

BIODIVERSITY AND BIOGEOGRAPHY OF MEXICAN BUTTERFLIES (LEPIDOPTERA: PAPILIONOIDEA AND HESPERIOIDEA)

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Abstract.—We present a brief history of the scientific study of butterflies in Mexico, which began in the 18th century, and provide an overview of the holdings of Mexican butterfly specimens in institutional collections worldwide. The current status of a massive database on Mexican butterflies, at present containing over 450,000 distributional records, is detailed. Around 1800 species of butterflies have been reported from Mexico, which equals roughly 10% of the world butterfly fauna, placing Mexico among the ten most butterfly-rich countries in the world. About 14.8% of Mexico's butterfly species are endemic, and six genera appear to be endemic to Mexico. For the first time, we present a list of all endemic Mexican butterfly taxa: 88 species and 150 additional subspecies of Papilionoidea, and 171 species and 14 additional subspecies of HesperIIDae. Patterns of species richness and endemism are not alike; the richest areas are in the southeastern part of Mexico, mostly in the tropical evergreen forests, whereas endemism is greater in the arid north, and the humid montane forest in the central and southern parts of the country. The twenty richest sites for butterfly diversity in Mexico are identified, and comparisons are made between these sites and regions.

Key Words: Rhopalocera, Papilionidae, Pieridae, Nymphalidae, Lycaenidae, HesperIIDae, endemism, species richness, biogeographical patterns, diversity

Scientific study of Mexican butterflies began with the Royal Scientific Expeditions to New Spain in the late 18th and early 19th centuries (Llorente et al. 1994). Since then, most lepidopterological research has been aimed at efforts to document the biodiversity of the country (Llorente and Luis 1993). Despite these efforts, the knowledge gathered in the last two centuries on the biodiversity and biogeography of Mexican butterflies remains incomplete. Considering the vast biodiversity that exists in Mexico, the continued existence of completely unexplored regions is not surprising, and the

scarcity of institutional collections continues to be a hindrance to efforts at furthering our knowledge (Llorente et al. 1996).

Worldwide, about 18,000 species of butterflies are known, which represent about 13% of the approximately 150,000 species of Lepidoptera [Shields (1989) estimates 17,280 butterfly species, Heppner (1991) estimates 19,238 butterfly species, Robbins and Opler (1997) estimate 17,500 total butterfly species]. Data from Shields (1989) and Heppner (1991) estimate that 1,800 species of butterflies inhabit Mexico, representing around 10% of the world total

Table 1. Richness of Mexican butterfly species, by family, compared to major biogeographical regions. Numbers are taken from Shields (1989) and Heppner (1991). N = Nearctic; M = Mexico; NL = Neotropical; P = Palaearctic; E = Ethiopian; O = Oriental; A = Australia/Oceania. About 13.1% of the species of Lepidoptera are butterflies.

Family	N	M	NL	P	E	O	A	Total
Hesperiidae	290	800	2,016	155	437	569	191	3,658
Papilionidae	33	56	120	84	87	178	70	572
Pieridae	64	90	323	167	174	307	187	1,222
Lycaenidae	164	430	2,611	407	1,413	1,540	429	6,564
Nymphalidae	214	440	2,857	1,083	1,156	1,563	349	7,222
Total	765	1,816	7,927	1,896	3,267	4,157	1,226	19,238

(see Table 1). This richness may be due to two facts: 1) Mexico is located in an area of tectonic convergence (termed the Mexican Transition Zone by Halffter (1976), also see Llorente (1996)), where the Nearctic and Neotropical regions overlap; together these regions contain 40% of the world's butterflies; and 2) Mexico has an extratropical-intertropical situation, with various mountain ranges, which generate a wide variety of climates (ranging from arid to humid), as well as many vegetation types ranging from xerophilous scrubs to tropical forests and various types of temperate forests (Morrone et al. 1999).

The Hesperioidea is the largest group of butterflies; a single family (Hesperiidae) is included, with about 3,600 species. According to Heppner (1991), the Papilionoidea include four families, which are, from largest to smallest: Nymphalidae, Lycaenidae, Pieridae, and Papilionidae (see Table 1) [following Weintraub and Miller (1987), we do not consider the Hedyliidae to be butterflies]. Considering all biogeographical regions, the Neotropical Region is the richest in butterfly species, with the exception of the Papilionidae, which are more diverse in the Oriental Region (Heppner 1991). Mexico harbors more than twice the number of species than the entire Nearctic Region north of Mexico. This figure is considerably larger than that of the Australian Region and similar to the number of species in the Palaearctic Region. Several groups have diversified extensively in Mexico, and there

are also a number of paleoendemic and relictual groups, such as *Baronia* Salvin, 1893; *Eucheira* Westwood, 1834; *Prestonia* Schaus, 1920; *Chlosyne* Butler, 1870; *Cyllopsis* R. Felder, 1869; *Paramacera* Butler, 1868; *Lamphiotas* Callaghan, 1982; *Zobera* H. A. Freeman, 1970; *Piruna* Evans, 1955; *Paratrytone* Godman, 1900; and all megathymine genera (especially *Agathymus* H. A. Freeman, 1959 and *Stallingsia* H. A. Freeman, 1959).

MATERIALS AND METHODS

Collections of Mexican butterflies.—The number of butterfly specimens in nine of the largest American collections exceeds 72,000 (see Table 2). Two of the three most important collections in Mexico are housed at UNAM, the collection of the Departamento de Zoología of the Instituto de Biología (IBUNAM), and the collection at the MZFC, which has specialized in the fauna of the Mexican humid montane forests (Navarro and Llorente 1996). Together, both collections contain over 100,000 mounted specimens and another 250,000 specimens papered in envelopes (Table 2). The third most important collection in Mexico is private and is the product of research conducted by members of the de la Maza family, which, according to G. Lamas (personal communication) [information obtained orally], is composed of approximately 35,000 specimens. Three other important private collections that have been assembled during the last three decades are those

Table 2. Numbers of Mexican butterfly records from major institutional collections. All numbers are from the database of butterfly localities maintained by the “Alfonso L. Herrera” Museum of Zoology, at UNAM in Mexico City.

