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Fruit-feeding butterflies (Lepidoptera: Nymphalidae) of the Área de Proteção Especial Manancial Mutuca, Nova Lima and Species list for the Region of Belo Horizonte, Minas Gerais, Brazil

*André Roberto Melo Silva^{1,3,4}, Douglas Vitor Pontes¹, Marco Paulo Guimarães^{1,3},
Marina Vicente de Oliveira¹, Lucas Tito Faria de Assis¹ & Marcio Uehara-Prado²*

¹Centro Universitário UNA, Faculdade de Ciências Biológicas e da Saúde, Rua Guajajaras, 175, Centro, CEP 30180-100, Belo Horizonte, MG, Brazil.

²Instituto Neotropical: Pesquisa e Conservação Caixa Postal 19009, CEP 81531-980, Curitiba, PR, Brazil.

³Rede de Pesquisa e Conservação de Lepidópteros de Minas Gerais, Belo Horizonte, MG, Brazil.

⁴Corresponding author: André Roberto Melo Silva, e-mail: andrermil@hotmail.com

SILVA, A.R.M., PONTES, D.V., GUIMARÃES, M.P., OLIVEIRA, M.V., ASSIS, L.T.F., UEHARA-PRADO, M. **Fruit-feeding butterflies (Lepidoptera: Nymphalidae) of the Área de Proteção Especial Manancial Mutuca, Nova Lima and Species list for the Region of Belo Horizonte, Minas Gerais, Brazil.** *Biota Neotropica*. 15(3): 1–9. <http://dx.doi.org/10.1590/1676-06032015011814>

Abstract: A study of the assembly of fruit-feeding butterflies in the Área de Proteção Especial Manancial Mutuca, Nova Lima, MG was conducted with the goal of inventorying the species of the site. Forty-two traps were used to attract fruit-feeding butterflies, divided between Cerrado (rupestrian field) and riparian vegetation, monthly over one year. 2245 butterflies, which belonged to 63 species, were recorded. Of this total, forty-eight species were collected in the Cerrado, twenty-one exclusively in this environment, forty-two in riparian forest, fifteen being exclusive to this environment, and twenty-seven species were sampled in both environments. From the total of sampled species, thirty-five were considered rare, eight accessory species, and twenty constant species. *Prepona deiphile deiphile* (Charaxine) is classified as vulnerable on the Minas Gerais' list and on the national list of threatened species. The collector curve showed no clear trend to stabilization, suggesting that there are species still not sampled in the study area. Adding the data from field sampling to the information on species occurrence in the literature and in entomological collections, the current number of frugivorous butterflies species for the region of Belo Horizonte is 104. This result foregrounds the importance of APE Mutuca for maintaining a rich fauna of frugivorous butterflies to the area.

Keywords: *Biodiversity, community, conservation, inventory, species richness.*

SILVA, A.R.M., PONTES, D.V., GUIMARÃES, M.P., OLIVEIRA, M.V., ASSIS, L.T.F., UEHARA-PRADO, M. **Borboletas frugívoras (Lepidoptera: Nymphalidae) da Área de Proteção Especial Manancial Mutuca, Nova Lima e lista de espécies da região de Belo Horizonte, Minas Gerais, Brasil.** *Biota Neotropica*. 15(3): 1–9. <http://dx.doi.org/10.1590/1676-06032015011814>

Resumo: Foi realizado um estudo da assembléia de borboletas frugívoras da Área de Proteção Especial Manancial Mutuca, Nova Lima-MG, com o objetivo de inventariar as espécies do local. Foram utilizadas 42 armadilhas atrativas para borboletas frugívoras, divididas entre mata ciliar e Cerrado (campo rupestre), mensalmente ao longo de um ano. Foram amostradas 2245 borboletas, pertencentes a 63 espécies. Deste total, 48 espécies foram coletadas no Cerrado, sendo 21 exclusivamente neste ambiente, 42 na Mata Ciliar com 15 exclusivas e 27 espécies foram amostradas nos dois ambientes. Do total de espécies amostradas, 35 foram consideradas raras, oito acessórias e 20 constantes. *Prepona deiphile deiphile* (Charaxine) encontra-se classificada como vulnerável na lista de Minas Gerais e na lista nacional de espécies ameaçadas. A curva do coletor não mostrou tendência nítida à estabilização, o que sugere que ainda existam espécies não amostradas na área de estudo. Somando-se aos dados de amostragem em campo, informações sobre ocorrência de espécies na literatura e em coleções entomológicas, o número atual de espécies de borboletas frugívoras para a região de Belo Horizonte é de 104. Esse resultado ressalta a importância da APE Mutuca na manutenção de uma fauna rica de borboletas frugívoras para a região.

