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Mexican Lepidoptera biodiversity

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Abstract. Being among the most habitat diverse countries in the world (and plant diversity is about 22,000 sp.), Mexico has a Lepidoptera fauna recorded at about 14,385 species but is estimated to be over 22,000 species, if not much higher (some estimates go to 35,000 sp.). High Lepidoptera numbers in Mexico are also due to the large influx of tropical species from the border with Guatemala, as well as Mexican endemics. In this report, the Lepidoptera families are summarized for Mexico, giving known species and what experts estimate to be the true total for each family when all have been described. Many regions of Mexico are still poorly known for smaller moths.

Introduction

Mexico encompasses one of the most diverse regions of the world, perhaps having only somewhat fewer habitats than does Peru, since Mexico ranges from desert areas just south of California and Arizona to the tropical rain forests of Chiapas next to Guatemala, plus great variations in topography and local habitats in between (Toledo and Ordóñez, 1993). Along with the correspondingly diverse plants known for Mexico (about 22,000 species) (Rzedowski, 1993), the Lepidoptera likewise are exceedingly numerous and biodiverse. Thus far, about 14,385 species of Lepidoptera are known for Mexico, including butterflies (ca. 1,800 species). The following notes have been organized to briefly summarize what is known thus far of Lepidoptera in Mexico. Besides Lepidoptera species described from Mexico, the Mexican totals for each family include all species from the USA border and those described from Guatemala and Belize, since these undoubtedly also occur in nearby areas of Mexico for the most part.

The Mexican Lepidoptera fauna is particularly species rich due to 5 main faunal elements to be found in the region: 1) endemic species (about 25%); 2) western North American species intruding south from the United States border areas and also into the higher mountains of central Mexico (about 15%); 3) eastern North American species intruding south from the United States border area of southeastern Texas and into parts of northeastern Mexico (about 5%); 4) Caribbean fauna in the Yucatan (about 15%); and 5) Central American fauna in Chiapas and nearby areas of southern Mexico (about 40%). The last element, the Central American component, also includes many species that are more widespread in the Neotropics, even as far as into the Amazon, and undoubtedly

brings in the highest number of species for the Mexican total, perhaps more than a third of all Lepidoptera species found in Mexico. Yucatan and Cuba, separated by only 220 km., undoubtedly have a large overlapping fauna, as Miller and Miller (1989) noted for butterflies. In comparing larger rainforest trees in Mexico with the biogeography of Lepidoptera, about 30% of the tropical trees are distributed into Guatemala, 25% range as far south as Amazonia, 21% are Antillean, and about 10% are Mexican endemics, with the remainder more widespread (Wendt, 1993), all of which compares favorably with the Lepidoptera figures.

Mexico being so exceedingly diverse in habitats, in part due to the many mountain ranges, has more endemic species than do most countries of the world, and this component forms perhaps a quarter of the Lepidoptera in Mexico. The least well known areas of Mexico are the northern region, near the border with the United States, and Yucatan, although for smaller moths most all of Mexico is relatively little known. The greatest biodiversity in Mexico is in Chiapas, as can be seen in the number of plant species (Rzedowski, 1993) and butterflies (Llorente *et al.*, 1996).

The notes on Lepidoptera families herein are modified in part from the chapter on Lepidoptera (Heppner, in press) in the *Encyclopedia of Entomology*, with emphasis on the Mexican fauna. Mexico species totals are taken from the catalogs of *Atlas of Neotropical Lepidoptera* (Heppner, ed., 1984, 1995, 1996), and from other works by the author (Heppner, 1991, 1998, in press) and others. Some information on Mexico Lepidoptera was also obtained from the overview summaries organized by Llorente *et al.*, eds. (1996-2000), from sections authored by Balcázar and Beutelspacher (2000a,b), Becker (2000), Davis (2000),

León (2000), Llorente *et al.* (1996), Miller (2000), Razowski (1996), Solis (1996), and Warren (2000).

The arrangement of the classification of Lepidoptera herein follows a progression somewhat in line with our knowledge of how the order evolved, from the most primitive moths that resembled Micropterigidae, to what are now considered the most advanced lepidopterans, the Noctuidae (Heppner, 1998, 2000; Kristensen, 1999). Yet, advanced features are also found in other groups, such as the Sesiidae, with their unique wing locking mechanism that nearly approaches the similar wing locking found in wasps (Hymenoptera), and butterflies, where some have evolved advanced features like the chordotonal organs found in wing veins of Satyrinae (Nymphalidae).

The taxonomic listing below gives an overview of the main groupings and superfamilies of Lepidoptera (not all groups listed occur in Mexico). Overall, the order has 33 superfamilies and 125 families (Heppner, 1998, 2003; Heppner, ed., 2000). Butterflies are in Papilionoidea, including skippers which sometimes are placed in their own superfamily, Hesperioidea. Groups preceeding Ditrysia contain the most primitive Lepidoptera, and among these, the first 3 suborders contain the most archaic relicts of ancient lepidopteran lineages still extant (many of these only occur in ancient biotic refugia such as South Africa, Australia, and Patagonia).

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Order LEPIDOPTERA

Suborder Zeugloptera

Micropterigoidea

Suborder Aglossata

Agathiphagoidea

Suborder Heterobathmiina

Heterobathmioidea

Suborder Glossata

Cohort Dacnonypha

Infraorder Dacnonypha

Eriocranioidea

Infraorder Lophocoronina

Lophocoronoidea

Cohort Myoglossata

Subcohort Myoglossata

Infraorder Neopseustina

Neopseustoidea

Subcohort Neolepidoptera

Infraorder Exoporia

Mnesarchaeoidea

Hepialoidea

Infraorder Heteroneura

Division Monotrysia

Section Nepticulina

Andesianoidea

Nepticuloidea

Tischerioidea

Palaephatoidea

Section Incurvariina

Incurvarioidea

Division Ditrysia

Section Tineina

Subsection Tineina

Tineoidea

Gelechioidea

Copromorphoidea

Yponomeutoidea

Immoidea

Pyraloidea

Pterophoroidea

Subsection Sesiina

Sesioidea

Zygaenoidea

Section Cossina

Subsection Cossina

Cossoidea

Castnioidea

Tortricoida

Subsection Bombycina

Calliduloidea

Uranioidea

Geometroidea

Papilionoidea

Drepanoidea

Bombycoidea

Sphingoidea

Noctuoidea

There is some controversy in terms of how many families and superfamilies there are and how they should be arranged. For example, some other recent classifications for Lepidoptera use 46 superfamilies, splitting many odd families to their own monobasic superfamilies (Kristensen, 1999). However, the foundations of the primitive groups (non-Ditrysiian groups) are fairly well established now, although new discoveries can still come to light from remote tropical regions of the world: for example, one small family of primitive moths, the Neothoridae, was only discovered within the past 25 years and was based on a single known specimen from Brazil. Also, a small group of South American moths misplaced in Cossidae

was just found to be monotrysian and the new family Andesianidae was formed (Davis and Gentilli, 2003).

The notes below summarize information on the 125 extant families of Lepidoptera in the world, and how this relates to the Mexican fauna. The species totals given for each family have been updated to include all valid species described to the year 2000, plus estimates of how many occur in Mexico. In the world, the total number of known Lepidoptera species comes to about 156,100 species. An estimated additional 100,000 species remain to be discovered and named, mainly from tropical regions of the world, including many of the most imperiled habitats.

During the decade from 1990-2000, about 8,500 Lepidoptera species were described from all regions, particularly from remote areas of temperate Central Asia and from the tropical forests of Southeast Asia and Central Africa. Thus, the rate of new discoveries and descriptions of new species remains fairly steady, averaging about 850 species per year among Lepidoptera. While most of these new species are moths, some larger butterflies are involved as well, and even a few swallowtails (Papilionidae) from such remote regions as parts of China and New Guinea. Mexico likewise has a great many undescribed species, particularly among the smallest micro-moths such as leafminers. Biological and morphological information can be obtained from such works as by Bourgonne (1951), Eaton (1988), Hering (1925), Portier (1949), Scoble (1992), Stehr (1987), Vane-Wright and Ackery (1984), Watson and Whalley (1975), and Young (1997). Keys to families are in Heppner (1996, 1998) and Holloway *et al.* (1987).

In Mexico, the Lepidoptera fauna totals about 14,385 described species and probably has an actual fauna, once all species are discovered and described, of about 22,500 species, possibly more. The table below summarizes these figures for groups known to occur in Mexico:

Superfamily	Species known	Expected total
Micropterigoidea	--	1
Eriocranioidea	--	1
Hepialoidea	15	20
Nepticuloidea	--	50
Tischerioidea	1	10
Incurvarioidea	16	35
Tineoidea	147	665
Gelechioidea	396	1,825
Copromorphoidea	6	10
Yponomeutoidea	35	110
Immoidea	2	5
Pyraloidea	1,375	3,045

Pterophoroidea	43	80
Sesioidea	117	230
Zygaenoidea	127	150
Cossoidea	154	175
Castnioidea	14	18
Tortricioidea	495	1,000
Uranioidea	30	50
Geometroidea	2,508	3,000
Papilionoidea	1,808	1,900
Drepanoidea	2	5
Bombycoidea	341	350
Sphingoidea	201	205
Noctuoidea	6,550	9,500
Totals for Mexico	14,383	22,440

Primitive moths

The families considered the most primitive of all lepidopterans, in the groups up to Ditrysia, include the first 22 families. The first 8 superfamilies are particularly primitive and of these, the first 3 superfamilies are all relictual base lineages of the Lepidoptera and also have only one family in each superfamily and each suborder: Micropterigidae (Micropterigoidea, suborder Zeugloptera), Agathiphagidae (Agathiphagoidea, suborder Aglossata), and Heterobathmiidae (Heterobathmioidea, suborder Heterobathmiina). These archaic superfamilies are all small moths (not over 16 mm in wingspan), concentrated most in what are now considered refugia regions of the world where the oldest faunas remain, so-called Gondwanaland distributions, notably in South Africa, Australia, New Zealand, and Chile, although some are more widespread like the Micropterigidae which occur in all regions. No archaic moths are known from Mexico, although it is possible some Micropterigidae may eventually be found in Mexico.

