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Arthropods associated to tree canopies in the edges of a forest fragment in the Cerrado of Minas Gerais, Brazil

Artrópodos en los doseles de árboles que cubren los bordes de un fragmento de bosque en el Cerrado de Minas Gerais, Brasil

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ABSTRACT

The Cerrado biome occupies 22% of Brazil's land area and has one of the highest levels of endemism of flora and fauna species of any biome. As components of the fauna, the arthropods stand out as they perform several functions within ecosystems and serve as bioindicators of environmental quality. This work aimed to evaluate the association of the arthropod fauna with tree canopies in an area surrounding a fragment of a legal reserve adjacent to a coffee plantation. The study was conducted at the Juliana farm (18º43'29"S; 47º29'55"W), located in the municipality of Monte Carmelo, Minas Gerais, Brazil. The canopy net methodology was used, in which a net bag was wrapped around the branches and shaken five times, covering the four cardinal directions in the crowns of 20 trees. The contents of the net were placed in plastic bags, sealed, identified, and taken to the laboratory. Twelve monthly collections were performed between August 2018 and July 2019, for a total of 240 samples. The collected specimens were identified in taxonomic groups using a taxonomic key. During the sampling period, 804 individuals were collected, belonging to 56 taxa of the classes Arachnida and Insecta. *Xylopia aromatica* (Annonaceae) was the most representative tree species, with 50% of the sampled taxa found in its branches. The order Araneae and the families Asilidae and Tephritidae (Diptera) and Formicidae (Hymenoptera) were the predominant taxa in the faunistic analysis. As potential predators, Araneae and Formicidae were the most important groups and were found in all tree species sampled. The families Braconidae and Ichneumonidae (Hymenoptera) were the most common among the parasitoids. We conclude that the legal reserve and permanent preservation areas maintain populations of tree species that can generate a survival site for natural enemies and other canopy arthropods.

Keywords: Brazilian savanna, faunistic analysis, natural biological control, parasitoids, predators.

RESUMEN

El Cerrado ocupa el 22% de la superficie terrestre de Brasil y tiene uno de los niveles más altos de endemismo de fauna y flora en comparación con otros biomas. Como componentes de la fauna se destacan los artrópodos, los cuales realizan varias funciones dentro de los ecosistemas y pueden servir como indicadores ambientales. Este trabajo tuvo como objetivo evaluar la asociación de la fauna de artrópodos con las copas de los árboles en un área de borde de un fragmento de bosque perteneciente a una reserva natural adyacente a una plantación de café. El estudio se realizó en la finca Juliana (18º43'29 "S; 47º29'55" O), ubicada en el municipio de Monte Carmelo, Minas Gerais, Brasil. Se adaptó la metodología de red de dosel para realizar la colecta de especímenes. Se envolvió una bolsa de red alrededor de las ramas de copas de 20 árboles y se agitó cinco veces, cubriendo los cuatro puntos cardinales. El contenido de la red se colocó en bolsas plásticas que luego de selladas e identificadas fueron llevadas al laboratorio. Se realizaron doce colectas mensuales entre agosto de 2018 y julio de 2019, totalizando 240 muestras. Los grupos taxonómicos a los que pertenecían los especímenes colectados fueron identificados utilizando una clave taxonómica. Se colectaron 804 individuos pertenecientes a 56 taxones de las clases Arachnida e Insecta. Xylopia aromatica *(Annonaceae) fue la especie arbórea más representativa, conteniendo en sus ramas el 50% de los taxones colectados. El orden Araneae y las familias Asilidae y Tephritidae (Diptera) y Formicidae (Hymenoptera) fueron los taxones predominantes en el análisis faunístico. Los depredadores potenciales Araneae y Formicidae fueron los grupos más conspicuos, encontrándose en todas las especies de árboles analizadas. Las familias Braconidae e Ichneumonidae (Hymenoptera) fueron las más comunes entre los parasitoides. Concluimos que la reserva natural y las áreas de preservación permanente mantienen poblaciones de especies arbóreas que pueden generar espacios de supervivencia para enemigos naturales y otros artrópodos del dosel.*