Palavras-chave: *Biodiversidade, comunidade, conservação, inventário, riqueza de espécies.*

Introduction

Biological diversity is being lost at a rapid pace (Wilson 1997) and habitat loss and degradation, especially deforestation, are among the factors that most contribute to species extinction events (Brown & Lomolino 2006, Machado et al. 2005). The Cerrado is no exception to this global trend. Most of the biome has already been cleared out or transformed, by human action, into pastures, annual crops and other types of land use (Klink & Machado 2005). Only in the State of Minas Gerais, approximately 75% of the original area of the Cerrado has been destroyed (Lins & Mendonça 2000).

The transformations which have happened in this biome have brought great environmental damages, such as fragmentation and reduction of habitats, species extinction, invasion of exotic species, soil erosion, pollution of aquifers, changes in fire regime, imbalances in the carbon cycle and possibly changes in regional climate (Klink & Machado 2005). The Cerrado is considered a global hotspot for being an area with high rate of endemism and less than 30% of remnant vegetation (Myers et al. 2000), and the conservation of its biodiversity should be considered a priority in Brazil. Inventories are important for filling gaps in our knowledge of local biodiversity, assisting in the identification of endemism and generating subsidies for conservation (Lewinsohn et al., 2005, Mielke et al., 2010, Ritter et al. 2011).

The Lepidoptera comprise approximately 160,000 species, 20,000 of which are butterflies, and in Brazil there should occur around 26,000 species, including over 3,000 butterflies (Brown 1996, Freitas & Almeida 2012). Among the butterflies, the Nymphalidae family is responsible for a significant portion of the species richness in the Neotropical region (DeVries et al. 1997), representing approximately 30% of this fauna (Lamas 2004). ‘Charismatic’ insects, such as butterflies, have the potential to become flagship groups in conservation programs (Lewinsohn et al. 2005). Butterflies are also considered good biological indicators as they respond quickly to environmental changes and are easily observed and sampled (Freitas et al., 2003, Freitas 2010).

Butterflies can be separated into two guilds, considering the eating habits of adults: nectarivorous, which feed on nectar; and frugivorous, which feed on fermented fruit, excrements, plants’ exudates and decaying animals (Uehara-Prado et al. 2004). All the strict frugivorous belong to the Nymphalidae family, and represent 20% of neotropical butterflies (Lamas 2004). The frugivorous butterflies are divided into four subfamilies and 13 tribes: Satyrinae (Brassolini, Haeterini, Melanitini, Morphini e Satyrini), Charaxinae (Anaeni e Preponini), Biblidinae (Ageroniini, Biblidini, Callicorini, Epicalini e Epiphilini) e Nymphalinae (Coeini) (Marín et al. 2011). For the sampling of those butterflies, traps containing fermented fruit as bait have been vastly used in the tropics (De Vries et al. 1999, Uehara-Prado et al., 2004, Marini-Filho & Martins, 2010, De Vries et al. 2011, Silva et al. 2012).

Only a few studies have been conducted with fruit-feeding butterflies in Cerrado areas, such as Pinheiro & Ortiz (1992) in Brasília, Fortunato & Ruszczyk (1997) in Uberlândia, Marini-Filho & Martins (2010) in the Parque Nacional da Serra da Canastra and Silva et al. (2012) in Belo Horizonte. In this context, knowing the assemblage of fruit-feeding butterflies in Cerrado areas can generate data for further evaluation of the local biodiversity conservation. In this paper, a inventory of

fruit-feeding butterflies from the Área de Proteção Especial (APE) Manancial Mutuca is presented. Moreover, the resulting list was supplemented with data from the occurrence of fruit-feeding butterflies in the region of Belo Horizonte.

Material e Methods

1. The study area

The study was conducted at a Área de Proteção Especial (Special Protection Area) Manancial Mutuca (20°00’3723” S and 43°58’8,92” W), a propriety of the Sanitation Company of Minas Gerais (COPASA - MG). The reserve is located in Nova Lima, Minas Gerais State, in the Ferriferous four-side. It is nestled in the Parque Estadual da Serra do Rola Moça, having joint administration with the State Forest Institute (SFI) and it borders the BR-040, two large mining companies and part of the Barreiro district in Belo Horizonte.

The APE Mutuca is 1250 hectares, with transitional vegetation between Cerrado and Atlantic Forest, with 371 hectares of arboreal coverage, including riparian zone of the Mutuca stream (Copasa 2013) (Figure 1). In this stream, there is a dam to capture water, composing, along with Cercadinho and Fechos reserves, the Supply System Morro Redondo, which provides water for a part of Nova Lima and southern area of Belo Horizonte (Copasa 2013).

In this region the climate is high-altitude tropical, characterized by dry winters and rainy summers (Brandão et al. 1997). The annual average temperature varies between 18° and 21° C. The rainfall shows variation between 1300-2100 mm annual rainfall, with the dry season between April and July and the rainy season starting in August (Cetec 1993).

