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ARTICLE

Butterfly fauna (Lepidoptera, Papilionoidea) in a heterogeneous area between two biodiversity hotspots in Minas Gerais, Brazil

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Abstract. This paper investigates the butterfly fauna of the 'Serra do Rola-Moça' State Park, Minas Gerais, Brazil. We evaluate i) the seasonal variation of species richness and composition; and ii) the variation in composition of the local butterfly assemblage among three sampling sites and between the dry and rainy seasons. Sampling was carried out monthly between November 2012 and October 2013, using entomological nets. After a total sampling effort of 504 net hours, 311 species were recorded. One of them is endangered in Brazil, and eight are probable new species. Furthermore, two species were new records for the region and eight considered endemic of the Cerrado domain. There was no significant difference in species richness between the dry and the rainy seasons, however the species composition varies significantly among sampling sites. Due to its special, heterogeneous environment, which is home to a rich butterfly fauna, its preservation is important for the conservation of the regional butterfly fauna.

Key-Words. *Actinote quadra;* Atlantic Rainforest; Butterfly richness; Cerrado; New records.

INTRODUCTION

The Atlantic Rainforest and the Cerrado domains present variable landscape structure (Tabarelli *et al.,* 2005; Emery *et al.,* 2006), being considered threatened and important biodiversity hotspots (Mittermeier *et al.,* 2004). The heterogeneous vegetation in those floristic domains is habitat for a diverse fauna of butterflies (Emery *et al.,* 2006). Although high butterfly species richness has been recorded in different areas of the Atlantic Rainforest and the Cerrado, as well as in transition areas between those domains, inventories in the various vegetation types in those ecosystems still need to be conducted (Carneiro *et al.,* 2008).

The butterfly fauna of the Brazilian Cerrado is still poorly known, even in southern and southeastern Brazil, where many faunistic inventories have been done (Carneiro *et al.,* 2008).

Some important butterfly inventories were done in the Cerrado in the Federal District and in the state of Minas Gerais (Brown Jr. & Mielke, 1967a, 1967b, 1968; Emery *et al.,* 2006; Mielke *et al.,* 2008; Motta, 2002). Few inventories were focused on the butterfly fauna of non-urban fragments of Atlantic Rainforest in Minas Gerais (Brown Jr. & Mielke, 1968; Brown Jr. & Freitas, 2000; Ebert, 1969; Silva *et al.,* 2010), although a significative portion of the Brazilian butterfly diversity occurs in this domain (Iserhard *et al.,* 2018).

Many studies demonstrate that the number of active butterfly species decreases during the dry season, mainly due to scarcity of larval food (Brown Jr. & Freitas, 2000). In the rainy season, when more species are active, adult females easily find new, soft, nutrient-reach leaves to feed the caterpillars (Iserhard *et al.,* 2013). However, environmental characteristics, such as vegetation type, are more relevant than the temporal variation (dry and rainy seasons) in organizing species composition for Hesperiidae butterfly assemblages (Carneiro *et al.,* 2014) and can also be relevant for the species composition of the other butterfly families.

The study of species diversity in different vegetation types is critical to planning and developing environmental protection and insect conservation actions (Lewinsohn *et al.,* 2005), and faunistic inventories are indispensable tools for

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recording and describing the local biodiversity, as well as for management and protection of remnants of the Cerrado, of the Atlantic Rainforest and of the transition areas between them.

Here, the butterfly fauna of a heterogeneous area in the border of the Cerrado and the Atlantic Rainforest domains, in the Brazilian state of Minas Gerais, is inventoried and its species richness and composition in different vegetation types, in the dry and rainy seasons, are analyzed.

MATERIAL AND METHODS

Study area

The study was conducted in the 'Serra do Rola-Moça' State Park (PESRM) (20°03'01"S, 44°00'20"W), located in the municipalities of Belo Horizonte, Brumadinho, Ibirité and Nova Lima in the state of Minas Gerais (Fig. 1). The park is in the region known as Quadrilátero Ferrífero ('Iron Quadrangle') in the southern Espinhaço Range, and is composed of different vegetation types of the Atlantic Rainforest domain (riparian and seasonal semi-deciduous forest) and of the Cerrado domain (cerrado sensu strictu [savanna], natural grasslands and rocky fields) (Drummond & Martins, 2007).

The park is a mountainous area with altitudes raging between 1,000 m and 1,430 m (Drummond & Martins, 2007), under a tropical climate, with a dry season between April and September, and a rainy season between October and March, with an average total rainfall of 850 mm (Drummond & Martins, 2007). Surrounding the park, there are mines and urban areas that directly affect the park's environment (Drummond & Martins, 2007).

Sampling and identification

Sampling was conducted between November 2012 and October 2013, in twelve transects, two in each of six different vegetational types: rocky field, Cerrado sensu strictu (savanna) and natural grassland (physiognomies of the Cerrado); riparian forests and seasonal semi-deciduous forest (Atlantic Rainforest); and Forest-Cerrado transition areas. The twelve transects are 1 km to 1.5 km away from each other and were chosen considering their accessibility and vegetation types. Due to low temperatures and rain, the sampling effort was reduced in March.

Entomological nets were used to capture adult butterflies, following the standard procedures established by Iserhard (2011). Samples were carried out twice a month, with three collectors sampling for 3.5 hours along each of two transects each day, between 09:00 and 16:30.

