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Thematic Review

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 endemismos 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. A maioria dos registros foi apresentada em categorias supragenéricas, mostrando que o conhecimento taxonômico é muito deficiente. Vinte e nove plantas são endêmicas do Brasil e totalizam 45 morfotipos de galhas com habitantes secundários; 46 espécies vegetais são úteis e hospedam habitantes secundários em 62 morfotipos de galhas. Estas informações acrescentam importância ecológica e econômica a estes artrópodes.
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 (Luz & 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 km^2 (23% of the national territory) (Oliveira & Ratter 2002) and one of the phytogeographical domains with the highest plant diversity in the world, containing over 12,000 species (Klink & Machado 2005, Mendonça et al. 2008). Furthermore, the Cerrado is considered one of the world`s biodiversity hotspots and a priority conservation area (Myers et al. 2000). Cintra et al. (2020) published a dataset of host plants and their gall-inducing insects for the Brazilian Cerrado, which represented a major effort to compile species lists of host plant communities for galling insects of the Neotropical region. However, Cintra et al. (2020) did not address the associated fauna.

Gall-inducers can influence the distribution and abundance of organisms in diverse communities by providing a physical structure that can be later used as shelter from the physical environment, protection from natural enemies as well as food resources. Therefore, they alter the local environment through habitat modification or amelioration of abiotic stress, with direct and indirect effects on other components of communities and ecosystem properties (Cuddington et al. 2007). This valuable role of gall-inducers as ecosystem engineers (Cornelissen et al. 2016) reinforces the importance of studying the associated fauna and knowing its composition, richness and ecological interactions.

The present study aims to compile data on arthropods associated with insect galls in the Brazilian Cerrado and answer the following questions: i) which guilds are represented? ii) which is the most frequent? iii) which is the most diverse? iv) what is the composition of each one? v) which plants host these guilds? vi) how many gall morphotypes host them? vii) do these guilds occur in endemic or useful hosts? vii) which galling insects stand out for sheltering the secondary fauna more often?

Material and Methods

We searched for papers in online academic databases: ISI Web of Knowledge, Google Scholar, Scielo, 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 41gall morphotypes (29.7% of the parasitized morphotypes), 20 (13.6%), 14 (9.5%) and 12 (8.2%), respectively.

Sucessors 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 Diplopoda, 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).

Concerning 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) Eurytomidae (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 australe Müll-Arg. (1)	Cecidomyiidae	Flower bud	Eurytomidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Hemiptera	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) Eulophidae 2 (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Cecidomyiidae	Bud	Eulophidae (Par) *Galeopsomyia* sp. (Eulophidae) (Par) *Eurytoma* sp. (Eurytomidae) (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Baccharis reticularia DC. (2)	Cecidomyiidae	Leaf	Platygastridae (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Lasiopteridi (Cecidomyidae)	Leaf	Heteroptera (Hemiptera) (Und)	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 (Cecidomyiidae)	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia 2004, Maia & Fernandes 2004 (as *Vannilosmopsis erythropapa* Schult)
Moquiniastrum barrosoae (Cabrera) G. Sancho (1)	Undetermined	Stem	Sciaridae (Diptera) (Inq)	Silvânia (GO)	Bergamini et al. 2017 (as *Gochnatia barrosii* 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) Eurytomidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988 (as *Moquinia paniculata* (Less) D.C.)
Moquiniastrum pulchrum (Cabrera) G. Sancho (1)	Cecidomyiidae	bud	Eulophidae (Par) Pteromalidae (Par) Torymidae (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) Lepidoptera (Inq)	Caetité (BA)	Silva et al. 2018a