The samplings were held in both of Cerrado phyto-physiognomies present in the area: riparian vegetation and rupestrian field. The rupestrian field is found in areas above a thousand feet high, along the Serra do Espinhaço, in rocky or sandy soils and its vegetation consists of herbs and sparse shrubs (Mendonça & Lins 2000). The riparian forest is a formation located along minor rivers and streams, but it is now reduced to scattered clumps (Mendonça & Lins 2000).

2. Sampling

Samples were collected monthly for one year (from October 2008 to September 2009) during four days per month, the first day being for the installation of traps and placement of bait (banana with sugar cane juice, prepared two days in advance). Van Someren-Rydon traps, consisting of a cylinder of tulle of approximately eighty centimetres high, closed at the top and mounted on a wooden platform where the bait lies (DeVries 1987) were used.

Twenty-one traps were placed in the riparian area and other twenty-one in the Cerrado (rupestrian field), organized into sampling units (UA) with three traps. Within an UA, the traps were set twenty meters apart from each other and each UA was 200 meters away from the other.

When possible, captured specimens were identified in the field, marked and released. The unidentified specimens were collected for later identification. At least two individuals of each species were collected and assembled, and this reference collection is deposited in the Laboratory of Zoology of the

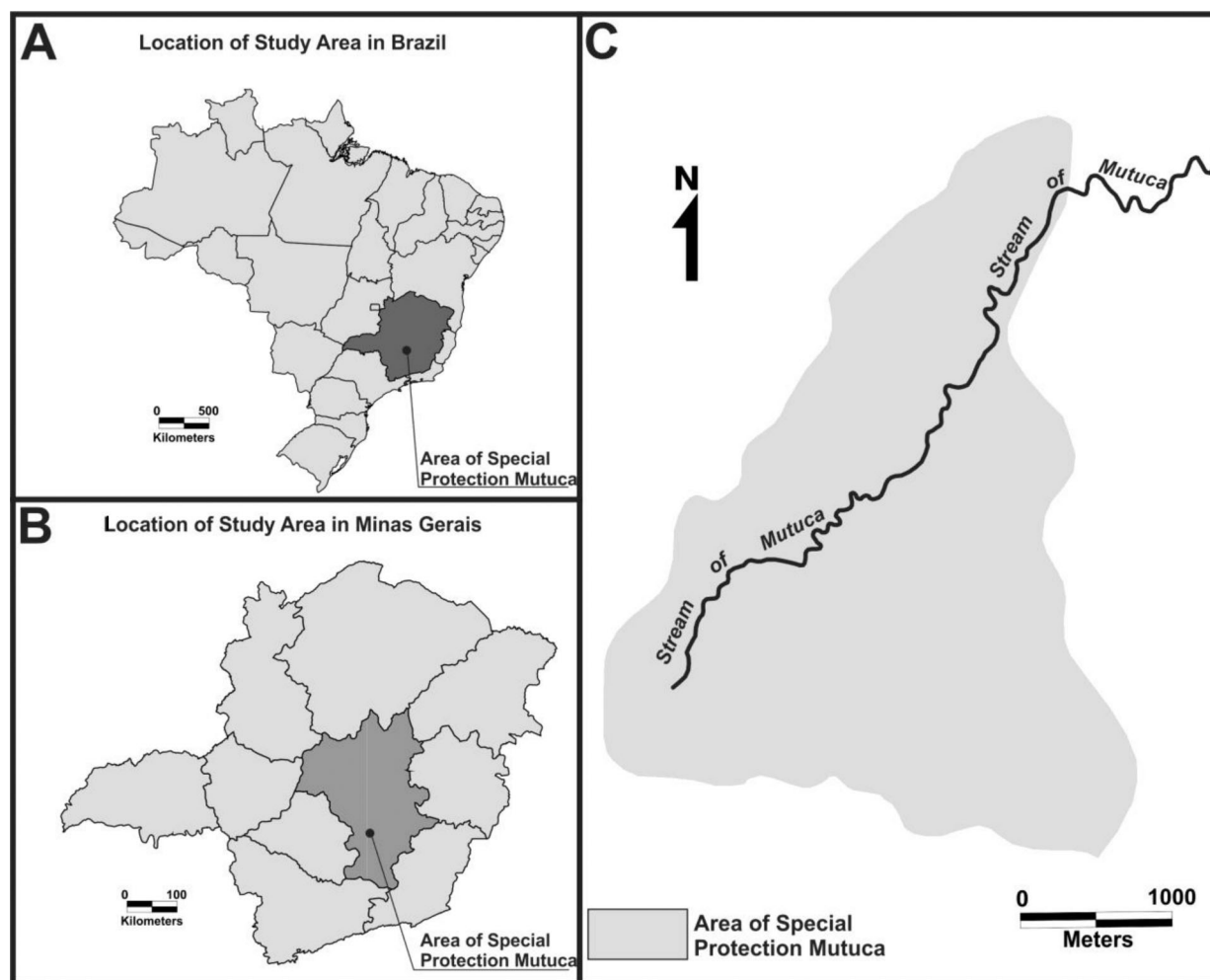


Figure 1. Location of Área de Proteção Especial Manancial Mutuca. A. Location of study area in Brazil, B. Location of study area in Minas Gerais and C. APE Mutuca.