The butterflies were sacrificed by thorax compression and stored in entomological envelopes for posterior identification. The following information was recorded for each captured butterfly: date, time, local of collection, and collector. The specimens collected were identified and deposited in the Centro de Coleções

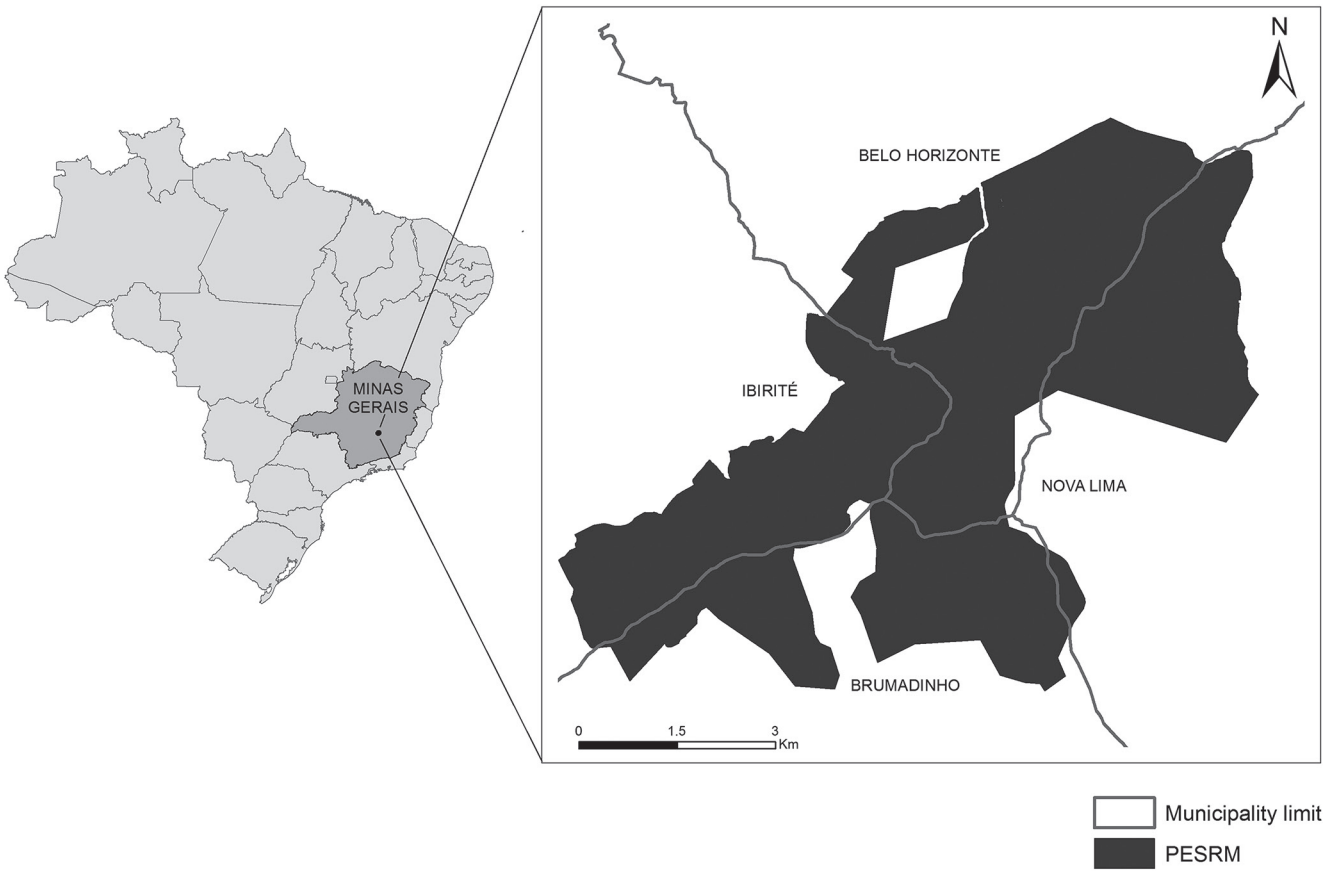

Figure 1. Location of the study site, the 'Serra do Rola-Moça' State Park (PESRM), in Minas Gerais state, Brazil.

Taxonômicas of the Universidade Federal de Minas Gerais (CCT-UFMG).

Specimen identification was accomplished with aid of the taxonomic literature (Brown Jr., 1992; Penz & Devries, 2002; Willmott, 2003; Uehara-Prado *et al.,* 2004; D'Abrera, 2005; Garwood *et al.,* 2009; Santos *et al.,* 2011), as well as of the illustrated list of South American butterflies (Warren *et al.,* 2017). Specimens that could not be identified by the authors were taken for identification in the Laboratory of Studies of Neotropical Lepidoptera, of the Universidade Federal do Paraná (UFPR) (Hesperiidae), and Laboratory of Ecology and Systematics of Butterflies of the Universidade Estadual de Campinas (UNICAMP) (Riodinidae, Satyrinae and Ithomiinae [Nymphalidae]). The classification employed here were those of Lamas (2004); Wahlberg *et al.* (2009); for Hesperiidae, Warren *et al.* (2008, 2009); and for Riodinidae, Seraphim *et al.* (2018).

Data analysis

The Generalized Linear Model (GLM) was used to compare the species richness of the dry and rainy seasons, with richness being the response and seasons the explanatory variables. GLM was used to compare the species richness (response variable) of the sampling sites (explanatory variable). All GLM were submitted to residual analyses to evaluate adequacy of the error distribution (Crawley, 2013). Non-metric multidimensional scaling (NMDS) analyses employing the Jaccard similarity index were employed to compare the species composition between seasons and between sampling sites. Analyses of similarities (ANOSIM) were performed to test for differences between seasons and sampling sites. All analyses were performed in R software (R Core Team, 2014) using gdata, vegan and RT4Bio packages. Sample coverage of species richness in each of the dry and rainy seasons and in both seasons were verified using the RStudio software (RStudio Team, 2015) with vegan, iNEXT, ggplot2, devtools, gridExtra and grid packages.