The other primitive groups, from Hepialoidea to Incurvarioidea, include some species from Mexico, although such leafminer families as Nepticulidae will have a larger fauna in Mexico once all species are described. Some of the Hepialidae include the largest moths among the primitive families (up to about 200mm in wingspan for some Mexican species).

Micropterigoidea

This superfamily is monobasic, including only the single family Micropterigidae.

1. Micropterigidae (mandibulate archaic moths) total 130 species worldwide. There are 2 subfamilies. Adults are minute to small and diurnal. Larvae feed on mosses, liverworts, or detritus. None is known for Mexico, but 2 species have been described from the Andes, in Chile and Ecuador, while 2 species are known from the United States.

Agathiphalgoidea

This is a monobasic superfamily, containing the relict family, Agathiphalgidae.

2. Agathiphalgidae (kauri moths) total only 2 known species, from Australia and Fiji. Adults are small and diurnal. Larvae are seed-borers of kauri pines (Araucariaceae). No New World species are known.

Heterobathmioidea

A monobasic superfamily, including only the single family Heterobathmiidae.

3. Heterobathmiidae (Valdivian archaic moths) include about 9 species, with 3 named thus far all from southern South America. Adults are small and diurnal. Larvae are leafminers of *Nothofagus* trees (Fagaceae). None is known for Mexico.

Eriocranioidea

The superfamily Eriocranioidea contains 2 families, together comprising the infraorder Dacnonypha.

4. Eriocraniidae (sparkling archaic sun moths) are a Holarctic family of 25 species, about half in Europe and half in North America. Adults are small and diurnal. Larvae are leafminers on a variety of hardwood trees and other plants. None is known for Mexico, however it is conceivable that there could be some species in Mexico.

5. Acanthopteroctetidae (archaic sun moths) are very similar to Eriocraniidae, and include only 4 species, all North American except for one in the Palearctic. Adults are small and thought to be diurnal. Larvae are blotch leafminers on *Ceanothus* (Rhamnaceae) for the single species known biological-

ly. None is in Mexico, but it is possible that there could be unknown species in northern dry regions of Mexico.

Lophocoronoidea

Representing the infraorder Lophocoronina, this monobasic superfamily contains the small archaic family, Lophocoronidae.

6. Lophocoronidae (Australian archaic sun moths) have 6 known species in Australia. Adults are small and crepuscular in sclerophyll eucalyptus woods. Biologies and larvae remain unknown. No New World species are known.

Neopseustoidea

This first group of the Myoglossata, infraorder Neopseustina, includes only the single archaic family Neopseustidae.

7. Neopseustidae (archaic bell moths) include 9 known species (6 from Southeast Asia and 3 from Chile). Adults are small (bell-shaped when at rest) and crepuscular or diurnal. Biologies and larvae remain unknown, but species in Chile are thought to possibly feed on native bamboos. None is known for Mexico.

Mnesarchaeoidea

This first superfamily of the infraorder Exoporia, of the Neolepidoptera, contains a single family of primitive moths, the Mnesarchaeidae.

8. Mnesarchaeidae (New Zealand primitive moths) occur only in New Zealand, with 8 known species. Adults are small and diurnally active in forest clearings and near ferns. Biologies and larvae remain unknown. No New World species are known.

Hepialoidea

This superfamily comprises the second superfamily of Exoporia, and the first group of lepidopterans with several families, although most species are in Hepialidae, the ghost moths. The superfamily comprises 518 known species worldwide. Only Hepialidae are known for Mexico, about 15 species.

9. Neotheoridae (Amazonian primitive ghost moths) include a single species from the Mato Grosso area of Brazil (2 more species have been discovered recently).

Adults are medium size. Biologies and larvae remain unknown. No species are known for Mexico.

10. Anomosetidae (Australian primitive ghost moths) comprise a single genus with 1 known species from Australia. Adults are small. Biologies and larvae remain unknown. No New World species are known.

11. Prototheoridae (African primitive ghost moths) comprise 12 species from southern Africa. Adults are small. Biologies and larvae remain unknown, but a pupa has been found in moss. No New World species are known.

12. Hepialidae (ghost moths, or swifts) comprise about 537 species from all faunal regions, but most are from Australia, South Africa, and Chile. Adults are medium size to very large and typically crepuscular or nocturnal, but a few are diurnally active. Larvae feed as borers on roots, trunks or under bark of trees, various bushes, or grasses, or even leaf litter. This is the first family with a number of species already described from Mexico, plus some species from the United States border probably also occur in northern Mexico. The Mexican total thus far amounts to at least 15 species, including some described from Guatemala and further south in Central America.

13. Palaeosetidae (miniature ghost moths) comprise 7 species worldwide (5 in Assam, Thailand and Taiwan, 1 in Australia, and 1 in Colombia). Adults are small and crepuscular or active during the day in dark forested areas, typically near wet moss-covered rock faces. Biologies remain unknown but larvae of a species in Taiwan are thought to feed on mosses. None is known from Mexico.

Andesianoidea

This monobasic superfamily includes the primitive Monotrysian family Andesianidae, recently described for species previously misplaced in Cossidae (Davis, 2003).

14. Andesianidae (Valdivian forest moths) total only 3 known species from southern Andean *Nothofagus* forests in Argentina and Chile. Biologies remain unknown. None is known for Mexico.

Nepticuloidea

The superfamily Nepticuloidea includes two families of the tiniest leafminer moths known, Nepticul-

idae and Opotegidae, and forms the first group of the Monotrysia. The world total is 990 species. Mexico has only 4 species recorded thus far, but the actual fauna may be over 60 species.

15. Nepticulidae (pygmy moths) comprise 868 species from all faunal regions, although most (over 510 species) are from the Palearctic region; actual world fauna likely exceeds 1,200 species. Two subfamilies are used. Adults are minute and diurnally active. Larvae are leafminers, usually blotch mines, although some also mine other plant parts. Many hostplants are used. No species are actually described from Mexico, but 80 species are known north of the U.S. border and some may occur in northern Mexico as well. Sampling of leaf mines will unquestionably result in the discovery of numerous Mexican species (perhaps as many as 50 species).

16. Opotegidae (eye-cap moths) total 122 known species from all faunal regions and especially Australia; actual fauna probably exceeds 175 species. Adults are minute to small and diurnally active. The few larvae known are leafminers, but some are stem borers. Hostplants are in several plant families. Four species have been described from Mexico, but more can be expected with thorough rearing of leafminers from all regions of Mexico (perhaps as many as 12 species).

Tischerioidea

This third group of Monotrysia, the superfamily Tischerioidea, includes the single family Tischeriidae.

17. Tischeriidae (trumpet leafminer moths) total 81 known species from all regions except Australia, with most species in the Nearctic (48 species); actual fauna likely exceeds 125 species. Adults are small and diurnally active. Larvae are leafminers, usually trumpet-shaped mines or blotch mines, on a variety of hostplants. One species has been described from Mexico. As with other leafminer groups, many more can be expected to be found in Mexico (perhaps as many as 10 species).

Palaephatoidea

The monobasic monotrysian superfamily Palaephatoidea contains one family from southern refugia regions of the world (except South Africa), the Palaephatidae.

18. Palaephatidae (Gondwanaland moths) total 39 described species (28 from Chile and Argentina, and 11 from Australia), but at least 25 more undescribed species are known from Australia alone; actual fauna probably exceeds 90 species. Adults are small to medium size. Biologies little known but adults presumed diurnally active. Larvae tie hostplant twigs together (on Verbenaceae and Proteaceae). No species are known for Mexico.

Incurvarioidea

This superfamily is the sole group comprising section Incurvariina of the Monotrysia. The superfamily has 589 known species. Only 16 species are known for Mexico thus far but more may be discovered.

19. Incurvariidae (leafcutter moths) total about 116 species from all regions, but most are Palearctic (64 species), divided into 2 subfamilies. Adults are small and mostly diurnal in shaded habitats. Larvae are leafminers at first, then switch to leaf skeletonizing on a variety of hostplants; some are casebearers or shoot borers. Although the only Neotropical species recorded thus far are from southern South America, a number of species from the western United States are now included in this family, so some may eventually also be discovered in northern Mexico.

20. Cecidosidae (gall moths) total only 7 species, with 5 species from southern South America and 2 from South Africa. Adults are small and probably diurnal. In Argentina larvae are gall makers on *Schinus* (Anacardiaceae). No species are known for Mexico.

21. Prodoxidae (yucca moths) total 65 species, mostly western Nearctic. There are 2 subfamilies. Adults are minute to small and diurnal. Larvae are seed, flower stalk, or stem borers; rarely gall makers. Hostplants are various yucca plants (Agavaceae) and other species are on hardwood trees and bushes. At least 3 species are known from Mexico, but some species known for southern Arizona and New Mexico also occur in northern Mexico, thus bringing the Mexican total to about 14 species.

22. Adelidae (longhorned fairy moths) comprise 295 species worldwide, but most are Palearctic (143 species), with 2 subfamilies; actual fauna probably exceeds 400 species. Adults are minute to small; antennae extremely long (often 2x wing lengths) in males,

but of average length in females (sometimes thickened). Adults are usually diurnal but a few are crepuscular. Larvae are leafminers, but in later instars change to casebearers. Hostplants include several plant families. Two species have been described from Mexico and there likely are more to be discovered, and at least a few more can be expected to occur in northern Baja California where the Californian fauna intrudes.