Palabras clave: *análisis faunístico, control biológico natural, depredadores, parasitoides, sabana brasileña.*

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Introduction

The Cerrado is the second-largest biome in Brazil in terms of land area. Occupying 22% of the country's area, it covers ten states and the Federal District and is considered a global hotspot due to the high rates of endemism among its fauna and flora. This biome comprises 11 main ecoregions, which are divided more broadly into forests, savannas, and grasslands. The forests are further divided into riparian forests (*Mata Ciliar*), gallery forests (*Mata de Galeria*), and the *Cerradão*. The savannas are comprised of the Cerrado *sensu stricto*, the Cerrado park (*Parque de Cerrado*), palm groves (*Palmeiral*), and the *Vereda*, while the grasslands consist of the *Campo Sujo*, *Campo Limpo*, and *Campo Rupestre*. Accounting for additional subtypes, a total of 25 distinct ecoregions are recognized in the Cerrado (Ribeiro and Walter, 2008).

The Cerrado has already lost about 50% of its original vegetation cover, with deforestation closely linked to the replacement of natural areas with areas of planted pasture, annual agriculture, and perennial agriculture (PPCerrado, 2018). The resulting decrease in natural areas can lead to habitat destruction and the consequent extinction of fauna and flora species, as well as causing soil erosion, aquifer pollution, regional climate change, and biome fragmentation (Klink and Machado, 2005).

In this regard, permanent preservation and legal reserve areas play a fundamental role in maintaining floral diversity and providing shelter and food for animal life. However, forest fragmentation can lead to the edge effects, which consist of abiotic and biotic changes that occur at the edges of fragmented forest ecosystems, where ecological interactions can be affected by increased exposure to hot and dry winds, reduced air and soil moisture, increased solar incidence, and modification of the species structure and composition (Aronson *et al*., 2011).

Insects are considered bioindicators as they establish direct and indirect interactions with surrounding organisms and respond to human actions that affect environmental quality. Surveys of insect life, especially of indicator species, are thus important methods for assessing the negative impact of human activities, such as agricultural and forestry practices, on the ecosystem function (Oliveira *et al*., 2014).

This study aims to carry out a survey of the arthropod fauna associated with the tree canopies at the edges of a remaining fragment of the Cerrado biome to evaluate the arthropod diversity, with a particular focus on potential biological indicators.

Material and methods

Location and characterization of the study area

Arthropod collection was carried out in a remnant of Cerrado, with mainly *Cerradão* vegetation, at the Juliana farm in the municipality of Monte Carmelo, Minas Gerais (MG), Brazil (18º43'29"S; 47º29'55"W). The farm has a total area of 379.29 ha, of which the legal reserve areas make up 75.56 ha, fragmented throughout the property. This survey was conducted in a fragment of the legal reserve of approximately 55.97 ha in area. Monte Carmelo belongs to the mesoregion of Alto Paranaíba, MG, and is about 890 m above the sea level.

The area is located in the hydrographic basin of the Paranaíba River, and the soils consist predominantly of red latosol. The region is characterized by a seasonal Aw-type Köppen climate, with two well-defined seasons: a hot and rainy summer and a cold and dry winter. The average temperature is 20.7 ºC, and the average annual precipitation is 1,569.1 mm.

Collection of canopy arthropods

The canopy net methodology was used to verify the composition, density, and population fluctuation of arthropods found in the tree canopies. The net consisted of an aluminum ring measuring ~40 cm in diameter and a tapered 80 cm long cotton cloth bag with a rounded end with a handle.

The arthropod fauna was surveyed at the edge of the fragment, with trees located an average of 26.275 m from the coffee plantation. In the study area, 20 trees, of the same species or not, were randomly chosen along a linear distance of approximately 248 m, with each tree located approximately ~15 m from the others. After selecting the trees, the net bag was wrapped around a branch and shaken five times; the bag was positioned so as to include branches located in the four cardinal directions in relation to the sampled tree.