RESULTS AND DISCUSSION

Species richness and composition

After a total sampling effort of 504 net hours, 1,638 individuals of 311 species were recorded. The richest family was Hesperiidae with 113 species (36.5%), followed by Nymphalidae with 98 species (31.5%), Riodinidae with 31 (10%), Lycaenidae with 29 (9.5%), Pieridae with 24 (7.5%) and Papilionidae with 16 species (5%) (Table 1).

The number of species of Pieridae and Papilionidae may have been underestimated, because observed individuals were hard to catch with entomological nets. Moreover, the sampling period (between 09:00 and16:30) may have also influenced the number of species recorded for some taxa, as Brassolini (Nymphalidae) and Hesperiidae, which include some typically crepuscular species (Mielke & Casagrande, 1997) that were rarely sampled.

In the rainy season (October to March), 230 species were recorded, of which, 102 were sampled only in that season. In the dry season (April to September), 209 species were recorded, 81 of them unique to that season. A total of 128 species were sampled in both seasons. Sample coverage of species richness, in each season, reached almost 70% and indicates that more species could have been sampled (Figs. 2, 3). The sampling cov-

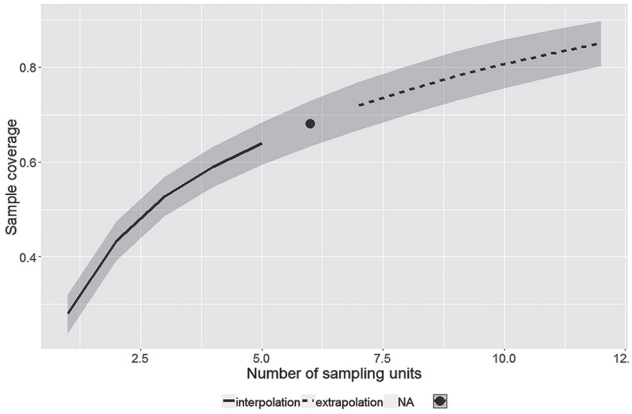

Figure 2. Sample coverage of species richness in rainy season, in the 'Serra do Rola-Moça' State Park, Minas Gerais state, Brazil.

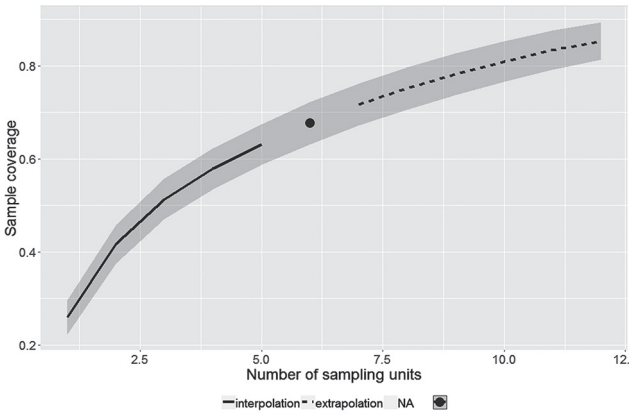

Figure 3. Sample coverage of species richness in dry season, in the 'Serra do Rola-Moça' State Park, Minas Gerais state, Brazil.

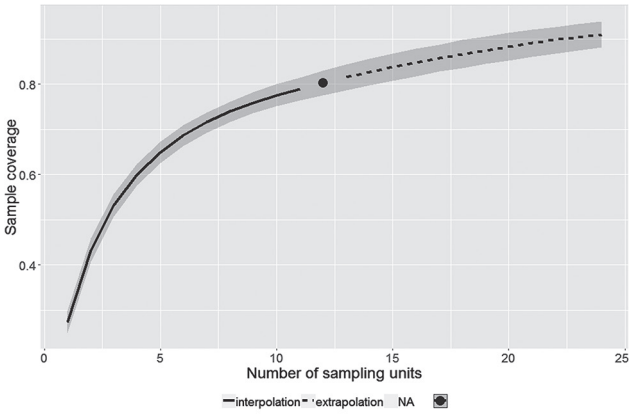

Figure 4. Sample coverage of species richness in rainy and dry seasons, in the 'Serra do Rola-Moça' State Park, Minas Gerais state, Brazil.

Table 1. Species collected in the dry and rainy seasons in environments of Cerrado domain (c), Atlantic Rainforest (f) and transition between Cerrado and Atlantic Rainforest (t). ˟ = new record for the Quadrilátero Ferrífero; * = new record for the state of Minas Gerais; • = endemic species of the Cerrado. Numbers in parenthesis after suprageneric taxa are the numbers of species sampled in each taxon.