Collection	# of Records
Allyn Museum of Entomology, Sarasota, FL	9,035
American Museum of Natural History, New York, NY	11,530
California Academy of Sciences, San Francisco, CA	5,330
Carnegie Museum of Natural History, Pittsburgh, PA	14,278
Los Angeles County Museum of Natural History, CA	9,484
San Diego Natural History Museum, CA	8,322
University of California, Berkeley, CA	2,394
National Museum of Natural History, Washington, DC	7,804
Nevada State Museum, Las Vegas, NV	3,850
The Natural History Museum, London	15,000
Museo de Zoología “Alfonso L. Herrera,” UNAM	300,000
Instituto de Biología, UNAM, Mexico City	55,000
Colegio de la Frontera Sur (Chetumal, QROO)	30,000
TOTAL	472,027

of Díaz Francés, Jesús Saldaña, and González Cota. These collections include a wide variety of material from all the southern Mexican states, and contain many species endemic to Mexico. Fortunately, the two former collections were recently acquired by IBUNAM, and the latter, by the MZFC, sponsored by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), thus ensuring their preservation in academic institutions.

Mexican butterfly database.—Over the past 15 years, one of the primary objectives of the Lepidoptera collection at the MZFC has been the computerization of Mexican butterfly records into a database. This database contains three groups of primary data, including data from specimen labels of Papilionoidea housed in Mexican institutions, the same data from Papilionoidea housed in major institutions in the U.S.A. and England, and data of Papilionoidea and Hesperioidea from over 1,000 literature sources (Table 3). Data from specimens of Mexican Hesperioidea housed in institutional collections are being added to the database. The database is currently supported by the “Sistema de Información Biótica,” a program developed by CONABIO to manage nomenclatural, geographic, biblio-

graphic and curatorial information on all of Mexico’s biota.

At present, the butterfly database contains over 450,000 records, of which almost 85,000 are from natural history museums outside of Mexico, mainly in the U.S.A. and England. About 55,000 of these records are from IBUNAM, a minimum of 10,000 are from literature reports, and the remaining records are from faunal studies or specific collecting efforts aimed at determining the distributions of certain taxa (Luis et al. 2000).

The records in this database have enabled us to examine the distributions of many of the species that make up the Mexican fauna (Llorente et al. 1997). One of the best studied butterfly faunas in Mexico is that of the western state of Michoacán. Through studies made during the last 10 years, over 100,000 records have been obtained from Michoacán, from 144 localities (Luis et al., in preparation). In contrast, despite its long history of butterfly collecting tracing back to the 18th century, the state of Veracruz is represented by 50,000 records from 562 localities. To supplement this database of locality information, three additional compilations have been or are being prepared: a catalogue of taxonomic names of Mexican

Table 3. Numbers of localities from which butterflies have been recorded in each Mexican state. All numbers are from the database of butterfly localities maintained by the “Alfonso L. Herrera” Zoology Museum, at UNAM in Mexico City.

State	Localities
VERACRUZ	562
BAJA CALIFORNIA SUR	547
BAJA CALIFORNIA	520
CHIAPAS	472
OAXACA	409
GUERRERO	228
SAN LUIS POTOSÍ	215
SINALOA	198
SONORA	196
JALISCO	178
DURANGO	157
MICHOACÁN	144
TAMAULIPAS	139
NAYARIT	139
CHIHUAHUA	137
NUEVO LEÓN	125
HIDALGO	117
PUEBLA	96
COLIMA	96
MORELOS	91
YUCATÁN	72
QUINTANA ROO	65
ESTADO DE MÉXICO	63
DISTRITO FEDERAL	56
CAMPECHE	40
TABASCO	38
COAHUILA	35
QUERÉTARO	19
ZACATECAS	19
AGUASCALIENTES	17
GUANAJUATO	15
TLAXCALA	4
TOTAL LOCALITIES	5,209

butterflies, one of geographical localities of Mexican butterflies (Luis et al. 1996), and one containing literature citations that deal with Mexican Papilionoidea (Luis et al. 2000).

GEOGRAPHICAL DISTRIBUTION OF MEXICAN BUTTERFLY RECORDS

Although Mexico is a large Latin American nation, thought by some to be relatively well known and explored, this is not true for insects (Burke and Fryxell 1995). According to the data from nearly 500,000

specimens held in nearly a dozen museums in the U.S.A., The Natural History Museum, London, Mexican collections, and reports from the literature, the number of Mexican localities that have been explored for butterflies since the beginning of the former century is just over 5,000. Such a representation is poor for a county like Mexico which contains a vast megadiversity of organisms (Llorente and Luis 1993).

Published distributional records on Mexican butterflies are varied in their scope. Reports range from occasional collections made during a few hours (e.g., Comstock 1959; Díaz 1975; Guzmán 1975; González 1977, 1978), to comprehensive faunistic studies (e.g., Luis and Llorente 1990; Luis et al. 1991, 1996; Vargas et al. 1994, 1999), with many reports that fall somewhere in between (e.g., Clench 1968, Freeman 1969, de la Maza 1976, Routeledge 1977, Brown et al. 1992, Balcazar 1993). For the Papilionidae and Pieridae (Llorente et al. 1997), it has been observed that the best studied sites are near, or geographically associated with, classic historical collecting sites such as the regions of Jalapa and Los Tuxtlas in Veracruz, the Sierra de Juárez in Oaxaca, and the Sierra Madre del Sur in Guerrero (Sierra de Atoyac de Álvarez, Chilpancingo and Omiltemi).

Our state of knowledge of the geographical distribution of butterflies within Mexico’s political boundaries remains poor; of the 31 states comprising the Republic, six states contain 52.56% of the recorded 5,209 collecting localities (Veracruz, Baja California Sur, Baja California, Chiapas, Oaxaca and Guerrero). States with fewer than twenty recorded collecting localities and no published faunal studies include Tlaxcala, Aguascalientes, Zacatecas and Querétaro (Table 3). However, given that a substantial number of Mexican species of papilionoids are known to have wide distributions, and several highly localized endemic species are known, it seems valid to assume that the primary general distributional patterns displayed by Mexican butterflies have been

Table 4. Numbers of butterfly species known from various Mexican states. BC = Baja California; BCS = Baja California Sur; DGO = Durango; COL = Colima; JAL = Jalisco; GRO = Guerrero; VER = Veracruz; OAX = Oaxaca; CHIS = Chiapas; QROO = Quintana Roo.

Family	BC	BCS	DGO	COL	JAL	GRO	VER	OAX	CHIS	QROO
Papilionidae	8	6	12	28	28	32	40	51	42	24
Pieridae	26	27	29	36	44	44	57	64	70	27
Nymphalidae	34	23	61	135	176	209	300	371	379	116
Lycaenidae	53	30	45	125	151	192	279	285	333	64
Hesperiidae	39	35	104	221	258	300	435	416	462	118
Total	159	121	251	545	657	777	1,111	1,187	1,276	349

identified. Nevertheless, a large number of faunal studies remain to be conducted in order to understand at a finer level the distribution of species and groups which are endemic to Mexico (Llorente et al. 1994, 1997; Soberón et al. 2000; Oñate et al. 2000).