23. Heliozelidae (shield bearer moths) total 106 species from all regions, with more than half the species split between North America (31 species) and Australia (36 species); actual fauna probably exceeds 200 species. Adults are minute to small and diurnal. Larvae make serpentine leaf mines at first, then make blotch mines in later instars. Hostplants include several of hardwood trees and bushes. No Mexican species have been found but some are likely to be discovered with further sampling of leaf mines (perhaps as many as 10 species).

Ditrysia

This division of the infraorder Heteroneura comprises all the remaining Lepidoptera, with 20 superfamilies involved for the 102 families included for the world among these higher evolved lepidopterans.

Tineoidea

The superfamily Tineoidea includes the most primitive of the Ditrysia. The superfamily total comes to about 5,730 known species for the world. In Mexico, about 147 species are known, but as many as 665 can be expected in total.

24. Acrolophidae (tube moths) total 270 species in the New World, mostly in the large genus *Acrolophus*; actual fauna likely exceeds 350 species. Two subfamilies are used. Adults are small to medium size, with rather robust bodies and usually large recurved labial palpi. Adults are mostly nocturnal, but some may be crepuscular. Larvae are root feeders, mostly of grasses, and construct long underground silken tubes to feed on hostplant roots. Mexico harbors a number of species and more are likely to be discovered: the current total for Mexico is about 76 described species.

25. Tineidae (fungus moths) comprise the first very large family of Lepidoptera, with about 2,160 described species. The actual world fauna probably

exceeds 4,000 species. The family is divided into 16 subfamilies. Adults are minute to medium size and nocturnal or crepuscular; rarely diurnal. Larval habits vary greatly, but most are detritus feeders, some making cases, tunnels, or silken tubes; also, odd groups are coprophagous, keratophagous, woolen feeders, and even myrmecophilous and termitophilous larvae are known. Included among Tineidae are some of the most well known household pest species, such as clothes moths and grain moths. Besides the cosmopolitan household pests (clothes moths), Mexico has about 35 known species, yet many more are to be expected (perhaps as many as 75 species).

26. Eriocottidae (Old World spiny-winged moths) are a small family of 212 known species, mostly African (120 species) and Oriental (66 species), now divided into 2 subfamilies. Adults are small to medium size and mostly diurnally active, or may be crepuscular. Biologies are little known but some larvae reported to tunnel in the soil, possibly feeding on roots or detritus. No New World species are known.

27. Psychidae (bagworm moths) total 1,001 known species, mostly Palearctic and African, with only 88 known for the New World; actual fauna likely exceeds 1,200 species. The family is now divided into 6 subfamilies. Adults are minute to medium size and mostly diurnal or crepuscular. Larvae are mostly leaf feeders or feed on lichens, all making distinctive types of larval cases, or bags. Pupation is within the larval case and females often remain there in a wingless or larviform shape, using pheromones to attract the winged males. Some species are economic and many are general plant feeders. Mexico has about 17 known species, but many more to be described.

28. Arrhenophanidae (tropical lattice moths) total 26 species, mostly Neotropical, but recently with some Southeast Asian additions; actual fauna probably exceeds 50 species. Adults are small to medium size. Adult activity mostly nocturnal, but some are diurnal. Biologies unknown except for one Neotropical species with casebearing larvae that feed on fungi. None described from Mexico, but 2 species occur in southern Mexico and another 2 remain to be described.

29. Amphitheridae (double-eye moths) are an unusual and small family of mostly tropical moths, totaling 35 species, mostly Indo-Australian (1 genus occurs in Europe and another in South America). Adults are small, with eyes usually divided. Adults

active diurnally. Larvae are leafminers, becoming leaf skeletonizers in later instars; host records are mostly in Betulaceae and Aceraceae. The family has been erroneously called Roeslerstammiidae in recent European literature. None known for Mexico.

30. Schreckensteiniidae (bristle-legged moths) are a small family of only 8 known species (3 in North America, 1 in Guatemala, 1 in Colombia, 1 in Europe, and 3 in Asia). Adults are small and diurnal. Larvae are leaf skeletonizers on Anacardiaceae or Rosaceae. At least one species should be in southern Mexico, probably the same as the one from Guatemala.

31. Douglassiidae (Douglas moths) comprise only 28 known species, mostly Palearctic (20 species). Adults are minute to small and crepuscular or diurnal. Larvae are leafminers or borers in petioles or stems. Hostplants are known in Boraginaceae, Labiatae, and Rosaceae. One species is known from Ecuador, but none have been recorded from Mexico.

32. Bucculatricidae (ribbed-cocoon maker moths) total 247 species worldwide, with most species being Nearctic (103 species) or Palearctic (86 species); most species are in the genus *Bucculatrix*. Adults are minute to small and mostly diurnal. Larvae are leafminers, with some changing to external leaf skeletonizing in later instars, but a few are gall makers or stem miners. Pupation is in a white spindle-shaped cocoon with a ribbed surface, unique to the family. Many different hostplants are known but many feed on Compositae. Some species are economic. Four species are known for Mexico, but many more are likely to be found (perhaps as many as 25 species).

33. Gracillariidae (leafminer moths) comprise the major leafmining family of Lepidoptera, with about 1,740 species from all regions. The actual world total probably exceeds 6,000 species. There are 3 subfamilies. Adults are minute to small and active diurnally. Larvae are usually leafminers but change form in later instars (hypermetamorphism) from sap feeders with reduced legs, to later instars with a 3-proleg pair larval form, which is unique among the Microlepidoptera. Later instars sometimes feed externally as leaf skeletonizers. Hostplants include a great number of plant families. A few species are of economic importance, such as the citrus leafminer (*Phyllocnistis citrella*) introduced from China. The current total for Mexico is about 13 species, but numerous species can be expected to occur in Mexico, and will be

discovered once more leafminers are reared and the species described (perhaps as many as 450 species).

Gelechioidea

This superfamily comprises a huge group of micro-moths, all having a scaled haustellum and unspined pupa. There has been considerable turmoil in recent classifications proposed for the group, either with a large family Oecophoridae or with conglomeration of various groups into an enlarged family Elachistidae. In the classification adopted herein, there are 11 families recognized, the largest being Oecophoridae and Gelechiidae. The entire superfamily encompasses about 18,230 described species worldwide, but the actual fauna may well exceed 45,000 species, since there are huge numbers of undescribed tropical species. In Mexico, there are 396 described species, but as many as 1,825 can be expected to occur there.

34. Oecophoridae (concealer moths) are a large family of about 7,550 described species from all faunal regions, with most species being from Australia; the actual fauna may well exceed 12,000 species worldwide. There are 10 subfamilies recognized. Adults are small to medium size and mostly nocturnal but some are diurnal or crepuscular. Larvae include many leaf litter feeders, but also leaf tiers, leaf webbers, bark feeders, and a few leafminers. Hostplants include a large number of plant families, plus lichens, fungi, and detritus or leaf litter. Few are economic. Mexico has 172 species recorded (actual Mexican fauna may exceed 350 species).

35. Lecithoceridae (tropical longhorned moths) total about 1,038 described species, mostly tropical Oriental, but also with one group in the Palearctic; actual fauna probably exceeds 1,500 species. There are 4 subfamilies. Adults are small and mostly diurnal and many have the habit of holding the long antennae together to the front when at rest. Larvae may mostly be leaf litter feeders or leaf tiers, but few species are known biologically. A few varied hostplants are recorded. None is recorded in the New World (the Neotropical genus *Deoclona* has been transferred to Oecophoridae).

36. Elachistidae (grass miner moths) comprise about 723 species worldwide, but most are Palearctic (472 species). Two subfamilies are used (or only tribes). Adults are small and often crepuscular or nocturnal, but some are diurnal. Larvae are leafminers (sometimes gregarious) or stem miners, especially on grass-

es (Gramineae) and related plant groups like Juncaceae and Cyperaceae, but other plant families are also utilized. None recorded from Mexico, but at least the sugarcane leafminer, *Dicranoctetes saccharella* (Busck), is likely to also occur in Mexico.

37. Pterolonchidae (lance-wing moths) total only 11 species, mostly Mediterranean, plus 2 are from South Africa. Adults are small and may be mostly crepuscular. Larvae are root borers as far as is known. Only recorded hostplants are in Compositae. One species introduced into western North America for control of knapweed. None recorded in Mexico.

38. Gelechiidae (twirler moths) are a very large family, with over 4,830 species described, however, possibly with a fauna exceeding 10,000 species worldwide. Subfamily arrangements have varied but now include 4. Adults are small and mostly nocturnal but some are diurnal or crepuscular. Larvae have a range of feeding habits but most are leaf skeletonizers, using a leaf fold or leaf tie as protection. A large variety of plants are used as hosts. Some species are economically important. A number of species are recorded for Mexico (175 species), but the actual fauna undoubtedly will exceed 1,200 species when all are discovered in Mexico.

39. Blastobasidae (scavenger moths) total over 296 species worldwide, with many known from North America and Europe; actual fauna probably exceeds 600 species. There are 2 subfamilies. Adults are small and nocturnal as far as is known. Larvae are scavengers or detritus feeders, sometimes feeding on plant fruits, flowers, or seeds, among a number of plant families, but few are known biologically. At least one species lives with coccids (Homoptera) but predation on the coccids has not been confirmed. Mexico has 9 species recorded, but the true fauna likely will be near 100 species.