Taxa	Sampling environment	Dry season	Rainy season
HESPERIIDAE (113)			
Hesperiinae (50)			
Anthoptus epictetus (Fabricius, 1793)	**t**	X	X
Artines aquilina (Plötz, 1882)	**t**	X	
Callimormus interpunctata (Plötz, 1884)	**t**		X
Callimormus saturnus (Herrich-Schäffer, 1869)	**f, t**	X	X
Chalcone briquenydan chalcone (Schaus, 1902)	**t**		X
Chalcone sp.n	**t**		X
Chalcone zisa (Plötz, 1882)	**t**	X	
Cobalopsis miaba (Schaus, 1902)	**f, t**	X	
Cobalopsis sp.	**t**	X	
Corticea mendica mendica (Mabille, 1898)	**t**		X
Cumbre belli eberti Evans, 1955	**t**	X	
Cumbre sp.n	**t**		X
Cymaenes gisca Evans, 1955	**f, t**	X	X
Cymaenes sp.	**c, t**	X	
Cymaenes sp.n	**t**	X	
Decinea lucifer (Hübner, [1831])	**t**		X
Gallio carasta (Schaus, 1902)	**t**		X
Hylephila phyleus phyleus (Drury, 1773)	**c, t**		X
Justinia kora (Hewitson, 1877)	**t**	X	
Lamponia elegantula (Herrich-Schäffer, 1869)	**f**	X	
Lerema duroca duroca (Plötz, 1882)	**f**		X
Lerema veadeira Mielke, 1968 •	**c**	X	X
Lerodea erythrostictus (Prittwitz, 1868)	**c, t**	X	
Lerodea eufala eufala (W.H. Edwards, 1869)	**c**	X	X
Levina levina (Plötz, 1884)	**c, t**	X	X
Libra anatolica (Plötz, 1883)	**t**		X
Lucida lucia lucia (Capronnier, 1874)	**f, t**	X	X
Lucida sp.	**t**	X	
Lucida sp.n	**t**	X	
Miltomiges cinnamomea (Herrich-Schäffer, 1869)	**f, t**	X	
Nastra dryas (Hayward, 1940)	**f**	X	
Niconiades merenda (Mabille, 1878)	**t**	X	
Panoquina hecebolus (Scudder, 1872)	**t**		X
Panoquina peraea (Hewitson, 1866) *	**t**	X	
Pheraeus argynnis (Plötz, 1884)	**t**		X
Phlebodes sp.n	**t**		X
Polites vibex catilina (Plötz, 1886)	**c, t**	X	
Pompeius dares (Plötz, 1883)	**f**	X	
Pompeius pompeius (Latreille, [1824])	**t**		X
Pompeius postpuncta (Draudt, 1923)	**c**	X	X
Remella remus (Fabricius, 1798)	**t**	X	X
Thespieus homochromus Mielke, 1978	**c**	X	X
Vehilius clavicula (Plötz, 1884)	**t**	X	
Vettius artona (Hewitson, 1868)	**f**	X	
Vettius diversa diversa (Herrich-Schäffer, 1869)	**t**	X	X
Vettius lucretius (Latreille, [1824])	**f**	X	X
Vettius marcus (Fabricius, 1787)	**f, t**	X	X
Vidius nostra nostra Evans, 1955	**c**	X	
Vidius sp. Evans, 1955	**t**	X	
Vinius letis (Plötz, 1883)	**t**	X	X
Pyrginae (63)			
Achlyodes busirus rioja Evans, 1953	**f**	X	
Aguna albistria albistria (Plötz, 1880)	**c**		X
Aguna asander asander (Hewitson, 1867)	**c, f**		X
Anastrus sempiternus simplicior (Möschler, 1877)	**t**		X
Anisochoria superior Mabille, 1898	**f**		X
Antigonus erosus (Hübner, [1812])	**c, f, t**		X
Antigonus liborius areta Evans, 1953	**f, t**	X	X
Astraptes fulgerator fulgerator (Walch, 1775)	**f**	X	
Astraptes naxos (Hewitson, 1867)	**t**		X
Celaenorrhinus similis Hayward, 1933	**t**		X
Chioides catillus catillus (Cramer, 1779)	**t**	X	X
Chiomara asychis autander (Mabille, 1891)	**c, f, t**	X	X
Chiomara basigutta (Plötz, 1884)	**c**		X
Cogia abdul Hayward, 1947	**c**	X	
Cogia calchas (Herrich-Schäffer, 1869)	**c, f, t**	X	X
Cogia cerradicola (Mielke, 1967) •	**c**		X
Cogia grandis Riley, 1921 •	**c**		X
Cogia hassan hassan Butler, 1870	**c**	X	
Cogia punctilia Plötz, 1882	**c**	X	
Cogia sp. Butler, 1870	**c**		X
Cogia sp.n	**c**	X	X
Diaeus lacaena (Hewitson, 1869)	**f**	X	
Elbella luteizona (Mabille, 1877)	**c**		X
Gesta gesta (Herrich-Schäffer, 1863)	**f, t**	X	
Gorgythion begga begga (Prittwitz, 1868)	**c, f, t**	X	X
Heliopetes alana (Reakirt, 1868)	**f, t**	X	
Heliopetes arsalte (Linnaeus, 1758)	**c, t**	X	X
Heliopetes macaira obrigera (Mabille, 1888)	**f, t**	X	X
Heliopetes ochroleuca J. Zikán, 1938	**f**	X	
Heliopetes omrina (Butler, 1870)	**c, t**	X	X
Heliopetes petrus (Hübner, [1819])	**t**	X	X
Heliopyrgus domicella willi (Plötz, 1884)	**c, f**	X	
Milanion leucaspis (Mabille, 1878)	**f, t**	X	X
Morvina fissimacula fissimacula (Mabille, 1878)	**f**		X
Mylon maimon (Fabricius, 1775)	**f**	X	
Nisoniades macarius (Herrich-Schäffer, 1870)	**f**		X
Oechydrus chersis evelinda (Butler, 1870)	**f**	X	
Phocides polybius phanias (Burmeister, 1880)	**c**		X
Polyctor polyctor polyctor (Prittwitz, 1868)	**f, t**		X
Pyrgus orcus (Stoll, 1780)	**c, f, t**	X	X
Pyrgus orcynoides (Giacomelli, 1928)	**c**		X
Pyrrhopyge charybdis charybdis Westwood, 1852	**c, t**		X
Pyrrhopyge charybdis semita Evans, 1951	**c**		X
Pyrrhopyge sp.	**c**		X
Pythonides lancea (Hewitson, 1868)	**f**	X	X
Quadrus cerialis (Stoll, 1782)	**t**		X
Quadrus u-lucida mimus (Mabille and Boullet, 1912)	**f**	X	
Sarbia catomelaena Mabille and Boullet, 1908 •	**c**		X
Sophista latifasciata (Spitz, 1930) •	**c, t**	X	X
Sostrata bifasciata bifasciata (Ménétriés, 1829)	**t**	X	
Sostrata cronion (C. Felder & R. Felder, 1867)	**f**	X	
Theagenes dichrous (Mabille, 1878)	**f**		X
Trina geometrina (C. Felder & R. Felder, 1867)	**f, t**	X	X
Urbanus chalco (Hübner, 1823)	**f**	X	
Urbanus dorantes (Stoll, 1790)	**f, t**	X	X