The material collected from each plant was placed in plastic bags with a capacity of 5 kg that

were properly sealed and identified. The bags were then packaged so as not to damage the collected specimens. The samples were then taken to the Forest Entomology Laboratory at the Federal University of Uberlândia (UFU), Uberlândia, MG, where they were kept refrigerated at a temperature of ~ –6 ºC until sorting.

Between August 2018 and July 2019, collections were performed every 30 days in the crowns of the 20 selected trees (Table 1) for a total of 240 samples throughout the sampling period. The collections were carried out in the morning between 9 a.m. and 12 p.m. Two editions of *Árvores Brasileiras* by Harri Lorenzi (1992; 1998) were used for the identification and information on forest species (Table 1).

Arthropod sorting and identification

In the laboratory, the collected material was sorted with tweezers and brushes using an SZ40 Physis binocular stereomicroscope. Arthropod samples were initially identified using a dichotomous key for identification at the lowest possible taxonomic level. The ecological classification of arthropods for potential parasitoid insects was carried out according to Parra *et al*. (2011), potential predator insects according to Torres and Silva-Torres (2011), and Arachnida according to Riechert and Lockley (1984).

The voucher specimens were preserved in 70% alcohol and deposited in the UFU Forestry Entomology Laboratory collection.

Data analysis

The taxonomic groups of the fauna samples were classified by frequency, abundance, evenness, and dominance following Silveira Neto *et al*. (1976). The taxonomic groups that obtained the highest faunal indexes in all the analyzed parameters were considered predominant. The fauna analysis was carried out using ANAFAU software.

The taxonomic groups were classified according to frequency, as follows: infrequent (if) when the frequency was below lower limit of the confidence interval (CI) of the mean; frequent (f) when the frequency was between the lower and upper limits of the mean CI; very frequent (vf) when the frequency was higher than the upper limit of the mean CI.

The taxonomic groups were grouped into the following abundance classes: rare (r) for species with a number of individuals lower than the lower limit of the average CI at 1%; scarce (s) when the number of individuals was between the lower bounds of the 5% CI and the 1% CI; common (c) when the number of individuals was within the average 5% CI; abundant (a) when the number of individuals was between the upper bounds of the 5% CI and the 1% CI; very abundant (va), when the number of individuals was greater than the upper bound of the 1% CI.

The evenness of the taxonomic groups was classified as follows: constant (W) if the value was higher than the upper CI limit; accessory (Y) if the value was within the CI interval; accidental (Z) if

Table 1. List of forest species sampled in the edge area and their respective botanical family, flowering season, and fruiting season. Juliana farm, Monte Carmelo, Minas Gerais, Brazil.

Tree species	Botanic family	Flowering season	Fruiting season	Number of individuals
Alibertia edulis (Rich.) A. Rich.	Rubiaceae	Oct to Dec	Dec to Feb	3
Aspidosperma tomentosum Mart. & Zucc.	Apocynaceae	Sep to Oct	Jul	1
Caryocar brasiliense Cambess.	Caryocaraceae	Sep to Nov	Nov to Feb	2
Cassia leptophylla Vogel	Fabaceae	Nov to Jan	Jun to Jul	1
Clethra scabra Pers.	Clethraceae	Dec to Mar	May to Jul	2
Erythroxylum sp.	Erythroxylaceae	–	–	1
Eugenia dysenterica (Mart) DC.	Myrtaceae	Aug to Sep	Oct to Nov	1
Heteropterys sp.	Malpighiaceae	–	–	1
Miconia albicans (Sw.) Triana	Melastomataceae	Nov to Jan	Apr to Jun	2
Qualea grandiflora Mart.	Vochysiaceae	Nov to Jan	Aug to Sep	2
Styrax ferrugineus Nees & Mart.	Styracaceae	Jun to Sep	Oct to Dec	1
Didymopanax macrocarpus (Cham. & Schltdl.) Seem.	Araliaceae	Jan to Mar	Aug to Sep	1
Xylopia aromatica (Lam.) Mart.	Annonaceae	Oct	Dec to Feb	2

the value was lower than the lower CI limit. Groups of arthropods were classified as dominant (D) if the was frequency was greater than the dominance limit and non-dominant (ND) otherwise.