40. Coleophoridae (casebearer moths) comprise about 1,525 species worldwide, with most being Palearctic and in the genus, *Coleophora*. The actual world fauna likely exceeds 2,000 species. Most are in subfamily Coleophorinae, while non-casebearers are in Batrachedrinae. Adults are small and may be mostly crepuscular but many are diurnal. Larvae make small cases (except for Batrachedrinae), often distinctly shaped for each species, skeletonizing host leaves, but some are seed borers, leafminers, or stalk borers, or skeletonize leaves beneath frass webs. A few Batrachedrinae are predacious on scale insects

(Homoptera). Various hostplants are used. A few species are economic. Ovovivipary has been recorded for a few species. Mexico has 8 known species, but there likely are 30 or more species.

41. Momphidae (mompha moths) total 127 species worldwide, with about half from the Palearctic. Adults are small and mostly diurnal or crepuscular. Larvae mostly leafminers, but some are borers in flowers and stems, or gall makers. Hosts are only known in Onagraceae. Mexico has 5 species recorded.

42. Agonoxenidae (palm moths) are a small family of 68 known species from all faunal regions. Adults are small and diurnal. Larvae are leaf skeletonizers, or borers in leaves, stems, and fruits; rarely gall makers. Hostplants mostly in Rosaceae or Palmae. A few are economic. None recorded from Mexico but there likely are at least 5 species to be found.

43. Cosmopterigidae (cosmet moths) total over 1,540 species worldwide, but the extant fauna may encompass 3,500 species. There are 3 subfamilies. Adults are small and mostly diurnal, but some are crepuscular. Larvae mostly leafminers or needleminers, but some are borers of various plant parts; a few are predacious on Homoptera. Hosts are varied. Ovovivipary recorded in a few species. Some economic species are known. A large group, with 27 species known for Mexico (actual fauna probably more than 100 species).

44. Scythrididae (flower moths) total about 523 species worldwide, but mostly known from Europe. Adults are small and diurnal but some may be crepuscular. Larvae are skeletonizers on leaves, buds, flowers, hiding under webbing. Many plant families are used as hosts, plus some on lichens and mosses. Not recorded for Mexico but the probably are at least 10 species to be found.

Copromorphoidea

This superfamily comprises 4 families related especially by larval characters. The world fauna totals 623 species. In Mexico, about 6 species are known, which may eventually total 10 species.

45. Copromorphidae (tropical fruitworm moths) are a small family of 58 species, mostly tropical; actual fauna probably exceeds 100 species. Adults are small to medium and nocturnal. Larvae are leaf feeders using a leaf web, or are borers (one feeds

beneath bark), but few biologies are known. Hostplants include Berberidaceae, Ericaceae, Moraceae, Podocarpaceae, and Rubiaceae. In Mexico, there are 2 species known.

46. Alucitidae (many-plumed moths) total about 184 species worldwide. Adults are small; wings with all veins as separate wing clefts to near the wing bases (rarely split only to center of wings). Adults active in deep shade, or may be crepuscular. Larvae are borers or gall makers as far as is known. Various hostplant records are known. There are 2 species recorded in Mexico.

47. Carposinidae (fruitworm moths) total about 279 species from all regions, but most are Australian and South Pacific. Adults are small to medium and nocturnal or crepuscular. Larvae are borers in fruits, seeds, buds, or trunks and limbs, but a few are leafminers. Hosts include a variety of plants. A few species are economic. Mexico should have about 3 species ranging from nearby areas in the United States.

48. Epermeniidae (fringe-tufted moths) total 102 species, with many being Palearctic (36 species) and Australian (23 species), in two subfamilies. Adults are small and diurnal or crepuscular. Larvae are leafminers, leaf skeletonizers, or borers of seeds, fruits, or buds; a few are gall makers. Host records include several plant families. One species is recorded for Mexico.

Yponomeutoidea

This superfamily of varied moths includes 9 families, some of which have been transferred from Tineoidea, while other previously contained groups are now in other superfamilies. About 1,853 species are known in the superfamily. In Mexico, 35 species are known and the actual fauna may be as high as 110 species.

49. Ochsenheimeriidae (cereal stem moths) include only 17 species from the Palearctic (1 species is from Kashmir), with 1 species introduced into North America. Adults are small and diurnal. Larvae are leafminers, but become stem borers in later instars, primarily on grasses (Gramineae), sedges (Cyperaceae) and rushes (Juncaceae). One species is economic. None is known for Mexico.

50. Glyphipterigidae (sedge moths) total 431 species from all regions, mostly in the genus *Glyphipterix*, with the largest number from the Australian-New Zealand region; actual world fauna probably exceeds 600 species. There are 2 subfamilies. Adults are small and diurnal, usually in proximity to the hostplants. Larvae are mostly borers in seeds, stems, or leaf axils, and a few are leafminers, but most tropical species are unknown biologically. Hostplants are mostly sedges (Cyperaceae), rushes (Juncaceae), and grasses (Gramineae), plus a few other plant families. Mexico has 6 species, but specialized collecting should verify a fauna of at least 50 species.

51. Plutellidae (diamondback moths) include 386 species worldwide; actual fauna probably exceeds 600 species. There are 4 subfamilies. Adults are small to medium size and mostly nocturnal or crepuscular, but some are diurnal. Larvae are leaf skeletonizers, but most remain unknown biologically. Hosts include different plant groups. A few species are economic. Including the cosmopolitan diamondback moth from Europe (*Plutella xylostella*), the family has only 3 species noted for Mexico, but the actual fauna should be at least 10 species.

52. Attevidae (tropical ermine moths) include 48 species, mostly tropical and in the genus *Atteva* (the single partially non-tropical species known occurs across the southern United States and into the Caribbean and Mexico); actual fauna probably at least 60 species. Adults are small to medium size and are diurnal or crepuscular. Larvae are leaf webbers and leaf skeletonizers on Araliaceae and Simaroubaceae. Minor economic species occur on *Ailanthus* trees in India and the United States. At least 3 species are in Mexico.

53. Yponomeutidae (ermine moths) total 395 species worldwide; actual fauna likely exceeds 500 species. Three subfamilies are recognized. Adults are small to medium size and mostly nocturnal. Larvae are leaf skeletonizers and leaf webbers, but some are leafminers or needleminers. Hosts include many plant families. A few species are economic. Mexico has 3 species recorded, but more should be found in the central mountains.

54. Argyresthiidae (shiny head-standing moths) include 160 species, mostly from Holarctic regions; actual fauna probably exceeds 450 species. Adults are small and mostly crepuscular, but many may be diurnal. Larvae are leafminers and needleminers,

and some mine in various plant parts. Numerous plants are recorded as hosts. Several species are economic. None recorded from Mexico.

55. Lyonetiidae (Lyonet moths) total 264 species, mostly Holarctic; the actual fauna probably exceeds 600 species. There are 3 subfamilies. Adults are minute to small and mostly crepuscular and nocturnal. Larvae are blotch leafminers; rarely mining stems. Many plant groups are recorded as hosts. A few species are economic. Mexico has at least 6 species.

56. Acrolepiidae (false diamondback moths) include 96 species, mostly Palearctic. Adults are small and crepuscular or diurnal. Larvae mostly leafminers, but some are borers in seeds, stems, and flower buds. Several hostplant groups are used, but mostly on Compositae. Very few are economic. Mexico probably has one species entering from Guatemala, and more may be found in northern areas.

57. Heliodinidae (sun moths) are a small family of 56 species, mostly Neotropical (31 species); actual fauna probably exceeds 100 species. Adults are small and diurnal. Larvae are mostly leaf skeletonizers, but some are borers in fruit racemes. Several plant families are used as hosts. Mexico has 13 species and more are likely to be found.

Immoidea

This is a monobasic superfamily for the single small family Immidae. It is somewhat related to Pyraloidea and may represent relatives of common ancestors.

58. Immidae (imma moths) comprise 246 species, all tropical, and mostly Indo-Australian and South Pacific; actual fauna likely exceeds 450 species. Adults are small to medium size and diurnal, but some may be crepuscular. Larvae are leaf feeders, but only 3 species have biological data. Hostplants are in Myrtaceae, Podocarpaceae, and Violaceae. None described from Mexico, but at least 2 species described from Guatemala should also be found in Chiapas.

Pyraloidea

This superfamily includes 3 families but mainly the very large family, Pyralidae. The superfamily comprises about 17,312 species worldwide. Some specialists split the group by placing each pyraloid family in its own monobasic superfamily (Hyblaeoidea,

Thyridoidea, and Pyraloidea). In Mexico, about 1,375 species are known and perhaps 3,045 will eventually be recorded there in this superfamily.

59. Hyblaeidae (teak moths) are a small tropical family of 18 species, mostly Indo-Australian and in the genus *Hyblaea* (1 pantropical species is also established in southern Florida). Adults are medium size; body usually robust. Adults are diurnal or perhaps crepuscular. Larvae are leaf rollers. Hostplants are in Bignoniaceae and Verbenaceae. One economic species is the teak leafroller, which also occurs in Mexico.

60. Thyrididae (picture-winged leaf moths) total 794 species worldwide, nearly all tropical, with nearly half the species Indo-Australian (only a few species are in the Nearctic and Palearctic regions); actual fauna likely exceeds 1,200 species. There are 6 subfamilies. Adults are small to large and diurnal or crepuscular. Larvae are leafrollers (one Australian species is gregarious), or borers in stems and flower racemes; a few are gall makers. Several hostplants are used. Only a few species are economic. Mexico has 24 species, but the complete fauna should approach at least 45 species.