According to the literature, museum collections, and recent faunal studies, less than one third of the Mexican states have a butterfly species checklist (Vargas et al. 1996, Warren et al. 1998). Additionally, most of the existing state checklists are based on one or two faunal studies centered in the most diverse parts of those states (leaving large parts of those states un-collected). Exceptions to this are the states of Baja California and Baja California Sur, where no rigorous faunal studies have been made but for which Brown et al. (1992) compiled in book-form numerous data from the literature, museum collections and field work conducted at several localities. Table 4 provides numbers of butterfly species from states for which we have species checklists, and Map 1 shows Mexico's ten richest states, in numbers of Papilionoidea and Hesperioidea species.

PATTERNS OF SPECIES RICHNESS

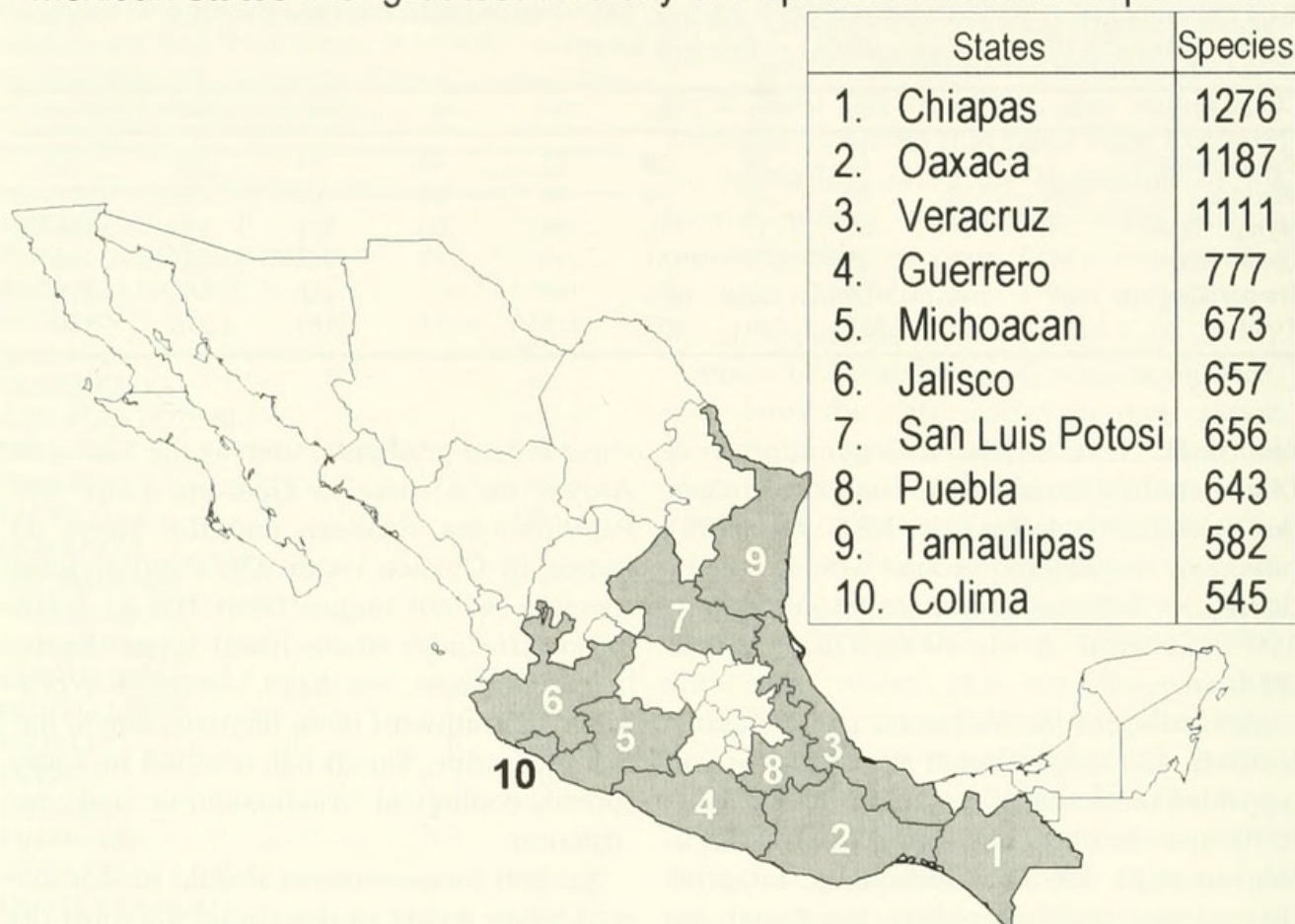
The nine richest regions in Mexico, in terms of butterfly diversity, are shown on Map 2. Each of these regions includes from three to more than 30 individual collecting localities that can arguably be classified as single biotic units. In general, these regions contain various altitudinal, climatic, and

vegetational gradients, such as the Sierra de Atoyac de Álvarez in Guerrero (with 339 Papilionoidea species), and the Sierra de Juárez in Oaxaca (with 450 Papilionoidea species), which ranges from 100 to 3,100 m. and includes many forest types. Sadly, in recent years, we have observed a profound alteration of these habitats, due to human activities, which has resulted in widespread ecological fragmentation and destruction.

Several measurements should be considered when trying to determine the most diverse of these areas; namely the size of the area, variations in elevation, environmental heterogeneity, and the biogeographical history of the region. Luis et al. (1991) shows that the Sierra de Juárez in Oaxaca is the region showing the widest altitudinal range (100–3,100 m), contrasted with the following regions: a) Los Tuxtlas, Veracruz (with 516 Papilionoidea species), with elevational extremes from sea level to 900 m, but with over 30 sampled localities and various vegetation types (Raguso and Llorente 1997), b) Chajul, Chiapas (with 396 Papilionoidea species), composed of a single forest type at 300 m. elevation (de la Maza and de la Maza 1985a, b), and c) Presidio, Veracruz (with 392 Papilionoidea species). Most of the records from the Presidio area are historical (up to 150 years old); forests in this area have been altered considerably, and only a few sites remain that still host native vegetation.

