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Long term survey of the butterfly fauna of Curitiba, Paraná, Brazil: How does a scientific collection gather local biodiversity information? (Lepidoptera: Papilionoidea)

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Abstract

Butterfly species lists are commonly published aiming to describe local or regional diversity, thus being primordial tools for subsiding nature preservation and management. However, tropical lands usually lack this kind of information. Inventories of megadiverse organisms, such as butterflies, usually require long term studies to detect a substantial fraction of species present in certain location. Through biological collections in scientific institutions it is possible to preserve a considerable amount of biodiversity information, which is not available in the literature, but can promote studies over time. Aiming at supplementing the knowledge on butterfly diversity in Curitiba, Paraná, Brazil, and to demonstrate how a scientific collection accumulates such information from the nearby surroundings, this study lists all species of butterflies recorded in the city since 1938. Since then, 554 species were recorded. Although there have been large sampling efforts since the 60s, 45 species were only recorded in the last decade. Species lists published in 1938, 1995, 2011 and 2015 contributed to a considerable fraction of species records and monitoring, but species richness observed in each study is usually low (less than 1/3 of all historical records). Therefore, the long term deposition of specimens gathered in a single collection evidences that Curitiba harbors a distinct higher number of species, though new records are still frequent. Taking into account that long term surveys of megadiverse insects offer a more complete analysis of their biological diversity, studies measuring diversity impacts, such as urban sprawl, must include historical data whenever available.

KEY WORDS: Lepidoptera, Papilionoidea, conservation, species richness, urban ecosystems, Atlantic Forest, Brazil.

Muestreo general, a largo plazo, de la fauna de mariposas de Curitiba, Paraná, Brasil: ¿Cómo se recoge la información de biodiversidad de una colección científica local? (Lepidoptera: Papilionoidea)

Resumen

Los listados de mariposas se publican normalmente aspirando a describir la diversidad local o regional, siendo, por tanto, herramientas primordiales para subvencionar la conservación y su gestión. Los inventarios de organismos mega o superdiversos, como las mariposas, requieren habitualmente estudios a largo plazo para detectar una fracción significativa de las especies presentes en una localidad. Sin embargo, las regiones tropicales carecen, generalmente, de esta clase de información. A través de colecciones biológicas en las instituciones científicas es posible mantener una considerable información de biodiversidad, que no se dispone en la literatura, pero puede promover estudios con el tiempo. Teniendo como objetivo complementar los conocimientos sobre la diversidad de mariposa en Curitiba, Paraná, Brasil y demostrar cómo una colección científica acumula tal información de los entornos cercanos desde entonces, este estudio recoge una lista, todas las especies de mariposas registradas en la ciudad desde 1938, desde entonces, se han registrado 554. Aunque ha habido grandes esfuerzos de muestreos desde el los 60, 45 especies sólo

fueron registradas en la última década. Las listas de especies se publicadas en 1938, 1995, 2011 y 2015 han aportando los registros de una fracción considerable de especies, pero la riqueza de especies observadas en cada estudio resulta usualmente baja (menos de 1/3 de todos los archivos históricos). Por lo tanto, el depósito a largo plazo de los especímenes en una sola colección, muestra claramente que Curitiba da refugio a un mayor número de especies, donde los nuevos registros todavía son frecuentes. Teniendo en cuenta que los muestreos a largo plazo de insectos megadiversos ofrecen un análisis más completo de su diversidad biológica, aquellos estudios que midan los impactos sobre la diversidad, como por ejemplo la aglomeración urbana, deben incluir los datos históricos disponibles.

PALABRAS CLAVE: Lepidoptera, Papilionoidea, conservación, riqueza de especies, ecosistema urbano, Bosque Atlántico, Brasil.

Introduction

Butterflies are recognized as the most common invertebrates used as bioindicators, given their sensitive to landscape changes from different types of anthropic disturbances (WOOD & GILLMAN, 1998; KITCHING *et al.*, 2000; BROWN & FREITAS, 2000; SUMMERVILLE & CRIST, 2001; UEHARA-PRADO & RIBEIRO, 2012), besides being easy to sample and to identify (DEVRIES *et al.*, 1997; KITCHING *et al.*, 2000). Therefore, there are several studies listing butterfly species aiming to quantify local or regional diversity (BROWN, 1991; KREMEN *et al.*, 1993; KREMEN, 1994). On the other hand, basic information of butterfly diversity, distribution, and population dynamics are still scarce in tropical region (BROWN & FREITAS, 1999; UEHARA-PRADO *et al.*, 2004; SANTOS *et al.*, 2008).

Thus, considering that butterfly diversity surveys can support several aspects of conservation management (BROWN & FREITAS, 1999; DOLIBAINA *et al.*, 2011), two main sources are of particular interest: published inventories, and biological collections. In this context, biological collections stand out because data can be used to evaluate space and time changes (FATTORINI, 2013), besides holding voucher material as demanded by the scientific method. Brazilian entomological collections are among the most significant from South America, in terms of Neotropical representatives, with a wide number of collections all over the country, products of different projects and expeditions done during several decades. In terms of Lepidoptera, the Museu Nacional and Instituto Oswaldo Cruz (Rio de Janeiro), Museu de Zoologia de São Paulo (São Paulo) and the Departamento de Zoologia, Universidade Federal do Paraná (Paraná), hold the largest collections from the Neotropical fauna (MARINONI, 2010).

The origin of specimens deposited in these collections is of course biased by locations within the Brazilian territory and by sites easily accessible to collectors (MARINONI, 2010). Butterfly species lists in Brazil, for example, are more common closer to the biggest metropolises and research centers (SANTOS *et al.*, 2008). These sites may regard most records from butterfly diversity in Brazil, but still historical studies on how this information accumulates through time are scarce. Curitiba is an example of a city where some butterfly species lists were produced (BIEZANKO, 1938; MIELKE, 1995; BONFANTTI, *et al.*, 2011; PEREIRA *et al.*, 2015), most of them depositing vouchers in a single collection located in the city. However, no study has investigated and compared historical variations in butterfly records gathered in species lists and random collects. This study's main objective was to rank butterfly species, based on records from Brazilian biological collections, and demonstrate, through this study model, how scientific collections accumulate and preserve biodiversity knowledge, especially on the megadiverse groups.

Material and Methods

STUDY AREA

Curitiba (25° 25' 40"S, 49° 16' 23"W), Paraná, Brazil, has 432.7 km² and is at approximately 930 m of altitude. The city is located in a Cfb type region, with a humid mesothermal climate, without a dry season, with cool summers, and winters with frequent frost and occasional snowfall (IPPUC, 2012).

