal (Urso-Guimarães et al. 2016, Ascendino & Maia 2018). Nevertheless, we emphasize that inquilines guild has been
Table 8. Richness of gall morphotypes with records of the associated fauna per ecological guild and arthropod taxon in the Brazilian Cerrado.

| Ecological guild | Taxon | Number of gall morphotypes |
|------------------|-------|-----------------------------|
| Inquiline        | Sciaridae (Diptera) | 1 |
|                  | Phlaeothripidae (Thysanoptera) | 1 |
|                  | Coleoptera | 1 |
|                  | Lepidoptera | 4 |
|                  | Hemiptera | 1 |
|                  | Lygaeidae (Hemiptera) | 1 |
|                  | Psocoptera | 1 |
|                  | Polyxenus sp. (Diplodopa) | 1 |
|                  | Anthonomus vis (Coleoptera) | 1 |
|                  | Camptoneuromyia sp. (Diptera) | 1 |
|                  | Clinodiplosis sp. (Diptera) | 1 |
|                  | Hymenoptera | 1 |
| Parasitoid       | Braconidae | 9 |
|                  | Chalcididae | 2 |
|                  | Eulophidae | 41 |
|                  | Encyrtidae | 12 |
|                  | Eupelmidae | 4 |
|                  | Eurytomidae | 20 |
|                  | Hymenoptera | 70 |
|                  | Ichneumonidae | 1 |
|                  | Platygastridae | 4 |
|                  | Pteromalidae | 6 |
|                  | Signiphoridae | 1 |
|                  | Tetracampidae | 1 |
|                  | Torymidae | 14 |
| Predator         | Lestodiplosis sp. (Cecidomyiidae) | 2 |
|                  | Fiebrigella sp. (Chloropidae) | 1 |
|                  | Pseudoscorpionida | 1 |
| Successor        | Acari | 5 |
|                  | Coleoptera | 1 |
|                  | Formicidae (Hymenoptera) | 2 |
|                  | Collembola | 1 |
|                  | Araneae | 1 |
|                  | Salina celebensis (Collembola) | 2 |
|                  | Seria mendoncae (Collembola) | 1 |
|                  | Meunieriella spinoa (Cecidomyiidae) | 1 |
|                  | Heteroptera (Hemiptera) | 1 |
| Undetermined     |       | 1 |

misunderstood as it includes cecidophages, kleptoparasites and true inquilines (Luz & Mendonça-Júnior 2019). Biological data are needed to relocate them in the correct guild. Successors have been reported in galls from other biomes, as Psocoptera in galls from Amazon Forest (Maia 2011) and Caatinga (Brito et al. 2018) and Araneae from the Caatinga (Brito et al. 2018). Predators showed the lowest frequency as in other inventories in Brazil (Maia 2001, Maia et al. 2008, Bregonci et al. 2010, Maia 2013, Maia & Souza 2013, Rodrigues et al. 2014, Maia & Carvalho-Fernandes 2016). Pseudoscorpiones and Diptera (Cecidomyiidae and Chloropidae) were the recorded taxa. In the Atlantic Forest, Pseudoscorpiones and Cecidomyiidae have been reported, as well as Formicidae (Maia 2001, Maia et al. 2008, Bregonci et al. 2010). The record of Chloropidae is known only in the Cerrado until this moment. Cecidomyiidae have been recorded in galls from the Amazon Forest (Maia 2011) and Pantanal (Ascendino & Maia 2018) too, Formicidae and Pseudoscorpiones from Pantanal (Ascendino & Maia 2018).

Taxonomic knowledge of the secondary dwellers is deficient, as only four species have been identified. Besides, there are five records at the genus level, four represented by Diptera: *Camptoneuromyia, Clinodiplosis, Lestodiplosis* and *Fiebrigella*, and one by Diplodopa. *Camptoneuromyia* comprises only gall inquilines, *Clinodiplosis* includes inquilinous, predaceous as well as gall-inducing species, *Lestodiplosis* is exclusively predator, whereas *Fiebrigella* includes predaceous and parasite species (Gagné & Jaschhof 2017, Smith et al. 2008).

Records of secondary dwellers in insect galls on undetermined plants did not allow us to establish the number of gall morphotypes, since we cannot know whether these morphotypes corresponded to others already recorded in identified species. However, we considered these records as they increased the number of host plant families and genera, as well as the richness of parasitoid and inquilines.

Multiparasitism was observed in 23 gall morphotypes. The fact that two or more parasitoid species attack the same host suggests that they can act together to control the gall-inducer population. Furthermore, multiparasitism can be associated with hyperparasitism, as showed by Maia & Monteiro, 1999. However, hyperparasitism has not yet been recorded in the Cerrado. The presence of two or more guilds in the same gall morphotype exemplifies how the associated fauna can compose complex food webs.

