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Checklist of butterflies from the rupestrian grasslands of Serra do Cipó, Minas Gerais, Brazil (Lepidoptera: Papilionoidea)

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Abstract

The aim of this study is to provide a list of the butterflies (Lepidoptera: Papilionoidea) that occur in the rupestrian grasslands of Serra do Cipó, Minas Gerais, Brazil. Butterflies were sampled using VSR traps and entomological nets in seven undisturbed plots between 800 and 1400m above sea level. We collected 1,520 individuals belonging to 172 species. Among these species, four are on the Brazilian list of endangered species: *Cunizza hirlanda planasia* (Stoll, 1790), *Magnastigma julia* Nicolay, 1977, *Strymon ohausi* (Spitz, 1933) and *Rhetus belphegor* (Westwood, 1851).

KEY WORDS: Lepidoptera, Papilionoidea, conservation, threatened species, inventory, Brasil.

Levantamento de borboletas dos campos rupestres da Serra do Cipó, Minas Gerais, Brasil (Lepidoptera: Papilionoidea)

Resumo

O objetivo desse estudo é fornecer uma lista de borboletas (Lepidoptera: Papilionoidea) que ocorrem nos campos rupestres da Serra do Cipó, Minas Gerais, Brasil. As borboletas foram coletadas utilizando a armadilha VSR e rede entomológica em sete áreas não perturbadas entre 800 e 1400 metros de altitude. Coletamos 1520 indivíduos pertencentes a 172 espécies. Entre as espécies coletadas, quatro constam na lista nacional oficial de espécies da fauna ameaçadas de extinção: *Cunizza hirlanda planasia* (Stoll, 1790), *Magnastigma julia* Nicolay, 1977, *Strymon ohausi* (Spitz, 1933) and *Rhetus belphegor* (Westwood, 1851).

PALAVRAS CHAVE: Lepidoptera, Papilionoidea, conservação, espécies ameaçadas, levantamento, Brasil.

Listado de mariposas de los campos rurales de la Serra do Cipó, Minas Gerais, Brasil (Lepidoptera: Papilionoidea)

Resumen

El objetivo de este estudio es proveer una lista de mariposas (Lepidoptera: Papilionoidea) que se encuentran en las praderas herbáceas de la Serra do Cipó, Minas Gerais, Brasil. Las mariposas fueron colectadas usando trampas VSR y red entomológica en siete áreas no perturbadas entre los 800 y 1.400 metros de altitud. Colectamos 1.520 individuos pertenecientes a 172 especies. Entre estas especies, cuatro de ellas figuran en la lista brasileña de especies amenazadas: *Cunizza hirlanda planasia* (Stoll, 1790), *Magnastigma julia* Nicolay, 1977, *Strymon ohausi* (Spitz, 1933) y *Rhetus belphegor* (Westwood, 1851).

PALABRAS CLAVE: Lepidoptera, Papilionoidea, conservación, especies amenazadas, inventario, Brasil.

Introduction

The Cerrado (savanna-like vegetation) is one of the most threatened ecosystem due to urban expansion, agriculture, fire, afforestation, extraction of ornamental species, mining and road construction (BARBOSA *et al.*, 2010; RIBEIRO & FREITAS, 2010; NEGREIROS *et al.*, 2011; FERNANDES *et al.*, 2014). The Espinhaço range comprises a group of mountains between the municipality of Ouro Branco (MG) and the southern part of the state of Bahia (Chapada de Diamantina), and extends for approximately 1200 km, with elevations greater than 800 m a.s.l.. Serra do Cipó is located in the southern part of the Espinhaço range, where there is a predominance of a complex ecosystem called the Rupestrian Grassland (FERNANDES, 2016; GIULIETTI, 1987). The plant species of this ecosystem have striking morpho-anatomical peculiarities that comprise a flora with high degree of morphological and behavioral convergence, diversity, and endemism (FERNANDES, 2016; ECHTERNAACHT *et al.*, 2011; RAPINI *et al.*, 2008; NEGREIROS *et al.*, 2014).

Butterflies have been considered one of the best flagship species for conservation because most species are conspicuous and colorful (NEW, 1997). Other reasons that make butterflies good environmental indicators are: short lifespan, diurnal habits, high diversity, easy sampling, identification and relatively well known taxonomy (BROWN & FREITAS, 1999; BHARDWAJ *et al.*, 2012). Butterflies are involved in many ecological interactions, have close relationships with plants, and have been used as models in ecological and evolutionary studies. Butterflies are also used in many studies for habitat conservation because they are especially vulnerable to landscape and habitat fragmentation and loss, responding quickly to changes in vegetation and climate (BROWN & FREITAS, 1999; ROY & SPARKS, 2000).