Average annual temperature is of 16.4 C and rainfall of 1600 mm/year. Nowadays, the landscape of Curitiba is predominately urbanized, but the original vegetation was characterized by fragments of mixed ombrophilous forest, isolated by a matrix of grassland. Currently, the city still presents some green areas (HILDEBRAND, 2001), but the matrix is urbanized. Its current vegetation cover is estimated in 129945000 m² (around 5% of its territory), composed of 22 parks, 454 public squares, 55 lakes, and four private reserves (VIEIRA & BIONDI, 2008; IPPUC, 2012; GRISE *et al.*, 2016).

DATA COLLECTION

A data matrix was built from the specimens deposited in the Coleção Entomológica Padre Jesus Santiago Moure, Departamento de Zoologia (DZUP), Universidade Federal do Paraná (UFPR), the private collection of Olaf H. H. Mielke, Curitiba, Paraná, compared to the names listed in previous survey data (BIEZANKO, 1938; MIELKE, 1995; BONFANTTI *et al.*, 2011; PEREIRA *et al.*, 2015). The specimens were identified through comparisons with specimens previously identified in the DZUP collection, through the use of specialized literature, or were identified / confirmed by specialists. Taxonomical nomenclature for Papilionoidea follows LAMAS (2004) and for Hesperioidea follows O. MIELKE (2005). Records of all surveyed species are deposited in the DZUP.

Results and discussion

According to data obtained from surveys done in Curitiba and in the DZUP, there are 554 species recorded in the city, belonging to six families, 25 subfamilies, and 320 genera (Table I). The family with highest species richness was Hesperidae 237 ssp. (42.8%), followed by Nymphalidae 161 ssp. (29%), Lycaenidae 68 ssp. (12.27%), Riodinidae 44 ssp. (7.94%), Pieridae 32 ssp. (5.78%) and Papilionidae 12 spp. (2.17%) (Figure 1).

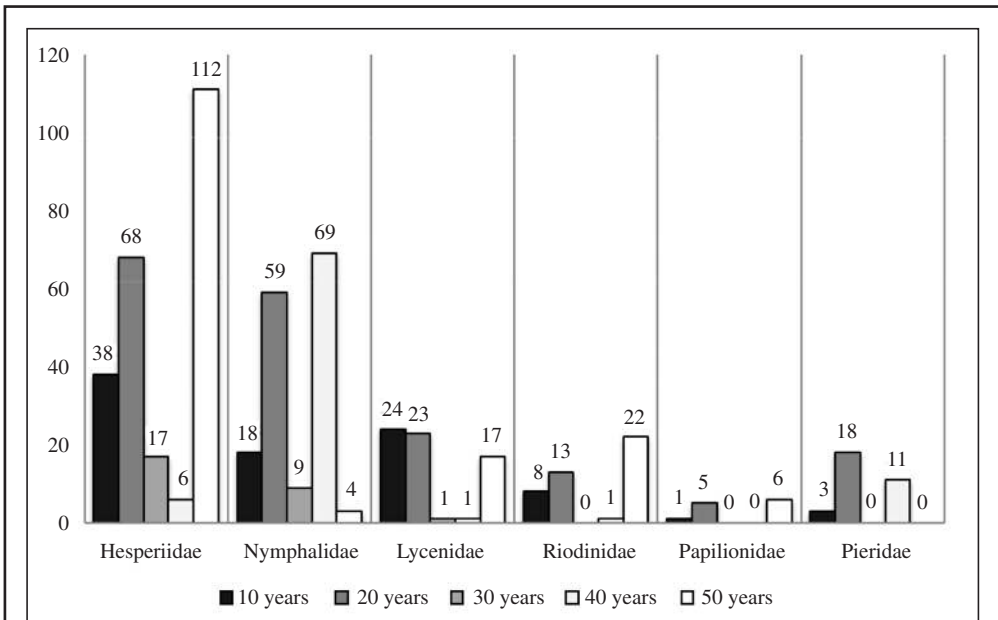
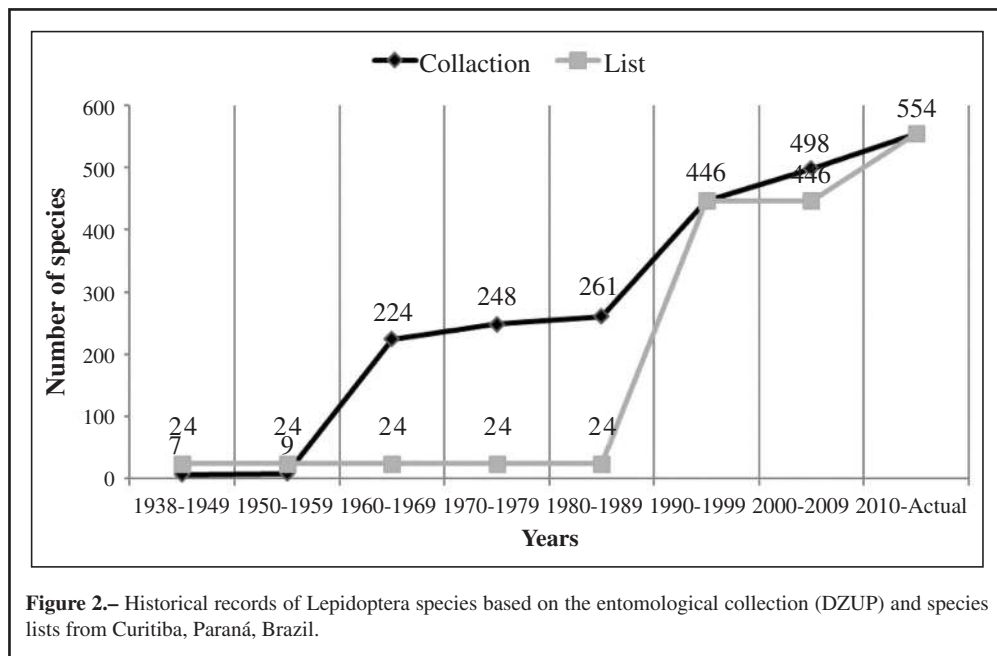


Figure 1.– Number of species records per decade during 50 sampling years in Curitiba, Paraná, Brazil.

BIEZANKO (1938) presented the first list with 24 species of butterflies and, after approximately five decades without updates, MIELKE (1995) published a new list with 498 species, using the same collection to gather butterfly records, but adding additional municipalities on Curitiba surroundings. From those, 446 species were confirmed to occur within Curitiba limits. Since then, recent studies on different urban parks of Curitiba, from 2010 and onward (BONFANTTI *et al.*, 2011; PEREIRA *et al.*, 2015), occasionally added more records (Figure 2).