Climate variables were obtained on a daily and monthly basis for: average temperature (average T.), maximum temperature (max. T.), and minimum temperature (min. T.), expressed in degrees Celsius (ºC); precipitation (PP) in millimeters (mm); relative air humidity (RH) as a percentage (%).

Spearman's correlation coefficient (rs) was used to relate the environmental factors (climate variables) and the abundance of canopy arthropods. The correlation was calculated using the program Past version 2.17c.

Results and discussion

In the sampling period, 804 individuals belonging to the classes Arachnida and Insecta were collected and identified into 56 taxonomic groups at the following levels: subclass, order, suborder, superfamilies, families, and subfamilies (Table 2).

The most common taxa collected in the area were the order Araneae (class Arachnida) and the families Asilidae (order Diptera), Tephritidae (order Diptera), and Formicidae (order Hymenoptera), all belonging to the class Insecta (Table 2).

The order Araneae is particularly diverse in Brazil compared to other countries. Brazil is home to the second-largest known number of arachnids, totaling approximately 49,235 species distributed in 128 families (World Spider Catalog, 2021). In the Cerrado, 625 described species are currently known, of which 169 occur only in this biome (Oliveira *et al*., 2017). Spiders are potential predators of pest insects (Riechert and Lockley, 1984).

Diptera is one of the most diverse insect groups, representing the second most diverse order worldwide, with approximately 155,000 known species (Stork, 2018). According to Pape *et al*. (2009), Tachinidae, Syrphidae, and Dolichopodidae are the dipteran families with the greatest numbers of species described in the Cerrado. Dipterans have a phytophagous or saprophagous habit and can be parasitoids, predators, or pollinators (Skevington and Dang, 2011).

The family Asilidae, which belongs to the order Diptera, has a high level of species diversity and is considered one of the largest groups of flies (Oak *et al*., 2012). According to Carvalho *et al*. (2012), there are 101 genera distributed in 458 species in Brazil. Adult insects (flies) and larvae of this family are exclusively predators and, due to their great diversity, can be found in various environments, with a preference for dry and open areas (Cezar, 2017).

The family Tephritidae, also belonging to the order Diptera, was also representative of the collections. This insect group is popularly known as fruit flies. According to Orth *et al*. (1986), these insects feed on fruit pulp and can thus pose risks to the fruit sector, causing economic damage to producers. In the present study, tephritids were found in ten of the sampled tree species. Uchôa and Nicácio (2010) verified frugivorous species of Tephritidae in *Alibertia edulis* (*puruí*) and *Miconia albicans* (*canela de velho*).

Another group of Insecta also classified as predominant is the Formicidae, belonging to the order Hymenoptera. According to the AntWeb (2020), ~27,771 species are currently described for this family worldwide, distributed into 502 genera. In Brazil, 1,528 species belonging to 115 genera are known (AntWeb, 2020). Ants have been very important predators and herbivores for over 100 million years and continue to influence numerous other organisms and the ecological dynamics of forests (Brandão *et al*., 2009). Plant species with extrafloral nectaries are common in the Cerrado biome, many of which have documented mutualistic interactions with ants (Belchior *et al*., 2016).

The three species of trees with the greatest diversity arthropod taxa were *Xylopia aromatica*, where 50% (N = 28) of the observed taxa were found, followed by *Clethra scabra* with 46.4% (N = 26), and *Qualea grandiflora* with 39.2% (N = 22). *Cassia leptophylla*, *Styrax ferrugineus*, and *Didymopanax macrocarpus* had the lowest number of taxa, with 10.7% (N = 6) present on each species (Figure 1).