61. Pyralidae (snout moths) comprise the third largest family of Lepidoptera, with about 16,500 described species, but a probable fauna of at least 25,000 species worldwide; 19 subfamilies are used in the classification. Recent specialists have taken to splitting Pyralidae into its two major lineages, as the separate families Crambidae and Pyralidae, but this reversion to what was done over 100 years ago is unnecessary and amply clarified by using the "group" category below the family level within a single family Pyralidae. Adults are small to large and mostly nocturnal, but some are crepuscular and a few are diurnal. Larvae are mostly leafrollers or leafwebbers, but many are borers, root feeders, detritus feeders (including stored products pests), and a few are leafminers, plus rare myrmecophilous species, and even some aquatic groups making cases (Nymphulinae). A large number of economic species are in this family, including pests on virtually all crops and forest trees. Hostplants are in a large number of plant families. The family is exceedingly large in Mexico also, with many species ranging through the Caribbean and the Neotropics, plus many from the United States. The Mexico total recorded thus far is about 1,350 species, but with the discovery of new species and more surveying both in southern and northern

Mexico, the actual fauna probably is at least 3,000 species.

Pterophoroidea

This superfamily includes only 3 families, but most species are in the Pterophoridae. About 1,309 species are known for the superfamily. In Mexico, 43 species are recorded thus far, but perhaps 80 species will eventually be found there.

62. Tineodidae (false plume moths) include only 11 species, all from Australia. Adults are small and possibly diurnal or crepuscular. Larvae are leaftiers, but most are not known biologically. Only recorded hostplants are in Euphorbiaceae and Oleaceae. No New World species known

63. Oxychirotidae (tropical plume moths) include only 6 species, all Indo-Australian and South Pacific. Some specialists include this family as part of the Tineodidae. Adults are small and may be crepuscular. Larva of one species feeds on seeds of white mangrove (Avicenniaceae); remainder unknown biologically. No New World species known.

64. Pterophoridae (plume moths) comprise about 1,292 species worldwide, with about a third being Palearctic; actual world fauna probably exceeds 1,800 species. Subfamilies number 5. Adults are small, usually with hindwings split into 3 fringed plumes; forewings often entire or split into 2 parts near the termen (a few species have both wings entire). Adults mostly nocturnal but some crepuscular or in shaded areas during the day. Larvae mostly leaf feeders, or miners and borers of various plant parts; a few are gall makers. Hostplants include many families. Several species are economic. Recorded species in Mexico total about 43 species, while the actual fauna probably will exceed 80 species.

Sesioidea

The Sesioidea include 4 families, although many specialists maintain separate superfamilies for most of them: Brachodidae, Sesiidae, Urodidae, and Choreutidae. Brachodidae are thought to be the basal group, with close ties to Sesiidae. The world fauna totals 1,964 known species in the superfamily. Mexico has 117 species recorded and may have an actual fauna of 230 species or more.

65. Brachodidae (little bear moths) comprise 141 species, most being Old World tropical, particularly Indo-Australian (none is North American). There are 3 subfamilies. Adults are small to medium size and diurnal. Larvae are root feeders of grasses (in the European *Brachodes*, Brachodinae), using silken tubes, or borers in palm trunks and leaf stems, or other plants; some are leaftiers (Phycodinae). Hostplants are in Gramineae, and also Bromeliaceae, Melistomaceae, Moraceae, and Palmae. A few are economic on palms. Southern Mexico has at least 1 species.

66. Sesiidae (clearwing moths) include about 1,325 species from all regions; the actual number probably exceeds 1,800 species. Subfamilies are 3. Adults are small to medium size; antennae usually thickened and with a slight distal club (most also with unique small terminal bristles on antennae). Wings very elongated and with unique wing-locking folding where the margins meet. Adults are diurnal, particularly during morning hours. Many species mimic various wasps (Hymenoptera). Larvae mostly borers on various plant parts, and a few are gall makers; 2 species are predaceous on scale insects (Homoptera). Host specificity is high for most species, but overall many plant families are used as hosts. A number of species are economic, including some major pests of fruit trees, forest trees, and grape vines. There are numerous species in northern Mexico that overlap at the United States border, bringing the Mexico total to about 150 species (includes new species from an upcoming monograph for Mexico; Eichlin, pers. comm.), but the actual fauna should be about 180 species when all are discovered.

67. Urodidae (false burnet moths) total only about 80 species, primarily Neotropical, but with a few species in North America and in Eurasia. Adults are small and may be crepuscular or mostly nocturnal, but a few possibly diurnal. Larvae are leaf webbers or skeletonizers, but few are known biologically. Pupation is in a specialized filigreed cocoon. Hostplants known in Lauraceae, Leguminosae, Salicaceae, Sapotaceae, and Theaceae. A few are minor pests. Mexico should have at least 3 species and likely as many as 10 species.

68. Choreutidae (metalmark moths) comprise 418 species worldwide; actual world fauna probably exceeds 800 species. There are 3 subfamilies. Adults are small, with haustellum scaled. Adults are diurnal; usually near their hostplants and tend to hop about on leaves. Larvae mostly leaf skeletonizers, but some are

budworms; rarely leafminers (Millieriinae). Numerous hostplant families are recorded, but many in Compositae and Moraceae. The Mexican fauna totals about 21 described species, but the actual fauna will probably exceed 50 species.

Zygaenoidea

This superfamily contains the burnet moth and flannel moth groups, with 6 families involved. The superfamily has 1,609 known species from all regions. In Mexico, 127 species are recorded, and 150 may be the true faunal total.

69. Heterogynidae (Mediterranean burnet moths) include only 7 species, with 3 species from the Mediterranean region of southern Europe and northern Africa and 4 species from South Africa. Adults are small and diurnal, but females are apterous and larviform. Larvae, upon hatching inside the female cocoon, feed first on the dead female and then become external leaf feeders. Hostplants are in Leguminosae. No New World species known.

70. Zygaenidae (burnet moths) comprise about 1,140 species worldwide, particularly well developed in tropical Asia (450 species) where also the largest species occur; actual world fauna likely exceeds 1,500 species. There are 7 subfamilies. Adults are small to large, with antennae sometimes clubbed. Adults are diurnal, often flying like butterflies, or commonly on flowers. Larvae are leaf skeletonizers, sometimes feeding communally and usually at night; often slug-like, with concealed head. Hostplants include various plant families. Economic species are mostly pests on grapevines in North America and Europe. In Mexico, the fauna is about 88 species, with perhaps 100 species actually extant.

71. Himantopteridae (long-tailed burnet moths) include 56 species from Africa and tropical Asia. Adults are small to medium size; hindwings with extremely long tails. Adults are diurnal but few are known biologically. Larvae are leaf skeletonizers, often communal; sometimes massing in the 1000s. Known hostplants are in Dipterocarpaceae. No New World species known.

72. Lacturidae (tropical burnet moths) total 138 species, mostly Indo-Australian but with a few in the southern United States; actual world fauna probably exceeds 250 species. Adults are small to medium size and nocturnal, but some may be crepuscular. Larvae

are leaf skeletonizers and are colorful, but most are not known biologically. Hostplants are in families Celastraceae, Moraceae, and Sapotaceae. Mexico should have about 7 species.

73. Somabrachyidae (Mediterranean flannel moths) include only 5 species, with 3 species from southern Europe and north Africa, plus 2 species from South Africa. Adults are small. Adults are diurnal, but females are larviform and wingless (females of the South African species are unknown). Larvae are leaf feeders (eggs laid on leaves, not in the female cocoon), somewhat slug-like, with concealed head. Hosts are grasses (Gramineae) and Compositae. No New World species known.

74. Megalopygidae (flannel moths) are a New World family of 263 species, mostly Neotropical; actual fauna likely exceeds 350 species. Adults are small to large and nocturnal. Larvae are leaf feeders, usually communal in early instars; slug-like, with concealed head; with poison spines usually beneath long hair-like setae. A large number of hostplants are recorded, and some species are polyphagous. A few are economic on forest trees and palms, but most are of medical importance due to urticating setae in adults and the poison spines in larvae. Mexico has about 32 species.

Cossoidea

This superfamily includes about 2,054 species in the world. In Mexico, 154 species are known and as many as 175 may occur there.

75. Cossidae (carpenterworm moths) total 682 species worldwide; actual fauna probably exceeds 750 species. There are 5 subfamilies. Adults are small to very large and nocturnal. Larvae are borers in trunks and limbs. Hostplants are recorded in a large number of plant families. A number of species are economic pests of forest trees. In Mexico there are about 60 species.

76. Dudgeoneidae (Dudgeon carpenterworm moths) includes only 6 species in the single genus *Dudgeonea*, with 2 species from Africa, 1 from India, and 3 from Australia. Adults are medium size; abdomen with small tympanal organs. Adults nocturnal as far as is known. Larvae mostly unknown, but one Australian species is a stem borer on Rubiaceae. No New World species known.

77. Metarbelidae (tropical carpenterworm moths) include 103 species, mainly Afrotropical and Oriental, with 1 species in the Palearctic region; actual world fauna likely exceeds 150 species. Adults are small to medium size and may be crepuscular. Larvae nocturnal borers on tree bark or in tree trunks, but most species remain unknown biologically. Hostplants include various trees. A few have minor economic status. No New World species known.

78. Cyclotornidae (Australian parasite moths) include only 5 known species from Australia, the most primitive of the Limacodiformes group of Cossoidea. Adults are small. Adult activity uncertain but may be crepuscular. Larvae flattened, with lateral protrusions; highly evolved as parasites of leafhoppers, scale insects, or psyllids (Homoptera) in early instars, and then as predators of ant larvae. No New World species known.