The number of species represents 17.1 % of the butterfly richness that is estimated to occur in Brazil. It is more than what was recorded in other city surveys in Paraná (e.g. Jaguariaíva, 226 spp., Diamante do Norte, 379 spp., Foz do Iguaçu, 106 spp. (Hesperiidae), Maringá, 106 spp., Balsa Nova, 432 spp and Palmito-Paranaguá, 200 spp. (MIELKE, 1968; ALMEIDA *et al.*, 1986; CASAGRANDE *et al.*, 2012; BELTRAMI *et al.*, 2014; GARCIA-SALIK *et al.*, 2014; LEVISKI *et al.*, 2016). However, studies with similar sampling efforts, and additional data from collections, presented species number closer or superior to the ones recorded for Curitiba (DOLIBAINA *et al.*, 2011; MIELKE *et al.*, 2012). These differences in the number of species are obviously related to sampling effort and number of localities sampled in these municipalities (DOLIBAINA *et al.*, 2011; RITTER *et al.*, 2011; BOGIANI *et al.*, 2012; BELLAVER *et al.*, 2012). Furthermore, we should emphasize that such differences might also be influenced by the presence of a nearby scientific collection. Besides the use of specimens deposited in local collections, the surveys available for Curitiba, Guarapuava and Ponta Grossa count with the active participation of collectors such as Hipólito Schneider and Felipe Justus, who founded the first Lepidoptera collections of the state (DOLIBAINA *et al.*, 2011; MIELKE *et al.*, 2012). As demonstrated by FATTORINI (2013), the sampling effort of amateurs often surpasses those of scientists in biological collections of renowned historical importance, contributing as an important legacy to local collections, biodiversity and science awareness.

The lepidoptero fauna of Curitiba was sampled with different efforts since 1938, as expected

for any museum data. There are several factors that contribute to maximize or minimize specimen deposition during certain periods. The 90s, as an example, was especially important for the publication of species lists for Curitiba and neighbouring cities (MIELKE, 1995), as mentioned before. Until then, there was only BIEZANKO (1938) list (24 spp.) as a published reference. Besides the available information from a long historical period, new records are constantly deposited, reflecting the complexity of sampling high diverse groups, such as butterflies.

From September / 2015 until March / 2016, 45 new records for Curitiba were added: Hesperidae (17), Lycaenidae (13), Nymphalidae (11) and Riodinidae (4) (Table I). Families such as Hesperidae and Nymphalidae are commonly reported as the most representative in Neotropical surveys (BROWN & FREITAS, 2000; SANTOS *et al.*, 2008), although the percentual number of species for each family depends on the sampling effort employed (ISERHARD *et al.*, 2013). In short surveys, with low sampling effort or systematic collectings, Nymphalidae usually exhibits the highest number of recorded species (MARCHIORI & ROMANOWSKI, 2006; DESSUY & MORAIS, 2007; LEMES *et al.*, 2008; PAZ *et al.*, 2008; PEREIRA *et al.*, 2015). Nevertheless, long term record additions are expected to show a disproportional increase in the number of species of Hesperidae (FRANCINI *et al.*, 2011; ISERHARD *et al.*, 2013; THIELE *et al.*, 2014), which is currently corroborated by the high number of recent records for the family, even after four decades of sampling efforts. Thus, the high number of Hesperidae species recorded in a survey can be considered a good indicator of the total butterfly species richness in a region (MIELKE *et al.*, 2008). Similarly, Riodinidae and Lycaenidae species numbers also tend to increase disproportionately to Nymphalidae although their richness is expected to be lower in temperate regions (BROWN & FREITAS, 2000; UEHARA-PRADO *et al.*, 2007; SANTOS *et al.*, 2008; SIEWERT *et al.*, 2014).

One of the great advantages of exploring historical data is the possibility of monitoring the presence/absence of species over time. Some of these species are particularly important to conservation strategies, such as the endangered and endemic *Pampasatyrus glaucope* (C. Felder & R. Felder, 1867). This species has disappeared from the Curitiba records after 47 years (DZ 24.474, DZUP), even though it was relatively common in grassland habitats within the city (pers. obs.). Currently, the urban matrix replaced all grasslands habitats previously present in Curitiba. Additionally, *Cyanophrys bertha* (Jones, 1912) and *Symphachia arion* (C. Felder & R. Felder, 1865) were also included in red lists of threatened fauna but, for different reasons. These species are represented only by sparse records in the national scientific collections. Thus, their disappearance from the collection records might be an artefact of the difficulty of detecting them in nature.

Therefore, the continuous development of butterfly species lists is of extreme relevance to planning conservation strategies in different kind of habitats. In highly degraded areas, such as urban places, the addition of historical records permits current species distribution to be more precisely determined as a factor of anthropogenic disturbance. Thus, conservation practices could also be applied based on local assemblage trends and its habitats preferences (BROWN & FREITAS, 1999, 2000; SUMMERVILLE & CRIST, 2001). We expect that the present species list to influence future ecological and conservation studies in Curitiba, besides contributing to circumscribing the original distribution of the Neotropical Lepidoptera.

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Table I.— Species list of Papilionoidea in Curitiba, Paraná, Brazil. (*) new records in the period from IX-2015 and III-2016. All subspecies names are omitted when typonomial.

