# A Catalog and Review of Immature Apoidea (Hymenoptera)

RONALD J. McGINLEY

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# A Catalog and Review of Immature Apoidea (Hymenoptera)

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## ABSTRACT

McGinley, Ronald J. A Catalog and Review of Immature Apoidea (Hymenoptera). *Smithsonian Contributions to Zoology*, number 494, 24 pages, 2 figures, 1 table, 1989.—The systematic literature covering the larvae and pupae of all bees is reviewed and presented in catalog form. Historical aspects of the study of immature apoids are reviewed with emphasis placed on what yet needs to be accomplished and which taxa should be considered primary targets for collection.



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# Contents

# A Catalog and Review of Immature Apoidea (Hymenoptera)

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## Introduction

The immature stages of holometabolous insects provide systematists with character sets that are too often overlooked in taxonomic and phylogenetic studies. The most obvious reason for this neglect is that the immatures of most species are unknown; this because they are often difficult to locate, collect and correctly associate with adults. Another reason for ignoring immature stages is that many systematists are reluctant to utilize character sets that are unfamiliar to them. In the case of apoid "paedophobia," the problem is exacerbated by a seemingly unorganized literature that leaves many workers bewildered. Because the publication of *Immature Insects* (Stehr, 1987) will hopefully stimulate greater interest in larval studies, this seems an appropriate time to summarize the immature-bee literature on a global basis.

The present paper presents a listing of those bee species that are known from the larval and/or pupal stages and provides the associated bibliographic information. It is hoped that this information will encourage bee biologists to preserve immature stages for future study, especially the immatures of those taxa that are unknown or poorly represented in the literature and collections. Immatures should be killed and preserved in alcohol (75 to 80 percent) or Kahle's Solution (a mixture of ethyl alcohol, formaldehyde, glacial acetic acid and water); techniques of specimen preparation and examination are presented in Rozen and McGinley (1974a) and Stephen, Bohart, and Torchio (1969).

ACKNOWLEDGMENTS.—The manuscript was greatly improved by the comments and suggestions provided by Robert W. Brooks, Connal D. Eardley, George C. Eickwort, Oliver S. Flint, Jr., Terry L. Griswold, Terry F. Houston, Wallace E. LaBerge, Charles D. Michener, Beth B. Norden, Frank D. Parker, Yuriy A. Pesenko, Jerome G. Rozen, Jr., Shoichi F. Sakagami, and Philip F. Torchio. Beth Norden also assisted with the literature search and figure lettering, and Philip Torchio kindly provided a prepublication copy of his 1987 paper (with B. Burwell) on colletid pupae. Radclyffe B. Roberts compiled the initial listing of bee taxa that was the basis for the general classification scheme followed herein.

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## Historical Review

As mentioned above, our knowledge of apoid diversity is understandably based primarily on studies of adults. The discrepancy in our knowledge of immature forms versus adults is well illustrated by the history of bee taxonomy in the United States and Canada, a fauna of approximately 3,589 species and subspecies (Figure 1). Study of this fauna (based on adults) from 1758 through the 1840s resulted in the description of 90 currently recognized species. During this early period, Thomas Say contributed significantly with descriptions of 33 species. Exploration of the North American bee fauna really began during the 1850–1870 period with the work of F. Smith and E.T. Cresson. T.D.A. Cockerell and P.H. Timberlake contributed most significantly to our knowledge of North American species with descriptions of 1138 and 735 species and subspecies, respectively; nine additional workers, listed in figure 1, have each contributed over 75 species descriptions to the North American fauna. Among these most prolific contributors, only Michener and LaBerge have published descriptions of immature forms and have utilized this information in assessments of phylogenetic relationships and classification. Mature larvae of only 174 (5.0%) of the approximately 3,589 species and subspecies in this area are known.

Among the earliest known larval descriptions of Apoidea are those of *Hoplitis parvula* and *H. tridentata* by Dufour and Perris (1840). Earlier depictions of the honey bee are so generalized as to be virtually useless for comparative purposes. Through the 1940s, several workers contributed scattered larval treatments (most notably F. Claude-Joseph and G. Grandi),

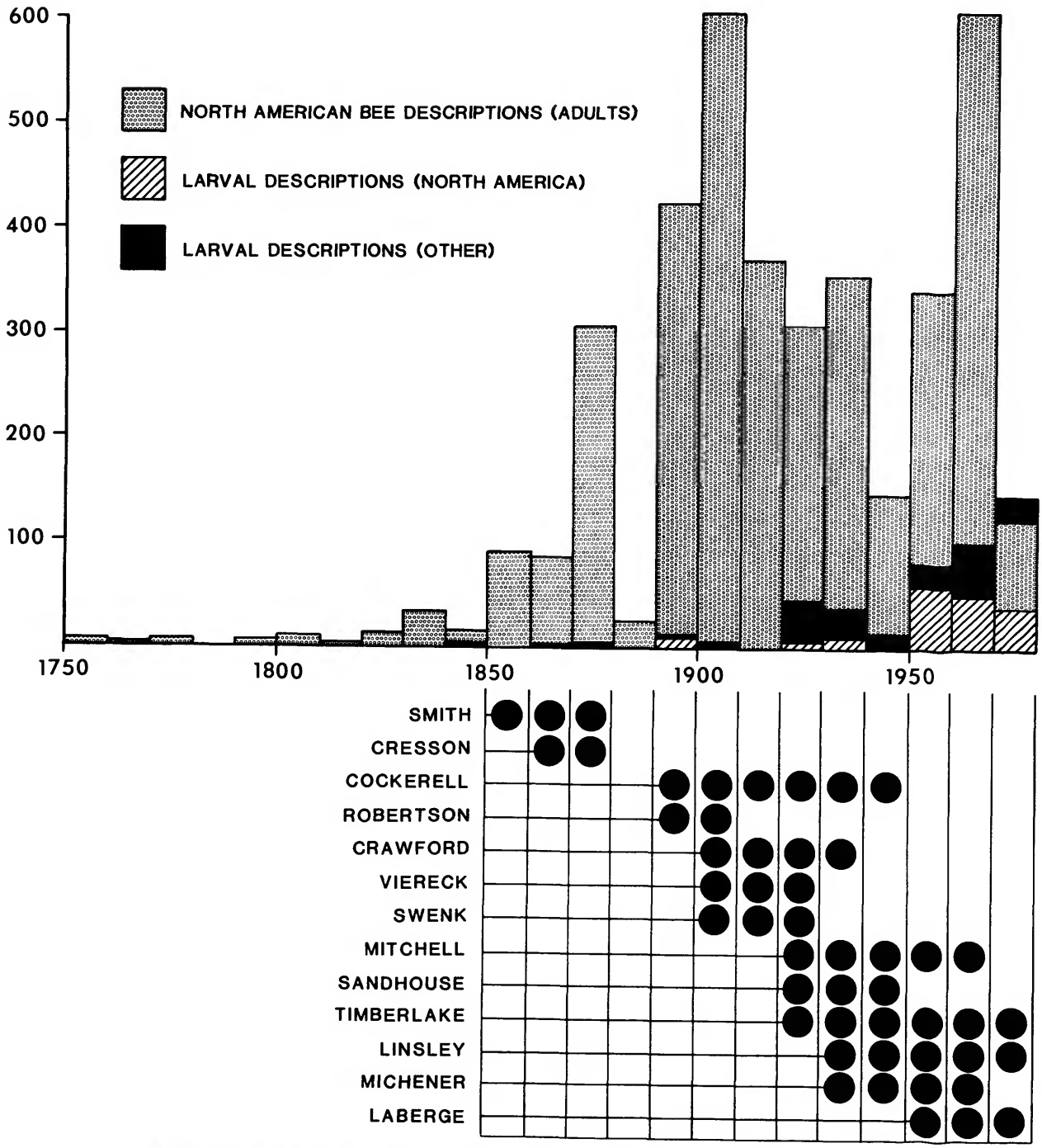


FIGURE 1.—History of the bee fauna in America north of Mexico: number of adult and larval descriptions per decade (including larval treatments outside North America) and associated systematists who have described over 75 species from this area (most adult data from Hurd, 1979).

but it wasn't until Michener's publication in 1953 that the study of larval bees became truly comparative and organized for the first time. In this publication, Michener described or redescribed the larvae of 135 species and subspecies, provided summary descriptions for the bee families based on mature larvae, presented a key to the larvae of the major hymenopteran taxa and discussed evolutionary trends among bee larvae. Michener followed this landmark paper with a similar treatment of apoid pupae in 1954. These papers have done much to stimulate other bee systematists to collect and study immature bees. Most notably, from 1954 to the present, J.G. Rozen, Jr., has contributed a large body of work that has greatly advanced our understanding of the immatures of virtually all bee families and has emphasized their value in phylogenetic considerations (literature cited in bibliography). Also contributing significantly during this period were G.C. Eickwort (primarily halictine immatures), B. Lucas de Oliveira (Neotropical species), W.P. Stephen and T. Koontz (*Bombus* larvae) and P.F. Torchio (various taxa). Stephen et al., (1969) provided an overview of apoid larval and pupal morphology and included an account of preservation and examination techniques. McGinley (1981) published a key to the known mature larvae throughout the Apoidea and described 96 genera in matrix form (126 characters). An illustrated key to North American bee taxa based on mature larvae, family treatments and introduction to the associated literature was published by McGinley, 1987. Torchio and Burwell (1987) have contributed descriptions (in tabular form) of several colletid pupae and discuss some general problems in studying apoid pupae.

### Systematic Contribution of Immature Apoid Studies

The few studies published that consider the immature forms of any significant number of congeneric species indicate that larvae and pupae, for some taxa, appear to be of limited value at the alpha-taxonomic level. In his study of adults and larvae of *Nomadopsis*, Rozen (1958) states, "there appears to be no differentiation of the larvae with respect to species groups or subgenera." Eickwort (1981) writes, "I have examined in detail larvae and pupae of 6 species of *Agapostemon* and they are all very similar in even the most minute morphological characters. This suggests that immature stages are unlikely to provide good characters to distinguish closely related halictine species but will prove valuable in generic studies." However, closely related species in other bee taxa can be distinguished by larval characters. For example, Torchio and Torchio (1975) were able to differentiate four closely related species of *Apis* on the basis of larval features and in an unpublished study they found it easy to distinguish the larvae of nine species of *Diadasia* (P.F. Torchio, pers. comm.). Rozen and McGinley (1974a) were able to provide a key to the mature larvae of eight species of *Hesperapis*. In his study of *Perdita*, Eickwort (1977 and pers. comm.) shows that larval characters might be valuable in this taxon at the subgeneric and species group level. As stated by P.F. Torchio (pers. comm.), at the species level "the value of larval characteristics may, therefore, vary from one taxon to another within Apoidea."

That larval and pupal characters can be extremely valuable in systematic studies at the generic and higher categorical levels is well illustrated by Rozen's various studies on the Nomadinae (1966c, 1977c), on the Panurginae (1966a, 1968, 1970a, 1971), and the Fideliinae (1970b, 1973b, 1977b) and Lithurginae (1973c). In contrast to the ordinary cell-reared bee larvae, allodapine larvae which do not live in cells have excellent characters at both generic and specific levels. Michener (1977) showed that allodapine larvae were extremely valuable in generic studies; analysis of larval characters alone gave the closest approximation of the topology of a general cladogram based on cladistic analysis of adult, pupal, larval and egg characters.

That apoid larvae do not seem to be highly informative at the higher apoid categorical levels was suggested by Michener and Greenberg (1980). An attempt to illustrate this apparent lack of resolution is presented in Figure 2, where the highest known categorical levels supported by larval synapomorphies are presented (characters listed in Appendix) and contrasted with the greater clustering detected on the basis of adult morphology (Michener and Greenberg, 1980). Among the larger bee families, only the Andrenidae is supported by larval characters alone. This does not argue against the monophyly of the other apoid families (supported by other character sets), but illustrates the lack of phylogenetic resolution detected at this categorical level.