A species checklist is of fundamental importance for conservation plans and environmental monitoring methods (MIELKE *et al.*, 2008). The recognition of endemisms and local rarities are also important criteria to determine which areas have conservation potential (ROMERO & NAKAJIMA, 1999). Among the threatened Brazilian Lepidoptera, *Rhetus belphegor* (Westwood, 1851) (Riodinidae: Riodininae) is the only species recorded from Serra do Cipó (BROWN, 1993; MACHADO *et al.*, 2008; NASCIMENTO & CAMPOS, 2011). However, this may be due to the lack of studies on Lepidoptera in the entire region. We expect that the number of endangered and endemic species will rise as more studies are carried out. Furthermore, we expect that these studies will lead to a better understanding of the butterfly fauna composition on the unique environment of the rupestrian grasslands. The aim of this study was to report the first list of butterfly species of the rupestrian grasslands in Serra do Cipó, a region that has been intensely studied for other groups of organisms (e.g., galling insects: LARA *et al.*, 2002; ants: ARAÚJO & FERNANDES, 2003; free-feeding herbivores: RIBEIRO *et al.*, 1998).

Materials and Methods

STUDY AREA

Serra do Cipó has a humid, subtropical climate with a dry winter and a temperate summer (Cwb in Köppen's classification) (ALVARES *et al.*, 2013), with mean temperatures between 17.4 and 19.8° C. The annual precipitation is about 1500 mm, with a wet season from November to January, a transitional period from February to April, and a dry season from May to September followed by another transitional post-dry period in October (MADEIRA & FERNANDES, 1999). The soil of Serra do Cipó is sandy, shallow, extremely oligotrophic and with high concentrations of aluminum and low capacity for water retention, (NEGREIROS *et al.*, 2008; NEGREIROS *et al.*, 2011). The study plots were located inside the National Park of Serra do Cipó and the Environmental Protection Area Morro da Pedreira, in the district of Serra do Cipó, Minas Gerais, Brazil (Fig. 1).