Centro Universitário UNA at Belo Horizonte. The nomenclature used was based on Lamas (2004).

To complement the local species list, three collections containing butterflies from neighbouring cities to Belo Horizonte and Nova Lima and that had similar ecosystems were consulted: Collection of the Museu de História Natural e Jardim Botânico da UFMG (MHNJB-UFMG), the Entomological Collection of the Museu de Ciências Naturais Puc Minas (MCN-PUC-MG) and the Coleção Entomológica das Coleções Taxonômicas da UFMG. Additionally, data from four studies on butterflies of the city of Belo Horizonte were included (Brown & Mielke 1968, Silva et al. 2007, Silva et al. 2012, Soares et al. 2012).

3. Analysis of data

The species accumulation curve (Mau Tau) and three richness estimators (Jackknife 2, Chao 2 and ACE) were calculated using the program EstimateS 8.2 (Cowell 2009). The percentage of the fauna in the field and the list supplemented with information from entomological collections and papers were compared to the estimates obtained. According to Magurran (2011), the nonparametric estimators are the most effective methods to estimate species richness in ecological assemblages.

Species present in over 50% of the sampled months were considered constant, species present between 25 and 50% (present between three and five months) were considered accessory and species present in less than 25% of samples (one or two samples) were considered rare (Dajoz 1983).

Results and Discussion

In all, 2245 specimens belonging to sixty-three species of fruit-feeding butterflies were sampled (Table 1). From the recorded species, one appears on the list of threatened Fauna of Minas Gerais (2006) and on the national list of threatened species (O.J. Marini-Filho, unpublished data): *Prepona deiphile deiphile* (Charaxinae), classified as vulnerable on both lists (Figure 2).

The Satyrinae subfamily was the most abundant with 1637 specimens (73%), followed by the Charaxinae with 348 (15.5%), Biblidinae with 220 (9.8%) and Nymphalinae with forty specimens (1.7%). Regarding the overall richness, Satyrinae had thirty-one species, representing 49.2% of the sample (from Satyrini, there were nineteen species, 80.9%, from Brassolini, nine species, 14.3%, and from Morphini three, 4.8%), followed by Biblidinae with seventeen species (27%), Charaxinae with twelve species (19%) and Nymphalinae with three species (4.8%),

Table 1. Species list, constancy and abundance of fruit-feeding butterflies species (Nymphalidae), in the rupestrian fields and riparian forest from the Área de Proteção Especial Manancial Mutuca, Nova Lima, MG, Brazil, (October 2008 and September 2009) and species found in the region of Belo Horizonte recorded in other studies.