### Immature Apoid Collecting/Research Priorities

The primary goal of this paper is not to review what has been accomplished in the study of immature apoids, but rather to identify what still needs to be done. The figures presented in Table 1 review the percentage of genera in each apoid family and subfamily that are known as mature larvae. Of the 480 genera listed in this compilation only 151 (31%) genera are known in the larval stage. The following listing points out the major synthetic papers within each family and emphasizes which taxa might be considered primary targets for future research efforts.

COLLETIDAE.—Although the mature larvae of this family were reviewed by McGinley (1981), only 26 percent of the currently recognized colletid genera are known as larvae. Most work is needed on the many genera of Neotropical and Australasian Paracolletini (Colletinae) and the Australasian Euryglossinae. Of special interest, would be the location of immature representatives of the Neotropical diphaglossine tribe Dissoglottini (*Mydrosoma, Mydrosomella, Ptiloglossidia*). In the United States and neotropics, immature forms of *Eulonchopria* (Paracolletini) remain unknown. Known colletid pupae

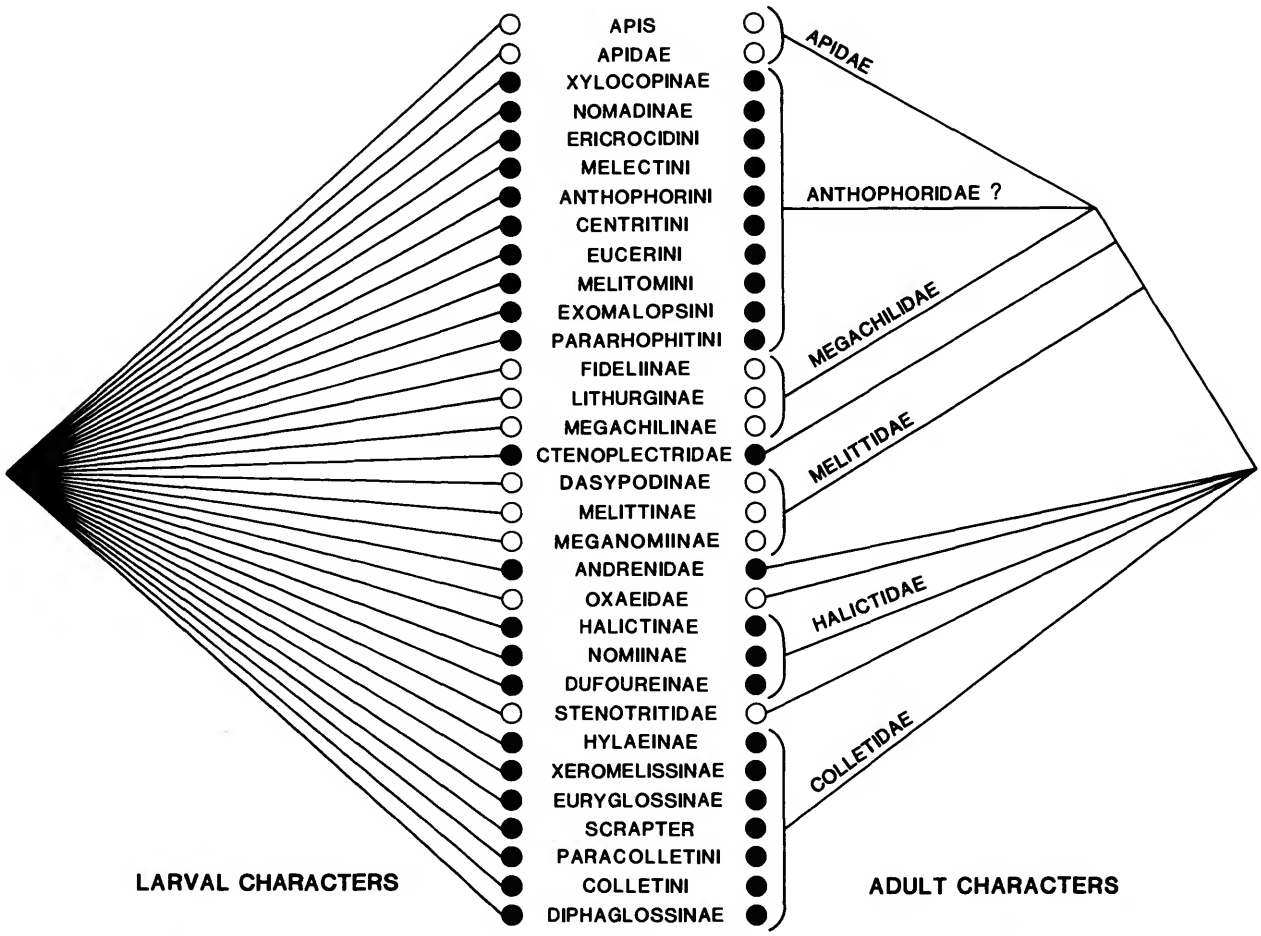


FIGURE 2.—Highest known categorical levels supported by apoid larval synapomorphies (left-hand side) contrasted with higher resolution detected from study of adult characters (Michener and Greenberg, 1980). Apparent larval synapomorphies are listed in Appendix.

TABLE 1.—Percentage of genera known as mature larvae among apoid families and subfamilies.

| | | | | | |
|---|---|---|---|---|---|
| COLLETIDAE | 26.0 | ANDRENIDAE | 41.0 | MEGACHILIDAE | 22.0 |
| Colletinae | 27.0 | Andreninae | 17.0 | Fideliinae | 100.0 |
| Diphaglossinae | 44.0 | Panurginae | 45.0 | Lithurginae | 66.0 |
| Euryglossinae | 11.0 | | | Megachilinae | 18.0 |
| Hylaeinae | 33.0 | OXAEIDAE | 50.0 | | |
| Xeromelissinae | 25.0 | | | ANTHOPHORIDAE | 39.0 |
| | | MELITTIDAE | 28.6 | Anthophorinae | 38.0 |
| STENOTRITIDAE | 50.0 | Dasypodinae | 38.0 | Nomadinae | 40.0 |
| | | Meganomiinae | 25.0 | Xylocopinae | 74.0 |
| HALICTIDAE | 20.0 | Melittinae | 40.0 | | |
| Dufoureinae | 15.0 | | | APIDAE | 72.0 |
| Halictinae | 20.0 | CTENOPLECTRIDAE | 50.0 | Apinae | 100.0 |
| Nomiinae | 100.0 | | | Bombinae | 62.0 |
| | | | | Meliponinae | 78.0 |

have been reviewed by Torchio and Burwell (1987).

STENOTRITIDAE.—Houston (1975) located and described larvae of *Stenotritus pubescens* and has recently collected the larvae of *S. greavesi* and larval representatives of two species of *Ctenocolletes* (McGinley, in prep.).

HALICTIDAE.—Despite the significant contributions by G.C. and K.R. Eickwort (literature cited in bibliography), the larvae and pupae of this family remain virtually unknown with only 20 percent of the recognized genera represented by immatures. Given the high level of diversity exhibited by adult nomiines, the study of additional immatures of this subfamily should prove most valuable. The immatures of Nomioidini (*Ceyalictus, Nomioides*) in the Halictinae are unknown.

ANDRENIDAE.—Among andrenines, immatures of only a few of the numerous *Andrena* subgenera are known; as more representatives become known they may contribute significantly to our understanding of species group relationships. In the United States, immatures of *Ancylandrena* and *Megandrena* are unknown.

Panurgine immatures are relatively well known, largely due the efforts of J.G. Rozen. Rozen (1966a) contributed a synthetic account of panurgine larvae and additional treatments of the immatures of *Meliturgula* (Rozen, 1968), *Hypomacrotera* and *Protandrena* (as *Psaenythia*) (Rozen, 1970a), and *Melitturga* and *Panurgus* (Rozen, 1971). Despite this progress, the immatures of 19 genera of panurgines remain unknown, including *Metapsaenythia* and *Xenopanurgus* from the United States. Yager and Rozen (1966) published a preliminary account of andrenid pupae.

OXAEIDAE.—The known larvae of *Oxaea* (Roberts, 1973) and *Protoxaea* (Rozen, 1964a) are very similar. Immatures of *Mesoxaea* and *Notoxaea* are unknown.

MELITTIDAE.—The known immatures of this family were reviewed by Rozen and McGinley (1974b). Rozen has contributed additional papers on the immatures of *Meganomia* (Rozen, 1977a) and *Macropis* (Rozen and Jacobson, 1980). Among those genera for which immature representatives are unknown, most interesting to locate would be immatures of the dasypodine tribes Promelittini (*Promelitta*) and Sambini (*Samba*).

CTENOPLECTRIDAE.—The mature larva of *Ctenoplectra armata* was described by Rozen (1978). At that time, the Ctenoplectrinae were classified as a melittid subfamily, and Rozen's phylogenetic considerations were made within that context. Larval characters should be reanalyzed in light of recent information presented by Michener and Greenberg (1980) that indicates ctenoplectrids are the sister group of the long-tongued bee families (Figure 2).

MEGACHILIDAE.—In a series of papers, Rozen (1970b, 1973b,c, 1977b) has contributed most significantly to our knowledge of fideliine and lithurgine megachilids. Immature representatives of all genera in these two subfamilies are known, with the exception of pupal *Parafidelia*. This progress contrasts sharply with our understanding of megachiline immatures, which have never been comprehensively reviewed. In the Anthidiini alone, 64 genera remain unknown in immature form.

ANTHOPHORIDAE.—Within the Anthophorinae, Rozen has contributed comprehensive papers on the Eucerini and Centridini (Rozen, 1965b) and the Melectini, Ericrocini, and Rhathymini (Rozen, 1969). Lucas de Oliveira (1962, 1966a) has published preliminary comparative studies of exomalopsine larvae. Within the Anthophorini, Michener (1953) compared a number of *Anthophora* larvae and Torchio and Stephen (1961) described the immatures of *Emphoropsis*. In spite of the above work, our understanding of larval/pupal diversity in this subfamily remains meager, for example, the immatures of 21 genera of Eucerini are unknown including those of *Gaesischia, Martinapis, Melissoptila, Simanthedon,* and *Xenoglossodes,* all of which occur within the United States. The immatures of four anthophorine tribes await discovery: Ancylini (*Ancyla, Tarsalia*), Canephorulini (*Canephorula*), Eucerinodini (*Eucerinoda*), and Tetrapediini (*Tetrapedia*). In the United States, immatures of *Ericrocis,* apparent parasites of *Centris,* should be considered primary targets.

Known mature larvae of the Nomadinae were reviewed by Rozen (1966c, 1977c) and those of the included Ammobatini by Rozen and McGinley (1974b). Because nomadines are cleptoparasitic in the nests of other bees, their immature forms are especially difficult to locate and to correctly associate with adult forms. Most exciting finds would include the discovery of immature Epeoloidini (*Epeoloides;* apparent parasites of *Macropis*) and Townsendiellini (*Townsendiella,* tentatively associated with *Hesperapis*), both of which occur within the United States. Other nomadine tribes unknown as immatures are the Ammobatoidini (*Ammobatoides*), Caenoprosopidini (*Caenoprosopidis*) and Osirini (*Osiris*). Important contributions could be made with the discovery of the many unknown genera of the Ammobatini and the Ericrocidini.

Within the Xylocopinae, study of immature allodapines include the early efforts of Rayment (1949a,b, 1951) and Syed (1963). This group, which exhibits the greatest morphological diversity known among apoid larvae, was the focus of a series of comprehensive papers by Michener (1964, 1975, 1976, 1977). The known immatures of *Xylocopa* have been studied by Lucas de Oliveira (1974). Immatures of *Lestis,* and *Proxylocopa* have not been treated in the literature.