There was a significant and positive correlation ($r_s = 0.6084$; $p < 0.01$) between the number of tephritids and the maximum daily temperature (Table 3). Indeed, 85.7% of tephritids (N = 42) were collected on days with a maximum daily temperature between 30.1 ºC and 32 ºC. According to Silveira Neto *et al*. (1976), the optimum temperature for insects is around 25 ºC, with minimum and maximum temperature thresholds of 15 ºC and 38ºC, respectively.

No significant correlation was found between the other predominant groups (Table 3) and climate variables. Although there was no significant

Table 2. Faunistic analysis of taxonomic groups of arthropods associated with the canopy of trees at the edge of a forest fragment in the Cerrado between August 2018 and July 2019. Juliana farm, Monte Carmelo, Minas Gerais, Brazil.

Taxonomic group	N. (%)*	Frequency*	Abundance*	Constancy*	Dominance*
CLASS ARACHNIDA					
Subclass Acari	1 (0.1)	lf	r	Z	ND
Order Araneae**	167 (20.8)	vf	va	W	D
CLASS INSECTA					
Order Blattodea					
Suborder Blattaria	2 (0.2)	lf	r	Z	ND
Order Coleoptera					
Family Brentidae	1 (0.1)	lf	r	Z	ND
Family Carabidae	10 (1.2)	f	c	Y	D
Family Cerambycidae	1 (0.1)	lf	r	Z	ND
Family Chrysomelidae	2 (0.2)	lf	r	Z	ND
Subfamily Bruchinae	22 (2.7)	f	c	W	D
Family Coccinellidae	11 (1.4)	f	c	W	D
Family Curculionidae	14 (1.7)	f	c	W	D
Subfamily Platypodinae	4 (0.5%)	lf	d	Z	ND
Subfamily Scolytinae	6 (0.7)	f	c	Y	D
Order Diptera					
Family Agromyzidae	12 (1.5)	f	c	Y	D
Family Asilidae **	46 (5.7)	vf	va	W	D
Family Bibionidae	1 (0.1)	lf	r	Z	ND
Family Calliphoridae	7 (0.9)	f	c	Z	D
Family Cecidomyiidae	3 (0.4)	lf	r	Z	ND
Family Lonchaeidae	1 (0.1)	lf	r	Z	ND
Family Muscidae	43 (5.3)	vf	va	Y	D
Family Sciaridae	1 (0.1)	lf	r	Z	ND
Family Syrphidae	7 (0.9)	f	c	Z	D
Family Tachinidae	5 (0.6)	lf	d	Y	ND
Family Tephritidae**	49 (6.1)	vf	va	W	D
Family Tipulidae	1 (0.1)	lf	r	Z	ND
Family Ulidiidae	2 (0.2)	lf	r	Z	ND
Order Hemiptera					
Suborder Auchenorrhyncha					
Family Cicadellidae	9 (1.1)	f	c	Y	D
Family Delphacidae	1 (0.1)	lf	r	Z	ND
Family Flatidae	1 (0.1)	lf	r	Z	ND
Family Membracidae	7 (0.9)	f	c	Y	D
Suborder Heteroptera					
Family Coreidae	2 (0.2)	lf	r	Z	ND
Family Miridae	8 (1.0%)	f	c	Y	D
Family Pentatomidae	1 (0.1)	lf	r	Z	ND
Family Scutelleridae	1 (0.1)	lf	r	Z	ND
Family Tingidae	1 (0.1)	lf	r	Z	ND
Suborder Sternorrhyncha					
Superfamily Aphidoidea	76 (9.5)	vf	va	Y	D
Superfamily Coccoidea	46 (5.7)	vf	va	Z	D
Superfamily Psylloidea	2 (0.2)	lf	r	Z	ND
Order Hymenoptera					
Superfamily Apoidea					
Family Sphecidae	1 (0.1)	lf	r	Z	ND
Superfamily Chalcidoidea	3 (0.4)	lf	r	Y	ND
Family Encyrtidae	1 (0.1)	lf	r	Z	ND
Family Eulophidae	1 (0.1)	lf	r	Z	ND
Family Pteromalidae	2 (0.2)	lf	r	Z	ND
Superfamily Ichneumonoidea					
Family Braconidae	7 (0.9)	f	c	Y	D