	APE Mutuca			
Subfamilies/Species	rupestrian field	riparian forest	constancy	Recorded in collections and literature
Biblidinae				
<i>Biblis hyperia nectanabis</i> (Fruhstorfer, 1909)	1	-	R	a, b, d, e, f
<i>Callicore astarte selima</i> (Guenée1872)				a, b, d, e
<i>Callicore pygas thamyras</i> (Ménétriés, 1857)	1	-	R	b, e, f, g
<i>Callicore sorana sorana</i> (Godart[1824])	128	-	C	a, b, c, d, e, f
<i>Catonephele numilia penthia</i> (Hewitson, 1852)	-	2	R	e
<i>Catonephele sabrina</i> (Hewitson, 1852)				b
<i>Cybdelis phaesyla</i> (Hübner, [1831])				b, d
<i>Diaethria candrena</i> (Godart[1824])	1	-	R	b, d, e, f
<i>Diaethria clymena</i> (Cramer, 1775)	1	-	R	b, d, f
<i>Diaethria eluina eluina</i> (Hewitson, 1855)				b
<i>Ectima thecla</i> (Fabricius, 1796)	-	1	R	g
<i>Epiphile hubneri</i> Hewitson, 1861	6	32	C	b, d, f
<i>Epiphile oreia</i> (Hubner[1823])	-	13	A	b, d
<i>Eunica bechina magnipunctata</i> Talbot, 1928				b, f
<i>Eunica cuvierii</i> (Godart, 1819)				f
<i>Eunica eburnea</i> Fruhstorfer, 1907				d
<i>Eunica margarita</i> (Godart, [1824])				b, e
<i>Eunica tatila bellaria</i> Fruhstorfer, 1908	9	-	R	d
<i>Hamadryas amphinome amphinome</i> (Linnaeus, 1767)	1	-	R	a, b, d, e, f, g
<i>Hamadryas chloe rhea</i> (Fruhstorfer, 1907)	-	1	R	d, e
<i>Hamadryas epinome</i> (C. Felder & R. Felder, 1867)				b, c, d, e, f, g
<i>Hamadryas februa februa</i> (Hübner, 1823)	13	-	C	a, b, c, d, e, f, g
<i>Hamadryas feronia feronia</i> (Linnaeus, 1758)	1	1	R	a, b, c, e, f, g
<i>Hamadryas fornax fornax</i> (Hübner, [1823])				e
<i>Hamadryas iphthime iphthime</i> (H. W. Bates, 1864)	-	1	R	g
<i>Hamadryas laodamia laodamia</i> (Cramer, 1777)				a, b, e, g
<i>Myscelia orsis</i> (Drury, 1782)	-	2	R	
<i>Nica flavilla</i> (Godart, [1824])				a
<i>Temenis laothoe meridionalis</i> Ebert, 1965	5	-	R	b, c, d, f
Nymphalinae				
<i>Colobura dirce</i> (Linnaeus, 1758)	1	23	C	a, b, d, e, f, g
<i>Historis odius</i> (Fabricius, 1775)	10	-	A	c, f
<i>Smyrna blomfieldia</i> (Fabricius, 1781)	4	2	A	e, f
Charaxinae				
<i>Archaeoprepona amphimachus</i> (Fabricius, 1775)	37	14	C	d, e
<i>Archaeoprepona chalciope</i> (Hubner, [1823])	2	9	R	d, e, f
<i>Archaeoprepona demophon thalpius</i> (Hubner, [1814])	7	6	C	a, b, d, f
<i>Archaeoprepona demophoon</i> (Hubner, [1814])	8	1	A	d
<i>Fountainea ryphea</i> (Cramer, 1775)	22	16	C	b, d, e, f
<i>Hypna clytemnestra</i> (Cramer, 1777)				b, d
<i>Memphis acidalia victoria</i> (H. Druce, 1877)				b
<i>Memphis appias</i> (Hubner, [1825])	75	44	C	b, d, e
<i>Memphis morius steno</i> (Prittwitz, 1865)	12	21	C	a, d, e, f
<i>Memphis otrere</i> (Hubner, [1825])	22	28	C	b, d, e
<i>Prepona deiphile deiphile</i> (Godart, [1824])	2	-	R	
<i>Prepona laertes</i> (Hubner, [1811])	1	-	R	
<i>Prepona pylene</i> Hewitson, [1854]	1	-	R	d
<i>Siderone galanthis</i> (Cramer, 1775)				d, e, f
<i>Zaretis isidora</i> (Cramer, 1779)	15	5	C	b, d, e, f

Continued on next page

Table 1. Continued.