Taxa	Sampling environment	Dry season	Rainy season
Urbanus esta Evans, 1952	**t**		X
Urbanus pronta Evans, 1952	**f, t**		X
Urbanus teleus (Hübner, 1821)	**t**		X
Urbanus virescens (Mabille, 1877)	**t**		X
Viola sp.	**f**	X	
Viola viollela (Mabille, 1898)	**t**		X
Zopyrion evenor evenor Godman, 1901	**c, t**	X	X
Zopyrion evenor thania Godman, 1901	**t**		X
NYMPHALIDAE (98)			
Apaturinae (1)			
Doxocopa laurentia (Godart, [1824])	**c, f**	X	X
Biblidinae (17)			
Callicore sorana sorana (Godart, [1824])	**c, f, t**	X	X
Cybdelis phaesyla (Hübner, [1831])	**f, t**	X	X
Diaethria clymena (Cramer, 1775)	**f, t**	X	X
Dynamine aerata (Butler, 1877)	**f, t**	X	X
Dynamine agacles agacles (Dalman, 1823)	**t**	X	X
Dynamine postverta postverta (Cramer, 1779)	**f, t**	X	X
Dynamine tithia (Hübner, 1823)	**t**		X
Ectima thecla (Fabricius, 1796)	**f, t**	X	
Epiphile hubneri Hewitson, 1861	**f, t**		X
Epiphile orea orea (Hübner, [1823])	**f**		X
Eunica volumna volumna (Godart, [1824])	**f, t**	X	X
Hamadryas epinome (C. Felder & R. Felder, 1867)	**f, t**	X	X
Hamadryas laodamia (Cramer, 1777)	**f**	X	
Marpesia chiron (Fabricius, 1775)	**f, t**	X	X
Marpesia petreus (Cramer, 1776)	**f**	X	
Myscelia orsis (Drury, 1782)	**f, t**	X	X
Nica flavilla (Godart, [1824])	**f**	X	
Charaxinae (4)			
Archaeoprepona chalciope (Hübner, [1823])	**t**		X
Fountainea ryphea (Cramer, 1775)	**t**	X	
Memphis moruus stheno (Prittwitz, 1865)	**f**		X
Memphis otrere (Hubner, [1825])	**c, f**	X	X
Danainae (20)			
Aeria elara (Hewitson, 1855)	**f, t**	X	X
Aeria olena olena Weymer, 1875	**f, t**	X	X
Danaus gilippus (Cramer, 1775)	**f**	X	
Danaus plexippus (Linnaeus, 1758)	**c, t**	X	X
Dircenna dero (Hübner, 1823)	**f, t**	X	X
Episcada carcinia Schaus, 1902	**t**		X
Episcada hymenaea (Prittwitz, 1865)	**f, t**	X	X
Hypoleria lavinia (Hewitson, [1855]) *	**f**	X	
Hypothyris euclea laphria (Doubleday, 1847)	**f**	X	
Hypothyris ninonia daeta (Boisduval, 1836)	**f, t**	X	X
Ithomia agnosia Hewitson, [1855]	**f, t**	X	X
Lycorea halia (Hübner, 1816)	**f, t**		X
Mcclungia cymo salonina (Hewitson, 1855)	**t**		X
Mechanitis lysimnia lysimnia (Fabricius, 1793)	**f, t**	X	X
Mechanitis polymnia casabranca Haensch, 1905	**f, t**	X	X
Oleria aquata (Weymer, 1875)	**f, t**	X	X
Pseudoscada acilla quadrifasciata Talbot, 1928 •	**t**	X	
Pseudoscada erruca (Hewitson, 1855)	**c, f, t**	X	X
Pteronymia carlia Schaus, 1902	**f**	X	
Thyridia psidii (Linnaeus, 1758)	**f, t**	X	X
Heliconiinae (13)			
Actinote parapheles Jordan, 1913	**f, t**	X	X
Actinote quadra (Schaus, 1902)	**c**		X
Actinote surima surima (Schaus, 1902)	**c**	X	X
Actinote thalia pyrrha (Fabricius, 1775)	**c, f, t**	X	X
Agraulis vanillae (Linnaeus, 1758)	**c, f, t**	X	X
Dione juno juno (Cramer, 1779)	**c**		X
Dryadula phaetusa (Linnaeus, 1758)	**c, t**	X	X
Dryas iulia (Fabricius, 1775)	**f, t**	X	X
Eueides pavana Ménétriés, 1857	**f, t**	X	X
Heliconius besckei Ménétriés, 1857	**c, f, t**	X	X
Heliconius erato phyllis (Fabricius, 1775)	**c, f, t**	X	X
Heliconius ethilla (Godart, 1819)	**f, t**	X	X
Philaethria wernickei (Röber, 1906)	**f**	X	
Limenitidinae (6)			
Adelpha calliphane Fruhstorfer, 1915	**f**		X
Adelpha gavina Fruhstorfer, 1915	**t**		X
Adelpha plesaure Hübner, 1823	**f, t**	X	X
Adelpha serpa serpa (Boisduval, 1836)	**f**		X
Adelpha syma (Godart, [1824])	**c, f, t**	X	X
Adelpha thessalia (C. Felder & R. Felder, 1867)	**t**	X	
Nymphalinae (9)			
Colobura dirce (Linnaeus, 1758)	**f, t**	X	X
Eresia lansdorfi (Godart, 1819)	**c, f, t**	X	X
Junonia evarete (Cramer, 1779)	**c, t**	X	X
Siproeta epaphus (Latreille, [1813])	**f, t**	X	X
Siproeta stelenes meridionalis (Fruhstorfer, 1909)	**f, t**	X	X
Tegosa claudina (Eschscholtz, 1821)	**c, f, t**	X	X
Telenassa teletusa (Godart, [1824])	**f, t**	X	X
Vanessa braziliensis (Moore, 1883)	**c**	X	X
Vanessa myrinna (Doubleday, 1849)	**c, f, t**	X	X
Satyrinae (28)			
Antirrhea archaea (Hübner, [1822])	**f**		X
Biblis hyperia (Cramer, 1779)	**f, t**	X	X
Blepolenis batea (Hübner, [1821])	**t**		X
Caligo illioneus (Cramer, 1775)	**t**	X	
Capronnieria galesus (Godart, [1824])	**f**	X	
Eryphanis reevesii reevesii (Doubleday, [1849])	**t**	X	
Godartiana muscosa (Butler, 1870)	**f, t**	X	X
Hermeuptychia atalanta (Butler, 1867)	**f**	X	
Hermeuptychia gisella (Hayward, 1957)	**f**	X	
Hermeuptychia sp.	**f**	X	
Moneuptychia itapeva Freitas, 2007	**c, t**	X	X
Moneuptychia paeon (Godart, [1824])	**t**		X
Moneuptychia soter (Butler, 1877)	**t**	X	X
Moneuptychia sp.n	**f**	X	
Morpho anaxibia (Esper, [1801])	**c**		X
Morpho helenor (Cramer, 1776)	**f, t**	X	X
Morpho menelaus (Linnaeus, 1758)	**f, t**	X	X
Paryphthimoides grimon (Godart, [1824])	**t**		X
Paryphthimoides eous (Butler, 1867)	**t**	X	
Paryphthimoides poltys (Prittwitz, 1865)	**f, t**	X	
Pharneuptychia innocentia (C. Felder & R. Felder, 1867)	**c, t**	X	X
Pharneuptychia sp.	**c, t**	X	X
Yphthimoides affinis (Butler, 1867)	**f**	X	
Yphthimoides angularis (Butler, 1867)	**t**	X	X
Yphthimoides manasses (C. Felder & R. Felder, 1867)	**c**		X
Yphthimoides pacta (Weymer, 1911)	**c**		X
Yphthimoides saltuensis (Hayward, 1962)	**c, f, t**	X	X