79. Epipyropidae (planthopper parasite moths) total 40 described species, with at least another 30 known species awaiting naming; most diversity is in Australia. Two subfamilies are known. Adults are minute to small and crepuscular or nocturnal; females are sedentary. Larvae slug-like with rounded dorsum; parasitic on fulgorids and planthoppers (Homoptera). Mexico should have about 2 species, if not more.

80. Dalceridae (tropical slug caterpillar moths) include 84 Neotropical species (1 species intrudes from Mexico into southern Arizona). Two subfamilies are known. Adults are small to medium size. Adult activity uncertain; possibly only nocturnal or crepuscular. Larvae slug-like, often with translucent gelatinous wart-like surface; feeding as leaf feeders (early instars as leaf skeletonizers), but few are known biologically. Various hostplants are used and some larvae are polyphagous. Few have any economic status. The Mexican fauna totals about 12 species.

81. Limacodidae (slug caterpillar moths) total 1,104 known species worldwide, the largest family of Cossoidea, mostly tropical and especially biodiverse in the Oriental tropics; likely world total is near 1,600 species or more. Adults are small to medium size. Adults perhaps only nocturnal; many with unique resting postures. Larvae slug-like and mostly polyphagous leaf feeders, usually with an extensive array of poisonous stinging spines dorsally. Large numbers of hostplants used. Few species are economic other than medically as stinging caterpillars, but

palm defoliators can be a problem in the tropics. Mexico has about 80 species.

82. Chrysopolomidae (African slug caterpillar moths) are a small African family of about 30 known species. Two subfamilies are known. Adults are medium size and nocturnal. Larvae leaf-feeding and slug-like, with small spines; often colorful. Hostplants include Celastraceae. No economic species are known. No New World species known.

Castnioidea

This superfamily contains only the single family Castniidae.

83. Castniidae (giant butterfly moths) total 170 known species, mostly Neotropical but with some species also in the Indo-Australian region; likely world total may exceed 180 species. Three subfamilies are known. Adults are medium to large size and diurnal or crepuscular. Larvae are borers of monocot plants, including grasses (Gramineae), Cyperaceae, Bromeliaceae, Marantaceae, Musaceae, and Palmae, among others. A few are economic on banana plants, various palms, and sugarcane. Mexico has 14 species recorded out of 134 Neotropical species described thus far.

Tortricoidea

A monobasic superfamily exclusively for the family Tortricidae. In the past, the tortricid subfamilies were often considered separate families, such as Olethreutidae and Chlidanotidae, and even groups like Ceracidae and Cochylidae which now are only tribes.

84. Tortricidae (leafroller moths) are a large family of 8,945 described species from all faunal regions; the actual fauna likely will exceed 12,000 species. Three subfamilies are known. Adults are small (rarely medium sized) and mostly nocturnal or crepuscular, but some are diurnal. Larvae mostly leafrollers, but some are borers in various plant parts, including stems, branches, flowers, and seeds; a rare few are leaf litter feeders. Most species are restricted to certain hostplants among innumerable plant families. Many species are economic. The Mexican fauna is exceedingly rich and has a large component of species from the United States border, plus endemic species. The Mexican total thus far is about 495

species, but the actual fauna probably exceeds 1,000 species.

Calliduloidea

This first superfamily of the Bombycina includes 3 families of ancient lineage with many primitive features: Ratardidae, Pterothysanidae, and Callidulidae. All are Old World and total 131 known species for the superfamily.

85. Ratardidae (Oriental parnassian moths) are butterfly-like moths of the Himalayas and Oriental tropics, with 10 described species, plus a few more still undescribed. Adults are medium sized (29-87 mm wingspan), but males often much smaller than females. Adults are diurnal. Larvae are bark feeders, but biologies and larvae are mostly unknown. No New World species known.

86. Pterothysanidae (parnassian moths) include 19 species from southern Africa (7 species) and Southeast Asia (12 species). There are two subfamilies. Adults are medium size and diurnal, possibly also crepuscular. Biologies and larvae remain unknown. No New World species known.

87. Callidulidae (Old World butterfly moths) include 102 species, mostly tropical Oriental, in 2 subfamilies. Adults are medium size and diurnal, flying like some butterflies in quick bursts to alternate leaf perches; resting position with wings held together and upright. Larvae largely unknown, except for 2 species which are leafrollers of ferns. No New World species known.

Uranoidea

This superfamily encompasses both very large and small moths among 5 families, but mostly Old World. Some of these families continue to be mixed up with Drepanoidea and Geometroidea, and recently many groups have been combined into Epiplemae. About 814 species are known in the superfamily. In Mexico, about 30 species are known, with as many as 50 species eventually to be found there.

88. Epicopeiidae (Oriental swallowtail moths) are a small family with 25 species known in 2 subfamilies, mostly Himalayan and East Asian. Adults are medium to large and diurnal. Larvae little known, but leaf feeders with waxy secretions over body. Hostplants

are in Clethraceae, Cornaceae, Ericaceae, Theaceae, and Ulmaceae. No New World species known.

89. Apoprogonidae (African skipper moths) include only a single species from South Africa. Adults are medium size; antennae clubbed (hooked at tip); body robust. Adults presumed diurnal, but nothing is known of the biology or larvae. No New World species known.

90. Sematuridae (American swallowtail moths) total 36 Neotropical species, one of which just reaches into the United States in southern Arizona. Adults are medium to large; antennae thickened, with elongated club (slightly hooked at tip). Adults nocturnal but some may be crepuscular. Larvae are leaf feeders, but few known biologically. Hostplants are unrecorded. Mexico has about 5 species.

91. Uraniidae (swallowtail moths) comprise about 120 species from all tropical regions, mostly Indo-Australian (85 species); one species strays into the United States-Mexican border region (mainly in Texas). Two subfamilies are used. Adults are medium to large and nocturnal or diurnal, with some of the larger diurnal species known to migrate. Larvae are leaf feeders. Hostplants are known in Asclepiadaceae, Myrtaceae, and Euphorbiaceae. Mexico has about 5 species.

92. Epiplemidae (crenulate moths) total about 632 species worldwide, with most being Neotropical (230 species) and Indo-Australian (301 species). Two subfamilies are used. Adults are small to medium size and nocturnal. Larvae are leaf feeders or webbers. Hostplants are in several plant families. Mexico has a fauna of about 20 species.

Geometroidea

One of the largest superfamilies of Lepidoptera, mainly with the large family Geometridae, but also including the odd Hedyliidae (some specialists place the latter family near the true butterflies, in its own superfamily, Hedyloidea). The superfamily total comes to 21,190 known species. Mexico has about 2,508 species recorded, but perhaps as many as 3,000 species.

93. Geometridae (geometer moths, also called inch worms) are the second largest family of Lepidoptera, with about 21,150 described species from all faunal regions; the actual fauna probably exceeds 26,500

species. The major biodiversity is in the Neotropics, with over 6,500 species described, and the Indo-Australian region with about 6,670 species. The family is divided into 8 subfamilies. Adults are small to large; a number of genera have brachypterous or apterous females. Adults mostly nocturnal, but also some crepuscular and diurnal groups. Larvae mostly leaf feeders, typically moving in looping fashion due to reductions in proleg numbers. Hostplants include most plant families. Some major defoliating pests are known in this family. The total for Mexico should be at least 2,500 species but may exceed 3,000 species.

94. Hedyliidae (American butterfly moths) total only 40 known species, all Neotropical. Adults are medium size and nocturnal. Larvae are leaf feeders. Hostplants are recorded in Euphorbiaceae, Malvaceae, Streuliaceae, and Tiliaceae. Mexico has about 8 species.

Papilionoidea

The butterflies, also called Rhopalocera, include 7 families, including the skippers, family Hesperidae. Skippers are sometimes placed in their own monobasic superfamily, Hesperioidea. Extant butterflies number about 20,400 described species, but the actual butterfly fauna probably will be about 23,500 species worldwide when all are discovered. In Mexico, 1,808 species are known thus far.

95. Hesperidae (skipper butterflies) include about 4,100 species from all faunal regions; most are Neotropical, with over 2,338 species. The actual world fauna probably exceeds 4,500 species. Seven skipper subfamilies are recognized. Adults are small to medium size and diurnal, usually with very rapid flight, but a few tropical species are crepuscular. Larvae are leafrollers or borers. Hostplants are primarily grasses (Gramineae) and other monocots. A few economic species are known, particularly on rice. Mexican records include 741 species.

96. Papilionidae (swallowtail butterflies) total about 589 species worldwide, with about 260 species being Indo-Australian, including the largest of all butterflies, the birdwings. Three subfamilies are recognized. Adults are medium size to very large and diurnal. Larvae are leaf feeders; with an osmeterium defensive gland behind head. Hostplants include many plant groups. Some economic species are known, mainly citrus feeders. Mexico has 56 species, includ-

ing what is the most primitive genus in the family, *Baronia*, in the subfamily Baroniinae.

97. Pieridae (yellow-white butterflies) total about 1,275 species worldwide, most being Indo-Australian (about 515 species). Four subfamilies are recognized. Adults are small to large and diurnal. Larvae are leaf feeding. Various plants are utilized. Some economic species are known, particularly on cabbages and other crucifers. Mexican species total about 90 species.

98. Lycaenidae (gossamer-winged butterflies) total about 5,955 species worldwide; the actual fauna probably exceeds 7,000 species. About 1,125 species are Neotropical. The family has 8 subfamilies. Adults are small to medium size and diurnal, but a few of the relict genera possibly crepuscular or only in dark forests. Larvae mostly somewhat slug-like, with tubercles and short setae; head usually retractable into thorax. Larvae feed as leaf feeders (some on other plant parts), but many are myrmecophilous and some even are carnivorous on ant larvae or homopterans. Hostplants are in a wide variety of plant families, but particularly Fagaceae and Leguminosae. A few economic species are known. Mexico has about 225 species.