The four richest single Mexican localities for butterflies are located on the Atlantic

Mexican states with greatest diversity of Papilionoidea and Hesperioidea



Map 1. Numbers of Papilionoidea and Hesperioidea species known from Mexico's ten richest states.

slope, which is the most diverse region in Mexico for several groups of organisms (Escalante et al. 1998, Flores 1998). Mexico's richest sites on the Pacific slope include humid areas with great physiological heterogeneity (Map 3). Along Mexico's Pacific slope there are only three localities that have more than 200 species. These are: Mismaloya and La Calera in Jalisco, and Río Santiago in Guerrero, all with tropical semi-deciduous forests that contain elements from the montane cloud forest (Monteagudo et al. 2001). While Mismaloya does not appear on Map 3 (see Map 2), Warren and Llorente (1999) reported 315 butterfly species from that site (including Papilionoidea and Hesperioidea).

PATTERNS OF ENDEMISM

The patterns of species richness and endemism among Mexican butterflies differ.

The tropical evergreen forests of southeastern Mexico comprise the richest region in Mexico, in terms of total numbers of species. Over 50% of the species of Papilionoidea that occur in Mexico (over 700 species, excluding Hesperioidea) are known to occur in these forests (Salinas 1999). Despite this great diversity, only about 2% of the butterfly species associated with the tropical evergreen forests are endemic to Mexico; most species in these forests range south into parts of Central and South America. According to Rzedowski (1978), tropical evergreen forests formerly occupied 12.8% of Mexico; the current remaining forest fragments cover at most between 10 and 15% of their original area (Granillo 1985, Toledo 1988).

Mexico's endemic fauna, in contrast, is associated both with the arid communities of northwestern Mexico, and with the humid

Mexican regions with greatest diversity of Papilionoidea

Regions	Species
1. Orizaba-Córdoba-Fortín de las Flores	537
2. Región de los Tuxtlas	516
3. Jalapa-Coatepec-Teocelo	486
4. Sierra de Juárez	450
5. Sierra de Atoyac	339
6. Sierra de Manantlán	315
7. Mismaloya-Bahía de Banderas	281
8. Acahuizotla	262
9. Sierra de San Juan	237



Map 2. Numbers of Papilionoidea species known from Mexico’s most diverse regions. Each region includes from three to more than 30 separate collecting sites.

montane forests (especially the montane cloud forests) of central and southern Mexico. The insular distribution of the montane cloud forests along various mountain chains in Mexico has resulted in the speciation of many taxa, a phenomenon evident in many plant and animal groups (Halffter 1987). According to Llorente (1984), there are two altitudinal barriers in Mexico which limit dispersion and generally prohibit continuous distributions of taxa: one around 600 m, and the other around 2,000 m. Each of these altitudinal barriers present dramatically different climatic and vegetational conditions. Throughout Mesoamerica, the lower altitudinal zone is composed of the tropical evergreen and semi-deciduous forests on the Atlantic slope, with tropical deciduous and semi-deciduous forests on the Pacific slope. The middle elevational zone (roughly 600–

2,000), is significantly cooler than the lower zone and is occupied by various humid forest types. The highest elevational zone is seasonally cold, often arid, and is dominated by fir, pine and oak forests.

The insularity of the humid montane forests in Mexico has made them spots of high endemism for several groups of butterflies at the specific and subspecific levels. The assemblages of subspecies scattered in a number of these submontane islands sometimes group together with tropical Mesoamerican species, whereas in other cases they are more closely related with montane Central American species. In Mexico, there are six discernible biogeographical “islands”: a) the highlands of Chiapas [and Guatemala]; b) the highlands of the Los Tuxtlas region in Veracruz; c) the Sierra de Juárez-Sierra Madre Oriental mountain chains in

Mexican localities with greatest diversity of Papilionoidea



Map 3. Numbers of Papilionoidea species known from the twenty richest localities in Mexico.

Veracruz and Oaxaca; d) the Sierra Madre del Sur mountain chain in Guerrero and Oaxaca; e) the Pacific slope of the Nueva Galicia region from Colima to southern Sinaloa; and f) in lesser degree, the Transmexican Volcanic Belt. Some of these “islands” may be further subdivided into two or three portions, such as the highlands of Chiapas and Guatemala (Llorente and Escalante 1992).

We know of 88 species and 150 additional subspecies of Papilionoidea that are endemic to Mexico, with three endemic genera (*Baronia*, *Prestonia* and *Eucheira*). These endemic species and subspecies include 11.7% of Mexican butterfly taxa. Papilionoid genera which have diversified extensively in Mexico include *Chlosyne*, *Cyllopsis*, and *Calephelis* Grote and Robinson, 1869. Currently, 171 species and 14 subspecies of Hesperioidea are known to be

endemic to Mexico, with three endemic genera (*Zobera*, *Aegiale* and *Turnerina*). These endemic hesperioids include 9.1% of Mexican butterfly taxa. Hesperioid genera that have diversified extensively in Mexico include *Piruna*, *Paratrytone* and *Agathymus*. The number of endemic species of Hesperioidea exceeds that of all four papilionoid families combined. Considering all 423 taxa considered to be endemic in this work (including species and subspecies), 43.7% are hesperioids (Appendix). Thus, overall, 14.8% of Mexican butterfly species are endemic, and over 60% of these endemic taxa are distributed in the Mexican Pacific region. The Pacific region is environmentally discontinuous with other Mesoamerican and Central American faunal elements, and possesses two well delimited biogeographical islands: the Sierra Madre del Sur in Guerrero and Oaxaca, and the

Pacific slope of the Nueva Galicia region from Colima to southern Sinaloa. The Tehuantepec Isthmus and the Balsas River Basin, respectively, play the role of physiographic and climatic barriers to these islands (Llorente 1984).

CONCLUSIONS

We summarize our biogeographical knowledge of Mexican butterflies, acquired through the past 200 years, as follows:

- 1) Mexico possesses 10% of the butterfly species of the world and 14.8% of these species are endemic, making Mexico one of ten countries with the greatest butterfly diversity.
- 2) Mexico and the areas adjacent to its borders possess relictual, palaeo- and neo-endemic butterfly groups of great scientific interest, mostly in the northwestern arid zones, and in the montane communities to the south.
- 3) Patterns of species richness and endemism are not alike; the richest areas are in the southeast, mostly in the tropical evergreen forests, whereas endemic taxa are mostly distributed in the arid north, and in the humid montane forests in the central and southern portions of the country.
- 4) Areas richest in species numbers and endemic taxa are those exhibiting physiographic, climatic and vegetational heterogeneity, in a mosaic of preserved and partially altered environments, (such as the Los Tuxtlas region in Veracruz, Chajul in Chiapas, and the Sierra de Juárez in Oaxaca, each one possessing over one third of Mexico's butterfly species). In contrast, whole states or physiographic provinces with less environmental heterogeneity, such as the Peninsula of Baja California (which claims less than 9% of the butterfly fauna of Mexico), possess fewer total and endemic taxa.
- 5) Mexico's complex biogeographical history has resulted in several intercontinental, insular, distributional patterns

that are evident among Mexican butterflies; these are the product of a heterogeneous and disjunct distribution of arid, humid and montane environments.