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Vernonanthura polyanthes (Spreng.) Vega & Dematteis (1)	*Tomoplagia rudolphi* (Lutz & Lima, 1918) (Diptera, Tephritidae)	Stem/Bud	Braconidae (Par) Eulophidae (Par) Hymenoptera (Par) Hymenoptera (Inq)	Belo Horizonte Tiradentes Delfinópolis	Fernandes et al. 1988 Maia & Fernandes Urso-Guimaraes et al. 2003 (as *Vernonia polyanthes* Less.)
	Asphondylia sp. (Cecidomyiidae)	Leaf/ Stem	Chalcididae (Par) Torymidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
BIGNONIACEAE					
Handroanthus ochraceus (Cham.) Mattos (1)	Lopesiini (Cecidomyiidae)	Leaf	Helconinae (Braconidae) (Par) Hemiptera (Inq)	Delfinópolis (MG)	Urso-Guimarães et al. 2003 (as *Tabebuia ochracea* (Cham.) Standl.)
BORAGINACEAE					
Cordia sellowiana Cham. (2)	Cecidomyiidae	Leaf	Braconidae (Par) Eulophidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Cecidomyiidae	Stem	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
BURSERACEAE					
Protium heptaphyllum (Aubl.) March. (1)	Cecidomyiidae	Leaf/ Stem	Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
CALOPHYLLACEAE					
Calophyllum brasiliense (1)	*Lopesia elliptica* Maia, 2002 (Cecidomyiidae)	Leaf	Eulophidae (Par) Eurytomidae (Par) Pteromalidae (Par)	Tiradentes (MG)	Madeira et al. 2002, Maia & Fernandes 2004 (as *Calophyllum s*p.)
	Thysanoptera	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004 (as *Calophyllum* sp.)
	Contarinia gemmae Maia, 2002 (Cecidomyiidae)	Bud	Hymenoptera (Par)	Tiradentes (MG)	Madeira et al. 2002, Maia & Fernandes 2004 (as *Calophyllum* sp.)
CANNABACEAE					
Celtis iguanaea (Jacq.) Sarg. (1)	Undetermined	Leaf	Encyrtidae (Par)	Goiânia (GO)	Santos et al. 2010
CARYOCACEAE					
Caryocar brasiliense Cambess. (1)	Cecidomyiidae	Leaf	Eulophidae (Par) Eurytomidae (Par) Torymidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
	Diaspididae (Hemiptera)	Leaf	Encyrtidae (Par)	Altinópolis (SP)	Ribeiro et al. 2019
CELASTRACEAE					
Plenckia populnea Reissek (1)	Cecidomyiidae	Stem	Braconidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
COMBRETACEAE					
Combretum leprosum Mart. (1)	Cecidomyiidae	Leaf	Hymenoptera (Par) Hymenoptera (Par) Lepidoptera (Inq)	Caetité (BA)	Nogueira et al. 2016 Silva et al. 2018a Vieira et al. 2018
CONNARACEAE					
Connarus suberosus Planch. (1)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Silvânia (GO)	Bergamini et al. 2017
DILLENIACEAE					