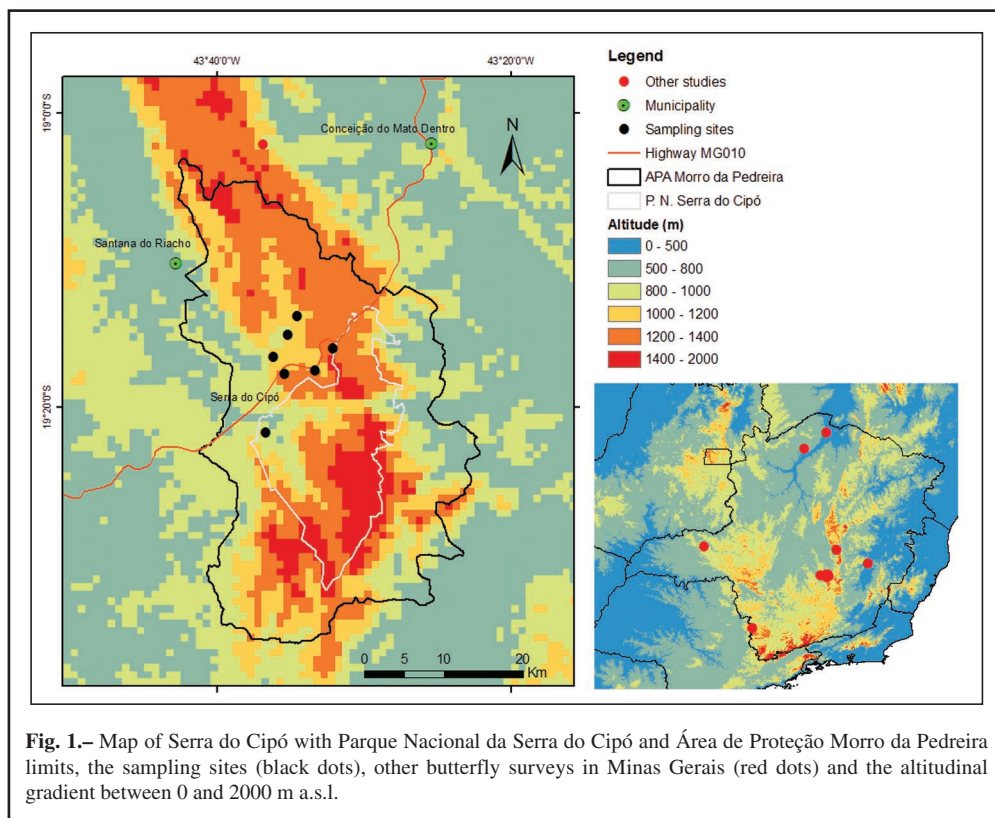


Fig. 1.— Map of Serra do Cipó with Parque Nacional da Serra do Cipó and Área de Proteção Morro da Pedreira limits, the sampling sites (black dots), other butterfly surveys in Minas Gerais (red dots) and the altitudinal gradient between 0 and 2000 m a.s.l.

SAMPLING

Butterflies were recorded in seven plots between 800 and 1400 m a.s.l.. In each plot three transects separated by 500m were sampled, for a total of 21 transects for the whole collecting area. Butterflies were sampled using both nets and traps. For sampling butterflies using nets, each transect was 250 m in length. Sampling employed two well-trained researchers sampling for two consecutive hours. Sampling took place 3 times during the day: soon after sun rise (at 08:00 am-10:00 am), in the heat of the day (11:00 am-1:00 pm) and just before sun set (2:00 pm-4:00 pm). For sampling butterflies using traps, four Van Someren-Rydon (VSR) traps were placed in each transect separated by a distance of 50 m. Traps were baited with a mixture of banana and sugar cane that had been fermented for 48 hs. Traps were set on the first day while the next three days were reserved for daily butterfly collection at all traps.

Sampled individuals were immediately sacrificed and placed in entomological envelopes. Each envelope included the date, time of sampling (in case of net study), sampling point, trap number (for trap sampling) and the name of the collector. In the laboratory, the butterflies were identified using available field guides (D'ABRERA, 1981, 1984, 1987, 1994, 1995; CANALS, 2003; UEHARA-PRADO *et al.*, 2004; SILVA *et al.*, 2010) and the specimen collections of the Campinas University (Unicamp), Zoological Museum of São Paulo University (MZUSP), and Coleção Entomológica Pe. Jesus Santiago Moure at Paraná University (UFPR). Classification followed LAMAS (2004) and subsequent revisions (MIELKE, 2005; WAHLBERG *et al.*, 2009; DUARTE & ROBBINS, 2010; WARREN *et al.*, 2013). Sampling occurred in January, April, July

and October 2012, and January, May, August and October 2013, encompassing the times of the year with the greatest differences in weather conditions (MADEIRA & FERNANDES, 1999).

ACCUMULATION CURVES

We constructed two accumulation curves, one for each method (entomological net and trap), in order to evaluate the sampling efficiency of both methods. Species curves were constructed using the Vegan package (2.2-1 version) (OKSANEN *et al.*, 2015) in the R program environment (R CORE TEAM, 2015).

Results

Total butterfly sampling effort was 336 net hours and 252 trap days. The traps sampled only four subfamilies (Biblidinae, Charaxinae, Satyrinae and the satyroid lineage of the subfamily Nymphalinae) of the family Nymphalidae (DEVRIES *et al.*, 2001; FREITAS & BROWN, 2004). We recorded 1,520 individual butterflies of 172 species belonging to 17 subfamilies (Table I). Six butterfly families were recorded and the number of species per family was: 59 species of HesperIIDae, 28 of Lycaenidae, 54 of Nymphalidae, 5 of Papilionidae, 12 of Pieridae, and 14 of Riodinidae. The most common species were *Paryphthimoides* sp2 (Nymphalidae) (N=135), *Eurema elathea flavescens* (Chavannes, 1850) (Pieridae: Coliadinae) (N=125), *Hemiargus hanno* (Stoll, 1790) (Lycaenidae: Polyommatainae) (N=122), *Ypthimoides manasses* (C. Felder & R. Felder, 1867) (Nymphalidae: Satyrinae) (N=92), and *Pyrishitia nise tenella* (Boisduval, 1836) (Pieridae: Coliadinae) (N=75). Together, these five species, represented 36% of the total sample. We recorded 71 (41%) species with only one capture (singletons). Only four species occurred in all seven studied areas: *Hemiargus hanno*, *Junonia evarete* (Cramer, 1779) (Nymphalidae: Nymphalinae), *Eurema elathea flavescens* (Chavannes, 1850) and *Phoebis sennae marcellina* (Cramer, 1777) (Pieridae: Coliadinae). One new species was found in this study: *Paryphthimoides* sp. 2 (Nymphalidae) (A. V. L. Freitas personal observation) was found between 800 and 1400 m a.s.l. The new species is deposited in Campinas University (Unicamp) museum. Some specimens cannot be identified at species level due to the damage suffered during the sampling or because of the wing scale loss that occurs naturally throughout the insect's life. Others belong to a poorly studied butterfly group, the Satyrinae, which has many species with uncertain taxonomic position.