Subfamilies/Species	APE Mutuca			Recorded in collections and literature
	rupestrian field	riparian forest	constancy	
Satyrinae: Brassolini				
<i>Blepolenis batea batea</i> (Hübner, 1821)	12	-	R	b, c, d, e, f
<i>Brassolis sophorae laurentii</i> Stichel, 1925				b, c, d, e, g
<i>Caligo arisbe</i> Hubner, [1822]	8	80	A	b, d, e, f
<i>Caligo illioneus illioneus</i> (Cramer, 1775)				b, c
<i>Catoblepia amphirhoe</i> (Hubner, [1825])	1	2	R	
<i>Catoblepia berecynthia</i> (Cramer, 1777)				d
<i>Dasyophthalma rusina</i> (Godart, [1824])	-	7	R	d, e
<i>Eryphanis reevesii</i> (Doubleday, [1849])	20	53	C	b, d, e, f
<i>Narope cyllarus</i> Westwood, 1851				b, d
<i>Narope cyllastros</i> Doubleday, [1849]	-	2	R	
<i>Opoptera syme</i> (Hubner, [1821])	3	36	R	d, e, f
<i>Opsiphanes cassiae</i> (Linnaeus, 1758)				a, b, c, e
<i>Opsiphanes invirae</i> (Hubner, [1808])	12	8	C	a, b, c, d, e, f
<i>Opsiphanes quiteria</i> (Stoll, 1780)	-	3	R	b, d, e
Satyrinae: Morphini				
<i>Antirrhea archaea</i> Hubner [1822]	-	11	R	d
<i>Morpho anaxibia</i> (Esper, [1801])				b, d, e
<i>Morpho helenor mielkei</i> (Blandin, 2007)	43	157	C	a, b, c, d, e, f
<i>Morpho menelaus coeruleus</i> (Perry, 1810)	-	5	R	d, e
Satyrinae: Satyrini				
<i>Capronnieria galesus</i> (Godart, [1824])				d
<i>Cissia terrestris</i> (Butler, 1867)				b
<i>Eteona tisiphone</i> (Boisduval, 1836)				g
<i>Euptychoides castrensis</i> (Schaus, 1902)	9	-	R	d, e, f
<i>Forsterinaria quantius</i> (Godart, [1824])	2	70	C	b, d, e
<i>Forsterinaria necys</i> (Godart, [1824])				d, e
<i>Forsterinaria pronophila</i> (Butler, 1867)				d
<i>Godartiana muscosa</i> (Butler, 1870)	84	466	C	b, d, e, f
<i>Hermeuptychia</i> sp.	1	-	R	a, b, d, e
<i>Carminda griseldis</i> (Weymer, 1911)				e
<i>Moneuptychia itapeva</i> Freitas, 2007	129	1	C	d, e, f
<i>Carminda paeon</i> (Godart, [1824])	-	2	R	d, e
<i>Moneuptychia soter</i> (Butler, 1877)				d
<i>Pareuptychia ocirrhoe interjecta</i> (d'Almeida, 1952)	-	1	R	
<i>Pareuptychia ocirrhoe ocirrhoe</i> (Fabricius, 1776)				b, d, e
<i>Pareuptychia summandosa</i> (Gosse, 1880)				d
<i>Paryphthimoides phronius</i> (Godart, [1824])	-	2	R	c, d, e, f, g
<i>Paryphthimoides poltys</i> (Prittwitz, 1865)	-	3	R	a, d, e, f, g
<i>Paryphthimoides</i> sp.	1	-	R	
<i>Paryphthimoides vetigiata</i> (Butler, 1867)				b
<i>Pharneuptychia innocentia</i> (C. Felder & R. Felder, 1867)	189	-	C	b, d, e, f
<i>Pierella nereis</i> (Drury, 1782)				b, d
<i>Taygetis acuta</i> Weymer, 1910	2	12	C	d, e
<i>Taygetis drogoni</i> Siewert, Zacca, Dias & Freitas, 2013	5	23	C	d, e, f
<i>Taygetis laches</i> (Fabricius, 1793)	2	10	A	a, c, d, e, f
<i>Taygetis rufomarginata</i> Staudinger, 1888				d
<i>Taygetis thamyra</i> (Cramer, 1779)				b
<i>Taygetis virgilia</i> (Cramer, 1776)				b, d, e
<i>Taygetomorpha celia</i> (Cramer, 1779)				f
<i>Yphthimoides affinis</i> (Butler, 1867)	8	-	R	d, g

Continued on next page

Table 1. Continued.

Subfamilies/Species	APE Mutuca			Recorded in collections and literature
	rupestrian field	riparian forest	constancy	
<i>Ypthimoides angularis</i> (Butler, 1867)				b, d, e
<i>Ypthimoides celmis</i> (Godart, [1824])	8	-	R	b, d, e, f
<i>Ypthimoides saltuensis</i>	126	1	A	d, e, f
<i>Ypthimoides ochracea</i> (Butler, 1867)	11	5	A	d, e, f
<i>Ypthimoides pacta</i> (Weymer, 1911)	1	-	R	d, e
<i>Ypthimoides renata</i> (Stoll, 1780)				d, e, f, g
<i>Ypthimoides straminea</i> (Butler, 1867)				e
<i>Ypthimoides ypthima</i> (C. Felder & R. Felder, 1867)				d, e
<i>Zischkaia paccus</i> (Godart, [1824])				d
Total	1063	1182		

C = Constant, A = Accessory and R = Rare; a = Silva et al. (2007); b = Brown & Mielke (1968); c = Collection of the MHNJB-UFGM; d = Entomological Collection of the MCN-PUC-MG; e = Entomological Collection of the Taxonomic Collections of UFGM; f = Silva et al. (2012); g = Soares et al. (2012).

the same sequence mentioned by Lamas (2004) regarding the richness of the butterflies subfamily of Nymphalidae in the Neotropical region.

A study conducted in APE Cercadinho, near APE Mutuca (Silva et al., 2012), found 78% species of Satyrinae in sampling, and in both locations the richness of this subfamily was close to 50% of species in the sample. Indeed, Satyrinae usually occupies a prominent position in number of species in the studies of fruit-feeding butterflies (De Vries et al. 1997, De Vries et al. 1999). Studies in other areas of Cerrado in Minas Gerais also found Satyrinae as the group with the highest number of species (Marini-Filho & Martins, 2010, Silva et al. 2012). This pattern is due to the fact that Satyrinae is the richest subfamily of fruit-feeding butterflies in the Neotropical region with 1235 species, having many more species than the second subfamily, Biblidinae, with 266 species (Lamas 2004).