HESPERIIDAE	
EUDAMINAE	
<i>Aguna asander</i> (Hewitson, 1867)	<i>Cobalopsis hazarma</i> (Hewitson, 1877)
<i>Aguna megaeles</i> (Mabille, 1888) *	<i>Cobalopsis miaba</i> (Schaus, 1902)
<i>Astrartes alardus</i> (Stoll, 1790)	<i>Cobalopsis nero</i> (Herrich-Schäffer, 1869)
<i>Astrartes aulus</i> (Plötz, 1881)	<i>Cobalopsis vorgia</i> (Schaus, 1902)
<i>Astrartes creteus siges</i> (Mabille, 1903) *	<i>Cobalus virbius hersilia</i> (Plötz, 1882)
<i>Astrartes elorus</i> (Hewitson, 1867)	<i>Conga chydadea</i> (Butler, 1877)
<i>Astrartes enotrus</i> (Stoll, 1781) *	<i>Conga iheringii</i> (Mabille, 1891)
<i>Astrartes erycina</i> (Plötz, 1881)	<i>Conga immaculata</i> (Bell, 1930)
<i>Astrartes fulgurator</i> (Walch, 1775)	<i>Conga urqua</i> (Schaus, 1902)
<i>Astrartes naxos</i> (Hewitson, 1867)	<i>Conga zela</i> (Plötz, 1883)
<i>Astrartes talus</i> (Cramer, 1777)	<i>Copaeodes jean favor</i> Evans, 1955
<i>Autochton integrifascia</i> (Mabille, 1891)	<i>Corticea corticea</i> (Plötz, 1882)
<i>Autochton zarex</i> (Hübner, 1818)	<i>Corticea immocerinus</i> (Hayward, 1934)
<i>Chiodides catillus</i> (Cramer, 1779)	<i>Corticea lysias potex</i> Evans, 1955
<i>Epargyreus socus pseudexadeus</i> Westwood, 1852	<i>Corticea noctis</i> (Plötz, 1882)
<i>Oechydrys chersis evelinda</i> (Butler, 1870)	<i>Corticea obliuina</i> (Mabille, 1891)
<i>Phanus australis</i> L. Miller, 1965	<i>Corticea obscura</i> Mielke, 1969
<i>Phocides charon</i> (Felder & Felder, 1867)	<i>Corticea</i> sp.
<i>Phocides pialia</i> (Hewitson, 1857)	<i>Cumbre cumbre</i> (Schaus, 1902)
<i>Phocides polybius phanias</i> (Burmeister, 1880)	<i>Cumbre</i> sp.
<i>Polygonus leo pallida</i> Röber, 1925	<i>Cyclosma altama</i> (Schaus, 1902)
<i>Polygonus savigny</i> (Latreille, [1824])	<i>Cymaenes campestris</i> Mielke, 1980
<i>Polythrix octomaculata</i> (Sepp, [1844])	<i>Cymaenes distigma</i> (Plötz, 1882)
<i>Proteides mercurius</i> (Fabricius, 1787)	<i>Cymaenes gisca</i> Evans, 1955
<i>Telemiades vespasius</i> (Fabricius, 1793)	<i>Cymaenes lepta</i> (Hayward, 1939)
<i>Typhedanus stylites</i> (Herrich-Schäffer, 1869)	<i>Cymaenes odilia</i> (Burmeister, 1878)
<i>Urbanus albimargo rica</i> Evans, 1952	<i>Cymaenes perlodes</i> (Plötz, 1882)
<i>Urbanus dorantes</i> (Stoll, 1790)	<i>Cymaenes tripunctata</i> (Latreille, [1824])
<i>Urbanus esma</i> Evans, 1952 *	<i>Cynea melius</i> (Geyer, 1832)
<i>Urbanus esta</i> Evans, 1952	<i>Cynea trimaculata</i> (Herrich-Schäffer, 1869)
<i>Urbanus procne</i> (Plötz, 1880)	<i>Decinea lucifer</i> (Hübner, [1831])
<i>Urbanus proteus</i> (Linnaeus, 1758)	<i>Euphyes cherra</i> Evans, 1955
<i>Urbanus simplicius</i> (Stoll, 1790) *	<i>Euphyes fumata</i> Mielke, 1972
<i>Urbanus teleus</i> Hübner, 1821	<i>Euphyes leptosema</i> (Mabille, 1891)
<i>Urbanus zagorus</i> (Plötz, 1880)	<i>Euphyes subferrugineus biezankoi</i> Mielke, 1972
	<i>Eutychide physcella</i> (Hewitson, 1866)
	<i>Gallio carasta</i> (Schaus, 1902) *
	<i>Ginungagapus ranesus</i> (Schaus, 1902)
HESPERIINAE	<i>Ginungagapus schmithi</i> (Bell, 1930)
<i>Alera furcata</i> Mabille, 1891	<i>Hansa devergens hydra</i> Evans, 1955
<i>Anatrytone perfida</i> (Möschler, 1879)	<i>Hylephila phyleus</i> (Drury, 1773)
<i>Ancyloxypha nitedula</i> (Burmeister, 1878)	<i>Igapophilus rufus</i> Mielke, 1980
<i>Anthoptus epictetus</i> (Fabricius, 1793)	<i>Justinia kora</i> (Hewitson, 1877)
<i>Arita arita</i> (Schaus, 1902) *	<i>Lamponia lamponia</i> (Hewitson, 1876)
<i>Arita polistion</i> (Schaus, 1902)	<i>Lerema duroca lenta</i> Evans, 1955
<i>Arotis derasa brunnea</i> (Mielke, 1972)	<i>Lerodea eufala</i> (Edwards, 1869)
<i>Artines satyr</i> Evans, 1955	<i>Libra aligula decia</i> (Hayward, 1948)
<i>Caligulana caligula</i> (Schaus, 1902)	<i>Lucida lucia</i> (Capronnier, 1874)
<i>Callimormus interpunctata</i> (Plötz, 1884)	<i>Lycas argentea</i> (Hewitson, 1866)
<i>Callimormus rivera</i> (Plötz, 1882)	<i>Lycas godart</i> (Latreille, [1824])
<i>Calpodus ethlius</i> (Stoll, 1782)	<i>Lychnuchoides ozias</i> (Hewitson, 1878)
<i>Cantha ivea</i> Evans, 1955	<i>Lychnuchus celsus</i> (Fabricius, 1793)