The accumulation curve for sampling by net butterfly richness per family did not indicate a tendency to asymptote. Although our sampling effort was similar to other studies in non-forest ecosystems (e.g. CARNEIRO *et al.*, 2014; CARVALHO *et al.*, 2015; MARCHIORI & ROMANOWSKI, 2006), the area studied showed a high richness of butterflies, indicating that we might be able to discover more butterfly species if more localities are sampled. The accumulation curve for sampling by trap exhibited a tendency towards asymptote (Fig. 2).

Discussion

The number of species found in this study is similar to that found by other surveys of grassland habitats in Brazil (ISERHARD *et al.*, 2010; DOLIBAINA *et al.*, 2011; CARNEIRO *et al.*, 2014; CARVALHO *et al.*, 2015), but is lower than that of other types of locations, such as the Atlantic rain forest (652 species: BROWN, 1992) and Cerrado (839 species: MIELKE *et al.*, 2008). However, in addition to the need for further sampling, as indicated by the accumulation curve, our study was restricted to a single area that was smaller than the areas in the other studies.

Among the sampled species, 107 (62.2%) are considered typical of open environments or have been recorded in other grassland environments (MIELKE *et al.*, 2008; ISERHARD *et al.*, 2010; DOLIBAINA *et al.*, 2011; CARVALHO *et al.*, 2015; BROWN, 1992; CALLAGHAN, 1982; KAMINSKI *et al.*, 2015; MARCHIORI & ROMANOWSKI, 2006; KAMINSKI *et al.*, 2012;

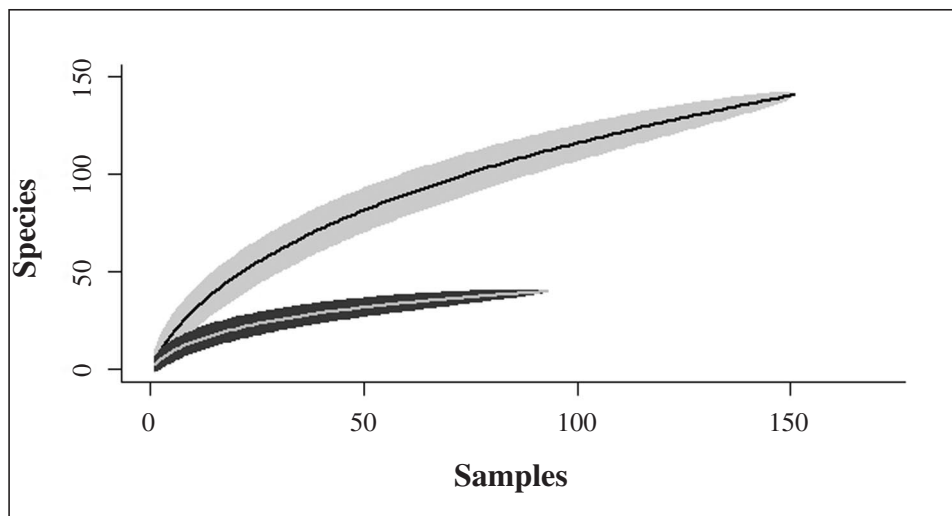


Fig. 2.– Accumulation curves for species of butterflies in Serra do Cipó (MG, Brazil). The gray curve is net sampling while the black curve is trap sampling.

KAMINSKI & CARVALHO-FILHO, 2012; PAZ *et al.*, 2013; FREITAS & MARINI-FILHO, 2011; GOZZI *et al.*, 2012; SILVA *et al.*, 2015). Only 25 (14.5%) of the species found in this study had been previously recorded in the only other study done in the Espinhaço mountain range (NERY *et al.*, 2014) (Table 1).

Table 1.– List of butterfly species from Serra do Cipó (MG, Brazil). S = number of species, * = registered species of nearby region [53] and + = species found in other grasslands.