Taxa	Sampling environment	Dry season	Rainy season
Yphthimoides straminea (Butler, 1867) •	**f**		X
RIODINIDAE (31)			
Riodininae (31)			
Baeotis johannae cearaica Seitz, 1916	**t**	X	X
Baeotis melanis Hübner, [1831])	**t**	X	
Barbicornis basilis melanops Butler, 1873	**f**		X
Calephelis sp.	**c, f, t**	X	X
Caria plutargus (Fabricius, 1793)	**t**		X
Chalodeta theodora (C. Felder & R. Felder, 1862)	**t**		X
Charis cadytis Hewitson, 1866	**f, t**	X	X
Chorinea licursis (Fabricius, 1775)	**c**		X
Dachetola azora (Godart, [1824])	**t**	X	
Emesis diogenia Prittwitz, 1865	**t**	X	X
Emesis ocypore (Geyer, 1837)	**t**		X
Emesis russula Stichel, 1910	**t**		X
Emesis sp.	**t**	X	
Eurybia elvina elvina Stichel, 1910	**f**	X	X
Eurybia misellivestis Stichel, 1910	**f**	X	
Eurybia pergaea (Geyer, 1832)	**f**	X	
Lasaia agesilas (Latreille, [1809])	**t**		X
Lemonias stalachtioides (Butler, 1867)	**c**	X	X
Leucochimona icare matatha (Hewitson, 1873)	**t**		X
Melanis xenia xenia (Hewitson, [1853])	**f**	X	X
Mesene sp.	**f**	X	
Mesosemia odice (Godart, [1824])	**t**	X	X
Metacharis ptolomaeus (Fabricius, 1793)	**t**		X
Notheme erota agathon (C. Felder & R. Felder, 1865)	**t**		X
Panara soana bacana Callaghan, 1997	**t**		X
Pirascca sagaris (Cramer, 1775)	**t**	X	X
Riodina lycisca (Hewitson, [1853])	**t**		X
Stalachtis phlegia susanna (Fabricius, 1787)	**t**		X
Stichelia bocchoris (Hewitson, 1876)	**t**	X	
Synargis calyce (C. Felder & R. Felder, 1862)	**t**	X	X
Synargis paulistina (Stichel, 1910)	**t**		X
LYCAENIDAE (29)			
Polyommatinae (3)			
Hemiargus hanno (Stoll, 1790)	**c, f, t**	X	X
Leptotes cassius (Cramer, 1775)	**c, f, t**	X	X
Zizula cyna (W.H. Edwards, 1881)	**t**		X
Theclinae (26)			
Allosmaitia strophius (Godart, [1824])	**c, t**	X	X
Arawacus ellida (Hewitson, 1867)	**c**		X
Arawacus meliboeus (Fabricius, 1793)	**f, t**	X	X
Arawacus tarania (Hewitson, 1868)	**c, t**	X	X
Aubergina vanessoides (Prittwitz, 1865)	**c**		X
Brangas getus (Fabricius, 1787)	**t**	X	
Brangas torfrida (Hewitson, 1867)	**c**		X
Calycopis sp.1	**c, f, t**	X	X
Calycopis sp.2	**f, t**		X
Cyanophrys sp.	**f, t**	X	
Erora opisena (H.H. Druce, 1912)	**c**		X
Ministrymon cruenta (Gosse, 1880)	**f, t**		X
Nicolaea cauter (H.H. Druce, 1907)	**c**	X	
Nicolaea schausa (Jones, 1912)	**c**	X	X
Nicolaea sp.	**t**		X
Ocaria ocrisia (Hewitson, 1868)	**c, t**		X
Parrhasius polibetes (Stoll, 1781)	**c**		X
Rekoa marius (Lucas, 1857)	**c**		X
Rekoa palegon (Cramer, 1780)	**t**	X	
Strymon azuba (Hewitson, 1874)	**c**	X	
Strymon bazochii (Godart, [1824])	**c**		X
Strymon bubastus (Stoll, 1780)	**c**	X	X
Strymon lucena (Hewitson, 1868)	**c**	X	
Strymon mulucha (Hewitson, 1867)	**t**		X
Strymon sp.	**c, t**		X
Thereus cithonius (Godart, [1824])	**t**		X
PIERIDAE (24)			
Coliadinae (15)			
Anteos menippe (Hübner, [1818])	**t**		X
Aphrissa statira (Cramer, 1777)	**c, t**		X
Eurema albula (Cramer, 1775) (undentified subespecies)	**c, f, t**	X	X
Eurema albula sinoe (Godart, 1819)	**c, f, t**	X	X
Eurema arbela Geyer, 1832	**f**		X
Eurema elathea flavescens (Chavannes, 1850)	**c, f, t**	X	X
Eurema phiale paula (Röber, 1909)	**c, f, t**	X	X
Leucidia brephos (Hübner, [1809])	**t**	X	X
Leucidia elvina (Godart, 1819)	**c, f, t**	X	X
Phoebis argante (Fabricius, 1775)	**f**		X
Phoebis neocypris (Hübner, [1823])	**t**		X
Phoebis sennae sennae (Linnaeus, 1758)	**c, f, t**	X	X
Pyrisitia leuce (Boisduval, 1836)	**c, f, t**	X	X
Pyrisitia nise tenella (Boisduval, 1836)	**c, f, t**	X	X
Rhabdodryas trite banksi (Breyer, 1939)	**t**		X
Dismorphiinae (3)			
Dismorphia amphione astynome (Dalman, 1823)	**t**		X
Dismorphia thermesia thermesia (Godart, 1819)	**c, f, t**	X	X
Pseudopieris nehemia nehemia (Boisduval, 1836)	**f, t**	X	X
Pierinae (6)			
Archonias bassolis tereas (Godart, 1819)	**f, t**	X	
Glutophrissa drusilla drusilla (Cramer, 1777)	**t**		X
Hesperocharis anguitia anguitia (Godart, 1819)	**c, f, t**	X	X
Hesperocharis leucania (Boisduval, 1836)	**t**		X
Melete lycimnia flippantha (Fabricius, 1793)	**c, t**	X	X
Pereute antodyca (Boisduval, 1836)	**f**		X
PAPILIONIDAE (16)			
Papilioninae (16)			
Battus polydamas (Linnaeus, 1758)	**c, t**	X	X
Eurytides dolicaon (Cramer, 1775)	**t**		X
Heraclides anchisiades capys (Hübner, [1809])	**c, t**		X
Heraclides astyalus (Godart, 1819)	**f**	X	
Heraclides hectorides (Esper, 1794)	**f, t**	X	X
Heraclides thoas brasiliensis (Rothschild & Jordan, 1906)	**c, f, t**	X	X
Heraclides torquatus polybius (Swainson, 1823)	**f, t**	X	X
Mimoides lysithous lysithous (Hübner, 1821)	**t**		X
Parides agavus (Drury, 1782)	**f, t**	X	X
Parides anchises nephalion (Godart, 1819)	**f, t**	X	X
Parides bunichus diodorus (Hopffer, 1865) •	**c, f, t**	X	X
Parides neophilus eurybates (G. Gray, [1853])	**f, t**	X	X
Parides proneus (Hübner, [1831])	**f, t**	X	X
Parides sesostris (Cramer, 1779)	**f**	X	
Protesilaus helios (Rothschild & Jordan, 1906)	**c, f, t**	X	X
Pterourus scamander scamander (Boisduval, 1836)	**f**	X	