<i>Metron oropa</i> (Hewitson, 1877)	<i>Thracides cleantes</i> (Latreille, [1824])
<i>Miltomiges cinnamomea</i> (Herrich-Schäffer, 1869)	<i>Vehilius celeus vetus</i> Mielke, 1969
<i>Mnasilus allubita</i> (Butler, 1870) *	<i>Vehilius clavicula</i> (Plötz, 1884)
<i>Mnasitheus nella</i> Evans, 1955 *	<i>Vehilius inca</i> (Scudder, 1872)
<i>Mnasitheus ritans</i> (Schaus, 1902)	<i>Vettius artona</i> (Hewitson, 1868)
<i>Moeris seth</i> Carneiro, Mielke & Casagrande, 2015	<i>Vettius diana</i> (Plötz, 1886)
<i>Molla molla</i> Evans, 1955	<i>Vettius diversa</i> (Herrich-Schäffer, 1869)
<i>Monca branca</i> Evans, 1955	<i>Vettius marcus</i> (Fabricius, 1787)
<i>Mucia zygia</i> (Plötz, 1886)	<i>Vidius fido</i> Evans, 1955
<i>Nastra chao</i> (Mabille, 1898) *	<i>Vidius mictra</i> Evans, 1955
<i>Nastra lurida</i> (Herrich-Schäffer, 1869)	<i>Vidius nappa</i> Evans, 1955
<i>Neoxeniades scipio</i> (Fabricius, 1793)	<i>Vidius similis</i> Mielke, 1980
<i>Niconiades caeso</i> (Mabille, 1891) *	<i>Vidius vidius</i> (Mabille, 1891)
<i>Niconiades merenda</i> (Mabille, 1878)	<i>Vinius letis</i> (Plötz, 1883)
<i>Nyctelius nyctelius</i> (Latreille, [1824])	<i>Vinius pulcherrimus</i> Hayward, 1934
<i>Orses itea</i> (Swainson, 1821)	<i>Virga austrinus</i> (Hayward, 1934)
<i>Orthos orthos hyalinus</i> (Bell, 1930)	<i>Virga hygrophila</i> Mielke, 1969
<i>Panoquina fusina viola</i> Evans, 1955	<i>Virga riparia</i> Mielke, 1969
<i>Panoquina hecebolus</i> (Scudder, 1872)	<i>Wallengrenia premnas</i> (Wallengren, 1860)
<i>Panoquina lucas</i> (Fabricius, 1793)	<i>Xeniades chalestra corna</i> Evans, 1955
<i>Panoquina ocola</i> (Edwards, 1863)	<i>Xeniades orchamus</i> (Cramer, 1777) *
<i>Papias phainis</i> Godman, 1900	<i>Zariaspes mys</i> (Hübner, [1808])
<i>Parphorus pseudodecorus</i> (Hayward, 1934)	<i>Zenis jebus jebus</i> (Plötz, 1882)
<i>Perichares philetes aurina</i> Evans, 1955	
<i>Perichares seneca</i> (Latreille, [1824])	HETEROPTERINAE
<i>Phemiades pohli</i> (Bell, 1932)	<i>Dardarina aspila</i> Mielke, 1966
<i>Pheraeus perpulcher</i> (Hayward, 1934)	<i>Dardarina castra</i> Evans, 1955
<i>Polites</i> sp.	<i>Dardarina rana</i> Evans, 1955
<i>Polites vibex catilina</i> (Plötz, 1886)	
<i>Pompeius amblyspila</i> (Mabille, 1898)	PYRGINAE
<i>Pompeius pompeius</i> (Latreille, [1824])	<i>Achlyodes busirus rioja</i> Evans, 1953
<i>Psoralis stacara</i> (Schaus, 1902)	<i>Achlyodes mithridates thraso</i> (Hübner, [1807])
<i>Pyrrhopygopsis socrates</i> (Ménétriér, 1855)	<i>Aethilla echina coracina</i> Butler, 1870
<i>Quinta cannae</i> (Herrich-Schäffer, 1869)	<i>Anastrus sempiternus simplicior</i> (Möschler, 1877)
<i>Remella remus</i> (Fabricius, 1798)	<i>Anastrus ulpianus</i> (Poey, 1832) *
<i>Saliana longirostris</i> (Sepp, [1840])	<i>Anisochoria subpicta</i> Schaus, 1902
<i>Saliana saladin catha</i> Evans, 1955	<i>Bolla catharina</i> (Bell, 1937) *
<i>Saliana triangularis</i> (Kaye, 1914)	<i>Carrhenes canescens pallida</i> Röber, 1925
<i>Saturnus reticulata conspicuus</i> (Bell, 1941)	<i>Celaenorrhinus eligius punctiger</i> (Burmeister, 1878)
<i>Saturnus reticulata meton</i> (Mabille, 1891)	<i>Celaenorrhinus</i> sp.
<i>Sodalia argyrospila</i> (Mabille, 1876)	<i>Chiomara asychis autander</i> (Mabille, 1891)
<i>Sodalia coler</i> (Schaus, 1902)	<i>Chiomara mithrax</i> (Möschler, 1879)
<i>Sucova sucova</i> (Schaus, 1902)	<i>Diaeus lacaena</i> (Hewitson, 1869)
<i>Synale hylaspes</i> (Stoll, 1781)	<i>Ebrietas anacreon</i> (Staudinger, 1876)
<i>Talides sergestus</i> (Cramer, 1775)	<i>Ebrietas infanda</i> (Butler, 1876) *
<i>Thargella evansi</i> Biezanko & Mielke, 1973 *	<i>Erynnis funeralis</i> (Scudder & Burgess, 1870)
<i>Thespheus aspernatus</i> Draudt, 1923	<i>Gindanes brebisson</i> (Latreille, [1824])
<i>Thespheus catochra</i> (Plötz, 1882)	<i>Gorgythion begga</i> (Prittwitz, 1868)
<i>Thespheus dalman</i> (Latreille, [1824])	<i>Gorgythion</i> sp. *
<i>Thespheus ethemides</i> (Burmeister, 1878)	<i>Helias phalaenoides palpalis</i> (Latreille, [1824])
<i>Thespheus jora</i> Evans, 1955	<i>Heliopetes alana</i> (Reakirt, 1868)
<i>Thespheus lutetia</i> (Hewitson, 1866)	<i>Heliopetes leucola</i> (Hewitson, 1868)
<i>Thespheus vividus</i> (Mabille, 1891)	<i>Heliopetes ochroleuca</i> Zikán, 1938
<i>Thespheus xarina</i> Hayward, 1948	<i>Heliopetes omrina</i> (Butler, 1870)
<i>Thoon circellata</i> (Plötz, 1882)	<i>Heliopetes purgia</i> Schaus, 1902