Species	Abundance	Species	Abundance
Hesperiidae (S= 59)		<i>Chalcone</i> sp.	6
Eudaminae (S= 14)		<i>Conga chydæa</i> (Butler, 1877) +	1
<i>Chioides catillus</i> (Cramer, 1779) +	11	<i>Conga urqua</i> (Weeks, 1909) +	23
<i>Cogia azila</i> Evans, 1953	3	<i>Copaeodes jean favor</i> Evans, 1955 +	2
<i>Cogia calchas</i> (Herrich-Schäffer, 1869)	6	<i>Cumbre</i> sp.	2
<i>Cogia hassan evansi</i> Bell, 1937	20	<i>Cymaenes warreni</i> (Weeks, 1901)	2
<i>Epargyreus</i> sp.	2	<i>Euphyes eberti</i> Mielke, 1972	6
<i>Phocides polybius phanias</i> (Burmeister, 1880) +	2	<i>Euphyes</i> sp.	1
<i>Typhedanus undulatus</i> (Hewitson, 1867) +	2	<i>Hylephila phyleus</i> (Drury, 1773) +	5
<i>Udranomia spitzzi</i> Hayward, 1942 +	14	<i>Hylephila</i> sp.	1
<i>Urbanus carmelita barra</i> Evans, 1952	2	<i>Lerema caraca</i> Mielke, 1992	3
<i>Urbanus cindra</i> Evans, 1952 +	11	<i>Lerema veadeira</i> Mielke, 1968 +	1
<i>Urbanus dorantes</i> (Stoll, 1790) +	2	<i>Lerodea erythrostictus</i> (Prittwitz, 1868) +	1
<i>Urbanus evenus</i> (Ménétrières, 1855) +	5	<i>Lerodea eufala</i> (Edwards, 1869) +	1
<i>Urbanus procne</i> (Plötz, 1881) +	2	<i>Nastra tanta</i> Evans, 1955 +	1
<i>Urbanus simplicius</i> (Stoll, 1790) +	1	<i>Panoquina bola</i> Bell, 1942 +	4
Hesperiinae (S= 30)		<i>Panoquina peraea</i> (Hewitson, 1866)	7
<i>Chalcone briquenydan</i> (Weeks, 1901) +	2	<i>Polites vibex catilina</i> (Plötz, 1886) +	2