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Davilla brasiliana DC. (1)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Asphondylia sp. (Cecidomyiidae)	bud	*Clinodiplosis* sp. (Cecidomyiidae) (Inq) Lepidoptera (Inq)	Tiradentes (MG)	Maia & Fernandes 2004
Davilla elliptica A. St-Hil. (1)	Cecidomyiidae	Leaf	Eulophidae (Par)	Serra dos Pireneus (GO)/ Silvânia (GO)	Araújo et al. 2011 Bergamini et al. 2017
EBENACEAE					
Diospyros burchellii DC. (1)	Lepidoptera	Stem	Hymenoptera (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
ERYTHROXYLACEAE					
Erythroxylum frangulifolium A. St-Hil. (2)	Eulophidae (Hymenoptera)	Bud/Stem	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
Erythroxylum suberosum A. St-Hil. (1)	Undetermined	Stem	Eurytomidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Myrciariamyia admirabilis Maia, 2007 (Cecidomyiidae)	leaf	Eulophidae (Par) Encyrtidae (Par) Torymidae (Par)	Tiradentes/ Serra do Cipó (MG)/ Hidrolândia (GO)	Maia & Fernandes 2004, 2007 Silva et al. 2018b
EUPHORBIACEAE					
Croton floribundus Spreng. (1)	*Clinodiplosis* sp. (Cecidomyiidae)	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Couridiplosis vena Maia, 2004 (Cecidomyiidae)	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia 2004 Maia & Fernandes 2004
	Undetermined	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Sapium glandulosum (L.) Morong (1)	*Neolithus fasciatus* Scott, 1882 (Triozidae, Hemiptera)	Fruit/ Inflorescence/ Leaf/ Stem	Encyrtidae (Par) Eurytomidae (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 humilis Max ex Benth. (2)	Cecidomyiidae	Leaf	Eulophidae (Par) Eurytomidae (Par)	Barreiras (BA)	Lima & Calado 2018
Andira paniculata Benth. (1)	Cecidomyiidae	Leaf	Encyrtidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Cecidomyiidae	Leaf	Encyrtidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Cecidomyiidae	Leaf	Encyrtidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Caldas Novas (GO)	Santos et al. 2012
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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	Schizomyia macropillata Maia, 2005 (Cecidomyiidae)	Leaf	Eulophidae (Par) Collembola: *Seira mendoncae* (Suc) *Salina celebensis* (Suc)	Barreiras (BA)	Maia & Fernandes 2005 Lima & Calado 2018
	Cecidomyiidae	Stem	Acari (Suc) Encyrtidae (Par)	Barreiras (BA)	Lima & Calado 2018
	Cecidomyiidae	Stem	Braconidae (Par) Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
Bauhinia cupulata Benth. (1)	Cecidomyiidae	Leaf	Salina celebensis	Barreiras (BA)	Lima & Calado 2018
Bauhinia holophylla (Bong.) Steud. (2)	*Schizomyia tuiuiu* Urso-Guimarães & Amorim, 2002 (Cecidomyiidae)	Leaf	Rileynae (Eurytomidae) (Par)	Altinópolis (SP)	Urso-Guimarães & Amorim 2002 Ribeiro et al. 2019
Bauhinia rufa (Bong.) Steud. (1)	Cecidomyiidae	Leaf	Eupelmidae (Par) Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Leaf	Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Stem	Eupelmidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Stem	Eupelmidae (Par) Tetracampidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Stem	Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
Bauhinia ungulata L. (1)	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
Calliandra macrocalyx Harms (2)	Undetermined	Bud	Hymenoptera (Par)	Caetité (BA)	Silva et al. 2018a
Copaifera depilis Dwyer (2)	Undetermined	Stem	Hymenoptera (Par)	Barreiras (BA)	Santos et al. 2018
	Undetermined	Leaf	Hymenoptera (Par)	Barreiras (BA)	Santos et al. 2018
Copaifera langsdorffii Desf. (1)	Hymenoptera	Bud/ Leaf/ Stem	Encyrtidae (Par) Eurytomidae (Par) Pteromalidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Cecidomyiidae	Leaf/ Stem	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Cecidomyiidae	Leaf	Pteromalidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Contarinia sp. (Cecidomyiidae)	Leaf	Platygasteridae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	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
	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
	Undetermined	Leaf	Hymenoptera (Par)	Barreiras (BA)	Santos et al. 2018
	Undetermined	Stem	Hymenoptera (Par)	Barreiras (BA)	Santos et al. 2018
Copaifera sabulicola J. Costa & L.P. Queiroz (2)	Undetermined	Stem	Hymenoptera (Par) Acari (Suc)	Barreiras (BA)	Santos et al. 2018
	Undetermined	Stem	Formicidae (Suc)	Barreiras (BA)	Santos et al. 2018
	Undetermined	Leaf	Coleoptera (Suc)	Barreiras (BA)	Santos et al. 2018

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Hymenaea courbaril L. (1)	Cecidomyiidae	Leaf	Eurytomidae (Par)	Barreiras (BA)	Lima & Calado 2018
	Cecidomyiidae	Leaf	Acari (Suc)	Barreiras (BA)	Lima & Calado 2018
Inga bahiensis Benth. (1)	Undetermined	Leaf	Coleoptera (Inq)	Caetité (BA)	Silva et al. 2018a
Inga cylindrica (Vell.) Mart. (1)	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
Inga ingoides (Rich.) Willd. (1)	Cecidomyiidae	Leaf/ Stem	Braconidae (Par) Eurytomidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
Inga edulis Mart. (1)	*Neolasioptera* sp. (Cecidomyiidae)	Leaf	Spalangiinae (Pteromalidae) (Par) *Meunieriella spinosa* Urso-Guimarães, 2019 (Cecidomyiidae) (Suc)	Delfinópolis (MG)	Urso-Guimarães et al., 2003 Urso-Guimarães, 2019
Lonchocarpus cultratus (Vell.) A.M.G. Azevedo & H.C. Lima (1)	*Euphaleurus* sp. (Psyllidae, Hemiptera)	Leaf	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988 (as *Lonchocarpus guilleminianus* (Tui.) Malme)
Machaerium aculeatum Raddi (2)	*Anadiplosis* sp. (Cecidomyiidae)	Leaf	Eulophidae (Par) Eurytomidae (Par) Platygastridae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
Mimosa gemmulata Barneby (1)	Undetermined	Stem	Hymenoptera (Par)	Caetité (BA)	Nogueira et al. 2016
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Caetité (BA)	Silva et al. 2018a
LAMIACEAE					
Leonotis nepetifolia (3)	*Asphondylia canastrae* Urso-Guimarães & Amorim, 2002 (Cecidomyiidae)	Inflorescence	Toryminae (Torymidae) (Par) Rileynae (Eurytomidae) (Par)	Delfinópolis (MG)	Urso-Guimarães & Amorim 2002 Urso-Guimarães et al. 2003
LAURACEAE					
Nectandra cuspidata Nees (1)	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
	Cecidomyiidae	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
	Undetermined	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
MALPIGHIACEAE					
Byrsonima pachyphylla Griseb. (1)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Caldas Novas (GO)	Santos et al. 2012
Byrsonima starnardii W. R. Anderson (2)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Caetité (BA)	Nogueira et al. 2016
Byrsonima variabilis A. Juss. (2)	Undetermined	Stem	Eulophidae (Par) Eupelmidae (Par) Eurytomidae (Par) Ichneunomidae (Par) Platygastridae (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Byrsonima verbascifolia (L.) DC. (1)	Cecidomyiidae	Leaf	Eulophidae (Par) Eulophidae (Par) Eurytomidae (Par) Torymidae (Par) Signiphoridae (Par)	Silvânia (GO)/ Tiradentes (MG)	Bergamini et al. 2017 Maia & Fernandes 2004
	Lepidoptera	Stem	Eurytomidae (Par)	Silvânia (GO)	Bergamini et al. 2017