<i>Milanion leucaspis</i> (Mabille, 1878)	<i>Chlorostrymon simaethis</i> (Drury, 1773)
<i>Mylon maimon</i> (Fabricius, 1775)	<i>Contrafacia catharina</i> (Draudt, 1920)
<i>Nisoniades bipuncta</i> (Schaus, 1902)	<i>Contrafacia imma</i> (Prittwitz, 1865)
<i>Nisoniades brazia</i> Evans, 1953	<i>Contrafacia muattina</i> (Schaus, 1902)
<i>Noctuana diurna</i> (Butler, 1870) *	<i>Cyanophrys acaste</i> (Prittwitz, 1865)
<i>Pellicia vecina</i> Schaus, 1902	<i>Cyanophrys amyntor</i> (Cramer, 1775) *
<i>Polycitor polycitor</i> (Prittwitz, 1868)	<i>Cyanophrys bertha</i> (Jones, 1912)
<i>Pyrgus orcus</i> (Stoll, 1780)	<i>Cyanophrys herodotus</i> (Fabricius, 1793)
<i>Pyrgus orcynoides</i> (Giacomelli, 1928)	<i>Cyanophrys remus</i> (Hewitson, 1868)
<i>Pythionides lancea</i> (Hewitson, 1868)	<i>Dicya dicaea</i> (Hewitson, 1874) *
<i>Quadrus u-lucida mimus</i> (Mabille & Boulet, 1917)	<i>Electrostrymon endymion</i> (Fabricius, 1775)
<i>Sostrata bifasciata</i> (Ménétriés, 1829)	<i>Erora</i> sp. 1
<i>Staphylus coecatus</i> (Mabille, 1891)	<i>Erora</i> sp. 2
<i>Theagenes dichrous</i> (Mabille, 1878)	<i>Kolana ergina</i> (Hewitson, 1867) *
<i>Timochares trifasciata</i> (Hewitson, 1868)	<i>Kolana ligurina</i> (Hewitson, 1874) *
<i>Viola minor</i> (Hayward, 1933)	<i>Laothus phydela</i> (Hewitson, 1867)
<i>Xenophanes tryxus</i> (Stoll, 1780)	<i>Magnastigma hirsuta</i> (Prittwitz, 1865)
<i>Zera hyacinthinus servius</i> (Plötz, 1884)	<i>Michaelus jebus</i> (Godart, 1822)
<i>Zera tetrastigma erisichthon</i> (Plötz, 1884)	<i>Michaelus thordesa</i> (Hewitson, 1867)
PYRRHOPYGINAE	<i>Ministrymon azia</i> (Hewitson, 1873)
<i>Elbella adonis</i> (E. Bell, 1931)	<i>Mithras catrea</i> (Hewitson, 1874)
<i>Elbella hegesippe</i> (Mabille & Boulet, 1908)	<i>Nesiostrymon calchinia</i> (Hewitson, 1868)
<i>Elbella mariae</i> (Bell, 1931)	<i>Nicolaea cupa</i> (Druce, 1907) *
<i>Granila paseas</i> (Hewitson, 1857)	<i>Nicolaea torris</i> (Druce, 1907)
<i>Olafia roscius</i> (Hopffer, 1874)	<i>Nicolaea xorema</i> (Schaus, 1902)
<i>Pseudocroniades machaon</i> (Westwood, 1852)	<i>Ocaria ocrisia</i> (Hewitson, 1868) *
<i>Pyrrhopyge charybdis</i> Westwood, 1852	<i>Ocaria thales</i> (Fabricius, 1793) *
<i>Sarbia antias</i> (Felder & Felder, 1859)	<i>Olyntus fanci</i> (Jones, 1912)
<i>Sarbia curitiba</i> Mielke & Casagrande, 2002	<i>Ostrinotes sophocles</i> (Fabricius, 1793) *
<i>Sarbia damippe</i> Mabille & Boulet, 1908	<i>Panthiades hebraeus</i> (Hewitson, 1867)
<i>Sarbia pertyi</i> (Plötz, 1879)	<i>Parrhasius orgia</i> (Hewitson, 1867)
<i>Sarbia xanthippe spixii</i> (Plötz, 1879)	<i>Parrhasius polibetes</i> (Stoll, 1781)
LYCAENIDAE	<i>Parrhasius selika</i> (Hewitson, 1874)
POLYOMMATINAE	<i>Rekoa malina</i> (Hewitson, 1867)
<i>Hemiargus hanno</i> (Stoll, 1790)	<i>Strephonota elika</i> (Hewitson, 1867)
<i>Leptotes cassius</i> (Cramer, 1775)	<i>Strymon bazochii</i> (Godart, [1824])
THECLINAE	<i>Strymon bubastus</i> (Stoll, 1780)
<i>Allosmaitia strophius</i> (Godart, [1824])	<i>Strymon cardus</i> (Hewitson, 1874) *
<i>Arawacus binangula</i> (Schaus, 1902)	<i>Strymon cestri</i> (Reakirt, [1867])
<i>Arawacus ellida</i> (Hewitson, 1867) *	<i>Strymon crambusa</i> (Hewitson, 1874)
<i>Arawacus meliboeus</i> (Fabricius, 1793)	<i>Strymon eurytulus</i> (Hübner, [1819])
<i>Arawacus tadita</i> (Hewitson, 1877)	<i>Strymon megarus</i> (Godart, [1824]) *
<i>Arcas ducalis</i> (Westwood, 1852)	<i>Strymon mulucha</i> (Hewitson, 1867)
<i>Arzecla nubilum</i> (Druce, 1907)	<i>Strymon oreala</i> (Hewitson, 1868)
<i>Arzecla taminella</i> (Schaus, 1902)	<i>Strymon ziba</i> (Hewitson, 1868)
<i>Atlides cosa</i> (Hewitson, 1867)	<i>Thereus ortalus</i> (Godman & Salvin, 1887)
<i>Aubergina vanessoides</i> (Prittwitz, 1865)	<i>Theritas chaluma</i> (Schaus, 1902)
<i>Badecla badaca</i> (Hewitson, 1868)	<i>Theritas deniva</i> (Hewitson, 1874)
<i>Brangas silumena</i> (Hewitson, 1867)	<i>Theritas triquetra</i> (Hewitson, 1865)
<i>Calycopis caulonia</i> (Hewitson, 1877)	<i>Tmolus echion</i> (Draudt, 1920)
<i>Celmia uzza</i> (Hewitson, 1873) *	<i>Ziegleria hesperitis</i> (Butler & Druce, 1872) *
<i>Chalybs chloris</i> (Hewitson, 1877)	
	NYMPHALIDAE
	APATURINAE
	<i>Doxocopa laurentia</i> (Godart, [1824])

Doxocopa kallina (Staudinger, 1886)*Doxocopa zunilda* (Godart, [1824])

BIBLIDINAE

Biblis hyperia nectanabis (Fruhstorfer, 1909)*Callicore pygas eucala* (Fruhstorfer, 1916)*Catonephele numilia penthia* (Hewitson, 1852)*Catonephele sabrina* (Hewitson, 1852)*Cybdelis phaesyla* (Hübner, [1831])*Diaethria candrena* (Godart, [1824])*Diaethria eluina* (Hewitson, [1855])*Diaethria meridionalis* (Bates, 1864)*Dynamine agacles* (Dalman, 1823)*Dynamine athemon athemaena* (Hübner, [1824])*Dynamine myrrhina* (Doubleday, 1849)*Dynamine postverta* (Cramer, 1779)*Dynamine tithia* (Hübner, [1823])*Ectima thecla* (Fabricius, 1796)*Epiphile huebneri* Hewitson, 1861*Epiphile orea* (Hübner, [1823])*Eunica eburnea* Fruhstorfer, 1907*Haematera pyrame* (Hübner, [1849])*Hamadryas amphinome* (Linnaeus, 1767)*Hamadryas epinome* (Felder & Felder, 1867)*Hamadryas februa* (Hübner, [1823])*Hamadryas feronia* (Linnaeus, 1758)*Hamadryas fornax* (Hübner, [1823])*Hamadryas iphthime* (Bates, 1864)*Marpesia chiron marius* (Cramer, 1779)**Marpesia petreus* (Cramer, 1776)*Myscelia orsis* (Drury, 1772)*Temenis laothoe meridionalis* Ebert, 1965