Endemic and useful plants host a diverse fauna of secondary dwellers. Such interactions add ecological importance to these arthropods as they can favor the host plants, acting in the control of the population of the gall-inducers (e.g. parasitoids and predators) or can damage the plants even more in the case of phytophagous dwellers.

Although the Cerrado partially or totally covers 15 states in Brazil (Ribeiro & Walter 2008), records of the associated fauna are restricted to four states: Minas Gerais, Goiás, Bahia, and São Paulo, showing that the current information is punctual and limited to a small fraction of the Cerrado’s territorial extension. The surveyed states correspond to those with research groups in cecidology.

**Conclusion**

A low percentage of the gall morphotypes from the Brazilian Cerrado hosted secondary dwellers. These galls were found on 94 plant species of 37 families. Other records on undetermined plant species increased the number of plant families to 46. The host families with
### Table 9. Uses of host plant species with secondary dwellers in the Brazilian Cerrado.

| Host plant | Edible | Medicinal | Carpentry and/or cabinet making | Fuel and/or charcoal | Reforestation | Others |
|------------|--------|-----------|---------------------------------|----------------------|---------------|--------|
| Annona coriacea | x | x | x | | | |
| A.crasiflora | x | x | x | | | Cork production |
| Duguetia furfuracea | x | x | | | | |
| Aspidosperma australe | x | | | x | | |
| Didymopanax morototoni | x | x | x | | | Paper industry |
| Eremanthus erythropappus | | | x | | | Living fence |
| Porophyllum ruderale | x | x | | | | Fungicide |
| Handroanthus ochraceous | x | | | x | | |
| Cordia sellowiana | | | | | | |
| Protium heptaphyllum | x | x | x | | | Incense |
| Caryocar brasiliense | x | x | x | x | | Varnishes |
| Plenckia populnea | | | | | | |
| Combretum leprosum | x | x | x | x | | |
| Connarus suberosus | x | x | x | | | Cork production |
| Erythroxylum suberosum | x | x | x | | | Dye |
| Croton floribundas | x | x | | | | |
| Sapium glandulosum | | | x | x | x | Latex |
| Andira cayabensis | x | x | x | | | |
| Andira fraxinifolia | x | x | x | | | |
| Bauhinia ungulata | x | x | x | x | | |
| Copaifera langsdorfii | x | x | x | x | | Cosmetic industry |
| Hymenaea courbaril | x (tea) | x | x | x | | Varnishes |
| Inga cylindrica | x | x | x | x | | Illuminant |
| Inga ingoides | x | x | x | x | | |
| Lonchocarpus cultratus | x | x | | | | Soil fertility |
| Macheirium aculeatum | | | | | | |
| Leonotis nepetilfolia | x | x | | | | |
| Nectandra cuspidata | | | | | | |
| Byrsonima verbascifolia | x | x | x | x | | Dye |
| Luehea divaricata | x | x | x | | | Shoe soles |
| Pseudobombax longiflorum | x | x | | x | | Stuffing |
| Myrtaria tenella | x | x | x | | | |
| Psidium salutare var. pohlianum | x | x | x | | | |
| Guapira opposita | x | | | | | |
| Neea theifera | x (tea) | x | | | | Dye |
| Piper arboreum | x | x | | | | |
| Roupala montana | x | x | | | | |
| Chomelia pohlana | x | x | x | | | |
| Casearia sylvestris | x | x | x | | | |
| Siparuna guianensis | x | | | | | |
| Smilax oblongifolia | x | | | | | |
| Styrax pohlil | x | x | x | x | | Source of tannins |
| Lippia alba | x | x | | | | |
| Qualea grandiflora | x | x | x | | | |
| Qualea multiflora | x | x | | | | |
| Qualea parviflora | x | x | | | | |

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the greatest number of records were the same with the highest richness of insect galls.

Most arthropod fauna were recorded in galls of Cecidomyiidae (Diptera), and on leaves, the predominant gall-forming insect and the most frequent galled organ. Parasitoids were the most frequent dwellers; among them, Eulophidae and Eurytomidae predominated as in other Brazilian biomes. All arthropod orders reported in the present study were also reported as part of the associated fauna in other Brazilian biomes, except Diplopoda. The taxonomic knowledge of these dwellers is very deficient as in the rest of our country.

Records of secondary dwellers of galls in endemic and useful plants add ecological and economic importance to the associated arthropods as they can favor or damage the host.

Data are restricted to MG, GO, BA and SP, the same states where there are cecidologists. This is the first overview of the fauna associated with insect galls in a Brazilian biome. Studies in other biomes are necessary to consolidate the current knowledge in our country.

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Author Contributions

Valéria Cid Maia: Substantial contribution in the concept and design of the study, contribution to data analysis and interpretation, manuscript preparation and critical revision, and adding intellectual content.

Bruno Gomes Silva: Contribution to data collection and analysis, manuscript preparation and critical revision.

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

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