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Diplopterys pubipetala (A. Juss.) W.R. Anderson & C. C. Davis (1)	*Clinodiplosis bellum* Urso-Guimarães & Garcia-Neto, 2015 (Cecidomyiidae)	Leaf	Eulophinae (Par) Entedoninae (Par) Torymidae (Par)	Altinópolis (SP)	Urso-Guimarães & Garcia-Neto, 2015 Ribeiro et al. 2019
	Dasineura sp. (Cecidomyiidae)	Leaf	*Lestodiplosis* sp. (Cecidomyiidae) (Pre) Eurytomidae (Par)	Altinópolis (SP) Hidrolândia (GO)	Ribeiro et al. 2019 Silva et al. 2018b
	Phlaeothripidae (Thysanoptera)	Leaf	Eulophidae (Par)	Hidrolândia	Silva et al. 2018b
Peixotoa goiana C. E. Anderson (2)	Undetermined	Leaf	Hymenoptera (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Leaf	Torymidae (Par) Phlaeothripidae (Thysanoptera) (Inq)	Silvânia (GO)	Bergamini et al. 2017
MALVACEAE					
Luehea divaricata Mart. (1)	Coleoptera	Leaf	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
Luehea cf. divaricata Mart.	Cecidomyiidae	Leaf/ Stem	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Pseudobombax longiflorum (Mart. & Zucc.) A. Robyns (1)	Lepidoptera	Leaf	Hymenoptera (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
Sida micrantha A.St.-Hil. (1)	Cecidomyiidae	Leaf/ Stem	Hymenoptera (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
MELASTOMATACEAE					
Leandra aurea (Cham.) Cogn. (1)	Lepidoptera	Bud	*Anthonomus vis* Clark, 1992 (Curculionidae) (Inq) *Fiebrigella* sp. (Chloropidae) (Pre) *Lestodiplosis* sp. (Cecidomyiidae) (Pre) Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004 Benà & Vanin 2013
	Lepidoptera	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Macairea radula (Bonpl.) DC. (1)	Gelechiidae (Lepidoptera)	Leaf	Chalcididae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Undetermined	Leaf	Microgastrinae (Braconidae) (Par)	Delfinópolis (MG)	Urso-Guimarães et al. 2003
Miconia theaezans (Bonpl.) Cogn. (1)	Cecidomyiidae	Bud	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Pleroma candolleanum (Mart. ex DC.) Triana (2)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004 (*as Tibouchina candolleana* (DC.) Cogn.)
MYRTACEAE					
Eugenia punicifolia (Kunth) DC. (2)	Undetermined	Leaf	Hymenoptera (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Stephomyia epeugeniae Gagné, 1994 (Cecidomyiidae)	Leaf	Eulophidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988 (as *Eugenia ovalifolia*)