BRASSOLINAE

Blepelenis bassus (Felder & Felder, 1867)*Blepelenis batea* (Hübner, [1821])*Brassolis astyra* Godart, [1824]*Caligo martia* (Godart, [1824])*Catoblepia amphirhoe* (Hübner, [1825])*Dasyophthalma creusa* (Hübner, [1821])**Dynastor napoleon* Doubleday, [1849]*Eryphanis reevesii* (Doubleday, [1849])*Narope cyllene* Felder & Felder 1859*Opoptera fruhstorferi* (Röber, 1896)*Opoptera sulcius* (Staudinger, 1887)*Opsiphanes invirae amplificatus* Stichel, 1904*Penetes pamphanis* Doubleday, [1849]

CHARAXINAE

Archaeoprepona amphinachus pseudomeander (Fruhstorfer, 1906)*Archaeoprepona chalciope* (Hübner, [1823])*Archaeoprepona demophon thalpius* (Hübner, [1814])*Consul fabius drurii* (Butler, 1874)*Memphis hirta* (Weymer, 1907)*Memphis moruus sthenos* (Prittwitz, 1865)*Prepona proschion* Fruhstorfer, 1904*Zaretis strigosus* (Gmelin, [1790])

DANAINAE

Danaus eresimus plexaure (Godart, 1819)*Danaus erippus* (Cramer, 1775)*Danaus gilippus* (Cramer, 1775)*Lycorea ilione* (Cramer, 1775)

HELICONIINAE

Actinote alalia (Felder & Felder, 1860)*Actinote carycina* Jordan, 1913*Actinote dalmeidai* Francini, 1996*Actinote discrepans* D'Almeida, 1958*Actinote genitrix* D'Almeida, 1922*Actinote mamita* (Schaus, 1902)*Actinote melanisans* Oberthür, 1917*Actinote parapheles* Jordan, 1913*Actinote pellenea* Hübner, [1821]*Actinote pyrrha* (Fabricius, 1775)*Actinote rhodope* D'Almeida, 1923*Actinote surima* (Schaus, 1902)*Agraulis vanillae maculosa* (Stichel, [1908])*Dione juno* (Cramer, 1779)*Dryadula phaetusa* (Linnaeus, 1758)*Dryas iulia alcionea* (Cramer, 1779)*Eueides aliphera* (Godart, 1819)*Eueides isabella dianasa* (Hübner, [1806])*Eueides pavana* Ménétériés, 1857*Euptoieta claudia hortensia* (Blanchard, 1852)*Euptoieta hegesia meridiania* Stichel, 1938**Heliconius besckei* Ménétériés, 1857*Heliconius erato phyllis* (Fabricius, 1775)*Heliconius ethilla narcaea* Godart, 1819*Heliconius sara apseudes* (Hübner, [1813])*Philaethria wernickei* (Röber, 1906)

ITHOMIINAE

Aeria olena Weymer, 1875**Dircenna dero* (Hübner, 1823)*Episcada carcinia* Schaus, 1902*Episcada clausina stripis* Haensch, 1909*Episcada hymenaea* (Prittwitz, 1865)*Episcada philoclea* (Hewitson, [1855])*Epityches eupompe* (Geyer, 1832)*Heterosais edessa* (Hewitson, [1855])*Hyalenna pascua* (Schaus, 1902)*Hypothyris euclea laphria* (E. Doubleday, 1847)**Hypothyris ninonia daeta* (Boisduval, 1836)**Ithomia agnosia zikani* D'Almeida, 1940*Ithomia drymo* Hübner, 1816*Mcclungia cymo salonina* (Hewitson, 1855)**Mechanitis lysimnia* (Fabricius, 1793)*Melinaea ludovica paraiya* Reakirt, 1866

Methona themisto (Hübner, 1818)
Oleria aquata (Weymer, 1875)
Placidina euryanassa (Felder & Felder, 1865)
Pseudoscada erruca (Hewitson, 1855)
Pteronymia sylvo (Geyer, 1832)
Thyridia psidii cetoides (Rosenberg & Talbot, 1914)

LIBYTHEINAE

Libytheana carinenta (Cramer, 1777)

LIMENITIDINAE

Adelpha abia (Hewitson, 1850)
Adelpha calliphane Fruhstorfer, 1915
Adelpha falcipennis Fruhstorfer, 1915
Adelpha gavina Fruhstorfer, 1915
Adelpha hyas (Doyère, [1840])
Adelpha mythra (Godart, [1824])
Adelpha poltius Hall, 1938*
Adelpha serpa (Boisduval, 1836)
Adelpha syma (Godart, [1824])
Adelpha thessalia indefecta Fruhstorfer, 1913
Adelpha zea (Hewitson, 1850)

MORPHINAE

Cytheritis aega (Hübner, [1822])
Cytheritis portis (Hübner, [1821])
Iphixibia anaxibia (Esper, [1801])
Pessonia epistrophus catenaria (Perry, 1811)

NYMPHALINAE

Anartia amathea roeselia (Eschscholtz, 1821)
Anartia jatrophae (Linnaeus, 1763)
Chlosyne lacinia saundersi (Doubleday, [1847])
Eresia lansdorfi (Godart, 1819)
Hypanartia bella (Fabricius, 1793)
Hypanartia lethe (Fabricius, 1793)
Junonia evarete (Cramer, 1779)
Ortilia ithra (Kirby, 1990)
Ortilia orthia (Hewitson, 1864)
Ortilia velica (Hewitson, 1864)
Siproeta epaphus trayja Hübner, [1823]
Tegosa claudina (Eschscholtz, 1821)
Tegosa orobia (Hewitson, 1864)
Telenassa teletusa (Godart, [1824])
Vanessa braziliensis (Moore, 1883)
Vanessa carye (Hübner, [1812])
Vanessa myrinna (Doubleday, 1849)

SATYRINAE

Capronnieria galesus (Godart, [1824])
Carminda griseldis (Weymer, 1911)
Carminda paeon (Godart, [1824])
Erichthodes narapa (Schaus, 1902)
Eteona tisiphone (Boisduval, 1836)
Euptychoides castrensis (Schaus, 1902)