99. Riodinidae (metalmark butterflies) total about 1,419 species worldwide but predominate in the Neotropics (1,322 species); the actual world fauna probably exceeds 2,500 species. Five subfamilies are recognized. Adults are small to medium size and diurnal; often with rapid flight. Larvae are leaf feeders, but many are myrmecophilous; one is known to be carnivorous on homopterans. Larvae mostly slug-like with short setae. Hostplants are recorded in numerous plant families. Mexico has about 255 species.

100. Libytheidae (snout butterflies) are a small family of only 12 species, with at least one species in each faunal region. Adults are medium size and diurnal. Larvae are leaf feeders. Hostplants are in Ulmaceae. A single species is known for Mexico.

101. Nymphalidae (brush-footed butterflies) are the largest family of butterflies, with about 7,080 described species worldwide; the actual fauna probably exceeds 8,000 species. To represent the division of relict basal groups within the family, the subfamilies are divided into two groups: Nymphaliniina, with 6 subfamilies, and Satyriniina, also with 6 subfamilies. Adults are medium to large and diurnal, although

crepuscular activity is known in a few cases (some Amathusiinae and Brassoliniinae). Larvae are mostly leaf feeders; a few feeding gregariously. Hostplant records are among almost all higher plants. Mexican records include about 440 species.

Drepanoidea

This superfamily includes 4 families perhaps most related to Geometroidea. Some recent classifications have greatly disorganized this superfamily, placing Axiidae in its own monobasic superfamily (Axiioidea) and merging Cyclidiidae and Thyatiridae into Drepanidae as subfamilies; the latter 3 families all have some cohesive features (e.g., abdominal tympanal organs) but also many unique features that provide evidence of family status. The superfamily comprises about 1,056 known species. In Mexico, only 2 species are known, and perhaps 5 will eventually be recorded there.

102. Axiidae (gold moths) are a very small family of only 6 Palearctic species in the Mediterranean region. Adults are medium size and nocturnal. Larvae are leaf feeders. Hostplants are in Euphorbiaceae. No New World species are known

103. Thyatiridae (false owlet moths) comprise 224 species from all regions except Australia, but most are tropical Oriental (199 species); the actual fauna probably exceeds 275 species. Two subfamilies are recognized. Adults are medium size and nocturnal. Larvae are mostly nocturnal leaf feeders. Hostplants are recorded in a number of plant groups. Two species are known for Mexico.

104. Cyclidiidae (giant hooktip moths) are a small family of 14 described species, all Oriental plus one species in the southern Palearctic. Adults are medium to large size and nocturnal. Larvae are leaf feeders. Hostplants recorded so far only in Alangiaceae. No New World species are known.

105. Drepanidae (hooktip moths) comprise 812 species worldwide, but predominately Oriental (647 species); none is known for the Neotropics and only a few are in the Nearctic; the actual fauna probably exceeds 950 species. Three subfamilies are known. Adults are small to medium size and nocturnal. Larvae are leaf feeders. Hostplants include a variety of plants. A few are economic. In Mexico, no species have been recorded, although the higher mountains of northern Mexico may harbor some relict species.

Bombycoidea

This superfamily includes many of the largest moths and encompasses 13 families and about 4,810 known species. The superfamily is divided into two groups: series Bombyciformes (Carthaeidae, Eupterotidae, Apatelodidae, Bombycidae, Mimallonidae, Anthelidae, and Lasiocampidae) and series Saturniiformes (Endromidae, Lemoniidae, Brahmaeidae, Oxytenidae, Cercophanidae, and Saturniidae). In Mexico, 341 species are known and perhaps 350 species will be the final total when all are described.

106. Carthaeidae (Australian silkworm moths) are a monobasic relict family in Bombycoidea with a single species from western Australia. Adults are large and nocturnal (usually flying after midnight). Larvae are leaf feeders, with numerous clubbed setae. Hostplants are only in Proteaceae. No New World species are known.

107. Eupterotidae (giant lappet moths) total 325 species worldwide (except the Nearctic), but most are Oriental (238 species); only 4 species are recorded in the Neotropics. Three subfamilies are known. Adults are small to large and nocturnal. Larvae are leaf feeders. Hostplants among numerous different plants. Few species are economic (e.g., rice or forest pests). Mexico has 2 species.

108. Apatelodidae (American silkworm moths) are exclusively New World, and total 252 species, mostly Neotropical (247 species). Three subfamilies are used. Adults are small to medium size and nocturnal. Larvae are leaf feeders. Hostplants are in various plant families. In Mexico, 43 species are known.

109. Bombycidae (silkworm moths) total 166 described species, all Old World and primarily Oriental (146 species), with only 5 species known for Africa. Two subfamilies are involved. Adults are medium size and nocturnal. Larvae are leaf feeders. Hostplants predominate in Moraceae. The silkworm (*Bombyx mori*) is used for silk production. None is native to the New World, but one species is domesticated worldwide for production of silk.

110. Mimallonidae (sackbearer moths) total 254 species, all New World and primarily Neotropical (250 species). Adults are medium size and nocturnal. Larvae are leaf feeders, with larval cases. Hostplants are recorded in a number of plant families. A few can be economic. Mexico has about 20 species.

111. Anthelidae (Australian lappet moths) total 100 species, all from Australia. There are two subfamilies. Adults are medium size to large; rarely with micropterous females. Adults nocturnal, but at least one species with diurnal males. Larvae are leaf feeders and generally colorful. Host plants recorded in several plant families. Some species have urticating larval setae. No New World species known.

112. Lasiocampidae (lappet moths) include 2,130 species worldwide, with many in Africa (790 species). Subfamilies are 5. Adults are small to large; some with micropterous females. Adults mostly nocturnal but some males are diurnal. Larvae are leaf feeders, sometimes communally in silken tent-like webbing. Hostplants are various. Some species are economic as tree defoliators. In Mexico there are about 78 species.

113. Endromidae (glory moths) are a monobasic family of 4 species, from Europe to Central Asia. There are two subfamilies. Adults are medium size. Adult males are diurnal but females are nocturnal. Larvae are leaf feeders. Hostplants recorded in Betulaceae, Caprifoliaceae, Salicaceae, Tiliaceae, and Ulmaceae. No New World species known.

114. Lemoniidae (autumn silkworm moths) total 21 species, mostly Mediterranean. There are two subfamilies. Adults are medium size and nocturnal, but some males are diurnal; flight periods are often in the autumn in Europe. Larvae are leaf feeders. Hostplants mostly in Compositae and Euphorbiaceae. No New World species known.

115. Brahmaeidae (brahmin moths) are a small family of 28 species, mostly Palearctic and African. There are two subfamilies. Adults are medium size to very large and nocturnal. Larvae are leaf feeders. Hostplants recorded in Asclepiadaceae and Oleaceae. No New World species known.

116. Oxytenidae (American tropical silkworm moths) include 60 species, all Neotropical. Adults are medium size to large and nocturnal. Larvae are leaf feeders; some mimic snakes. Hostplants recorded in Rubiaceae. Mexico has about 3 species.

117. Cercophanidae (Andean moon moths) include 30 species of mostly austral South American moths. There are two subfamilies. Adults are medium size to large and nocturnal. Larvae are leaf feeders. Hostplants recorded in Celastraceae, Lauraceae,

Saxifragaceae, and Tiliaceae. None is known from Mexico.

118. Saturniidae (emperor moths) include 1,435 species worldwide, but are predominately Neotropical (860 species). There are 7 subfamilies. Adults are medium size to very large and mostly nocturnal or crepuscular, but some are diurnal. Larvae are leaf feeders and many are polyphagous, some being communal or gregarious; many are extremely large. Hostplants are extremely varied. Some species are economic for agriculture, but major urticating larvae are involved in dermatitis and more severe allergic reactions, and in a few cases even from adult scales. Mexico has about 195 species.

Sphingoidea

This is a monobasic superfamily for the hawk moth family, Sphingidae. Some specialists include the family in Bombycoidea.

119. Sphingidae (hawk moths) total 1,238 species worldwide. Tropical regions of the New World, Africa, and Asia have the most biodiversity. There are three subfamilies. Adults are medium size to very large and nocturnal or crepuscular, but some are diurnal. Larvae are leaf feeders, usually with a posterior horn-like scolus (thus, the common name, hornworms, for the larvae); many larvae extremely large. Hostplants recorded in numerous plant families. Some are economic. Mexico has about 201 species.

Noctuoidea

The largest superfamily, containing nearly a third of all lepidopterans, the Noctuoidea comprise about 44,025 described species worldwide, mainly in the families Noctuidae and Arctiidae. In Mexico, about 6,550 species are known, but as many as 9,500 species may occur there.

120. Notodontidae (prominent moths) total 3,562 species from all faunal regions, particularly from the Neotropics (1,766 species); actual world fauna likely exceeds 4,000 species. The subfamily classification varies, but currently involves 10 subfamilies, with segregation into 3 groups: Oenosandrinina (for Oenosandrinae, with 3 species in Australia), Thaumetopoeina (for Thaumetopoeinae), and Notodontina (for the remaining 8 subfamilies). Adults are small to very large; some with massive bodies. Adults are mostly nocturnal. Larvae are leaf feeders, sometimes gregar-

ious (especially among Thaumetopoeinae) and feeding nocturnally. Hostplants include a large variety of plant families, especially for broadleaf forest trees. A number of economic species are known. In Mexico, about 800 species are known.