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	Stephomyia sp. (Cecidomyiidae)	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004 (as *Eugenia* cfr. *ovalifolia*)
	Undetermined	Stem	Hymenoptera (Par)	Caetité (BA)	Vieira et al. 2018a
Myrcia retorta Cambess. (2)	*Dasineura* sp. (Cecidomyiidae)	Leaf	Eulophidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988 (as *Myrcia itambensis* O. Berg.)
	Triozoida sp. (Psyllidae, Hemiptera)	Leaf	Encyrtidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
	Cecidomyiidae	Leaf	Eulophidae (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
Myrciaria tenella (DC.) O. Berg. (1)	*Myrciariamyia fernandesi* Maia, 2004 (Cecidomyiidae)	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Psidium brownianum Mart. ex DC. (2)	Undetermined	Leaf	Pseudoscorpiones (Pre)	Caetité (BA)	Silva et al. 2018a
Psidium salutare var. *pohlianum* (O. Berg.) Laundrum (2)	Psyllidae (Hemiptera)	Leaf	Eulophidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
NYCTAGINACEAE					
Guapira opposita (Vell.) Reitz (1)	Cecidomyiidae	Stem	Hymenoptera (Par)	Caetité (BA)	Vieira et al. 2018
Neea theifera Oerst. (1)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Caldas Novas (GO)	Santos et al. 2012
OCHNACEAE					
Ouratea floribunda (A. St-Hil.) Engl. (2)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Belo Horizonte (MG)	Fernandes et al. 1988
PIPERACEAE					
Piper arboreum Aubl. (1)	Undetermined	Leaf	Eulophidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
PROTEACEAE					
Roupala montana Aubl. (1)	Cecidomyiidae	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
RUBIACEAE					
Borreria cfr. brachystemonoides Cham. & Schltdl. (1)	Cecidomyiidae	Stem	Encyrtidae (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Chomelia pohliana Müll.Arg (2)	Undetermined	Spine base	Lygaeidae (Hemiptera) (Inq)	Delfinópolis (MG)	Urso-Guimarães et al. 2003
SALICACEAE					
Casearia sylvestris Sw. (1)	Undetermined	Stem	Hymenoptera (Par)	Silvânia (GO)	Bergamini et al. 2017
SAPINDACEAE					
Serjania obtusidentata Radlk. (2)	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
SIPARUNACEAE					
Siparuna guianensis Aubl. (1)	Undetermined	Stem	Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Stem	Eurytomidae (Par)	Hidrolândia (GO) Silvânia (GO)	Silva et al. 2018b Bergamini et al. 2017
	Undetermined	Stem	Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
SMILACACEAE					

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Smilax oblongifolia Pohl ex Griseb. (2)	Cecidomyiidae	Leaf	Hymenoptera (Par) *Polyxenus* (Diplopoda) (Inq) Psocoptera (Inq) Eulophidae (Par) *Camptoneuromyia* sp. (Cecidomyiidae) (Inq)	Delfinópolis (MG) Altinópolis (SP)	Urso-Guimarães et al., 2003 (as Smilax coriifolia A. DC.) Ribeiro et al. 2019
STYRACACEAE					
Styrax pohlii A.DC. (1)	Cecidomyiidae	Leaf	Eulophidae (Par)	Goiânia (GO)	Santos et al. 2010
	Diptera	Stem	Hymenoptera (Par)	Goiânia (GO)	Santos et al. 2010
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Goiânia (GO)	Santos et al. 2010
TRIGONIACEAE					
Trigonia nivea Cambess. (1)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Caetité (BA)	Nogueira et al. 2016
VERBENACEAE					
Lantana fucata Lindl. (1)	*Neolasioptera* sp (Cecidomyiidae)	Stem	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004 (as *Lantana lilacina* Desf.)
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Lippia alba (Mill.) N. E. Br. ex Britton & P. Wilson (1)	Cecidomyiidae	Leaf	Hymenoptera (Par)	Caetité (BA)	Vieira et al. 2018
VOCHYSIACEAE					
Qualea grandiflora Mart. (1)	Undetermined	Leaf	Eulophidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Hymenoptera	Leaf	Collembola (Suc)	Barreiras (BA)	Lima & Calado 2018
	Cecidomyiidae	Stem	Hymenoptera (Par)	Caldas Novas (GO)	Santos et al. 2012
Qualea multiflora Mart. (1)	Cecidomyiidae	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
	Cecidomyiidae	Leaf	Braconidae (Par) Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
Qualea parviflora Mart. (1)	Undetermined	Leaf	Eulophidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
			Encyrtidae (Par)	Hidrolândia (GO)	Silva et al. 2018b
	Cecidomyiidae	Leaf	Lepidoptera (Inq)	Caetité (BA)	Silva et al. 2018a