Forsterinaria necys (Godart, [1824])
Forsterinaria quantius (Godart, [1824])
Godartiana muscosa (Butler, 1870)
Hermeuptychia hermes (Fabricius, 1775)
Moneuptychia soter (Butler, 1877)
Pampasatyrus glaucope (Felder & Felder, 1867)
Paryphthimoides eous (Butler, 1867)*
Paryphthimoides grimon (Godart, [1824])*
Paryphthimoides numeria (C. Felder & R. Felder, 1867)
Paryphthimoides phronius (Godart, [1824])
Praepedaliodes phanias (Hewitson, 1862)
Stegosatyrus ocelloides (Schaus, 1902)
Stegosatyrus periphias (Godart, [1824])
Taydebis peculiaris (Butler, 1874)
Taygetis ypthima Hübner, [1821]
Ypthimoides ochracea (Butler, 1867)
Ypthimoides ordinaria Freitas, Kaminski & Mielke 2012*

PAPILIONIDAE

PAPILIONINAE

Battus polydamas (Linnaeus, 1758)
Battus polystictus (Butler, 1874)
Heraclides anchisiades capys (Hübner, [1809])
Heraclides astyalus (Godart, 1819)
Heraclides hectorides (Esper, 1794)
Heraclides thoas brasiliensis (Rothschild & Jordan, 1906)
Mimoides lysithous (Hübner, [1821])
Parides agavus (Drury, 1793)
Parides anchises nephalion (Godart, 1819)
Parides bunichus (Hübner, [1821])
Protesilaus helios (Rothschild & Jordan, 1906)
Pterourus scamander grayi (Boisduval, 1836)

PIERIDAE

COLIADINAE

Anteos clorinde (Godart, [1824])
Anteos menippe (Hübner, 1818)
Aphrissa statira (Cramer, 1777)
Colias lesbia (Fabricius, 1775)
Eurema albula (Cramer, 1775)
Eurema arbela Geyer, 1832
Eurema deva (Doubleday, 1847)
Eurema phiale paula (Röber, 1909)
Phoebis argante (Fabricius, 1775)
Phoebis neocypris (Hübner, [1823])
Phoebis philea (Linnaeus, 1763)
Phoebis sennae marcellina (Cramer, 1777)
Pyrisitia leuce (Boisduval, 1836)
Rhabdodryas trite banski (Breyer, 1939)

DISMORPHINAE

Dismorphia amphione astynome (Dalman, 1823)

<i>Dismorphia astyocha</i> Hübner, [1831]	<i>Dachetola azora</i> (Godart, [1824])*
<i>Dismorphia melia</i> (Godart, [1824])	<i>Emesis diogenia</i> Prittwitz, 1865
<i>Dismorphia thermesia</i> (Godart, 1819)	<i>Emesis fatimella</i> Westwood, 1851
<i>Enantia clarissa</i> (Weymer, 1895)	<i>Emesis mandana</i> (Cramer, 1780)
<i>Enantia limmorina</i> (Felder & Felder, 1865)	<i>Emesis neemias</i> Hewitson, 1872
<i>Pseudopieris nehemia</i> (Boisduval, 1836)	<i>Emesis ocyptore zelotes</i> Hewitson, 1872
PIERINAE	<i>Emesis russula</i> Stichel, 1910
<i>Archoneas brassolis tereas</i> (Godart, 1819)	<i>Emesis satema</i> (Schaus, 1902)
<i>Ascia monuste orseis</i> (Godart, 1819)	<i>Eurybia misellivestris</i> Stichel, 1910
<i>Catasticta bithys</i> (Hübner, [1831])	<i>Eurybia pergaea</i> (Geyer, 1832)
<i>Glutophrissa drusilla</i> (Cramer, 1777)	<i>Ithomiola nepos</i> (Fabricius, 1793)
<i>Hesperocharis erota</i> (Lucas, 1852)	<i>Lasaia agesilas</i> (Latreille, [1809])*
<i>Hesperocharis paranensis</i> Schaus, 1898	<i>Lasaia incoides</i> (Schaus, 1902)
<i>Leptophobia aripa balidia</i> (Boisduval, 1836)	<i>Lemonias ochracea</i> (Mengel, 1902)
<i>Melete lycimnia petronia</i> Fruhstorfer, 1907	<i>Melanis smithiae</i> (Westwood, 1851)
<i>Pereute swainsoni</i> (Gray, 1832)	<i>Mesosemia acuta</i> Hewitson, 1873*
<i>Tatochila autodice</i> (Hübner, 1818)	<i>Mesosemia friburgensis</i> Schaus, 1902
<i>Theochila maenacte</i> (Boisduval, 1836)	<i>Mesosemia odice</i> (Godart, [1824])
RIODINIDAE	<i>Mesosemia rhodia</i> (Godart, [1824])*
EUSELASIINAE	<i>Monethe alphonsus</i> (Fabricius, 1793)
<i>Euselasia eucerus</i> (Hewitson, 1872)	<i>Panara soana</i> Hewitson, 1875
<i>Euselasia hygenius occulta</i> Stichel, 1919	<i>Pheles atricolor</i> (Butler, 1871)
<i>Euselasia</i> sp.	<i>Pirascia sagaris phrygiana</i> (Stichel, 1916)
RIODININAE	<i>Rhetus periander eleusinus</i> Stichel, 1910
<i>Adelotypa sejuncta</i> (Stichel, 1910)	<i>Riodina lycisca</i> (Hewitson, [1853])
<i>Aricoris tutana</i> (Godart, [1824])	<i>Stichelia bocchoris</i> (Hewitson, 1886)
<i>Barbicornis basilis</i> Godart, [1824]	<i>Stichelia dukenfieldia</i> (Schaus, 1902)
<i>Brachyglenis drymo</i> (Godman & Salvin, 1886)	<i>Symmachia arion</i> (Felder & Felder, 1865)
<i>Chalodeta theodora</i> (Felder & Felder, 1862)	<i>Synargis paulistina</i> (Stichel, 1910)
<i>Charis cadytis</i> Hewitson, 1866	<i>Synargis phliasus</i> (Clerck, 1764)
<i>Chorinea licursis</i> (Fabricius, 1775)	<i>Synargis regulus</i> (Fabricius, 1793)
<i>Crocozona croceifasciata</i> Zikán, 1952	<i>Symmatia nyx</i> (Hübner, 1817)
	<i>Theope thestias</i> Hewitson, 1860
	<i>Voltinia cebrenia</i> (Hewitson, [1873])