APIDAE.—The known larvae of *Apis* were thoroughly studied by Torchio and Torchio (1975). Their study is especially notable for documenting considerable levels of intraspecific morphological variability which should be considered in future larval work. Larval Bombini were subject to early study by Ritcher (1933) and more recently by Stephen and Koontz (1973). Surprisingly, immatures of only two genera of the popularly studied Euglossini are known; immatures of *Eufriesea, Exaerete,* and *Aglae* remain unknown and should be considered primary targets. What we know about the immatures of the Meliponinae comes mostly from the

contributions of Lucas de Oliveira (1958, 1960, 1965, 1966a, 1968, 1970). Many more larval/pupal representatives of this subfamily need to be collected; immatures of *Dactylurina* and *Meliponula* are unknown.

### Catalog of Immature Apoidea

The information presented below was obtained from a personal card catalog maintained since 1977. A computer search of the literature was carried out in August 1988; the data bases searched were the Biosis Previews Database (1969–1988), the Zoological Record Database (1978–1983) and the Life Sciences Collection Database (1978–1985). Only systematic treatments of immatures are listed; a large body of literature dealing with immature development, physiology and biology exists but is not included here (see for example the paper on embryogenesis by Torchio and Trostle, 1986). Some larvae are known to have been collected but as of yet have not been treated in the literature; these are herein listed as being unknown.

The classification utilized largely follows an unpublished listing of bee taxa at and above the subgeneric level compiled by Radclyffe B. Roberts; this listing is not intended to be exhaustive, especially for Old World taxa, but is most adequate for cataloging immature studies.

Papers dealing only with larvae are cited without annotation; papers treating both larvae and pupae are cited with the annotation "[+ PUPA]"; citations followed by "[PUPA]" indicate that only pupae were treated. The numbers in parentheses after the higher categories indicate the percentage of bee genera in that taxon known as mature larvae. Taxa enclosed by brackets are known to have been collected, but as yet have not been treated taxonomically (listed depositories are: the University of Kansas (KU), the Bee Biology and Systematics Laboratory, Utah State University (UTAH), and the Smithsonian Institution (USNM; Karl V. Krombein trap-nesting material). The American Museum of Natural History, New York, is a major depository for immature apoids and houses many unstudied specimens not listed herein; interested biologists should contact Jerome G. Rozen, Jr., for information concerning loan and deposition policies.

#### COLLETIDAE (26%)

#### COLLETINAE (27%)

#### COLLETINI (25%)

*Colletes araucariae* Friese.—Claude-Joseph, 1926; Michener, 1953; McGinley, 1981.

*Colletes ciliatoides* Stephen.—Nielsen and Bohart, 1967 [sex characters]; Torchio and Burwell, 1987 [PUPA].

*Colletes ciliatus* Friese.—Claude-Joseph, 1926; Michener, 1953.

*Colletes cognatus* Spinola.—Torchio and Burwell, 1987 [PUPA].

*Colletes daviesanus* Smith.—Semichon, 1936.

*Colletes fulgidus* Swenk.—Michener, 1953, 1954 [PUPA]; McGinley, 1981.

*Colletes kincaidii* Cockerell.—Torchio and Burwell, 1987 [PUPA].

*Colletes laticeps* Friese.—Claude-Joseph, 1926; Michener, 1953; McGinley, 1981.

*Colletes michenerianus* Moure.—McGinley, 1981.

*Colletes succinctus* (Linnaeus).—Mayet, 1875 [+ PUPA]; Michener, 1953.

*Colletes thoracicus* Smith.—McGinley, 1981.

*Colletes validus* Cresson.—Rajotte, 1979.

Unknown: *Hemicotelles, Mourecotelles, Xanthocotelles.*

#### PARACOLLETINI (27%)

*Callomelitta* species A.—McGinley, 1981.

*Leioproctus cingulatus* (Moure).—McGinley, 1981.

*Leioproctus zonalis* (Reed).—Claude-Joseph, 1926 [as *Lonchopria marginata*]; Michener, 1953; McGinley, 1981.

*Leioproctus zonatus* (Moure).—McGinley, 1981.

*Leioproctus* species near *semipurpureus* (Cockerell).—McGinley, 1981.

*Scrapter longula* (Friese).—McGinley, 1981.

Unknown: *Anthoglossa, Eulonchopria, Hesperocolletes, Hexantheda, Neopasiphae, Paracolletes, Tetraglossula, Trichocolletes.*

#### DIPHAGLOSSINAE (44%)

#### CAUPOLICANINI (100%)

*Caupolicana gayi* Spinola.—Claude-Joseph, 1926; Michener, 1953; McGinley, 1981.

*Crawfordapis luctuosa* (Smith).—Otis et al., 1982; Roubik and Michener, 1985 [PUPA]; Torchio and Burwell, 1987 [PUPA].

*Ptiloglossa fulvopilosa* (Cameron).—McGinley, 1981.

*Ptiloglossa* species A.—McGinley, 1981.

*Ptiloglossa* species B.—McGinley, 1981.

#### DIPHAGLOSSINI (33%)

*Cadeguala occidentalis* (Haliday).—Claude-Joseph, 1926 [as *Policana occidentalis*]; Michener, 1953; McGinley, 1981; Torchio and Burwell, 1987 [PUPA].

*Cadeguala albopilosa* (Spinola).—Claude-Joseph, 1926; Michener, 1953, 1954 [PUPA]; McGinley, 1981 [all above as *Policana herbsti*]; Torchio and Burwell, 1987 [PUPA].

Unknown: *Cadegualina, Diphaglossa.*

#### DISSOGLOTTINI (0)

Unknown: *Mydrosoma, Mydrosomella, Ptiloglossidia.*

EURYGLOSSINAE (11%)

*Euryglossa fasciatella* Cockerell.—Michener, 1953.
*Euryglossa subsericea* Cockerell.—McGinley, 1981.
*Euryglossa* species A.—McGinley, 1981.
*Pachyprosopis angophorae* Cockerell.—McGinley, 1981.
*Pachyprosopis indicans* (Cockerell).—McGinley, 1981.
Unknown: *Argohesma, Brachyhesma, Dasyhesma, Euryglossina, Euryglossella, Euryglossula, Heterohesma, Hyphesma, Melittosmithia, Parapachyprosopis, Quasihesma, Sericogaster, Stenohesma, Stilpnosoma, Turnerella, Xanthesma.*

HYLAEINAE (33%)

*Amphylaeus morosus* (Smith).—McGinley, 1981.
*Hylaeus alcyoneus* (Erichson).—McGinley, 1981.
*Hylaeus asininus* (Cockerell and Casad).—McGinley, 1981.
*Hylaeus bisinuatus* Forster.—Torchio and Burwell, 1987 [PUPA].
*Hylaeus brevicornis* (Nylander).—Danks, 1970.
*Hylaeus cressoni* (Cockerell).—Nielsen and Bohart, 1967 [sex characters].
*Hylaeus modestus* Say.—McGinley, 1981.
*Hylaeus nigritus* Fabricius.—Janvier, 1969.
*Hylaeus parvulus* Janvier.—Janvier, 1972.
*Hylaeus perhumilis* (Cockerell).—McGinley, 1981.
*Hylaeus pictus* Smith.—Janvier, 1969.
*Hylaeus pubescens* (Perkins).—Daly and Coville, 1982.
*Hylaeus variegata* (Fabricius).—Stockhert, 1922; Michener, 1953.
*Hylaeus* species—Michener, 1953.
[*Hylaeus* species, UTAH.]
*Hyleoides concinna* (Fabricius).—McGinley, 1981.
*Meroglossa* species A, near *torrida* (Smith).—McGinley, 1981.
[*Palaeorhiza gratiosa* Cheesman; Y. Hirashima material, on loan to R.J. McGinley.]
[*Palaeorhiza gressittorum* Hirashima; Y. Hirashima material, on loan to R.J. McGinley.]
Unknown: *Agogenohylaeus, Gephyrohylaeus, Hemirhiza, Heterapoides, Hylaeorhiza, Nothylaeus, Pharohylaeus.*

XEROMELISSINAE (25%)

*Chilicola ashmeadi* (Crawford).—Eickwort, 1967 [+ PUPA]; McGinley, 1981; Torchio and Burwell, 1987 [PUPA].
*Chilicola friesei* Herbst.—Claude-Joseph, 1926; Michener, 1953.
*Chilicola inermis* Friese.—Claude-Joseph, 1926; Michener, 1953.
*Xeromelissine* species A.—McGinley, 1981.
Unknown: *Chilimelissa, Xenochilicola, Xeromelissa.*

STENOTRITIDAE (50%)

[*Stenotritus greavesi* (Rayment); T.F. Houston material, on loan to R.J. McGinley.]
*Stenotritus pubescens* (Smith).—Houston, 1975; McGinley, 1981.
[*Ctenocolletes nicholsoni* (Cockerell); T.F. Houston material, on loan to R.J. McGinley.]
[*Ctenocolletes ordensis* Michener; T.F. Houston material, on loan to R.J. McGinley.]

HALICTIDAE (20%)

DUFOUREINAE (15%)

*Dufourea mulleri* (Cockerell).—Torchio et al., 1967 [partial description]; McGinley, 1981.
*Dufourea novaeangliae* (Robertson).—Eickwort et al., 1986.
*Rophitoides canus* (Eversm.).—Enslin, 1921 [as *Rhophites canus*].
[*Systropha punjabensis* Batra and Michener.—Batra and Michener, 1966 (immature larva)].
Unknown: *Conanthalictus, Michenerula, Micralictoides, Morawitzia, Morawitzeiella, Penapis, Protodufourea, Rophites, Sphecodosoma,* [*Systropha,* UTAH], *Xeralictus.*

HALICTINAE (20%)

AUGOCHLORINI (17%)

*Augochlora cordiaefloris* Cockerell.—Eickwort and Eickwort, 1972a [+ PUPA].
*Augochlora hallinani* Michener.—Eickwort and Eickwort, 1973a [+ PUPA].
*Augochlora nominata* Michener.—Eickwort and Eickwort, 1972a [+ PUPA].
*Augochlora pura* (Say).—Michener, 1953, 1954 [PUPA]; McGinley, 1981.
*Augochlora sidaefoliae* Cockerell.—Eickwort and Eickwort, 1973a [+ PUPA].
*Corynura chloris* (Spinola).—Claude-Joseph, 1926 [as *Halictus chloris*].
*Corynura cristata* (Smith).—Claude-Joseph, 1926 [as *Halictus cristatus*].
*Neocorynura colombiana* Eickwort.—Eickwort, 1979 [+ PUPA].
[*Neocorynura* species, KU.]
*Pereirapis edentata* Michener.—Eickwort and Eickwort, 1973b [+ PUPA, as *Augochlorella*]; McGinley, 1981.
Unknown: *Andinaugochlora, Ariphanarthra, Augochlorella, Augochlorodes,* [*Augochloropsis,* KU], *Caenaugochlora, Ceratalictus, Chlerogas, Chlerogella, Corynurella, Halictillus, Megalopta, Megaloptidia, Megommation, Paroxystoglossa,* [*Pseudaugochloropsis,* KU], *Rhectomia, Rhinocorynura, Temnosoma, Thectochlora.*

HALICTINI (24%)