- 6) There are a number of relictual taxa that occur in unique biogeographical areas in Mexico.

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APPENDIX

Species and Subspecies of Endemic Mexican Butterflies

- * = Taxon that has been reported from the USA by stray specimens or in error.
- ^ = Taxon reported from Belize or Guatemala by rare strays.
- ^a = Taxon originally described from Arizona but now extinct in the USA.
- « = Questionable taxonomic status, further study required (this symbol is after names).

Taxa listed in **bold** are endemic to Mexico at the species level. We note that some taxa listed as endemic herein may be found to have distributions that extend outside of Mexico with future fieldwork. However, taxonomic revisions and new species discoveries also will increase the number of endemic species in the future.

Endemic genera include: *Baronia* (Papilionidae), *Prestonia*, *Eucheira* (Pieridae), *Zobera*, *Aegiale*, and *Turnerina* (Hesperiidae).

We list subspecies (geographical races) to aid in the identification of patterns of endemism. Distributions of many Theclinae and Hesperiiidae are less well known, and most modern publications on these groups have not recognized subspecies extensively.

PAPILIONIDAE

Baroniinae

- Baronia brevicornis brevicornis* Salvin, 1893
- Baronia brevicornis rufodiscalis* J. Maza & J. White, 1987

Papilioninae

- Battus philenor orsua* (Godman & Salvin, 1889)
- ^*Battus philenor acauda* (Oberthür, 1880)
- Battus laodamas iopas* (Godman & Salvin, 1897)
- Battus eracon* (Godman & Salvin, 1897)
- **Parides alopius* (Godman & Salvin, 1890)
- Parides erithalion trichopus* (Rothschild & Jordan, 1906)
- Parides panares panares* (Gray, [1853])
- Protographium agesilaus fortis* (Rothschild & Jordan, 1906)
- Protographium epidaus tepicus* (Rothschild & Jordan, 1906)

- Protographium epidaus fenochionis* (Salvin & Godman, 1868)
Protographium thyastes occidentalis (R. G. Maza, 1982)
Mimoides ilus occiduus (Vázquez, 1956)
Mimoides thymbraeus aconophos (Gray, [1853])
Heraclides erostratus erostratinus (Vázquez, 1947)
Heraclides erostratus vazquezae (Beutelspacher, 1986)
Heraclides rogeri rogeri (Boisduval, 1836)
Heraclides torquatus mazai (Beutelspacher, 1974)
Heraclides astyalus bajaensis (J. W. Brown & Faulkner, 1992)
Pterourus esperanza (Beutelspacher, 1975)
Pterourus glaucus alexiaries (Hopffer, 1865)
Pterourus glaucus garcia (Rothschild & Jordan, 1906)
Pterourus palamedes leontis (Rothschild & Jordan, 1906)
**Pterourus abderus abderus* (Hopffer, 1856)
Pterourus abderus baroni (Rothschild & Jordan, 1906)
Pterourus garamas (Geyer, [1829])
Pterourus menatius morelius (Rothschild & Jordan, 1906)

PIERIDAE

Dismorphiinae

- Enantia mazai mazai* Llorente, 1984
Enantia mazai diazi Llorente, 1984
Lieinix lala turrenti J. Maza & R. G. Maza, 1984
Lieinix neblina J. Maza & R. G. Maza, 1984
Lieinix nemesis nayaritensis Llorente, 1984
Dismorphia amphione lupita Lamas, 1979
Dismorphia amphione isolda Llorente, 1984
Dismorphia crisia alvarezi J. Maza & R. G. Maza, 1984
Dismorphia eunoe eunoe (Doubleday, 1844)
Dismorphia eunoe popoluca Llorente & Luis, 1988
Dismorphia eunoe chamula Llorente & Luis, 1988

Coliadinae

- *Phoebis agarithe fisheri* (H. Edwards, 1883)
Prestonia clarki Schaus, 1920
Eurema agave millerorum Llorente & Luis, 1987

Pierinae

- Anthocharis cethura bajacalifornia* J. Emmel, T. Emmel & Mattoon, 1998
Anthocharis limonea (Butler, 1871)
**Euchloe guaymasensis* Opler, 1987
Hesperocharis crocea jaliscana (Schaus, 1898)
Hesperocharis graphites avivolans (Butler, 1865)
Eucheira socialis socialis Westwood, 1834
Eucheira socialis westwoodi Beutelspacher, 1984
Catasticta flisa oaxaca Beutelspacher, 1986
Catasticta undescribed species
**Catasticta nimbe nimbe* (Boisduval, 1836)
Catasticta teutila flavifaciata Beutelspacher, 1986
Catasticta teutila teutila (Doubleday, 1847)
Pereute charops charops (Boisduval, 1836)

- Pereute charops leonilae* Llorente, 1986
Pereute charops sphocra Draudt, 1931
Melete polyhymnia serrana R. G. Maza, 1984
Perrhybris pamela chajulensis J. Maza & R. G. Maza, 1989
Perrhybris pamela mapa J. Maza & R. G. Maza, 1989
Ascia monuste raza Klots, 1930
**Ganyra howarthi* (Dixey, 1915)

NYMPHALIDAE

Heliconiinae

- Actinote stratonice oaxaca* (L. Miller & J. Miller, 1979)
Actinote guatemalena guerrerensis J. Maza, 1982
Actinote guatemalena veraecrucis Jordan, 1913
Eueides isabella nigricornis R. G. Maza, 1989
Heliconius erato cruentus Lamas, 1998
Speyeria nokomis wenona dos Passos & Grey, 1945 «
Speyeria nokomis melaena Mooser & García, 1979 «
**Speyeria nokomis coerulescens* (Holland, 1900)