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 Metteniusaceae. 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, *Arrabidaea* DC. (Bignoniaceae), *Hirtella* L. (Chrysobalanaceae), *Doliocarpus* Rol. (Dilleniaceae), *Manihot* Mill. and *Sebastiania* Spreng, (Euphorbiaceae), *Emmotum* Dsv. ex Ham. (Metteniusiaceae), *Struthanthus* Mart. (Loranthaceae), *Diplusodon* Pohl. (Lythraceae), *Heteropterys* Kunth. and *Thryallis* L. (Malpighiaceae), *Tibouchina* Aubl. (Melastomataceae), *Guarea* F. Allam ex L. and *Trichilia* P. Browne (Meliaceae), *Camponanesia* 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, Perilampidae, Pteromalidae, Tanaostigmatidae, Torymidae, and Trichogrammatidae; Diptera: Sciaridae and Brachycera; Thysanoptera; Collembola: *Salina celebensis, Salina* sp. and *Seria mendoncae*; 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
	Cecidomyiidae	Stem	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					
Combretum sp.	Phlaeothripidae (Thysanoptera)	Leaf	Eurytomidae (Par) *Seria mendoncae* (Collembola) (Suc)	Barreiras (BA)	Lima & Calado 2018
Connaraceae					
Connarus sp.	Undetermined	Stem	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Dilleniaceae					
Doliocarpus sp.	Cecidomyiidae	Stem	Elasmidae (Par) Eurytomidae (Par) Eulophidae (Par) Torymidae (Par) Sciaridae (Inq)	Silvânia (GO)	Bergamini et al. 2017
Erythroxylaceae					
Erythroxylum sp.	Cecidomyiidae	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
	Cecidomyiidae	Leaf	Pteromalidae (Par)	Hidrolândia (GO)	Silva et al. 2018
	Cecidomyiidae	Leaf midvein	Pteromalidae (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
	Cecidomyiidae	Leaf	Pteromalidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Sebastiania sp.	Cecidomyiidae	Leaf	Eulophidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
Fabaceae					
Andira sp.	Cecidomyiidae	Stem	Eulophidae (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Bauhinia sp.	Cecidomyiidae	Leaf vein	Eulophidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Cecidomyiidae	Leaf	Braconidae (Par) Eulophidae (Par) Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Lepidoptera	Stem	Araneae (Suc)	Caetité (BA)	Silva et al. 2018
	Cecidomyiidae	Leaf	Braconidae (Par) Eulophidae (Par) Pteromalidae (Par)	Hidrolândia (GO)	Silva et al. 2018
	Undetermined	Stem	Braconidae (Par)	Hidrolândia (GO)	Silva et al. 2018
	Lepidoptera	**Stem**	**Torymidae (Par)**	**Hidrolândia (GO)**	**Silva et al. 2018**
Inga sp.	Cecidomyiidae	Leaf midvein	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Loranthaceae					
Struthanthus sp.	Undetermined	Leaf	Hymenoptera (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
Lythraceae					
Diplusodon sp.	Undetermined	Stem	Brachycera (Diptera) (Inq)	Silvânia (GO)	Bergamini et al. 2017
Malpighiaceae					