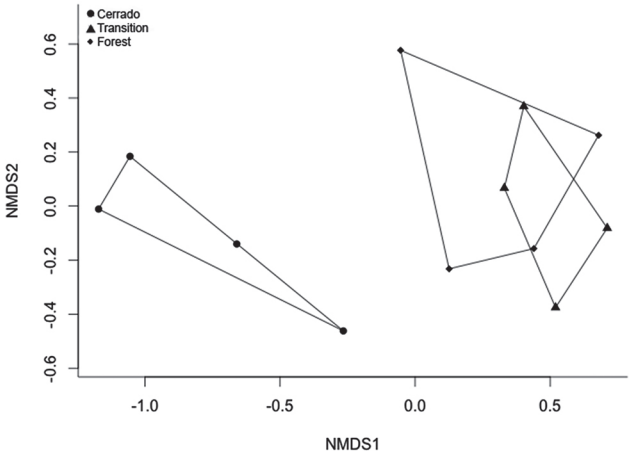

Figure 5. Non-metric multidimensional scaling (NMDS) of the butterfly species composition in sampling sites of Cerrado domain, Atlantic Rainforest and Forest-Cerrado transition areas, in the 'Serra do Rola-Moça' State Park, Minas Gerais state, Brazil.

erage of both seasons reached 80% (Fig. 4), but demonstrates that with more one year of sampling the coverage of species richness would tend to the estimated number. This suggests that the actual overlap between the faunas of the two seasons may be greater than the observed.