Taxonomic group	N. (%)*	Frequency*	Abundance*	Constancy*	Dominance*
Family Ichneumonidae	15 (1.9)	f	c	Y	D
Superfamily Platygastroidea	1 (0.1)	lf	r	Z	ND
Family Platygastridae	1 (0.1)	lf	r	Z	ND
Superfamily Scolioidea					
Family Scoliidae	3 (0.4)	lf	r	Y	ND
Superfamily Vespoidea					
Family Formicidae**	156 (19.4)	vf	va	W	D
Family Vespidae	1 (0.1)	lf	r	Z	ND
Order Lepidoptera	9 (1.1)	f	c	W	D
Order Mantodea	4 (0.5%)	lf	d	Y	ND
Order Neuroptera					
Family Chrysopidae	8 (1.0%)	f	c	Y	D
Order Orthoptera					
Family Acrididae	3 (0.4)	lf	r	Z	ND
Family Tettigoniidae	1 (0.1)	lf	r	Z	ND
Order Psocoptera	2 (0.2)	lf	r	Z	ND
Order Thysanoptera					
Family Phlaeothripidae	11 (1.4)	f	c	Y	D
Total	804 (100.0)				

*N., number of individuals. Frequency: if, infrequent; f, frequent; vf, very frequent. Abundance: r, rare; s, scarce; c, common; a, abundant; va, very abundant. Evenness: W, constant; Y, accessory; Z, accidental. Dominance: D, dominant; ND, non-dominant.
** Predominant taxonomic groups.

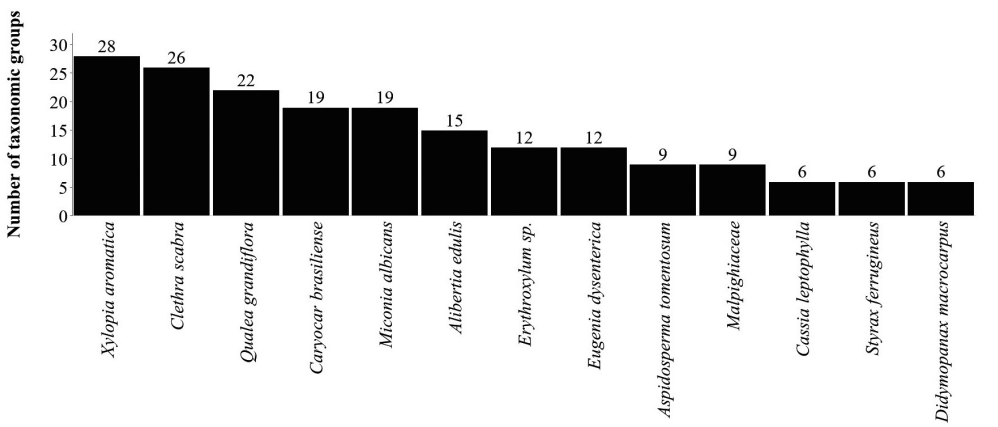

Figure 1. Number of arthropod taxa found in the canopy of trees at the edge of a forest fragment in the Cerrado between August 2018 and July 2019. Juliana farm, Monte Carmelo, Minas Gerais, Brazil.

Table 3. Spearman's correlation (rs) between the number of arthropods associated with the canopy of edge trees and daily climate variables from August 2018 to July 2019. Juliana farm, Monte Carmelo, Minas Gerais, Brazil.