Byrsonima sp.	Cecidomyiidae	Leaf	Trichogrammatidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
Heteropterys sp.	Undetermined	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Peixotoa sp.	Cecidomyiidae	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Thryallis sp.	Undetermined	Leaf	Hymenoptera (Par)	Caetité (BA)	Nogueira et al. 2016
Malvaceae					
Luehea sp.	Cecidomyiidae	Leaf	*Salina celebensis* (Suc) *Salina* sp. (Suc)	Barreiras (BA)	Lima & Calado 2018
Melastomataceae					
Miconia sp.	Cecidomyiidae	Leaf/ Stem	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Miconia sp.	Undetermined	Stem	Hymenoptera (Par)	Goiânia (GO)	Silva et al. 2015
Tibouchina sp.	Cecidomyiidae	Leaf	Perilampidae (Par)	Altinópolis (SP)	Ribeiro et al. 2019
Meliaceae					
Guarea sp.	Cecidomyiidae	Leaf	Thysanoptera (Inq)	Caetité (BA)	Silva et al. 2018
Trichilia sp.	Undetermined	Stem	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Metteniusaceae					
Emmotum sp.	Undetermined	Stem	Hymenoptera (Par) Formicidae (Suc)	Caetité (BA)	Nogueira et al. 2016
Myrtaceae					
Campomanesia sp.	Undetermined	Leaf	Hymenoptera (Par)	Caetité (BA)	Vieira et al. 2018
Eugenia sp.	Undetermined	Leaf	Hymenoptera (Par)	Caetité (BA)	Vieira et al. 2018
Myrcia sp.	Cecidomyiidae	Leaf	Hymenoptera (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Cecidomyiidae	Bud	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Thysanoptera	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Undetermined	Stem	Eurytomidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Nyctaginaceae					
Guapira sp.	*Lopesia bilobata* Maia, 2004 Cecidomyiidae	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia 2004 Maia & Fernandes 2004
	Asphondyliini (Cecidomyiidae)	Stem	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Cecidomyiidae	Leaf	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Piperaceae					
Piper sp.	*Parametasphondylia piperis* Maia & Santos, 2007 (Cecidomyiidae)	Leaf/ stem	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004 Maia & Santos 2007
	Cecidomyiidae	Leaf midvein	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Sapindaceae					
Paullinia sp.	Cecidomyiidae	Stem	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Undetermined	Leaf bud	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Serjania sp.	Cecidomyiidae	Leaf	Eulophidae (Par) Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Stem	Eurytomidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Smilaceae					
Smilax sp.	Undetermined	Leaf	Eulophidae (Par) Torymidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Styracaceae					
Styrax sp.	Undetermined	Leaf	Eupelmidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011

five (Eulophidae, Eupelmidae, Eurytomidae, Ichneumonidae, and Platygastridae) 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. (Dilleniacaeae).

Different inquilines – *Clinodiplosis* sp. (Cecidomyiidae) 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 mendoncae* 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) Sciaridae (Diptera) (Inq)	Silvânia (GO)	Bergamini et al. 2017
	Undetermined	Stem	Eulophidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Undetermined	Stem	Hymenoptera (Par)	Caetité (BA)	Silva et al. 2018
Celastraceae	Undetermined	Leaf	Eulophidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Undetermined	Stem	Eurytomidae (Par) Torymidae (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) Eurytomidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Fabaceae	Cecidomyiidae	Bud	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Neolasioptera sp. (Cecidomyiidae)	Stem	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Malpighiaceae	Cecidomyiidae	Leaf	Eulophidae (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Undetermined	Stem	Pseudoscorpiones (Pre)	Caetité (BA)	Nogueira et al. 2016
	Undetermined	Leaf midvein	Hymenoptera (Par)	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	Hymenoptera (Par)	Caetité (BA)	Vieira et al. 2018
Malvaceae	Undetermined	Leaf	Eurytomidae (Par) Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
Melastomataceae	Undetermined	Leaf	Hymenoptera (Par)	Serra dos Pireneus (GO)	Araújo et al. 2011
	Undetermined	Stem	Sciaridae (Inq)	Silvânia (GO)	Bergamini et al. 2017
	Undetermined	Stem	Torymidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Meliaceae	Undetermined	Leaf	Eulophidae (Par)	Silvânia (GO)	Bergamini et al. 2017
Moraceae	Undetermined	Stem	Araneae (Suc)	Caetité (BA)	Silva et al. 2018
Myrtaceae	Undetermined	Leaf	Eulophidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Leaf	Hymenoptera (Par)	Silvânia (GO)	Bergamini et al. 2017
	Undetermined	Leaf	Eurytomidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Cecidomyiidae	Stem	Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Phlaeothripidae) (Thysanoptera)	Leaf	Collembola (Suc)	Barreiras (BA)	Lima & Calado 2018