From the total of sampled species, thirty-five were found to be rare (56%), eight were considered accessory and twenty were considered constant (Table 1). From the thirty-five rare species, fourteen (22%) were singletons and seven (11%) doubletons. In insect assemblages, species represented by a single individual are prevalent (Magurran 2011). Pinheiro & Ortiz (1992), in a study in Jardim Botânico de Brasília, found 26% of singletons and, in an area near APE Mutuca (APE Cercadinho) there were records of 18% of singletons (Silva et al., 2012), similar numbers to the ones in this paper.

According to Magurran (2011), in all environments (either tropical or temperate), most species in an assembly are rare, and a small number of common species will represent 90% of total abundance. As a matter of fact, in this study, ten species accounted for 71% of total abundance. The four most abundant species in the sample belong to the subfamily Satyrinae: *Godartiana muscosa*, with 550 specimens; *Morpho helenor mielkei* (200); *Pharneuptychia innocentia* (189) and *Moneuptychia itapeva*, with 130 specimens. Of these, three are small, being better able to survive in small fragments of habitat because their larvae require a smaller volume of host plants, having large populations (Shahabuddin & Ponte 2005, Marini-Filho & Martins 2010), what could explain the large abundances found. *M. helenor* was one of the most abundant species in riparian forests in the

Cerrado in the Parque Nacional da Serra do Canastra MG (Marini-Filho & Martins 2010), showing similar results to the ones in the present study. Species of the genus *Morpho* can fly in the understory or canopy, and *M. helenor* flies to about one meter above ground along streams and forest edges (De Vries et al. 2010), being considered typical of riparian forest (Pinheiro et al. 2008), which may explain the great abundance of this butterfly in APE Mutuca, having 79% of individuals sampled in this environment.

When considering the sampled environments, it was recorded in the rupestrian field 1063 specimens (47.4%) of forty-eight species, twenty-one of which are exclusive to this environment, while in riparian area it was recorded 1182 specimens (52.6%) belonging to forty-two species, fifteen of which were exclusive to this site (Table 1). According to Baz & Boyero (1995), the structural heterogeneity of a place with distinct vegetation types is a favourable factor to increase diversity of butterflies. The various vegetation types recognized in the Cerrado region provide a spatial variation in the distribution of butterfly species, influencing the composition of their communities (Camargo 2001), supported by the large number of species exclusive to each environment in the present study. The establishment and persistence of butterfly populations in riparian forest and rupestrian field are related to the availability of resources for larvae and adults, vegetation type, climate and degree of disturbance, which certainly varies between these two sites in APE Mutuca, in addition to the intrinsic characteristics of the organisms involved, such as population dynamics, mobility and adaptability to disturbed environments (Fortunato & Rusczyk 1997).

Even when taking into account differences in relation to sampling effort, it is important to observe that the species richness of fruit-feeding butterflies APE Mutuca was similar or greater when compared to other sites in Cerrado. The APE Mutuca showed greater richness other places, such as APE Cercadinho in Belo Horizonte, a very similar and nearby area, where forty-five species (Silva et al. 2012) were recorded; in Uberlândia, where thirty-six species were found in urban and extra urban areas (Fortunato & Rusczyk 1997); in Jardim Botânico de Brasília, where forty-six species were recorded in



Figure 2. Male *Prepona deiphile deiphile*. Species classified as vulnerable on the list of threatened Fauna of Minas Gerais (2006) and on the national list of threatened species.

riparian forest, Cerrado and transition area (Pinheiro & Ortiz 1992); and in riparian and Cerrado areas of Campus Darcy Ribeiro in Brasília, there were thirty-one species (Pinheiro et al. 2008). The number of species found in the APE Mutuca was similar only to the Parque Nacional da Serra do Canastra (MG), where sixteen fragments of riparian vegetation were sampled, and sixty-seven species were registered (Marini-Filho & Martins 2010).

Regarding the region of Belo Horizonte, Brown & Mielke (1968) registered forty nine species of fruit-feeding butterflies (eight exclusive records this location) and estimated 107 species

for the city. Silva et al. (2007) studied an urban area of Belo Horizonte, finding seventeen species of fruit-feeding butterflies, four of which had not been found by Brown & Mielke (1968) and one was not recorded in this study; *Nica flavilla*. Silva et al. (2012) studied an area in Belo Horizonte (APE Cercadinho), registering forty-five species, two exclusive ones. Soares et al. (2012) studied other urban area, in the centre of Belo Horizonte, finding fifteen species, with one exclusive to this area (*Eteona tisiphone*, Satyrinae).