Taxonomic group	Min. T. (ºC)	Average T. (ºC)	Max. T. (ºC)	RH (%)	PP (mm)
Araneae	–0.2540 ns	–0.3534 ns	–0.3175 ns	–0.2187 ns	0.2651 ns
Asilidae	–0.2030 ns	–0.1380 ns	–0.1958 ns	–0.3916 ns	0.0259 ns
Tephritidae	0.3247 ns	0.4879 ns	0.6084 **	0.0560 ns	0.0378 ns
Formicidae	0.1016 ns	0.2070 ns	0.4098 ns	0.0245 ns	–0.3301 ns

Daily climate variables: average temperature (average T.), maximum temperature (maximum T.), minimum temperature (minimum T.), precipitation (PP), and relative humidity (RH).
Spearman's correlation (r_s): ** significant correlation ($p < 0.01$); ns non-significant correlation ($p > 0.05$).

correlation with climate variables, the highest densities of individuals belonging to the order Araneae were observed during the region's cool and dry winter (Figure 2).

The order Araneae, along with the family Formicidae (Hymenoptera), are known to include potential predatory species; both families were found in all sampled tree species (Table 4). The

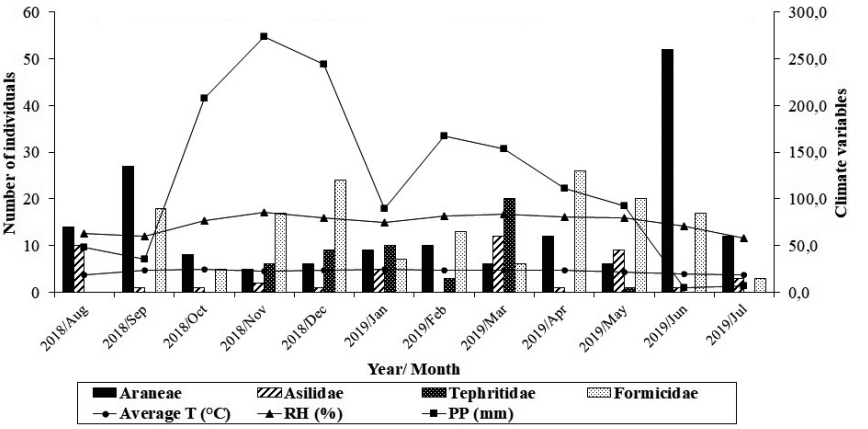

Figure 2. Population fluctuations of the predominant arthropod taxa found in the canopies of trees at the edge of a forest fragment in the Cerrado between August 2018 and July 2019. Juliana farm, Monte Carmelo, Minas Gerais, Brazil. Climate variables: average temperature (average T.), relative humidity (RH), and precipitation (PP).

Table 4. Classification of arthropod taxa as potential biological control agents (parasitoids and predators). Species found in the canopy of trees at the edges of a forest fragment in the Cerrado between August 2018 and July 2019. Juliana farm, Monte Carmelo, Minas Gerais, Brazil.

Order	Family	Ecological relationship*	Tree species**
Araneae	–	Predator	All species
Coleoptera	Carabidae	Predator and Parasitoid	AT; CS; MA; QG; DM; XA
	Coccinellidae	Predator	AE; CB; MA; QG; XA
Diptera	Asilidae	Predator	AE; CB; CS; ED; MA; QG; XA; MPG
	Cecidomyiidae	Predator and Parasitoid	CL; QG; XA
	Syrphidae	Predator	AT; CS; MA; XA
	Tachinidae	Parasitoid	CL; CS; QG; XA
Hemiptera	Miridae	Predator	AT; CS; ED
Hymenoptera	Pentatomidae	Predator	QG
	Braconidae	Parasitoid	AE; CB; CS; MA; QG; XA
	Encyrtidae	Parasitoid	ED
	Eulophidae	Parasitoid	QG
	Formicidae	Predator	All species
	Ichneumonoidae	Parasitoid	CB; CS; ER; MA; QG; XA
	Platygastridae	Parasitoid	QG
	Pteromalidae	Parasitoid	AE
	Scoliidae	Parasitoid	CS; DM; XA
	Vespidae	Predator	XA
Mantodea	Mantidae	Predator	CB; CS; MA; XA
Neuroptera	Chrysopidae	Predator	AT; CB; CL; ED; XA