The species richness and composition of the butterfly assemblage did not vary significantly between the dry and the rainy seasons (GLM = Gaussian distribution, p = 0.79 and ANOSIM, p = 0.49). This result could be different maximizing the sample effort, either using bait trap for fruit-feeding species, and/or increasing the years of sampling. Pereira *et al.* (2017), for instance, collected for two years and found statistical differences in fruit-feeding butterfly composition between dry and rainy seasons. On the other hand, significant differences were found when the composition of butterfly assemblages was compared among sampling sites, (ANOSIM, p = 0.005; Fig. 5), but not among their species richness (GLM = Gaussian distribution, p = 0.065).

Among the 311 recorded species, eight are probably new, of which seven belong each to one of the following genera: *Chalcone, Cogia, Cumbre, Cymaenes, Lucida, Moneuptychia, Phlebodes*. A probably new species of Hesperiinae, however, could not be identified even to genus level. This specimen was collected in the Ibirité municipality, in riparian forest, at the rainy season.

Environmental variation

The NMDS indicates that grassland and forest environments in the PESRM have distinct faunas. Most species restricted to the Cerrado domain (Brown Jr. & Mielke, 1967b; Mielke *et al.,* 2008, 2012) in our sample belong to Pyrginae (Hesperiidae) and Theclinae (Lycaenidae), especially to the genera *Cogia* and *Strymon,* respectively. According to the list presented by Mielke *et al.* (2012), the species of Pyrginae also sampled in this study *Chiomara basigutta* (Plötz, 1884), *Cogia calchas* (Herrich-Schäffer, 1869), *Heliopetes omrina* (Butler, 1870) and *Viola viollela* (Mabille, 1898) have preference for natural grassland habitats. Moreover, Hesperiinae (Hesperiidae) and Satyrinae (Nymphalidae) are more abundant in grassland habitats (Casagrande *et al.,* 2012), probably because larvae of Hesperiinae feed exclusively on monocots (Carneiro *et al.,* 2014), and those of Satyrinae almost exclusively on monocots (Peña & Wahlberg, 2008), which are poorly represented in the forest environment. Despite the fact that those feeding habits justify their abundance in the Cerrado vegetation, in the PESRM, almost 50% of the species of Hesperiinae and 30% of the Satyrinae were found only in the transition areas.

More attention has been given to the butteflies of the Atlantic Rainforest than to those of the Cerrado (Brown Jr. & Freitas, 2000; Uehara-Prado *et al.,* 2007; Carneiro *et al.,* 2008). However, as emphasized by Dolibaina *et al.* (2011) and Carneiro *et al.* (2014), the characteristic species of natural grasslands must also be considered conservation priorities since this vegetation type is either under threat.

New record, endemic and threatened species

Among the species sampled in the PESRM, *Hypoleria lavinia* (Hewitson, [1855]) was known, until now, only from the Parque Estadual do Rio Doce (Silva *et al.,* 2010) and from Viçosa (Cruz *et al.,* 2012), both in the core of the Atlantic Rainforest, in the state of Minas Gerais. This is, therefore, a new record for the Quadrilátero Ferrífero. *Panoquina peraea* (Hewitson, 1866), previously known to occurs only in the states of Rio de Janeiro (Mielke & Casagrande, 2002) and Bahia (Lima & Zacca, 2014), is a new record for Minas Gerais.

Actinote quadra (Schaus, 1902) (Nymphalidae), classified as vulnerable in the Red Book of Brazilian Threatened Fauna (Machado *et al.,* 2008), was sampled in the rock field at an altitude of about 1,475 m (20°03'29"S, 44°00'06"W; municipality of Brumadinho, Minas Gerais). This new record for the species and other three records are best detailed in Gomes *et al.* (2014). This species occurs in isolated populations in mountain regions in the states of Minas Gerais, São Paulo and Rio de Janeiro, especially in the Serra da Mantiqueira, usually in wet forests above 1,000 m (Freitas *et al.,* 2009; Freitas & Marini-Filho, 2011). Main threats to *Actinote quadra* are habitat degradation and destruction (Freitas & Marini-Filho, 2011) and this reinforces the importance of the PESRM for the preservation of the species, as well as for all species of this genus inhabiting the park, since they are all endemic of mountainous environments and frequently rare (Gomes *et al.,* 2014).

Eight species endemic or potentially endemic of the Cerrado domain, according to Mielke *et al.* (2008) and Pinheiro *et al.* (2010), were also found in the PESRM: *Yphthimoides straminea* (Butler, 1867), *Cogia grandis* Riley, 1921, *Cogia cerradicola* (Mielke, 1967), *Lerema veadeira* Mielke, 1968, *Parides bunichus diodorus* (Hopffer, 1865), *Pseudoscada acilla quadrifasciata* Talbot, 1928, *Sarbia catomelaena* Mabille & Boullet, 1908 and *Sophista latifas-*

ciata (Spitz, 1930). However, some of them were found in the forest and/or transition environments. In fact, Murray & Prowell (2005) pointed out that many species of the genus *Yphthimoides* are endemic of the Brazilian Southeast Region and Freitas *et al.* (2012) indicated that most of them are found both in the Atlantic Rainforest and in the Cerrado domain. This is due to the isolated forests patches in the Cerrado, as well as riparian forests that are found along the rivers in the Cerrado domain (Silva & Bates, 2002; Werneck, 2011). This means that butterflies species in the Cerrado domain can also inhabit forests.

The geological formation of the PESRM is very peculiar, composed by ferruginous field, savanna and forest. This is one of the few parks in Brazil where this rare environment is preserved. This and the fact that those fields are the natural habitat for many species of butterflies make the PESRM an especially important conservation area. The knowledge about the rich fauna of butterflies of Minas Gerais, mainly the new records and possible new species as well as endangered species provides important information for preservation actions and environmental conservation, especially on places with such a peculiar environment.

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