	Undetermined	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
	Sternorrhyncha (Hemiptera)	Leaf	Hymenoptera (Par)	Tiradentes (MG)	Maia & Fernandes 2004
Rubiaceae	Cecidomyiidae	Stem	Eupelmidae (Par) Tanaostigmatidae (Inq)	Silvânia (GO)	Bergamini et al. 2017
	Undetermined	Stem	Torymidae (Par)	Silvânia (GO)	Bergamini et al. 2017
	Undetermined	Leaf	Araneae (Suc) Hemiptera (Suc)	Caetité (BA)	Silva et al. 2018
Sapindaceae	Undetermined	Stem	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
	Cecidomyiidae	Leaf	*Seria mendoncae* (Suc) *Salina celebensis* (Suc) Hymenoptera (Par) Phlaeothripidae (Suc)	Barreiras (BA)	Lima & Calado 2018
	Undetermined	Stem	Eulophidae (Par)	Hidrolândia (GO)	Silva et al. 2018
Solanaceae	Undetermined	Bud	Hymenoptera (Par)	Caetité (BA)	Silva et al. 2018
Tiliaceae	Undetermined	Leaf	Hymenoptera (Par)	Goiânia (GO)	Silva et al. 2015
Turneraceae	Undetermined	Stem	Hymenoptera (Par)	Caetité (BA)	Silva et al. 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 + predators + 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), *Byrsonima starnardii* W. R. Anderson, *Peixotoa goiana* C. E. Anderson (Malpighiaceae), *Pleroma candolleanum* (Mart. ex DC.) Triana (Melastomataceae), *Psidium salutare* var. *pohlianum* (O. Berg.) Laundrum (Myrtaceae) and *Ouratea floribunda* (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, Ichneunomidae, and Platygastridae), 2) successors (Formicidae, Acari, and Coleoptera), 3) predators (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, Platygastridae, 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^{0}04'S and 44^{0}08'W) with records in 33 gall morphotypes, Belo Horizonte (Campus Pampulha – 19^{0}48'S and 43^{0}57'W) with 26, Delfinópolis – 20^{0}15'S and 46^{0}45'W with seven, and Serra do Cipó – 19^{0}12-34'S and 43^{0}27-38'W) with one; Goiás – Silvânia (16^{0}38'S and 48^{0}39'W) with 18, Serra dos Pireneus (15^{0}48'S and 48^{0}52'W) with 14, Goiânia (16^{0}36'S and 49^{0}16'W) with 13, Hidrolândia (17^{0}00'S and 49^{0}12'W) with 13, and Caldas Novas (17^{0}42'S and 48^{0}38'W) with 4; Bahia – Barreiras (11^{0}37'S and 44^{0}34'W) with 19 and Caetité (14^{0}05'S and 42^{0}29'W) with 19; and São Paulo (Altinópolis – 21^{0}00'S and 47^{0}23'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 are 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, Torymidae, 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
Trigoniaceae	1	1
Verbenaceae	2	3
Vochysiaceae	3	8
Total 35	94	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 at. 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~~inquilinous~~ 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. (Diplopoda)	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
	Friebrigella 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 spinosa (Cecidomyiidae)	1
Undetermined	Heteroptera (Hemiptera)	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).

Taxonomical 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 Diplopoda. *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	Uses					
	Edible	Medicinal	Carpentry and/or cabinet making	Fuel and/or charcoal	Reforestation	Others
Annona coriacea		x	x			
A.crassiflora	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			x			
Protium heptaphyllum	x	x	x			Incense Varnishes
Caryocar brasiliense	x	x	x	x		Cosmetic industry
Plenckia populnea			x			
Combretum leprosum		x	x	x	x	
Connarus suberosus		x	x	x		Cork production
Erythroxylum suberosum		x	x			Dye
Croton floribundus		x	x			
Sapium glandulosum				x	x	Latex
Andira cuyabensis		x	x	x		
Andira fraxinifolia		x	x		x	
Bauhinia ungulata		x	x	x	x	
Copaifera langsdorfii	x	x	x	x		Cosmetic industry Varnishes
Hymenaea courbaril	x (tea)	x	x	x		illuminant
Inga cylindrica	x		x	x	x	
Inga ingoides	x		x	x	x	
Lonchocarpus cultratus						
Machaerium aculeatum			x			Soil fertility
Leonotis nepetifolia	x	x				
Nectandra cuspidata			x			
Byrsonima verbascifolia	x	x	x	x		Dye
Luehea divaricata		x	x			Shoe soles
Pseudobombax longiflorum			x		x	Stuffing
Myrciaria tenella	x		x	x		
Psidium salutare var. *pohlianum*	x					
Guapira opposita			x			
Neea theifera	x (tea)	x				Dye
Piper arboreum		x				
Roupala montana			x			
Chomelia pohliana						
Casearia sylvestris		x	x		x	
Siparuna guianensis		x				
Smilax oblongifolia		x				
Styrax pohlii		x	x		x	
Lippia alba	x	x				
Qualea grandiflora			x			
Qualea multiflora			x			
Qualea parviflora			x			Source of tannins

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 galling-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 intelectual 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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