121. Dioptidae (American false tiger moths) total 507 species, primarily Neotropical (505 species); actual fauna likely exceeds 800 species. Two subfamilies are known. Adults are medium size and mostly nocturnal, but some are diurnal or crepuscular. Larvae are leaf feeders, particularly toxic plants in families like Aristolochiaceae, Euphorbiaceae, Passifloraceae, and Violaceae, but also on various others like Fagaceae. Very few are economic. In Mexico, about 200 species are known.

122. Thyretidae (African maiden moths) include 212 species, all African. Adults are medium-size. Adults perhaps mostly diurnal; often wasp mimics. Larvae are thought to be leaf feeders, but most species remain unknown biologically. Hostplant records include Thymelaeaceae and Ulmaceae. No New World species are known.

123. Lymantriidae (tussock moths) total 2,490 species worldwide; actual fauna likely exceeds 3,000 species. Most of the fauna is Old World tropical (about 2,090 species). Two subfamilies are used. Adults are small to very large and mostly nocturnal, but some are diurnal or crepuscular. Larvae are leaf feeders, sometimes gregariously. Hostplants include many different plant families. Many species are serious defoliators of forest trees. About 50 species occur in Mexico.

124. Arctiidae (tiger moths) include 11,155 species worldwide, primarily Neotropical (about 6,000 species); actual world fauna likely exceeds 14,000 species. There are 5 subfamilies among 3 groups: group Pericopina (with Pericopinae), group Arctiina (for Lithosiinae and Arctiinae), and group Ctenuchina (for Ctenuchinae and Syntomini). Adults are small to large; hindwings greatly reduced in some groups (wasp moths). Adults mostly nocturnal but many are crepuscular or diurnal (Pericopinae, Ctenuchinae, and Syntomini). Larvae are leaf feeders. Hostplants are varied among numerous plant families, including mosses and lichens. Mexico has about 1,000 species, with many more to be described.

125. Noctuidae (owlet moths) are the largest family of Lepidoptera, with about 26,310 described species

worldwide; actual fauna likely exceeds 30,000 species. Major regions of biodiversity are in the Neotropics (about 8,600 species) and the Indo-Australian region (6,500 species). Numerous subfamilies and tribes have been described and the classification is still in flux, but 26 subfamilies are now recognized, mostly in group Noctuinina; also segregated are Aganainae (previously in Arctiidae), in group Aganainina, and Herminiinae, in group Herminiinina. Adults are small to very large and mostly nocturnal, but some are crepuscular and several groups are diurnal. Larvae mostly leaf feeders, but many are borers; herminines are litter feeders. Hostplants include numerous plant families, but the majority of owl moths are not known biologically. Some agricultural pests are included in the family (e.g., cutworms, armyworms, and others). In Mexico, there are about 4,500 species, with a likely actual fauna of perhaps 5,500 species.

References cited

- Balcázar-L., M. A., and C. R. Beutelspacher-B.** 2000a. Saturniidae (Lepidoptera). In J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 2: 501-513. Universidad Nacional Autónoma de México, Mexico City.
- Balcázar-L., M. A., and C. R. Beutelspacher-B.** 2000b. Arctiidae: Lithosiinae, Arctiinae, Pericopinae (Lepidoptera). In J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 2: 516-525. Universidad Nacional Autónoma de México, Mexico City.
- Becker, V. O.** 2000. Microlepidoptera. In J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 2: 453-468. Universidad Nacional Autónoma de México, Mexico City.
- Bourgogne, J.** 1951. Ordre des lépidoptères. In P. P. Grassé (ed.), Traité de zoologie: anatomie, systématique, biologie. Insectes, 10: 174-448, 3 pl. Masson, Paris.
- Davis, D. R.** 2000. Tineoidea and Gracillarioidea (Lepidoptera). In J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 2: 469-482. Universidad Nacional Autónoma de México, Mexico City.
- Davis, D. R., and P. Gentili.** 2003. Andesianidae, a new family of monotrysian moths (Lepidoptera: Andesianoidea) from austral South America. Invertebrate systematics, 17: 15-26.
- Eaton, J. L.** 1988. Lepidopteran Anatomy. John Wiley, New York. 257pp.
- Heppner, J. B.** 1991. Faunal regions and the diversity of Lepidoptera. Tropical Lepidoptera, 2(suppl. 1): 1-85.
- Heppner, J. B.** 1996. Keys to families of Lepidoptera. Tropical Lepidoptera, 4 (suppl. 3): 1-28. (1993)
- Heppner, J. B.** 1998-in prep. Classification of Lepidoptera. Holarctic Lepidoptera, 5 (suppl. 1): 1-148 (1998); 10 (suppl. 1): 149-320 (2003); 11 (suppl. 1): [in prep].
- Heppner, J. B.** In press. Lepidoptera. In J. L. Capinera. (ed.), Encyclopedia of entomology. CRC Press, Boca Raton.
- Heppner, J. B. (ed.).** 1984. Atlas of Neotropical Lepidoptera. Checklist: Part 1. Micropterigoidea - Immoidea. W. Junk, Leiden. 27 + 112pp.
- Heppner, J. B. (ed.).** 1995. Atlas of Neotropical Lepidoptera. Checklist: Part 2. Hyblaeoidea - Pyraloidea - Pterophoroidea. Association for Tropical Lepidoptera, Gainesville. 54 + 243pp.
- Heppner, J. B. (ed.).** 1996. Atlas of Neotropical Lepidoptera. Checklist: Part 4B. Drepanoidea - Bombycoidea - Sphingoidea. Association for Tropical Lepidoptera, Gainesville. 50 + 87pp.
- Heppner, J. B. (ed.).** 2000. Lepidoptera (moths, butterflies, and skippers). In R. H. Arnett, Jr. (ed.), American Insects: a handbook of the Insects of America north of Mexico (2nd ed.), 631-827. CRC Press, Boca Raton.
- Hering, E. M.** 1925. Biologie der Schmetterlinge. J. Springer, Berlin. 480pp.
- Holloway, J. D., J. D. Bradley, and D. J. Carter.** 1987. Lepidoptera. In CIE guides to Insects of importance to Man. 1. CABI and Brit. Mus. (Nat. Hist.), London. 262pp.
- Kristensen, N. P. (ed.).** 1999. Lepidoptera, moths and butterflies. Volume 1: evolution, systematics, and biogeography. In Handbuch der Zoologie. Band IV. Arthropoda: Insecta. Teilband 35. W. De Gruyter, Berlin. 487pp.
- León-C., J. L.** 2000. Sphingoidea (Lepidoptera). In J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 2: 483-500. Universidad Nacional Autónoma de México, Mexico City.
- Llorente-B., J., A. Luis-M., I. Vargas-F., and J. Soberón-M.** 1996. Papilionoidea (Lepidoptera).

- In* J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de artrópodos de México: hacia una síntesis de su conocimiento, 1: 531-548. Universidad Nacional Autónoma de México, Mexico City.
- Miller, J. Y.** 2000. Castniidae (Lepidoptera). *In* J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 2: 527-533. Universidad Nacional Autónoma de México, Mexico City.
- Miller, L. D., and J. Y. Miller.** 1989. The biogeography of West Indian butterflies (Lepidoptera: Papilionoidea, Hesperioidea): a vicariance model. *In* C. A. Woods (ed.), Biogeography of the West Indies: past, present, and future, 229-262. Sandhill Crane Press, Gainesville.
- Portier, P.** 1949. La biologie le lépidoptères. *In* Encyclopédie entomologique, (A) 23: 1-643, 1 pl. P. Lechevalier, Paris.
- Razowski, J.** 1996. Tortricidae (Lepidoptera). *In* J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 1: 513-520. Universidad Nacional Autónoma de México, Mexico City.
- Rzedowski, J.** 1993. Diversity and origins of the phanerogamic flora of Mexico. *In* T. P. Ramamoorthy, R. Bye, A. Lot, and J. Fa (eds.), Biological diversity of Mexico: origins and distribution, 129-144. Oxford University Press, Oxford.
- Scoble, M. J.** 1992. The Lepidoptera: form, function and diversity. Oxford University Press, Oxford. 404pp.
- Solis, M. A.** 1996. Pyraloidea (Lepidoptera). *In* J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 1: 521-530. Universidad Nacional Autónoma de México, Mexico City.
- Stehr, F. W. (ed.).** 1987. Lepidoptera. *In* F. W. Stehr (ed.), Immature Insects [1], 288-596. Kendall-Hunt, Dubuque.
- Toledo, V. M., and M. de J. Ordóñez.** 1993. The biodiversity scenario of Mexico: a review of terrestrial habitats. *In* T. P. Ramamoorthy, R. Bye, A. Lot, and J. Fa (eds.), Biological diversity of Mexico: origins and distribution, 757-777. Oxford University Press, Oxford.
- Vane-Wright, R. I., and P. R. Ackery (ed.).** 1984. The biology of butterflies. Royal Ent. Soc. London, London. 429pp.
- Warren, A. D.** 2000. Hesperioidea (Lepidoptera). *In* J. Llorente-B., E. González-S., and N. Papavero (eds.), Biodiversidad, taxonomía y biogeografía de Artrópodos de México: hacia una síntesis de su conocimiento, 2: 535-580. Universidad Nacional Autónoma de México, Mexico City.
- Watson, A., and P. E. S. Whalley.** 1975. The dictionary of butterflies and moths in color. McGraw Hill, New York. 296pp (144 pl.).
- Wendt, T.** 1993. Composition, floristic affinities, and origins of the canopy tree flora of the Mexican Atlantic slope rain forests. *In* T. P. Ramamoorthy, R. Bye, A. Lot, and J. Fa (eds.), Biological diversity of Mexico: origins and distribution, 595-680. Oxford University Press, Oxford.
- Young, M.** 1997. The natural history of moths. T. & A. D. Poyser, London. 271pp, 16 pl.