Five of the seven surveys conducted in the region of Belo Horizonte had fourteen species in common: *Biblis hyperia*

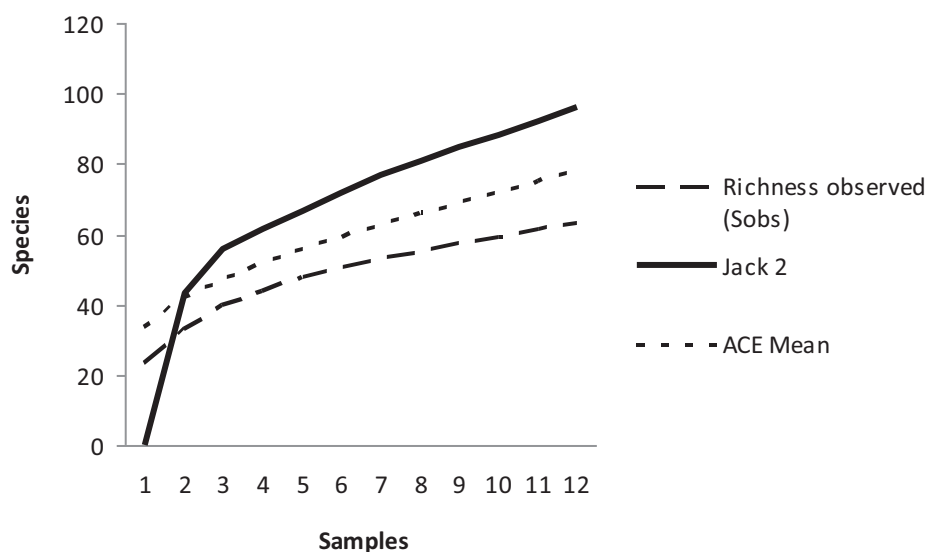


Figure 3. Species accumulation curve of butterflies recorded at the Área de Proteção Especial Manancial Mutuca, Nova Lima, MG, Brazil, between October 2008 and September 2009.

Table 2. Estimators of species richness and proportion of the number of species observed in APE Mutuca and of the compiled species in the region of Belo Horizonte.

Estimators of species richness	Estimated number of species	Proportion of observed species (63)	Proportion of species compiled list for Belo Horizonte (104)
Chao 2	107	59%	97%
Jackknife 2	95	66%	109%
ACE	79	80%	131%

nectanabis, *Callicore sorana sorana*, *Hamadryas amphinome amphinome*, *Hamadryas epinome*, *Hamadryas februa februa*, *Hamadryas feronia feronia* (Biblidinae), *Colobura dirce* (Nymphalinae), *Brassolis sophorae laurentii*, *Blepopenis batea batea*, *Opsiphanes invirae*, *Morpho helenor mielkei*, *Paryphthimoides phronius*, *Paryphthimoides poltys* and *Taygetis laches* (Satyrinae). These species could be the focus of population studies at the regional scale (eg: long-term monitoring), since most of them are easily identified and occur with high abundance in the samples.

From the fruit-feeding butterflies species found in collections, seventy-one were identified in the collection of MCN-PUC-MG, including twelve exclusive species this collection. In the Coleção Entomológica da UFMG sixty species were identified, with three exclusive ones, while in the collection of MHNJB-UFMG fourteen species of fruit-feeding butterflies were recorded, neither exclusive specie.

In APE Mutuca, six species, which were not recorded in any of the studies or collections mentioned above, were sampled, and are new records for the region of Belo Horizonte: *Myrcelia orsis*, *Prepona deiphile deiphile*, *Prepona laertes*, *Catoblepia amphirhoe*, *Narope cyllastros* and *Pareuptychia ocirrhoe interjecta*. Adding the records of the four papers (Brown & Mielke 1968, Silva et al. 2007, Silva et al. 2012, Soares et al. 2012), the three collections and the present study, the total number of fruit-feeding butterflies in the region of Belo Horizonte is of 104 species. Brown & Freitas (2000), referring to articles, collections, an personal communication, recorded eighty species of fruit-feeding butterflies in Belo Horizonte.

The species accumulation curve of APE Mutuca showed no clear stabilization trend (Figura 3), indicating that other species could be recorded with increasing sampling effort, a result corroborated by the richness estimators. The estimated species richness reached 107 species by the Chao 2 estimator, ninety-five species by the Jackknife 2 estimator, and seventy-nine species by ACE estimator (Table 2). Therefore, the compiled list in this study, with 104 species in the region of Belo Horizonte, approaches the richness achieved by estimators Chao 2 and Jackknife 2 for SPA Mutuca (Table 2). The Chao 2 estimator was closer to the list of Belo Horizonte (104 species), with an estimate of 107 species, indicating a congruence between the locally estimated and regionally observed values for fruit-feeding butterflies.

The number of fruit-feeding butterflies species recorded in this study (sixty-three) may be considered high, especially if it is taken into account that the APE Mutuca is a relatively small vegetation sample (1250 ha). The present study demonstrates that the APE Mutuca is essential for the maintenance of local diversity of butterflies because, even though the area is subjected to anthropogenic impact, it harbors an important portion of the fruit-feeding butterfly fauna in the region – including thirty-five rare and one endangered species. This

study also reinforces the importance of the creation and preservation of protected areas, even near large cities, for the maintenance of biodiversity at the regional scale.

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