Nymphalinae

- Nymphalis cyanomelas* (Doubleday, [1848])
Polygonia g-argenteum (Doubleday, 1848)
Polygonia haroldii (Dewitz, 1877)
Anartia amathea colima Lamas, 1995
Chlosyne kendallorum Opler, 1999
**Chlosyne ehrenbergii* (Geyer, [1833])
Chlosyne definita anastasia (Hemming, 1934)
Chlosyne definita schausi (Godman, 1901)
Chlosyne endeis endeis (Godman & Salvin, 1894)
Chlosyne gaudialis wellingi L. Miller & Rotger, 1979
**Chlosyne eumeda* (Godman & Salvin, 1894)
Chlosyne marina (Geyer, 1837)
**Chlosyne melitaeoides* (R. Felder 1867)
Chlosyne janais gloriosa Bauer, 1960
Chlosyne janais marianna Röber, [1914]
Chlosyne rosita mazarum L. Miller & Rotger, 1979
Chlosyne rosita riobalsensis Bauer, 1961
Thessalia cyneas cynisca (Godman & Salvin, 1882)
Thessalia leanira austrina Austin & M. J. Smith, 1998
Thessalia theona brocki Austin & M. J. Smith, 1998
Thessalia theona mullinsi Austin & M. J. Smith, 1998
Texola anomalus (Godman & Salvin, 1897)
Texola coracara (Dyar, 1912)
Texola elada elada (Hewitson, 1868)
Phyciodes pallescens (R. Felder, 1869)
Phyciodes mylitta mexicanus Hall, 1928
Anthanassa alexon (Godman & Salvin, 1889)
Anthanassa ptolema amator (Hall, 1929)
Anthanassa sitalces cortes (Hall, 1917) «
Anthanassa otanes cyno (Godman & Salvin, 1889)
Anthanassa otanes oaxaca Beutelspacher, 1990
Castilia chinantlensis (R. R. Maza, 1978)

Limenitidinae

- Myscelia cyananthe diaziana* R. G. Maza & J. Maza, 1985

- **Myscelia cyananthe skinneri* Mengel, 1894
Myscelia cyananthe streckeri Skinner, 1889
Myscelia cyaniris alvaradia R. G. Maza & Díaz, 1982
Catonephele cortesi R. G. Maza, 1982
Eunica malvina almae Vargas, Llorente & Luis, 1998
Hamadryas amphinome mazai Jenkins, 1983
**Hamadryas atlantis lelaps* Godman & Salvin, 1883
**Hamadryas glauconome grisea* Jenkins, 1983
**Hamadryas guatemalena marmarice* (Frühstorfer, 1916)
^*Hamadryas honorina* (Frühstorfer, 1916)
Pyrrhogrya edocla paradisea R. G. Maza & J. Maza, 1985
Temenis laothoe quilapayunia R. G. Maza & Turrent, 1985
Epiphile adrasta escalantei Descimon & Mast, 1979
Bolboneura sylphis beatrix R. G. Maza, 1985
Bolboneura sylphis lacandona R. G. Maza & J. Maza, 1985
Bolboneura sylphis veracruzana Draudt, 1931
Diaethria astala asteroidea R. G. Maza & R. R. Maza, 1985
Diaethria asteria (Godman & Salvin, 1894)
Diaethria salvadorensis mixteca J. Maza, 1977
Callicore astarte casta (Salvin, 1869)
Callicore texa grijalva R. G. Maza & J. Maza, 1983
Callicore texa loxicha R. G. Maza & J. Maza, 1983
Callicore tolima tehuana R. G. Maza & J. Maza, 1983
Adelpha milleri Beutelspacher, 1976
Adelpha boeotia oberthurii (Boisduval, 1870)
Adelpha diazi Beutelspacher, 1975
Adelpha diocles creton Godman, 1901
Adelpha leucerioides leucerioides Beutelspacher, 1975
Basilarchia archippus hoffmanni (Chermock, 1947)

Charaxinae

- Archaeoprepona amphinachus baroni* J. Maza, 1982
Archaeoprepona demophon occidentalis Stoffel & Descimon, 1974
Archaeoprepona demophoon mexicana Llorente, Descimon & Johnson, 1993
Archaeoprepona phaedra aelia (Godman & Salvin, 1889)
Prepona deiphile brooksiana Godman & Salvin, 1889
Prepona deiphile diaziana L. Miller & J. Miller, 1976
Prepona deiphile escalantiana Stoffel & Mast, 1973
Prepona deiphile ibarra Beutelspacher, 1982
Prepona deiphile lambertoana Llorente, Luis & González, 1992
Hypna clytemnestra mexicana Hall, 1917
Consul electra undescribed subspecies
Fountainea euryphyle glanzi (Rotger, Escalante & Coronado, 1965)
Fountainea halice martinezi (J. Maza & Díaz, 1978)
Fountainea halice maya (Witt, 1980)
Fountainea halice tehuana (Hall, 1917)
Fountainea nobilis rayoensis (J. Maza & Díaz, 1978)
Memphis schausiana (Godman & Salvin, 1894)
Memphis wellingi L. Miller & J. Miller, 1976

Morphiinae

- Morpho achilles guerrerensis* Le Moult & Réal, 1962
Morpho achilles montezuma Guenée, 1859
Iphimedeia telemachus oaxacensis Le Moult & Réal, 1962

Satyrinae

- Cissia cleophes* (Godman & Salvin, 1889) «
Cyllopsis caballeroi Beutelspacher, 1982
Cyllopsis clinas (Godman & Salvin, 1889)
Cyllopsis diazi L. Miller, 1974
Cyllopsis dospassosi L. Miller, 1969
Cyllopsis hedemanni tamaulipensis L. Miller, 1974
Cyllopsis henshawi hoffmanni L. Miller, 1974 «
Cyllopsis jacquelineae L. Miller, 1974
Cyllopsis nayarit Chermock, 1947 «
Cyllopsis parvimaculata L. Miller, 1974
Cyllopsis perplexa L. Miller, 1974
Cyllopsis pertepida pertepida (Dyar, 1912)
Cyllopsis pertepida intermedia L. Miller, 1974
Cyllopsis pseudopephredo Chermock, 1947
Cyllopsis suivalens suivalens (Dyar, 1914)
Cyllopsis whiteorum L. Miller & J. Maza, 1984
Cyllopsis windi L. Miller, 1974 «
Euptychia fetna Butler, 1870
Euptychia rubrofasciata L. Miller & J. Miller, 1988
“Megisto” *pellonia* (Godman, 1901)
Megisto rubricata pseudocleophes L. Miller, 1976
Paramacera chinanteca L. Miller, 1972
Paramacera copiosa L. Miller, 1972
Paramacera xicaque rubrosuffusa L. Miller, 1972
Paramacera xicaque xicaque (Reakirt, [1867])
Splendeuptychia kendalli L. Miller, 1976
Taygetis mermeria griseomarginata L. Miller 1978
Taygetis uncinata Weymer, 1907
Taygetis weymeri Draudt, 1912
Pedaliodes undescribed species