*Agapostemon angelicus* Cockerell.—Eickwort, 1981 [+ PUPA].
*Agapostemon cockerelli* Crawford.—Eickwort, 1981 [+ PUPA].
*Agapostemon nasutus* Smith.—Eickwort and Eickwort, 1969 [+ PUPA].
*Agapostemon sericeus* (Forster).—LaBerge and Ribble, 1966a [as *A. radiatus*]; Eickwort, 1981 [+ PUPA]; McGinley, 1981 [as *A. radiatus*].
*Agapostemon texanus* Cresson.—Eickwort, 1981 [+ PUPA].
*Agapostemon virescens* (Fabricius).—Abrams and Eickwort, 1980 [+ PUPA].
[*Halictus (Halictus) farinosus* Smith, UTAH.]
*Halictus (Halictus) ligatus* Say.—Packard, 1897; Michener, 1953; McGinley, 1981.
*Halictus (Halictus) parallelus* Say.—Packard, 1897; Michener, 1953.
*Halictus (Halictus) scabiosae* Rossi.—Grandi, 1954, 1961.
*Halictus (Halictus) sexcinctus* (Fabricius).—Grandi, 1937, 1961; Michener, 1953.
*Halictus (Seladonia) tripartitus* Cockerell.—Michener, 1953, 1954 [PUPA].
*Lasioglossum (Dialictus) spinolae* (Friese).—Claude-Joseph, 1926.
*Lasioglossum (Ctenonomia) albescens sepulchralis* Cameron.—Sakagami, 1968 [+ PUPA].
*Lasioglossum (Evylaeus) duplex* Dalla Torre.—Sakagami and Hayashida, 1960 [+ PUPA].
*Lasioglossum (Dialictus) herbstiellum* (Friese).—Claude-Joseph, 1926 [as *Halictus herbstiellus*].
*Lasioglossum (Dialictus) imitatum* (Smith).—Michener, 1953 [as *L. sparsum*], 1954 [PUPA, as *L. sparsum*].
*Lasioglossum (Evylaeus) kincaidii* (Cockerell).—Michener, 1953, 1954 [PUPA].
*Lasioglossum (Hemihalictus) lustrans* (Cockerell).—Daly, 1961.
*Lasioglossum (Evylaeus) malachurum* (Kirby).—Soika, 1934 [+PUPA]; Michener, 1953.
*Lasioglossum (Evylaeus) ohei* Hirashima and Sakagami.—Sakagami, Hirashima, and Ohe, 1966.
*Lasioglossum (Dialictus) umbripenne* (Ellis).—Eickwort and Eickwort, 1971 [+ PUPA].
*Lasioglossum (Dialictus) zephyrum* (Smith).—(McGinley, 1981).
*Lasioglossum (Dialictus)* species.—Michener, 1953.
*Microsphecodes kathleenae* Eickwort.—Eickwort and Eickwort, 1972b [+ PUPA].
*Ruizantheda (Ruizanthedella) mutabilis* (Spinola).—Claude-Joseph, 1926 [as *Halictus mutabilis*].
*Sphecodes albilabris* (Kirby).—Rozen, 1965a [+ PUPA]; McGinley, 1981.
*Sphecodes* species.—Michener, 1953, 1954 [+ PUPA; reported as *Neopasites* species?].
*Sphecodes* species, near *fragariae* Cockerell.—Torchio, 1975 [+ PUPA].
Unknown: *Archihalictus*, [*Caenoha lic tus*, KU], *Dinagapostemon*, *Echthralictus*, *Eupetersia*, [*Habralictus*, KU], *Homalictus*, *Madagalictus*, *Mexalictus*, *Pachyhalictus*, *Paragapostemon*, *Parathrincostoma*, *Patellapis*, [*Pseudagapostemon*, KU], *Ptilocleptis*, *Rhinetula*, *Thrincohalictus*, *Thrinchostoma*, *Zonalictus*.

NOMIOIDINI (0)

Unknown: *Ceyalictus*, *Nomioides*.

NOMIINAE (100%)

(Many taxa in this group have variously been treated as genera or subgenera; undoubtedly, there are several valid nomiine genera but the following conservative scheme, i.e., *Nomia* (s.l.), is used here to avoid additional confusion).

*Nomia australica* Smith.—Rayment, 1957.
*Nomia esakii* Hirashima.—Hirashima, 1961 [as *Rhopalomelissa*].
[*Nomia heteropoda* Say, UTAH.]
*Nomia melanderi* Cockerell.—Michener, 1953, 1954 [PUPA]; Nielsen and Bohart, 1967 [sex characters]; McGinley, 1981.
*Nomia n. nevadensis* Cresson.—Michener, 1953; Nielsen and Bohart, 1967 [sex characters].
*Nomia punctulata* Dalla Torre.—Masuda, 1943; Hirashima, 1961.
*Nomia ruficornis* Spinola.—Soika, 1932; Michener, 1953.
*Nomia triangulifera* Vachal.—Nielsen and Bohart, 1967 [sex characters].
*Nomia yasumatsui* Hirashima.—Hirashima, 1961 [as *Rhopalomelissa*].
*Nomia* species.—LaBerge and Ribble, 1966a [as *Agapostemon splendens*].

ANDRENIDAE (41%)

ANDRENINAE (17%)

*Andrena (Callandrena) accepta* Viereck.—Rozen, 1973a; McGinley, 1981.
*Andrena (Leucandrena) barbilabris* (Kirby).—Thorp and Stage, 1968 [+ PUPA; as *A. placida* Smith].
*Andrena (Thysandrena) bisalicis* Viereck.—Yager and Rozen, 1966 [PUPA]; Rozen, 1973a.
*Andrena (Euandrena) caerulea* Smith.—Michener, 1953 [as *A. complexa* Viereck].
*Andrena (Thysandrena) candida* Smith.—Youssef and Bohart, 1968 [+ PUPA].
*Andrena (Melandrena) carlini* Cockerell.—Schrader and LaBerge, 1978.
*Andrena (Diandrena) chalybaea* (Cresson).—Thorp, 1969.
*Andrena (Melandrena) dunningi* Cockerell.—Johnson, 1981.
*Andrena (Ptilandrena) erigeniae* Robertson.—Davis and LaBerge, 1975.

*Andrena (Leucandrena) erythronii* Robertson.—Michener, 1953; Yager and Rozen, 1966 [PUPA].
*Andrena (Scrapteropsis) imitatrix* Cresson.—Yager and Rozen, 1966 [PUPA]; Rozen, 1973a.
*Andrena (Larandrena) miserabilis* Cresson.—Norden and Scarbrough, 1979.
*Andrena (Scrapteropsis) morrisonella* Viereck.—Rozen, 1973a.
*Andrena (Tylandrena) perplexa* Smith.—Stephen, 1966 [+ PUPA; as *A. viburnella*].
*Andrena (Melandrena) regularis* Malloch.—Schrader and LaBerge, 1978.
*Andrena (Melandrena) vicina* Smith.—Packard, 1897 [+ PUPA]; Michener, 1953.
*Andrena* species.—Michener, 1953.
Unknown: *Alocandrena, Ancylandrena, Euherbstia, Megandrena, Orphana.*

PANURGINAE (45%)

*Acamptopoeum submettallicum* (Spinola).—Claude-Joseph, 1926 [as *Camptopaeum*]; Michener, 1953.
*Calliopsis andreniformis* Smith.—Michener, 1953; Rozen, 1966a; Yager and Rozen, 1966 [PUPA].
*Calliopsis crypta* Shinn.—Rozen, 1966a; McGinley, 1981.
*Calliopsis rozeni* Shinn.—Rozen, 1966a.
*Camptopoeum bakeri* Rozen.—Rozen, 1988.
*Heterosarus boylei* (Cockerell).—Rozen, 1966a; McGinley, 1981.
*Hypomacrotera callops callops* Cockerell and Porter.—Rozen, 1970a [+ PUPA]; McGinley, 1981.
*Melitturga caudata* Perez.—Rozen, 1971.
*Melitturga clavicornis* (Latreille).—Rozen, 1965a; Yager and Rozen, 1966 [PUPA]; McGinley, 1981.
*Meliturgula braunsi* Friese.—Rozen, 1968 [+ PUPA]; McGinley, 1981.
*Nomadopsis anthidia anthidia* (Fowler).—Rozen, 1958; Yager and Rozen, 1966 [PUPA]; Nielsen and Bohart, 1967 [sex characters].
*Nomadopsis anthidia lutea* Rozen.—Rozen, 1958.
*Nomadopsis australior* (Cockerell).—Custer, 1929; Michener, 1953; Rozen, 1958.
*Nomadopsis barbata* Timberlake.—Rozen, 1958.
*Nomadopsis boharti* Rozen.—Rozen, 1958; Yager and Rozen, 1966 [PUPA].
*Nomadopsis comptula* (Cockerell).—Rozen, 1958.
*Nomadopsis edwardsii* (Cresson).—Rozen, 1958.
*Nomadopsis filiorum* Rozen.—Rozen, 1963.
*Nomadopsis fracta* Rozen.—Michener, 1953; Rozen, 1958.
*Nomadopsis helianthi* (Swenk and Cockerell).—Michener, 1953, 1954 [PUPA, described as *N. euphorbiae* (Cockerell)]; Rozen, 1958; Yager and Rozen, 1966 [PUPA].
*Nomadopsis hesperia equina* (Cockerell).—Rozen, 1958; Yager and Rozen, 1966 [PUPA].
*Nomadopsis linsleyi* Rozen.—Rozen, 1958.
*Nomadopsis micheneri* Rozen.—Rozen, 1958.
*Nomadopsis personata* (Cockerell).—Yager and Rozen, 1966 [PUPA].
*Nomadopsis puellae* (Cockerell).—Rozen, 1958; Yager and Rozen, 1966 [PUPA]; McGinley, 1981.
*Nomadopsis scitula* (Cresson).—Yager and Rozen, 1966 [PUPA].
*Nomadopsis scutellaris scutellaris* (Fowler).—Rozen, 1958; Yager and Rozen, 1966 [PUPA]; Nielsen and Bohart, 1967 [sex characters].
*Nomadopsis trifolii* Timberlake.—Rozen, 1958.
*Nomadopsis zonalis sierrae* Rozen.—Rozen, 1963; Yager and Rozen, 1966 [PUPA].
*Panurginus albopilosus* Lucas.—Rozen, 1971 [+ PUPA].
*Panurginus atriceps* (Cresson).—Rust, 1976.
*Panurginus melanocephalus* (Cockerell).—Michener, 1953; Rozen, 1966a.
*Panurginus potentillae* (Crawford).—Rozen, 1966a; McGinley, 1981.
*Panurginus* species A.—Rozen, 1966a; Yager and Rozen, 1966 [PUPA].
*Panurgus banksianus* (Kirby).—Micheli, 1931; Michener, 1953.
*Panurgus calcaratus* Scopoli.—Micheli, 1936; Michener, 1953.
*Panurgus dentipes* Latreille.—Rozen and Rozen, 1966; McGinley, 1981.
*Panurgus intermedius* Rozen.—Rozen, 1971 [+ PUPA].
*Panurgus oraniensis* Perez.—Rozen, 1971 [+ PUPA].
*Panurgus podagricus* Perez.—Rozen, 1971.
[*Perdita (Cockerellia) albipennis* Cresson, UTAH.]
[*Perdita (Perdita) bohartorum* Timberlake, UTAH.]
*Perdita (Perdita) confusa* Timberlake.—Rozen, 1966a.
*Perdita (Perdita) halictoides* Smith.—Eickwort, 1977 [+ PUPA].
*Perdita (Perdita) lenis* Timberlake.—Rozen, 1966a.
*Perdita (Cockerellia) lingualis* Cockerell.—Michener, 1963 [+ PUPA]; Rozen, 1966a; Yager and Rozen, 1966 [PUPA]; McGinley, 1981.
*Perdita (Perdita) maculigera maculipennis* Graenicher.—Michener and Ordway, 1963 [+ PUPA]; Rozen, 1966a; Yager and Rozen, 1966 [PUPA].
*Perdita (Perdita) nuda* Cockerell.—Torchio, 1975 [+ PUPA].
*Perdita (Perdita) octomaculata* (Say).—Eickwort, 1977 [+ PUPA].
*Perdita (Cockerellula) opuntiae* Cockerell.—Custer, 1929; Michener, 1953.
*Perdita (Perdita) sexmaculata* Cockerell.—Rozen, 1966a.
*Perdita (Perdita) zebrata zebrata* Cresson.—Custer, 1929; Michener, 1953; Rozen, 1966a.
*Protandrena bicolor* (Timberlake).—Rozen, 1970 [+ PUPA]; McGinley, 1981.
*Pseudopanurgus aethiops* (Cresson).—Rozen, 1966a.