Species	Abundance	Species	Abundance
<i>Pompeius dares</i> Plötz, (1883) +	1	<i>Rubroserrata ecbatana</i> (Hewitson, 1868)	1
<i>Quasimellana mielkei</i> Burns, 1994	7	<i>Strymon cestri</i> (Reakirt, [1867]) +	1
<i>Synale metella</i> (Plötz, 1882) +	1	<i>Strymon cyanofusca</i> Johnson, Eisele & MacPherson, 1990	1
<i>Thespieus homochromus</i> Mielke, 1978	5	<i>Strymon mulucha</i> (Hewitson, 1867)	3
<i>Vehilius inca</i> (Scudder, 1872) +	5	<i>Strymon ohausi</i> (Spitz, 1933)	15
<i>Vettius lucretius</i> (Latreille, 1824) +	1	<i>Strymon oreala</i> (Hewitson, 1868) +	2
<i>Vidius nostra nostra</i> Evans, 1955 +	3	<i>Thereus</i> sp.	1
<i>Vidius similis</i> Mielke, 1980 +	3	<i>Theritas triquetra</i> (Hewitson, 1865) +	1
<i>Vidius</i> sp.	8	Nymphalidae (S= 54)	
<i>Wallengrenia premnas</i> (Wallengren, 1860) +	1	Biblidinae (S= 10)	
<i>Xeniades chalestra</i> Hewitson, 1866 +	1	<i>Biblis hyperia</i> (Cramer, 1779) **	1
Pyrginae (S= 14)		<i>Callicore astarte</i> (Cramer, 1779) **	1
<i>Chiomara basigutta</i> Plötz, 1884 +	27	<i>Callicore sorana</i> (Godart, [1824]) **	43
<i>Elbella intersecta losca</i> Evans, 1951+	1	<i>Eunica cuvierii</i> (Godart, 1819) **	12
<i>Elbella luteizona</i> (Mabille, 1877) +	2	<i>Eunica tatila</i> (Herrich-Schäffer, [1855]) **	12
<i>Gesta gesta</i> Prittwitz, 1868 +	1	<i>Hamadryas amphinome</i> (Linnaeus, 1767) **	2
<i>Gesta heteropterus</i> (Plötz, 1884) +	1	<i>Hamadryas februa</i> (Hübner, [1823]) **	2
<i>Gorgythion</i> sp.	4	<i>Hamadryas feronia</i> (Linnaeus, 1758) **	6
<i>Heliopterus arsalte</i> (Billberg, 1820) +	8	<i>Temenis laothoe</i> (Cramer, 1777) **	1
<i>Heliopterus macaira orbiger</i> (Mabille, 1888) +	7	<i>Nica flavilla</i> (Godart, [1824])	1
<i>Heliopterus omrina</i> (Butler, 1870) **	16	Charaxinae (S= 3)	
<i>Pyrgus orcus</i> (Stoll, 1780) **	30	<i>Memphis moruus</i> (Fabricius, 1775) **	3
<i>Pyrrhopyge amythaon</i> Bell, 1931	1	<i>Siderone galanthis</i> (Cramer, 1775) **	3
<i>Sophista latifasciata</i> (Spitz, 1930) +	3	<i>Zaretis strigosus</i> (Gmelin, [1790]) +	1
<i>Timochreon doria</i> (Plötz, 1884)	1	Danainae (S= 2)	
<i>Viola violella</i> (Mabille, 1897) +	5	<i>Danaus gilippus</i> (Bates, 1863) +	9
<i>Zopyrion evenor</i> Godman & Salvin, 1901 +	5	<i>Danaus plexippus</i> (Linnaeus, 1758)	1
Lycaenidae (S= 28)		Heliconiinae (S= 3)	
Lycaeninae (S= 1)		<i>Heliconius besckei</i> (Ménétriés, 1857) *	1
<i>Arcas ducalis</i> (Westwood, 1852) +	1	<i>Heliconius erato phyllis</i> (Fabricius, 1775) **+	4
Polyommatainae (S= 2)		<i>Heliconius ethilla nacarea</i> (Godart, 1819) **	1
<i>Hemiargus hanno</i> (Stoll, 1790) +	124	Ithomiinae (S= 1)	
<i>Leptotes cassius</i> (Cramer, 1775) *	32	<i>Placidina euryanassa</i> (Felder & Felder, 1860)	1
Theclinae (S= 25)		Nymphalinae (S= 10)	
<i>Allosmaitia strophius</i> (Godart, [1824])	4	<i>Anartia jatrophae</i> (Linnaeus, 1763) +	2
<i>Arawacus tarania</i> (Hewitson, 1868)	2	<i>Colobura dirce</i> (Linnaeus, 1758) **	1
<i>Badecla badaca</i> (Hewitson, 1868)	10	<i>Eresia lansdorfi</i> (Godart, 1819) **	1
<i>Calycopis caulonina</i> (Hewitson, 1877) +	1	<i>Euptoieta hegesia meridiania</i> Stichel, 1938	3
<i>Calycopis janeirica</i> (Felder, 1862)	1	<i>Junonia evarete</i> (Cramer, 1779) **	43
<i>Chlorostymon telea</i> (Hewitson, 1868)	2	<i>Smyrna blomfieldia</i> (Fabricius, 1781) **	1
<i>Cyanophrys herodotus</i> (Fabricius, 1793)	1	<i>Tegosa claudina</i> (Eschscholtz, 1821) +	2
<i>Evenus regalis</i> (Cramer, 1775)	1	<i>Vanessa braziliensis</i> (Moore, 1883) +	11
<i>Gargina gargophia</i> (Hewitson, 1877)	1	<i>Vanessa myrina</i> (Doubleday, 1849) +	7
<i>Magnastigma julia</i> Nicolay, 1977 +	4	Satyrinae (S= 25)	
<i>Michaelus thordesa</i> (Hewitson, 1867)	1	<i>Caligo brasiliensis</i> (Felder, 1862) +	2
<i>Nicolaea schausa</i> (E. Jones, 1912)	3	<i>Cissia</i> sp.1	6
<i>Nicolaea socia</i> (Hewitson, 1868)	2	<i>Eryphanis automedon</i> (Cramer, 1775)	2
<i>Nicolaea</i> sp.	1	<i>Guianaza pronophila</i> (Butler, 1870)*	1
<i>Ocaria ocrisia</i> (Hewitson, 1868)	1	<i>Forsterinaria quantius</i> (Godart, [1824])**	4
<i>Pseudolycaena marsyas</i> (Linnaeus, 1758) **	1	<i>Godartiana muscosa</i> (Butler, 1870) **	3
<i>Rekoa marius</i> (Lucas, 1857)	1		