Ithomiinae

- Melinaea ethra flavicans* Hoffmann, 1924
Oleria zea diazi J. Maza & Lamas, 1978
Callithomia hezia wellingi Fox, 1968
Episcada salvinia portilla J. Maza & Lamas, 1978
Pteronymia artena praedicta J. Maza & Lamas, 1982
Pteronymia rufocincta (Salvin, 1869)
Pteronymia simplex timagenes Godman & Salvin, 1889
Greta annette moschion (Godman, 1901)

LYCAENIDAE

Theclinae

- Habrodais poodiae* J. W. Brown & Faulkner, 1982

Eumaeinae

- Micandra tongida* Clench, 1971
Laothus erybathis (Hewitson, 1867)
Callophrys dospassosi Clench, 1981
Callophrys estela Clench, 1981

Symbiopsis undescribed species

Ministrymon undescribed species

Erora undescribed species

Thecla semones (Godman & Salvin, 1887)

Ipidecla miadora Dyar, 1916

Polyommatainae

Everes undescribed species

Euphilotes bernardino garthi Mattoni, 1989

Lycaeides melissa mexicana (Clench, 1965)

Riodininae

Euselasia cataleuca (R. Felder, 1869)

Euselasia hypophaea mexicana Lathy, 1926

Euselasia undescribed species

Mesosemia gemina J. Maza & R. G. Maza, 1980

Napaea danforthi A. Warren & Opler, 1999

Rhetus arcus beutelspacheri Llorente, 1987

Calephelis acapulcoensis McAlpine, 1971 «

Calephelis azteca McAlpine, 1971 «

**Calephelis dreisbachi* McAlpine, 1971 «

Calephelis huasteca McAlpine, 1971 «

Calephelis nemesis bajaensis McAlpine, 1971 «

Calephelis matheri McAlpine, 1971 «

Calephelis mexicana McAlpine, 1971 «

Calephelis montezuma McAlpine, 1971 «

Calephelis perditalis donahuei McAlpine, 1971 «

Calephelis sinaloensis sinaloensis McAlpine, 1971 «

Calephelis sinaloensis nuevoleon McAlpine, 1971 «

Calephelis yautepequensis R. G. Maza & Turrent, 1971

Caria melino Dyar, 1912

Caria stillaticia Dyar, 1912

Exoplisia undescribed species

Melanis cephise huasteca J. White & A. White, 1989

Melanis cephise acroleuca (R. Felder, 1869)

Emesis poeas Godman & Salvin, 1901

Emesis zela zela Butler, 1870

Apodemia hepburni remota Austin, 1991

Apodemia mormo dialeuca Opler & Powell, 1962

Apodemia mormo maxima A. G. Weeks, 1891

Apodemia murphyi Austin, 1988

Apodemia palmerii australis Austin, 1988

**Apodemia phyciodoides* Barnes & Benjamin, 1924

Apodemia hypoglaucia wellingi Ferris, 1985

Adelotypa eudocia (Godman & Salvin, 1897)

Theope villai Beutelspacher, 1981

HESPERIIDAE

Pyrrhopyginae

Chalypyge chalybea chalybea (Scudder, 1872) «

Jonaspyge tzotzili H. A. Freeman, 1969

Melanopyge mulleri (Bell, 1934)

Apyrrothrix araxes araxes (Hewitson, 1867)

Mysoria wilsoni H. A. Freeman, 1969

Pyrginae

Entheus crux Steinhauser, 1989

Epargyreus brodkorbi H. A. Freeman, 1966 (must also occur in GUAT)

Epargyreus deleoni H. A. Freeman, 1977

Typhedanus salas H. A. Freeman, 1977

Typhedanus undescribed species

Zestusa elwesi (Godman & Salvin, 1893)

Zestusa undescribed species

Codatractus cyledis (Dyar, 1912)

Codatractus uvydixa (Dyar, 1914)

Codatractus yucatanus H. A. Freeman, 1977

Ridens mercedes Steinhauser, 1983

Urbanus undescribed species #1

Urbanus dorantes calafia (R. C. Williams, 1926)

Urbanus undescribed species #2

Urbanus viridis H. A. Freeman, 1970

**Autochton pseudocellus* (Coolidge & Clemence, [1910])

Autochton siernadror Burns, 1984

Thorybes undescribed species

Cephise mexicanus Austin & Mielke, 2000

Cogia aventinus (Godman & Salvin, 1894)

Cogia hippalus peninsularis L. Miller & MacNeill, 1969

Telemiades choricus (Schaus, 1902)

Mimia chiapaensis H. A. Freeman, 1969

Polycitor undescribed species

Myrinia raymundo H. A. Freeman, 1979

Bolla cybele Evans, 1953

Bolla fenestra Steinhauser, 1991

Bolla guerra Evans, 1953

Bolla litus (Dyar, 1912)

Bolla oriza Evans, 1953

Bolla solitaria Steinhauser, 1991

Staphylus undescribed species

Staphylus tepeca (Bell, 1942)

Staphylus tierra Evans, 1953

Zera eboneus (Bell, 1947)

Quadrus francesius H. A. Freeman, 1969

Pythonides mundo H. A. Freeman, 1979

Pythonides rosa Steinhauser, 1989

Zobera albopunctata H. A. Freeman, 1970

Zobera marginata H. A. Freeman, 1979

Zobera oaxaquena Steinhauser, 1991

**Antigonus emorsa* (R. Felder, 1869)

Antigonus funebris (R. Felder, 1869)

Systasea microsticta Dyar, 1923

Doberes hewitsonius (Reakirt, [1867])

Doberes sobrinus Godman & Salvin, 1895

Anastrus luctuosus Godman & Salvin, 1894

Camptopleura oaxaca H. A. Freeman, 1969

Chiomara georgina pelagica (Weeks, 1891)

Erynnis brizo mulleri (Draudt, 1923)

Erynnis mercurius (Dyar, 1926)