*Pseudopanurgus verticalis* Timberlake.—Rozen, 1966a.
*Pterosarus occidus* (Timberlake).—Rozen, 1966a.
*Spinoliella herbsti* (Friese).—Claude-Joseph, 1926 [as *Camptopaeum*]; Michener, 1953.
*Spinoliella maculata* (Spinola).—Claude-Joseph, 1926 [as *Camptopaeum*]; Michener, 1953.
Unknown: *Anthemurgus, Anthrenoides, Austropanurgus, Callonychium, Cephalurgus, Epimethea, Liopoeum, Liphanthus, Mermiglossa, Metapsaenythia, Parafriesea, Parapsaenythia, Plesiopanurgus, Poecilomelitta, Protomeliturga, Pseudosarus, Rhophitulus, Xenopanurgus.*

OXAEIDAE (50%)

*Oxaea flavescens* Klug.—Roberts, 1973 [+ PUPA]; Torchio and Burwell, 1987 [PUPA].
*Protoxaea gloriosa* (Fox).—Rozen, 1964a; McGinley, 1981.
Unknown: *Mesoxaea, Notoxaea.*

MELITTIDAE (29%)

DASYPODINAE (38%)

DASYPODINI (60%)

*Capicola braunsiana* Friese.—Rozen and McGinley, 1974a; McGinley, 1981.
*Dasypoda plumipes* Panzer.—Rozen and McGinley, 1974a; McGinley, 1981.
*Hesperapis carinata* Stevens.—Rozen and McGinley, 1974a.
*Hesperapis ilicifoliae* (Cockerell).—Rozen and McGinley, 1974a.
*Hesperapis nitidula* Cockerell.—Rozen and McGinley, 1974a.
*Hesperapis pellucida* Cockerell.—Rozen and McGinley, 1974a.
*Hesperapis regularis* (Cresson).—Burdick and Torchio, 1959; Rozen and McGinley, 1974a.
*Hesperapis rufipes* (Ashmead).—Michener, 1953; Rozen and McGinley, 1974a.
*Hesperapis trochanterata* Snelling.—Rozen, 1987a.
*Hesperapis* species A.—Rozen and McGinley, 1974a.
*Hesperapis* species B.—Rozen and McGinley, 1974a.
Unknown: *Eremaphanta, Xeralictoides.*

PROMELITTINI (0)

Unknown: *Promelitta.*

SAMBINI (0)

Unknown: *Haplomelitta, Samba.*

MEGANOMIINAE (25%)

*Meganomia gigas* Michener.—Rozen, 1977a [+ PUPA; as *M. binghami* (Cockerell)]; McGinley, 1981.
Unknown: *Agemmonia, Ceratomonia, Uromonia.*

MELITTINAE (40%)

*Macropis europaea* Warncke.—Rozen and McGinley, 1974a [+PUPA]; McGinley, 1981.
*Macropis nuda* (Provancher).—Rozen and Jacobson, 1980 [+ PUPA].
*Melitta leporina* (Panzer).—Rozen and McGinley, 1974a [+ PUPA]; McGinley, 1981.
Unknown: *Dolichochile, Rediviva, Redivivoides.*

CTENOPLECTRIDAE (50%)

*Ctenoplectra armata* Magretti.—Rozen, 1978; McGinley, 1981.
Unknown: *Ctenoplectrina.*

MEGACHILIDAE (22%)

FIDELIINAE (100%)

*Fidelia villosa* Brauns.—Rozen, 1970b [+ PUPA]; McGinley, 1981.
*Neofidelia profuga* Moure and Michener.—Rozen, 1973b [+ PUPA]; McGinley, 1981.
*Parafidelia pallidula* Cockerell.—Rozen, 1977b; McGinley, 1981.

LITHURGINAE (66%)

*Lithurge apicalis* (Cresson).—Rozen, 1973c.
*Lithurge atratiformis* Cockerell.—Rozen, 1973c; McGinley, 1981.
*Lithurge chrysurus* Fonscolombe.—Roberts, 1978 [+ PUPA].
*Lithurge echinocacti* (Cockerell).—Rozen, 1973c [compared to *L. apicalis*].
*Trichothurgus dubius* (Herbst).—Claude-Joseph, 1926 [as *Lithurge*]; Michener, 1953; Rozen, 1973c [+ PUPA].
*Trichothurgus echinocacti* (Cockerell).—Rozen, 1973c [as *Lithurge*].
*Trichothurgus* species—Rozen, 1973c [as *Lithurge*].
Unknown: *Microthurge.*

MEGACHILINAE (18%)

ANTHIDIINI (12%)

*Anthidium chilense* Spinola.—Claude-Joseph, 1926; Michener, 1953.
*Anthidium oblongatum* Latreille.—Xambeu, 1896; Maneval, 1937; Michener, 1953.
*Anthidium 7-dentatum* Lepeletier.—Grandi, 1961.
*Anthidium* species—McGinley, 1981.
*Anthidiellum ehrhorni* (Cockerell).—Michener, 1953 [as *Anthidium ehrhorni*].
*Anthidiellum perplexum* (Smith).—Baker et al., 1985 [PUPA].
*Anthidiellum notatum robertsoni* (Cockerell).—Michener, 1953.

*Dianthidium curvatum sayi* Cockerell.—Michener, 1953.
*Dianthidium heterulkei heterulkei* Schwarz.—Clement, 1976.
*Dianthidium* species—Michener, 1953; McGinley, 1981.
[*Dianthidium* spp., UTAH.]
*Heterostelis hurdi* Thorp.—Thorp, 1966 [+ PUPA].
*Odontostelis bilineolata* (Spinola).—Rozen, 1966b [+ PUPA; as *Stelis*]; McGinley, 1981.
*Paranthidiellum lituratum* (Panzer).—Enslin, 1923; Micheli, 1934; Michener, 1953.
*Paranthidium caturigense* (Giraud).—Micheli, 1935; Maneval, 1936; Michener, 1953.
*Paranthidium septemdentatum* (Latreille).—Xambeu, 1896; Grandi, 1934; Michener, 1953.
*Stelis chlorocyanea* (Cockerell).—Rust and Thorp, 1973 [+ PUPA].
*Stelis elongativentris* Parker.—Rozen, 1987b.
*Stelis lateralis* Cresson.—Michener, 1953; Rozen, 1966b.
*Stelis minuta* Lepeletier.—Enslin, 1925; Michener, 1953.
*Stelis nasuta* (Latreille).—Maneval, 1937; Michener, 1953.
*Stelis ornatula* Nylander.—Micheli, 1935; Michener, 1953.
[*Stelis* spp., UTAH.]
*Trachusa perdita* Cockerell.—Michener, 1953; McGinley, 1981.
Unknown: *Adanthidium, Afranthidium, Allanthidium, Anthidioma, Anthodioctes, Apianthidium, Archianthidium, Asianthidium, Aspidosmia, Atropium, Ausanthidium, Axillanthidium, Aztecanthidium, Bathanthidium, Bellanthidium, Benanthis, Branthidium, Bothranthidium,* [*Callanthidium,* UTAH], *Capanthidium, Carinanthidium, Cyphanthidium,* [*Dolichostelis,* UTAH], *Domanthidium, Doxanthidium, Epanthidium, Euaspis, Exanthidium, Gnathanthidium, Heteranthidium, Honanthidium, Hypanthidioides, Hypanthidium, Icteranthidium, Immanthidium, Malanthidium, Manthidium, Meganthidium, Melanthidium, Mesanthidiellum, Mesanthidium, Nananthidium, Neanthidium, Nigranthidium, Notanthidium, Oranthidium, Oxyanthidium, Pachyanthidium, Paraanthidium,* [*Parevaspis,* UTAH], *Plesianthidium, Pseudoanthidium, Pyctanthidium, Reanthidium, Rhodanthidium, Royanthidium, Serapista, Spinanthidium, Trianthidiellum, Trianthidium, Trichanthidium, Tuberanthidium, Ulanthidium, Xenanthidium.*

### DIOXINI (100%)

*Dioxys cincta* (Jurine).— Micheli, 1936; Michener, 1953.
*Dioxys pomonae pomonae* Cockerell.—Rozen, 1967 [+ PUPA]; McGinley, 1981.
*Dioxys productus productus* (Cresson).—Rozen, 1967.

### MEGACHILINI (75%)

*Chalicodoma (Chelostomoides) campanulae campanulae* (Robertson).—Baker, Kuhn, and Bambara, 1985.
*Chalichodoma (Pseudomegachile) flavipes* Spinola.—Moustafa and Mazeed, 1977 [+ PUPA].
*Chalicodoma (Callomegachile) mystaceana* Michener.—King, 1984 [+ PUPA].
*Chalicodoma (Chelostomoides)* species.—Michener, 1953, 1954 [PUPA].
[*Chalicodoma* spp., UTAH.]
*Coelioxys elongata* Lepeletier.—Iwata, 1939.
[*Coelioxys funeraria* Smith, UTAH.]
*Coelioxys modesta* Smith.—Baker et al., 1985 [additional material in USNM].
*Coelioxys octodentata* Say.—Michener, 1953; Baker, 1971.
*Coelioxys sayi* Robertson.—Baker, 1971; Baker et al., 1985 [PUPA]; [first instar in USNM].
*Coelioxys* species.—McGinley, 1981.
*Megachile albisecta* Klug.—Grandi, 1931; Michener, 1953; Grandi, 1961.
*Megachile argentata* Fabricius.—Grandi, 1931; Michener, 1953; Grandi, 1961.
*Megachile brevis* Say.—Michener, 1953, 1954 [PUPA]; McGinley, 1981.
*Megachile buyssonii* Perez.—Buysson, 1902; Michener, 1953.
*Megachile centuncularis* (Linnaeus).—Packard, 1897; Buysson, 1902; Grandi, 1934; Michener, 1953; Grandi, 1961; Romasenko, 1983b.
*Megachile euzona* Perez.—Claude-Joseph, 1926; Michener, 1953.
*Megachile lagopoda* (Linnaeus).—Buysson, 1902; Michener, 1953; Marikovskaja, 1984.
*Megachile ligniseca* Kirby.—Romasenko, 1983a.
*Megachile macularis* Dalla Torre.—King, 1984.
*Megachile maritima* (Kirby).—Buysson, 1902; Michener, 1953.
*Megachile mendica* Cresson.—Baker et al., 1985 [+ PUPA].
*Megachile montivaga* Cresson.—Baker et al., 1985.
*Megachile muraria* Fabricius.—Grandi, 1934; Michener, 1953; Grandi, 1961.
*Megachile nigriventris* Schenck.—Micheli, 1937; Michener, 1953.
*Megachile policaris* Say.—Baker et al., 1985 [+ PUPA; as *Eumegachile*].
*Megachile pollinosa* Spinola.—Claude-Joseph, 1926; Michener, 1953.
*Megachile pyrenaica pyrenaica* Lepeletier.—Buysson, 1902; Michener, 1953.
*Megachile pyrenaica alpina* Morawitz.—Micheli, 1935; Michener, 1953.
*Megachile rancaguensis* Friese.—Claude-Joseph, 1926; Michener, 1953.
*Megachile rotundata* (Fabricius).—Nielsen and Bohart, 1967 [sex characters].
*Megachile saulcyi* Guerin-Meneville.—Claude-Joseph, 1926; Michener, 1953.
*Megachile versicolor* Smith.—Danks, 1970.
*Megachile* species.—King, 1984.