* Classification of insect families with parasitoid species based on Parra *et al.* (2011) and with predator species based on Torres and Silva-Torres (2011). Spider classification was carried out following Riechert and Lockley (1984).
** Tree species: AE – *Alibertia edulis*; AT – *Aspidosperma tomentosum*; CB – *Caryocar brasiliense*; CL – *Cassia leptophylla*; CS – *Clethra scabra*; DM – *Didymopanax macrocarpus*; ER – *Erythroxylum* sp.; ED – *Eugenia dysenterica*; HE - *Heteropterys* sp.; MA – *Miconia albicans*; QG – *Qualea grandiflora*; SF – *Styrax ferrugineus*; XA – *Xylopia aromatica*.

order Araneae can assist in the natural biological control of insects since it includes predatory species (Riechert and Lockley, 1984). The same applies to the Formicidae family, in which the following guilds are found: predatory generalist epigeic and hypogeic species, predatory Dacetini species, and arboreal predatory species (Brandão *et al*., 2009), which can also assist in biological control of insects.

Table 4 shows other taxa that can perform control through interspecific ecological relationships of predation or parasitism.

The same tree species that stood out for the total number of arthropod taxa they contained (Figure 1) also contained the highest number of potential biological control agents (Table 4). The largest number of such taxa were identified for *X. aromatica* (N = 14), followed by *Q. grandiflora* (N = 12) and *Clethra scabra* (N = 11) (Table 4).

Xylopia aromatica (Annonaceae) is commonly known in Brazil as *pindaíba* or *pimenta-de-macaco.* The species is characterized as semi-deciduous, heliophyte, and selective xerophyte (Lorenzi, 1992). It is an ornamental plant, and its wood is light and of low durability. *Xylopia aromatica* occurs in several Brazilian states along the Cerrado and is more common in the Cerrado *sensu stricto* and *Cerradão* ecoregions (Marimon-Junior and Haridasan, 2005).

Qualea grandiflora (Vochysiaceae) is popularly known in Brazil as *pau-terra*. It occurs in the Cerrado Mineiro and in fragments of the states of Amazonas, São Paulo, Goiás, and Mato Grosso do Sul (Lorenzi, 1992). According to Lorenzi (1992), it is a deciduous, heliophyte plant and can be used in land restoration, reforestation, and landscaping. Its wood can also be used for several purposes.

Clethra scabra (Clethraceae), popularly known in Brazil as *vassourão*, occurs in the states from Rio de Janeiro to Santa Catarina, as well as Minas Gerais. It is a semi-deciduous, heliophyte, selective xerophyte, and a pioneer plant. It can be used for reforestation and restoration, and its wood is recommended for box work and charcoal (Lorenzi, 1998).

The study area contained a high diversity of tree species, which stood out for the diversity of taxonomic groups of arthropods found in their crowns. Moreover, they offer a variety of economic products, allowing the owner to sustainably use products such as seeds and fruits under the current legislation for legal reserves of this kind. Such areas can therefore contribute to the generation of extra income for rural producers and serve as survival sites for a diversity of arthropod groups that provide important ecosystem services, such as potential natural enemies of pest insects (Skorupa, 2003).

Conclusions

Legal reserves and fragments of the Cerrado biome contribute to the conservation of the arthropod fauna associated with tree species, especially the order Araneae and the families Asilidae and Tephritidae (Diptera) and Formicidae (Hymenoptera). Maintaining such areas is therefore of particular importance for the local ecology.

Of the tree species in the area, *X. aromatica, C. scabra*, and *Q. grandiflora* had the greatest potential as survival sites for natural enemies and other canopy arthropods in fragments of the Cerrado biome.

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