Species	Abundance	Species	Abundance
<i>Hermeuptychia atalanta</i> (Butler, 1867) +	1	<i>Aphrissa statira</i> (Cramer, 1777) +	1
<i>Hermeuptychia maimoune</i> (Butler, 1870)	1	<i>Eurema albula</i> (Cramer, 1775) **	1
<i>Moneuptychia itapeva</i> (Freitas, 2007) **	14	<i>Eurema elathea flavescens</i> (Chavannes, 1850) **	125
<i>Moneuptychia soter</i> (Butler, 1877) **	2	<i>Eurema phiale paula</i> (Röber, 1909) **	3
<i>Morpho helenor mielkei</i> Blandin, 2007 **	11	<i>Phoebis sennae marcellina</i> (Cramer, 1777) +	28
<i>Opsiphanes invirae</i> (Hübner, [1808]) **	3	<i>Pyrisitia leuce</i> (Boisduval, 1836) +	5
<i>Paryphthimoides melobosis</i> (Capronnier, 1874)	41	<i>Pyrisitia nise tenella</i> (Boisduval, 1836) +	75
<i>Paryphthimoides phronius</i> (Godart, [1824]) **	5	Pierinae (S= 4)	
<i>Paryphthimoides poltys</i> (Prittwitz, 1865) **	7	<i>Ascia monuste orseis</i> (Godart, [1819]) **	1
<i>Paryphthimoides sp.1</i>	135	<i>Cunizza hirlanda planasia</i> Fruhstorfer, 1910 +	1
<i>Paryphthimoides sp.2</i>	21	<i>Glutophrissa drusilla</i> (Cramer, 1777) +	3
<i>Pharneuptychia phares</i> (Godart, [1824])	2	<i>Hesperocharis anguitia</i> (Godart, 1819)	2
<i>Taygetina kerea</i> (Butler, 1869) +	2	Riodinidae (S= 15)	
<i>Taygetis laches</i> (Fabricius, 1793) **	6	Riodininae (S= 15)	
<i>Yphthimoides affinis</i> (Butler, 1867) **	24	<i>Anteros lectabilis</i> Stichel, 1909 +	1
<i>Yphthimoides patricia</i> (Hayward, 1957)	92	<i>Ariconias glaphyra</i> (Westwood, 1851)	28
<i>Yphthimoides ochracea</i> (Butler, 1867) **	2	<i>Aricoris pasquita</i> (Stichel 1910)	1
<i>Yphthimoides renata</i> (Stoll, 1780) **	4	<i>Aricoris propitia</i> (Stichel, 1910) +	48
<i>Yphthimoides sp.1</i>	6	<i>Aricoris tutana</i> (Godart, [1824]) +	12
Papilionidae (S= 5)		<i>Baeotis johannae</i> Sharpe, 1890	8
Papilioninae (S= 5)		<i>Chalodeta theodora</i> (Felder & Felder, 1862)	1
<i>Battus polydamas</i> (Linnaeus, 1758) +	1	<i>Dachetola azora</i> (Godart, [1824]) +	4
<i>Heracles thoas brasiliensis</i> (Rothschild & Jordan, 1906) +	1	<i>Emesis diogenia</i> Prittwitz, 1865	13
<i>Parides anchises</i> (Linnaeus, 1758) +	1	<i>Lemonias stalactioides</i> (Butler, 1867)	4
<i>Parides bunichus diodorus</i> (Hopffer, 1865) +	37	<i>Lyropteryx terpsichore</i> Westwood, 1851	3
<i>Parides neophilus eurybates</i> (Gray, [1853])	1	<i>Rhetus belphegor</i> (Westwood, 1851) +	3
Pieridae (S= 12)		<i>Stichelia bocchoris</i> (Hewitson, 1876)	5
Coliadinae (S= 8)		<i>Synargis axenus</i> (Hewitson, 1876) +	7
<i>Anteos clorinde</i> (Godart, [1824])	1	<i>Synargis calyce</i> (Felder & Felder, 1862)	1

The most abundant and species rich families were Hesperidae (over one third of all collected species, 33.7%) and Nymphalidae (31.9%). These are the most species rich butterfly families in the Neotropics (LAMAS, 2004). They are also known to have a positive association with monocotyledons during their early life stage (DEVRIES, 1985; FERRER-PARIS *et al.*, 2013), and since monocotyledons are dominant in the rupestrian grasslands of Serra do Cipó (RAPINI *et al.*, 2008), they likely contribute to the wide distribution of these butterfly taxa. The most abundant butterfly species was a new species of *Paryphthimoides*, indicating the need for more inventories in the region of Serra do Cipó. The other abundant butterfly species in this study are known to be common in open, grassland, ruderal or even in disturbed areas (BROWN, 1992). The species that were found at all of the sampling points of this study have wide distributions and occur in many regions of Brazil (MOTTA, 2002).