*Megachile* species.—Michener, 1953.
[*Megachile* spp., USNM.]
Unknown: *Creightoniella.*

OSMIINI (23%)

Many unstudied taxa, including nearly all species of *Ashmeadiella,* are in the collections of the Bee Biology and Systematics Laboratory, Utah State University and the Smithsonian Institution.

*Ashmeadiella* species.—Michener, 1953; McGinley, 1981.
*Heriades carinatus* Cresson.—Matthews, 1965.
*Heriades crenulatus* Nylander.—Grandi, 1934; Grandi, 1961; Michener, 1953.
*Hoplitis adunca* (Panzer).—Grandi, 1935 [as *Osmia*]; Michener, 1953; Grandi, 1961 [as *Osmia*].
*Hoplitis anthocopoides* (Schenck).—Eickwort, 1973 [+ PUPA].
*Hoplitis cylindrica* (Cresson).—Baker, Kuhn, and Bambara, 1985.
*Hoplitis lepeletieri* (Perez).—Micheli, 1933; Michener, 1953.
*Hoplitis leucomelanena* (Kirby).—Enslin, 1925; Micheli, 1930; Michener, 1953.
*Hoplitis loti* (Morawitz).—Micheli, 1931; Michener, 1953.
*Hoplitis parvula* (Dufour and Perris).—Dufour and Perris, 1840; Michener, 1953.
*Hoplitis tridentata* (Dufour and Perris).—Dufour and Perris, 1840; Michener, 1953.
*Hoplitis* species—Michener, 1953; McGinley, 1981.
*Osmia aurulenta* (Panzer).—Marechal, 1926; Michener, 1953.
*Osmia lignaria lignaria* Say.—Baker, Kuhn, and Bambara, 1985.
*Osmia lignaria propinqua* Cresson.—Michener, 1953; McGinley, 1981.
*Osmia rufa* (Linnaeus).—Losinski, 1911; Michener, 1953.
*Osmia submicans* (Morawitz).—Maneval, 1939; Michener, 1953; Wafa and El Berry, 1972 [+ PUPA]; Moustafa and El Berry, 1976 [+ PUPA].
*Proteriades bunocephala* (Michener).—Thorp, 1968.
*Proteriades xerophila* (Cockerell).—Michener, 1953.
Unknown: *Archeriades, Bytinskia,* [*Chelostoma,* UTAH], *Hofferia, Jaxartinula, Kumobia, Megaloheriades, Metallinella, Noteriades, Ochreriades, Othinosmia,* [*Prochelostoma,* USNM], [*Protosmia,* UTAH], *Pseudoheriades, Stenosmia, Wainia, Xeroheriades.*

ANTHOPHORIDAE (39%)

ANTHOPHORINAE (38%)

ANCYLINI (0)

Unknown: *Ancyla, Tarsalia.*

ANTHOPHORINI (33%)

*Amegilla crinipes* (Smith).—Radovic and Krunic, 1977.
*Amegilla parietina fulvocinerea* (Dours).—Radovic and Krunic, 1977.
*Amegilla pulchra* (Smith).—Cardale, 1968 [+ PUPA].
*Amegilla species* .—Cardale, 1968 [+ PUPA].
*Anthophora abrupta* Say.—Michener, 1953; Norden, 1984 [+ PUPA].
*Anthophora bomboides stanfordiana* Cockerell.—Michener, 1953 [as *A. stanfordiana*]; McGinley, 1981; Brooks, 1983 [PUPA].
*Anthophora borealis* Morawitz.—Popova, 1984.
*Anthophora edwardsii* Cresson.—Michener, 1953.
*Anthophora furcata syringae* (Cockerell).—Michener, 1953, 1954 [+ PUPA].
*Anthophora incerta* Spinola.—Claude-Joseph, 1926 [as *Podalirius*]; Michener, 1953.
*Anthophora linsleyi* Timberlake.—Michener, 1953, 1954 [+ PUPA].
*Anthophora occidentalis* Cresson.—Nielsen and Bohart, 1967 [sex characters].
*Anthophora personata* (Illiger).—Semichon, 1922 [+ PUPA]; Michener, 1953, 1954 [PUPA].
*Anthophora urbana* Cresson.—Michener, 1953.
*Anthophora villosula* Smith.—Torikata, 1931; Michener, 1953.
*Emphoropsis miserabilis* (Cresson).—Torchio and Stephen, 1961 [+ PUPA]; McGinley, 1981.
Unknown: *Deltoptila, Elaphropoda, Habrophorula, Habropoda, Heliophila, Pachymelus.*

CANEPHORULINI (0)

Unknown: *Canephorula.*

CENTRIDINI (66%)

*Centris aenea* Lepeletier.—Rozen, 1965b.
*Centris cineraria* (Smith).—Claude-Joseph, 1926; Michener, 1953.
*Centris derasa* Lepeletier.—Rozen, 1965b.
*Centris lanipes* (Fabricius).—Rozen, 1965b; McGinley, 1981.
*Centris rufosuffusa* Cockerell.—Rozen, 1965b.
[*Centris* spp., UTAH.]
*Epicharis fasciata* Lepeletier and Serville.—Rozen, 1965b; McGinley, 1981.
*Epicharis rustica* (Olivier).—Rozen, 1965b.
*Epicharis rustica flava* (Olivier).—Camargo, Zucchi, and Sakagami, 1975 [+ PUPA].
Unknown: *Ptilotopus.*

ERICROCIDINI (15%)

*Acanthopus splendidus urichi* Cockerell.—Rozen, 1969; McGinley, 1981.
*Mesoplia rufipes* (Perty).—Rozen, 1969.
Unknown: *Abromelissa, Aglaomelissa, Ctenioschelus, Cyphomelissa, Epiclopus, Ericrocis, Eurytis, Hopliphora, Mesocheira, Mesonychium, Oxynedys.*

EUCERINI (31%)

*Alloscirtetica gayi* (Spinola).—Claude-Joseph, 1926 [as *Tetralonia chilensis* Herbst]; Michener, 1953.
*Alloscirtetica tristrigata* (Spinola).—Claude-Joseph, 1926 [as *Tetralonia*]; Michener, 1953.
*Eucera sociabilis* Smith.—Masuda, 1946 [+ PUPA; as *E. difficilis* Perez].
*Florilegus condignus* (Cresson).—LaBerge and Ribble, 1966b.
[*Melissodes agilis* Cresson, UTAH.]
*Melissodes pallidisignata* Cockerell.—Rozen, 1965b; McGinley, 1981.
*Melissodes persimilis* Cockerell.—Buchmann and Jones, 1980.
*Melissodes robustior* Cockerell.—Rozen, 1965b.
*Melissodes rustica* (Say).—Clement, 1973.
*Melissodes* species.—Michener, 1953.
*Peponapis fervens* (Smith).—Rozen, 1965b; McGinley, 1981.
*Svastra obliqua obliqua* (Say).—Rozen, 1964b; McGinley, 1981.
*Svastrides melanura* (Spinola).—Claude-Joseph, 1926; Michener, 1953.
*Tetralonia hamata* Bradley.—Miliczky, 1985.
*Tetralonia lanuginosa* Klug.—Mohamed, 1974 [+ PUPA].
*Tetralonia malvae* Rossi.—Grandi, 1954, 1961.
*Thygater* species.—Packer, 1987.
*Xenoglossa angustior* Cockerell.—Rozen, 1965b; McGinley, 1981.
*Xenoglossa fulva* Smith.—Rozen, 1965b.
*Xenoglossa strenua* (Cresson).—Bohart, 1964; Rozen, 1965b.
Unknown: *Anthedonia, Cemolobus, Dithygater, Eucara, Gaesischia, Gaesochira, Lophothygater, Loxoptilus, Martinapis, Melissina, Melissoptila, Megascirtetica, Micronychapis, Pachysvastra, Pectenapis, Simanthedon, Svastrina, Syntrichalonia, Tetraloniella, Thygatina, Trichocerapis, Xenoglossodes.*

EUCERINODINI (0)

Unknown: *Eucerinoda.*

EXOMALOPSINI (40%)

*Exomalopsis caerulea* Friese.—Claude-Joseph, 1926; Michener, 1953; Rozen, 1957.
*Exomalopsis chionura* Cockerell.—Rozen, 1957; McGinley, 1981.
*Lanthanomelissa* species—Lucas de Oliveira, 1966a.
*Paratetrapedia gigantea* (Schrottky).—Lucas de Oliveira, 1962.
[*Paratetrapedia swainsonae* (Cockerell), KU.]
*Tapinotaspis caerulea* (Friese).—Lucas de Oliveira, 1962.
Unknown: [*Ancyloscelis*, UTAH], *Caenonomada, Chalepogenus, Chilimalopsis*, [*Eremapis*, UTAH], *Monoeca.*

MELECTINI (57%)

*Melecta armata* Panzer.—Semichon, 1922 [+ PUPA]; Michener, 1953, 1954 [PUPA].
*Melecta luctuosa* Sopoli.—Soika, 1936 [first instar].
*Melecta pacifica* Cresson.—Torchio and Youssef, 1968.
*Melecta separata callura* (Cockerell).—Rozen, 1969; McGinley, 1981.
*Thyreus caeruleopunctatus* (Blanchard).—Cardale, 1968 [PUPA].
*Thyreus lieftincki* Rozen.—Rozen, 1969; McGinley, 1981.
*Thyreus lugubrus* (Smith).—Cardale, 1968.
*Thyreus* species—Rozen, 1969.
*Xeromelecta californica* (Cresson).—Michener, 1953, 1954 [PUPA]; Rozen, 1969.
*Zacosmia maculata* (Cresson).—Torchio and Youssef, 1968 [+ PUPA]; Rozen, 1969; McGinley, 1981.
Unknown: *Brachymelecta, Nesomelecta, Tetralonoidiella.*

MELITOMINI (100%)

*Diadasia chilensis* Spinola.—Claude-Joseph, 1926 [as *Melitoma*]; Michener, 1953.
[*Diadasia consociata* Timberlake, UTAH.]
*Diadasia diminuta* (Cresson).—McGinley, 1981.
*Diadasia enevata* (Cresson).—Michener, 1953, 1954 [+ PUPA]; Nielsen and Bohart, 1967 [sex characters].
*Melitoma euglossoides* Lepeletier and Serville.—McGinley, 1981.
*Ptilothrix bombiformis* (Cresson).—Michener, 1953 [as *Emphor bombiformis*], 1954 [+ PUPA].

PARARHOPHITINI (100%)

*Pararhophites orobinus* (Morawitz).—McGinley and Rozen, 1987.

RHATHYMINI (100%)

*Rhathymus bicolor* Lepeletier.—Rozen, 1969; McGinley, 1981.
*Rhathymus trinitatis* Cockerell.—Rozen, 1969.
*Rhathymus* species—Camargo, Zucchi, and Sakagami, 1975 [+ PUPA].

TETRAPEDIINI (0)

[*Tetrapedia*, UTAH.]

NOMADINAE (40%)

AMMOBATINI (33%)

*Ammobates carinatus* Morawitz.—Rozen and McGinley, 1974b; McGinley, 1981.
*Morgania histrio transvaalensis* Bischoff.—Rozen and McGinley, 1974b [+ PUPA]; McGinley, 1981.