Erynnis meridianus fieldi Burns, 1964

Erynnis tristis pattersoni Burns, 1964

Heliopyrgus sublinea Schaus, 1902

Celotes undescribed species

Heteropterinae

- Piruna ceracates* (Hewitson, 1874)
Piruna cyclosticta (Dyar, 1920)
Piruna dampfi (Bell, 1942)
Piruna gyrans (Plotz, 1884)
Piruna jonka Stainhauser, 1991
Piruna kemneri H. A. Freeman, 1990
Piruna maculata H. A. Freeman, 1970
Piruna microsticta (Godman, 1900)
Piruna millerorum Steinhauser, 1991
Piruna mullinsi H. A. Freeman, 1991
Piruna purepecha A. Warren & Gonzalez, 1998
Piruna roeveri (L. Miller & J. Miller, 1972)
Piruna undescribed species #1
Piruna sina H. A. Freeman, 1970
Piruna undescribed species #2
Dalla bubobon (Dyar, 1921)
Dalla dividuum (Dyar, 1913)
Dalla faula (Godman, 1900)
Dalla kemneri Steinhauser, 1991
Dalla undescribed species
Dalla mentor Evans, 1955
Dalla nubes Steinhauser, 1991
Dalla steinhauseri H. A. Freeman, 1991

Hesperinae

- Synapte silna* Evans, 1955
**Synapte syraces* (Godman, 1901)
Zariaspes mythecus Godman, 1900
Anthoptus macalpinei H. A. Freeman, 1969
Pheraeus covadonga covadonga H. A. Freeman, 1969
Pheraeus covadonga loxicha Steinhauser, 1991
Virga clenchi L. Miller, 1970
Monca jera Godman, 1900
Remella undescribed species
Cobalopsis zetis (Bell, 1942)
Turesis tabascoensis H. A. Freeman, 1979
Thoon wellingi H. A. Freeman, 1969
Enosis matheri H. A. Freeman, 1969
Ebusus ebusus nigrrior L. Miller, 1985
Carystoides escalantei H. A. Freeman, 1969
Carystoides abrahami H. A. Freeman, 1969
Carystoides floresi H. A. Freeman, 1969
Carystoides mexicana H. A. Freeman, 1969
Cynea nigricola H. A. Freeman, 1969
Decinea rindgei H. A. Freeman, 1968
Decinea mustea H. A. Freeman, 1979
Oeonus pyste Godman, 1900
Oarisma era Dyar, 1927
Adopaeodes bistriata Godman, 1900
Stinga undescribed species
Hesperia uncas gilberti MacNeill, 1964
Polites norae MacNeill, 1993
Polites pupillus (Plotz, 1883)
Polites puxillus (Mabille, 1891)
Polites sabuleti margaretae L. Miller & MacNeill, 1969

- Ochlodes samenta* Dyar, 1914
Poanes monticola (Godman, 1900)
"Poanes" benito H. A. Freeman, 1979
Paratrytone aphractioia Dyar, 1914
Paratrytone decepta L. Miller & J. Miller, 1972
Paratrytone kemneri Steinhauser, 1996
Paratrytone undescribed species #1
Paratrytone raspa (Evans, 1955)
Paratrytone undescribed species #2
Paratrytone omiltemensis Steinhauser, 1996
Paratrytone undescribed species #3
Paratrytone pilza Evans, 1955
Paratrytone polyclea Godman, 1900
Paratrytone rhexenor Godman, 1900
Paratrytone undescribed species #4
Quasimellana siblinga Burns, 1994
Quasimellana agnesae (Bell, 1959)
Quasimellana mulleri (Bell, 1942)
"Mellana" gala (Godman, 1900)
Librita heras (Godman, 1900)
Euphyes chamuli H. A. Freeman, 1969 (must also occur in GUAT)
Euphyes canda Steinhauser & Warren, [2002]
Atrytonopsis frappenda (Dyar, 1920)
Atrytonopsis zweifeli H. A. Freeman, 1969
Atrytonopsis undescribed species
Amblyscirtes anubis (Godman, 1900)
Amblyscirtes brocki H. A. Freeman, 1992
Amblyscirtes fimbriata pallida H. A. Freeman, 1993
Amblyscirtes fluonia Godman, 1900
Amblyscirtes folia Godman, 1900
Amblyscirtes novimmaculatus A. Warren, 1998
Amblyscirtes raphaelli H. A. Freeman, 1973
Lerodea similea Bell, 1942 «
Vacerra undescribed species #1
Vacerra gayra (Dyar, 1918)
Vacerra undescribed species #2
Vacerra undescribed species #3
Niconiades comitana H. A. Freeman, 1969
Halotus jonaveriorum Burns, 1992
Aides undescribed species

Megathyminae

- Stallingsia smithi* (H. H. Druce, 1896)
Stallingsia undescribed species
Stallingsia jacki D. Stallings, Turner, & V. Stallings, 1963
Megathymus beulahae beulahae D. Stallings & Turner, 1958
Megathymus beulahae gaylae D. Stallings, Turner & V. Stallings, 1963
Aegiale hesperiaris (Walker, 1856) (may represent a species complex)
Turnerina mejicanus (Bell, 1938)
Turnerina hazelae (D. Stallings & Turner, 1958)
Agathymus belli (H. A. Freeman, 1955)
Agathymus comstocki (Harbison, 1957)
Agathymus dawsoni Harbison, 1963
Agathymus undescribed species #1

- Agathymus* undescribed species #2
Agathymus undescribed species #3
Agathymus undescribed species #4
Agathymus escalantei D. Stallings, Turner & V. Stallings, 1966
Agathymus remingtoni (D. Stallings & Turner, 1958)
Agathymus fieldi H. A. Freeman, 1960
Agathymus hoffmanni (H. A. Freeman, 1952)
Agathymus juliae (D. Stallings & Turner, 1958)
Agathymus undescribed species #5
Agathymus undescribed species #6
- Agathymus* undescribed species #7
Agathymus undescribed species #8
Agathymus micheneri D. Stallings, Turner & V. Stallings, 1961
Agathymus undescribed species #9
Agathymus undescribed species #10
Agathymus undescribed species #11
Agathymus undescribed species #12
Agathymus undescribed species #13
Agathymus rethon (Dyar, 1913)
Agathymus ricei D. Stallings, Turner & V. Stallings, 1966



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nez,
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s Armando. et al. 2003. "Biodiversity and biogeography of Mexican butterflies (Lepidoptera: Papilionoidea and Hesperioidea)." *Proceedings of the Entomological Society of Washington* 105, 209–224.

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