In comparison to other surveys in Minas Gerais, the present study was fourth in the total number of butterfly species encountered, behind studies in Poços de Caldas (EBERT, 1969), São Francisco River (SOARES *et al.*, 1999) and Uberlândia (MOTTA, 2002) (see Table II). Of all the species collected by us, 61 had not been previously recorded for Minas Gerais, with 32 (52.4%) species of Hesperidae, 14 (22.9%) species of Lycaenidae, 22 (36%) species of Nymphalidae, 2 (3.2%) species of Pieridae, and 10 (16.4%) species of Riodinidae. Therefore, this study greatly expands knowledge of the butterfly fauna of Minas Gerais.

Butterflies of tropical mountains remain poorly known, which makes it difficult to recognize and determine the conservation and endemic status of these major taxa of herbivores. For example, the species *Arcas ducalis* (Westwood, 1852) (Lycaenidae: Theclinae), which was found in our study, was previously known to be restricted to mountaintop environments with preserved vegetation in southern and southeastern Brazil (NICOLAY, 1971; BROWN, 1992; BROWN, 1993).

Table II.— Comparison of butterfly surveys in Minas Gerais, Brazil. * = studies with only fruit feeding butterflies (Nymphalidae)

Reference	EBERT, 1969	SOARES <i>et al.</i> , 1999	MOTTA, 2002	SILVA <i>et al.</i> , 2007	SILVA <i>et al.</i> , 2010 *	SILVA <i>et al.</i> , 2012 *	SOARES <i>et al.</i> , 2012	GOZZI <i>et al.</i> , 2012 *	NERY <i>et al.</i> , 2014	ARAÚJO & PAPROCKI, 2015	SILVA <i>et al.</i> , 2015*	This study
Local	Poços de Caldas	São Francisco River	Uberlândia	Belo Horizonte	Rio Doce	Belo Horizonte	Belo Horizonte	Januária	Serra do Intendente	Betim	Nova Lima	Serra do Cipó
Habitat	Primary forest and open grassland	Caatinga, riparian forest and Cerrado	Cerrado	Urban	Atlantic Forest	Urban	Urban	Cerrado e caatinga	Cerrado and riparian forest	Urban	Rupestrian field and riparian forest	Rupestrian grassland
Number of species	572	180	251	91	83	45	78	39	60	23	63	172
Number of individuals				170		1219	165	5249	394	66	2245	1520
Hesperiidae	223	66	52	26			10		5	2		59
Lycaenidae	87	32	36	1			7		3	0		28
Nymphalidae	164	56	110	42	83	45	46	39	46	17	63	54
Papilionidae	16	3	8	4			3		0	2		5
Pieridae	35	16	17	14			7		5	2		12
Riodinidae	42	7	28	4			5		1	0		15

This species is considered endangered in the states of São Paulo, Rio de Janeiro, and Espírito Santos (BROWN & FREITAS, 1999; OTERO *et al.*, 2000; AZEVEDO *et al.*, 2007). Another example is *R. belphegor*, with three individuals collected in one plot at 1300 m a.s.l. in the present study. This species is on the Brazilian red list of threatened species (MMA, 2014) and is classified as Endangered (EN) by the International Union for Conservation of Nature (IUCN). Another species reported here, *M. julia* and *Strymon ohausi*, both belonging to family Lycaenidae, are also classified as Endangered (EN) by the IUCN (FREITAS & MARINI-FILHO, 2011; MMA, 2014). *Cunizza hirlanda planasia* (Pieridae: Pierinae) is another species on the national red list of threatened species (MMA, 2014), and is listed as Vulnerable (VU) indicating that more information about its biology and distribution are required. This was the first record of *M. julia*, *S. ohausi* and *C. hirlanda planasia* in Serra do Cipó, all sampled outside the Serra do Cipó National Park (a full protection conservation unit); however, they were found in Morro da Pedreira Environmental Protection Area (a sustainable use conservation unit). Our record on the distribution of *Hermeuptychia atalanta* (Butler, 1867) (Nymphalidae: Satyrinae) represents a new record for southeastern Brazil (SERAPHIM *et al.*, 2014).

Conclusion

Results have shown that rupestrian grasslands host a great diversity of butterflies, including species listed as endangered. Because it is a montane environment, particularly exposed to the consequences of global warming, conservationist efforts are needed in order to protect the integrity of this unique ecosystem.

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