*Oreopasites vanduzeei* Cockerell.—Rozen, 1954, 1966c; Rozen and McGinley, 1974b [+ PUPA]; McGinley, 1981.
*Pseudodichroa fumipennis* Bischoff.—Rozen and McGinley, 1974b; McGinley, 1981.
Unknown: *Caesarea, Melanempis, Omachthes, Parammobatodes, Pasites, Pasitomachthes, Pseudopasites, Sphecodopsis.*

AMMOBATOIDINI (0)

Unknown: *Ammobatoides.*

BIASTINI (50%)

*Neopasites cressoni* Crawford.—Rozen, 1966c; McGinley, 1981.
Unknown: [*Biastes*, UTAH].

CAENOPROSOPIDINI (0)

Unknown: *Caenoprosopidis.*

EPEOLINI (66%)

*Doeringiella gayi* (Spinola).—Claude-Joseph, 1926 [as *Epeolus*]; Michener, 1953.
*Epeolus pusillus* Cresson.—Rozen, 1966c.
*Epeolus tristis* Smith.—Mayet, 1875 [+ PUPA]; Michener, 1953.
*Epeolus* species A.—Michener, 1953; Rozen, 1966c; McGinley, 1981.
*Odyneropsis apicalis* Ducke.—Rozen, 1966c.
*Triepeolus dacotensis* (Stevens).—Nielsen and Bohart, 1967 [sex characters].
[*Triepeolus helianthi* (Robertson), UTAH.]
*Triepeolus mesillae* Cockerell.—Rozen, 1966c.
*Triepeolus remigatus* (Fabricius).—Rozen, 1966c.
*Triepeolus* species A.—Rozen, 1966c; McGinley, 1981.
*Triepeolus* species B.—Rozen, 1966c.
*Triepeolus* species C.—Michener, 1953; Rozen, 1966c.
Unknown: *Thalestria, Trophocleptria.*

EPEOLOIDINI (0)

Unknown: *Epeoloides.*

HOLCOPASITINI (50%)

*Holcopasites calliopsidis* (Linsley).—Rozen, 1966c.
*Holcopasites insoletus* (Linsley).—Rozen, 1966c; McGinley, 1981.
*Holcopasites* species A.—Rozen, 1966c.
Unknown: *Schmiedeknechtia.*

ISEPEOLINI (100%)

*Isepeolus luctuosus* (Spinola).—Claude-Joseph, 1926; Michener, 1953.
*Isepeolus viperinus* (Holmberg).—Michener, 1957; Rozen, 1966c; Lucas de Oliveira, 1966b; McGinley, 1981.

NEOLARRINI (100%)

*Neolarra pruinosa* Ashmead.—Rozen, 1966c; McGinley, 1981.

NOMADINI (71%)

*Kelita tuberculata* Ehrenfeld and Rozen.—Ehrenfeld and Rozen, 1977.
*Melanomada sidaefloris* (Cockerell).—Rozen, 1977c [+ PUPA]; McGinley, 1981.
*Melanomada annectens* Snelling and Rozen.—Snelling and Rozen, 1987.
*Nomada obscurella* Fowler.—Michener, 1953 [as *N. fowleri*]; Rozen, 1966c; McGinley, 1981.
*Nomada imbricata* Smith.—Packard, 1897 [+ PUPA]; Michener, 1953.
*Nomada japonica* Smith.—Masuda, 1946 [+ PUPA].
*Nomada suavis* Cresson.—Rozen, 1966c.
*Nomada* species A.—Rozen, 1966c.
*Nomada* species B.—Rozen, 1966c.
*Nomada* species C.—Rozen, 1966c.
*Paranomada velutina* Linsley.—Rozen, 1977c [+ PUPA]; McGinley, 1981.
*Triopasites penniger* (Cockerell).—Rozen, 1977c.
Unknown: *Brachynomada, Hexepeolus.*

OSIRINI (0)

Unknown: *Osiris.*

PROTEPEOLINI (50%)

*Protepeolus singularis* Linsley and Michener.—Rozen, Eickwort, and Eickwort, 1978 [+ PUPA]; McGinley, 1981.
Unknown: *Leiopodus.*

TOWNSENDIELLINI (0)

Unknown: *Townsendiella.*

XYLOCOPINAE (74%)

CERATININI (81%)

*Allodape ceratinoides* Gribodo.—Brauns, 1926; Michener, 1953, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape collaris* Vachal.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape dapa* Strand.—Michener, 1975.
*Allodape exoloma* Strand.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape friesei* Strand.—Michener, 1975; Michener and

Scheiring, 1976 [PUPA].
*Allodape interrupta* Vachal.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape mucronata* Smith.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape panurgoides* Smith.—Michener, 1975; McGinley, 1981 [as *A. crinita* Brauns MS].
*Allodape pernix* (Bingham).—Michener, 1975.
*Allodape pictifrons* Smith.—Michener, 1975.
*Allodape quadrilineata* (Cameron).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape rufogastra* Lepeletier and Serville.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape stellarum* Cockerell.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodape* species.—Friese, 1914; Brauns, 1926; Michener, 1953.
*Allodapula acutigera* Cockerell.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodapula dichroa* (Strand).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodapula hessei* Michener.—Michener, 1975.
*Allodapula melanopus* (Cameron).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodapula ornaticeps* Michener.—Michener, 1975.
*Allodapula rozeni* Michener.—Michener, 1975.
*Allodapula variegata* (Smith).—Brauns, 1926 [as *Allodape pringlei*]; Michener, 1953, 1975; Michener and Scheiring, 1976 [PUPA].
*Allodapula xerica* Michetner.—Michenesr, 1975.
*Braunsapis acuticauda* Michener.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapins albitarsis* (Friese).—Michener, 1975.
*Braunsapis bouyssoui* (Vachal).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis draconis* Michener.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis elizabethana* (Strand).—Michener, 1975.
*Braunsapis facialis* (Gerstaecker).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis foveata* (Smith).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis ghanae* Michener.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis gorillarum* (Cockerell).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis iwatai* (Sakagami and Yoshikawa).—Sakagami and Yoshikawa, 1961 [as *Allodape iwatai*].
*Braunsapis leptozonia* (Vachal).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis luapulana* (Cockerell).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis natalica* Michener.—Michener, 1975.
*Braunsapis nitida* (Smith).—Michener and Syed, 1962 [as *Allodapula*].
*Braunsapis pallida* Michener.—Michener, 1975.
*Braunsapis paradoxa* (Strand).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis perkinsiella* (Michener and Syed).—Michener and Syed, 1962 [as *Allodapula*].
*Braunsapis plebeia* (Cockerell).—Michener and Syed, 1962 [as *Allodapula*].
*Braunsapis rhodesi* (Cockerell).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis rolini* (Vachal).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis sauteriella* Cockerell.—Yasumatsu, 1938 [as *Allodape marginata* Cockerell]; Michener, 1953 [as *A. marginata*]; Sakagami and Yoshikawa, 1961 [as *Allodape sauteriella*].
*Braunsapis simillima* (Smith).—Michener and Syed, 1962 [as *Allodapula*].
*Braunsapis simplicipes* Michener.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis strandi* (Masi).—Masi, 1930 [as *Allodape*]; Michener, 1953.
*Braunsapis stuckenbergorum* Michener.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis trochanterata* (Gerstaecker).—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
*Braunsapis unicolor* (Smith).—Michener and Syed, 1962 [as *Allodapula*]; Michener, 1962 [+ PUPA].
*Braunsapis vitrea* (Vachal).—Michener, 1975.
*Ceratina callosa* (Fabricius).—Micheli, 1936; Michener, 1953.
*Ceratina chalcites* Latreille.—Grandi, 1957.
*Ceratina cucurbitina* (Rossi).—Grandi, 1935; Michener, 1953.
*Ceratina dupla* Say.—Packard, 1897; Michener, 1953.
*Ceratina* species.—McGinley, 1981.
[*Ceratina* spp., UTAH.]
*Compsomelissa stigmoides* (Michener).—Michener, 1976; Michener and Scheiring, 1976 [PUPA].
*Eucondylops konowi* Brauns.—Michener, 1975.
*Eucondylops reducta* Michener.—Michener and Scheiring, 1976 [PUPA].
*Exoneura apposita* Rayment.—Rayment, 1949b; Michener, 1953.
*Exoneura concava* Rayment.—Rayment, 1949b; Michener, 1953.
*Exoneura concinnula* Cockerell.—Syed, 1963; Michener and Scheiring, 1976 [PUPA].
*Exoneura frogattii* Cockerell.—Rayment, 1949a; Michener, 1953.
*Exoneura fultoni* Cockerell.—Rayment, 1949a; Michener, 1953.
*Exoneura hamulata* Cockerell.—Rayment, 1951; Michener, 1953; Syed, 1963; Michener and Scheiring, 1976 [PUPA].
*Exoneura illustris* Erickson and Rayment.—Erickson and Rayment, 1951; Michener, 1953.

*Exoneura montana* Rayment.—Rayment, 1949b; Michener, 1953.
*Exoneura obliterata* Cockerell.—Rayment, 1949a; Michener, 1953.
*Exoneura obscuripes* Michener.—Syed, 1963.
*Exoneura pictifrons* Alfken.—Erickson and Rayment, 1951; Michener, 1953.
*Exoneura richardsoni* Rayment.—Rayment, 1951; Michener, 1953.
*Exoneura roddi* Rayment.—Rayment, 1949b; Michener, 1953.
*Exoneura rufitarsis* Rayment.—Rayment, 1951 [+ PUPA]; Michener, 1953.
*Exoneura setosa* Houston.—Houston, 1976 [+ PUPA].
*Exoneura simillima* Rayment.—Rayment, 1949a; Michener, 1953.
*Exoneura subbaculifera* Rayment.—Rayment, 1951; Michener, 1953; Syed, 1963.
*Exoneura subholmesi* Rayment.—Rayment, 1949b; Michener, 1953.
*Exoneura variabilis* Rayment.—Rayment, 1949b; Michener, 1953; Syed, 1963; Michener and Scheiring, 1976 [PUPA].
*Exoneurella eremophila* (Houston).—Houston, 1976 [+ PUPA; as *Exoneura*].
*Exoneurella lawsoni* (Rayment).—Syed, 1963 [this and following citations as *Exoneura*]; Michener, 1964; Michener and Scheiring, 1976 [PUPA].
*Exoneurella tridentata* (Houston).—Houston, 1976 [+ PUPA; as *Exoneura*].
*Halterapis angustula* (Cockerell).—Michener, 1976; Michener and Scheiring, 1976 [PUPA].
*Halterapis nigrinervis* (Cameron).—Michener, 1976; Michener and Scheiring, 1976 [PUPA].
*Inquilina excavata* (Cockerell).—Rayment, 1949b [also included as *Exoneura concava*]; Michener, 1953 [also as *E. concava*]; Syed, 1963; Michener and Scheiring, 1976 [PUPA].
*Macrogalea candida* (Smith).—Michener, 1976; Michener and Scheiring, 1976 [PUPA].
*Manuelia gayatina* (Spinola).—Claude-Joseph, 1926; Michener, 1953.
*Nasutapis straussorum* Michener.—Michener, 1975; Michener and Scheiring, 1976 [PUPA].
Unknown: *Effractapis, Exoneuridia, Pithitis.*

XYLOCOPINI (33%)

*Xylocopa aestuans* (Linnaeus).—Dover, 1924 [+ PUPA]; Michener, 1953.
*Xylocopa augusti* Lepeletier.—Lucas de Oliveira, 1974.
*Xylocopa brasilianorum* Linnaeus.—Lucas de Oliveira, 1974.
*Xylocopa ciliata* Burmaister.—Lucas de Oliveira, 1974.
*Xylocopa frontalis* Oliver.—Lucas de Oliveira, 1974; McGinley, 1981.
*Xylocopa hirsutissima* Maidl.—Lucas de Oliveira, 1974.
*Xylocopa iris* Christ.—Grandi, 1957, 1961.
*Xylocopa macrops* Lepeletier.—Lucas de Oliveira, 1974.
*Xylocopa mordax* Smith.—Lucas de Oliveira, 1974.
*Xylocopa nogueirai* Hurd and Moure.—Lucas de Oliveira, 1974.
*Xylocopa subcyanea* Perez.—Lucas de Oliveira, 1974.
*Xylocopa submordax* Cockerell.—Lucas de Oliveira, 1974.
*Xylocopa violacea* (Linnaeus).—Lucas, 1868, 1888; Grandi, 1934; Michener, 1953; Janvier, 1977.
*Xylocopa virecens* Lepeletier.—Lucas de Oliveira, 1974.
*Xylocopa virginica* (Linnaeus).—Packard, 1897; Michener, 1953, 1954 [PUPA].
Unknown: *Lestis, Proxylocopa.*

APIDAE (72%)

APINAE (100%)

*Apis cerana* Fabricius.—Torchio and Torchio, 1975.
*Apis dorsata* Fabricius.—Torchio and Torchio, 1975.
*Apis florea* Fabricius.—Torchio and Torchio, 1975.
*Apis mellifera* Linnaeus.—Nelson, 1924; Grandi, 1934; Michener, 1953, 1954 [PUPA]; Grandi, 1961; Dade, 1962; Nielsen and Bohart, 1967 [sex characters]; Torchio and Torchio, 1975; McGinley, 1981.

BOMBINAE (62%)

BOMBINI (100%)

*Bombus agrorum* (Fabricius).—Stephen and Koontz, 1973; Cumber, 1949.
*Bombus agrorum pascuorum* Scopoli.—Grandi, 1937; Michener, 1953.
*Bombus appositus* Cresson.—Stephen and Koontz, 1973.
*Bombus atratus* Franklin.—Lucas de Oliveira, 1979 [+ PUPA].
*Bombus bimaculatus* Cresson.—Ritcher, 1933; Michener, 1953.
*Bombus brasiliensis* Lepeletier.—Lucas de Oliveira, 1979 [+ PUPA].
*Bombus californicus* Smith.—Stephen and Koontz, 1973.
*Bombus caliginosus* (Frison).—Stephen and Koontz, 1973.
*Bombus crotchii* Cresson.—Stephen and Koontz, 1973.
*Bombus deuteronynus* Schulz.—Sakagami, 1951 [as *B. senilis* Smith]; Michener, 1953 [as *B. senilis*].
*Bombus fervidus* (Fabricius).—Packard, 1866, 1897; Ritcher, 1933; Michener, 1953.
*Bombus griseocollis* (Degeer).—Ritcher, 1933; Michener, 1953; Stephen and Koontz, 1973.
*Bombus hortorum* (Linnaeus).—Cumber, 1949.
*Bombus hypnorum* (Linnaeus).—Stephen and Koontz, 1973.
*Bombus hyperboreus* Schonherr.—Stephen and Koontz, 1973.
*Bombus impatiens* Cresson.—Ritcher, 1933; Michener, 1953; Stephen and Koontz, 1973.
*Bombus lapidarius* (Linnaeus).—Cumber, 1949.

*Bombus lucorum* (Linnaeus).—Cumber, 1949.
*Bombus mastrucatus* Gerstaecker.—Moczar, 1938; Michener, 1953.
*Bombus morio* (Swederus).—Lucas de Oliveira, 1979.
*Bombus morrisoni* Cresson.—Stephen and Koontz, 1973.
*Bombus nevadensis* Cresson.—Stephen and Koontz, 1973.
*Bombus nevadensis auricomus* (Robertson).—Ritcher, 1933; Michener, 1953; Stephen and Koontz, 1973.
*Bombus pennsylvanicus* (Degeer).—Ritcher, 1933; Michener, 1953, 1954 [PUPA; as *B. americanorum*]; Stephen and Koontz, 1973; McGinley, 1981.
*Bombus pennsylvanicus sonorus* Say.—Stephen and Koontz, 1973.
*Bombus perplexus* Cresson.—Ritcher, 1933; Michener, 1953.
*Bombus pratorum* (Linnaeus).—Cumber, 1949.
*Bombus ruderarius* (Muller).—Cumber, 1949.
*Bombus silvarum* Linnaeus.—Grandi, 1934; Michener, 1953.
*Bombus sylvicola* Kirby.—Stephen and Koontz, 1973.
*Bombus terrestris* (Linnaeus).—Cumber, 1949.
*Bombus terricola* Kirby.—Ritcher, 1933; Michener, 1953; Stephen and Koontz, 1973.
*Bombus terricola occidentalis* Greene.—Stephen and Koontz, 1973.
*Bombus vagans* Smith.—Ritcher, 1933; Michener, 1953.
*Bombus vandykei* (Frison).—Stephen and Koontz, 1973.
*Bombus vosnesenskii* Radoszkowski.—Ritcher, 1933; Michener, 1953, 1954 [PUPA]; Stephen and Koontz, 1973.
*Psithyrus rupestris* (Fabricius).—Cumber, 1949.
*Psithyrus variabilis* (Cresson).—Ritcher, 1933; Michener, 1953.
[*Psithyrus suckleyi* (Greene), UTAH.]

EUGLOSSINI (50%)

*Euglossa intersecta* Latreille.—Zucchi, de Oliveira, and de Camargo, 1969 [+ PUPA].
*Euglossa imperialis* Cockerell.—Roberts and Dodson, 1967.
*Eulaema nigrita* Lepeletier.—Zucchi, Sakagami, and de Camargo, 1970.
*Euplusia violacea* (Blanchard).—Michener, 1953 [as *Centris (Euplusia) violacea*].
Unknown: *Eufriesea*, [*Exaerete*, UTAH], *Aglae*.

MELIPONINAE (78%)

*Hypotrigona muelleri* (Friese).—Lucas de Oliveira, 1970.
*Lestrimelitta ehrhardti* Friese.—Lucas de Oliveira, 1968 [+ PUPA].
*Lestrimelitta limao* (Smith).—Lucas de Oliveira, 1968 [+ PUPA].
*Melipona fasciata trinitatis* Cockerell.—McGinley, 1981.
*Melipona marginata* Lepeletier.—Michener, 1953.
*Melipona nigra schencki* Gribodo.—Lucas de Oliveira, 1960.
*Melipona quadrifasciata quadrifasciata* Lepeletier.—Michener, 1953.
*Melipona variegatipes* Gribodo.—Michener, 1953.
*Nannotrigona postica* (Latreille).—Lucas, 1958.
*Partamona cupira* Smith.—Michener, 1953 [as *Trigona*], 1954 [PUPA].
*Partamona testacea* (Klug).—McGinley, 1981 [as *Trigona*].
*Plebeia droryana* (Friese).—Lucas de Oliveira, 1965.
*Trigona corvina* Cockerell.—Michener, 1953.
Unknown: *Dactylurina*, *Meliponula*.

# Appendix

This section lists the apparent larval synapomorphies supporting the taxa listed in Figure 2 (in upper case, below). Many of these taxa, while clearly defined by adult characters, are only tenuously supported by presumed larval synapomorphies; below, these characters are followed by a question mark. Future research may result in greater resolution based on larval features; this treatment should be considered preliminary.

COLLETIDAE.—DIPHAGLOSSINAE: elongate, cylindrical salivary lips (McGinley, 1981, figs. 2, 17); COLLETINI: extremely broad, unproduced spiracular atria? (McGinley, 1981, fig. 63); PARACOLLETINI: maxilla greatly exceeding labium in lateral view (McGinley, 1981, figs. 29, 33, 38, 45); *Scrapter:* genal area conspicuously expanded (McGinley, 1981, fig. 51); EURYGLOSSINAE: labiomaxillary region strongly recessed? (McGinley, 1981, figs. 66, 74); XEROMELISSINAE: frontal swellings above antennae present, maxillary palpi enlarged (McGinley, 1981, fig. 80); HYLAEINAE: salivary lips absent with labiomaxillary region produced? (McGinley, 1981, figs. 86, 87).

STENOTRITIDAE.—Mandibular apex obliquely truncate? (Houston, 1975, fig. 15).

HALICTIDAE.—DUFOUREINAE: venter of abdominal segment IX strongly protuberant (Eickwort et al., 1986, fig. 10); NOMIINAE: dorsal tubercles well developed, conical (Michener, 1953, fig. 68), mandibular apex usually bifid? (Michener, 1953, fig. 71; Hirashima, 1961, figs. 61–66); HALICTINAE: maxillary palpi apparently absent (Michener, 1953, fig. 51).

OXAEIDAE.—Primary tracheal opening slit-like, not circular (Rozen, 1964a, fig. 6), labral apex cleft (Rozen, 1964a, fig. 2).

ANDRENIDAE.—Salivary opening appearing U-shaped in frontal view (Rozen, 1966a, fig. 5; Rozen, 1973a, fig. 5; see Torchio (1975) for discussion).

MELITTIDAE.—MEGANOMIINAE: area immediately behind posterior mandibular articulation projecting (Rozen, 1977a, figs. 18, 19), spiracular subatrial wall spinose (Rozen, 1977a, fig. 20); MELITTINAE: salivary plate present (Rozen and McGinley, 1974a, figs. 10, 21); DASYPODINAE: salivary lips absent? (Rozen and McGinley, 1974a, figs. 29, 35, 46).

CTENOPLECTRIDAE.—Monophyly based on larval characters alone is questionable (see Rozen, 1978).

MEGACHILIDAE.—MEGACHILINAE: conspicuous body setae present? (see Rozen, 1978:644); LITHURGINAE: large, conspicuous tooth at the base of the apical mandibular concavity (Rozen, 1973c, figs. 7, 19, 21); FIDELIINAE: monophyly based on larval characters alone is questionable (two of three known generic representatives share with the Lithurginae a conspicuous, adoral tooth; see Rozen, 1977b).

ANTHOPHORIDAE.—PARARHOPHITINI: the traditional classification of this taxon as an anthophorid is probably incorrect; more likely associated with the megachiloid lineage (McGinley and Rozen, 1987). EXOMALOPSINI: body slender, venter of abdominal segment IX protuberant? (Rozen, 1957, fig. 4), maxillary apices not bent mesiad? (Rozen, 1957, fig. 1); MELITOMINI: body extremely slender, venter of abdominal segment IX protuberant (Michener, 1953, figs. 206, 213), maxillary apices strongly bent mesiad (Michener, 1953, figs. 208, 215; most likely plesiomorphic); at present, this tribe is difficult to differentiate from the Exomalopsini on the basis of larval synapomorphies. EUCERINI: larvae extremely uniform but difficult to define cladistically? (see Rozen, 1965b); CENTRITINI: anus situated dorsally on segement X, mandibular concavity extremely broad and scoop-shaped? (Rozen, 1965b); ANTHOPHORINI: monophyly based on larval characters questionable? (salivary lips absent, mandibular concavity scoop-shaped, Michener, 1953, figs. 220, 223); MELECTINI: labiomaxillary region recessed (Rozen, 1969, figs. 4, 12, 26); ERICROCIDINI and RATHYMINI: labiomaxillary region greatly enlarged (Rozen, 1969, figs. 33, 40, 47); NOMADINAE: position of posterior tentorial pits and/or posterior arms modified, mandibles with simple apex and reduced cusp (Rozen et al., 1978); XYLOCOPINAE: salivary opening on dorsal surface of labium (hidden from view, Michener, 1953, figs. 177, 178).

APIDAE.—APINAE (except *Apis*): conical, often highly sclerotic and darkly pigmented, dorsal papillae on thorax (Michener, 1953, figs. 248, 266).

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