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A Combined Molecular and Morphological Revision of Cirrospilini LaSalle (Hymenoptera: Eulophidae) with a Focus on *Zagrammosoma* Ashmead and *Cirrospilus* Westwood

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Ryan Kevin Perry

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Dissertation Committee:
Dr. John Heraty, Chairperson
Dr. Christiane Weirauch
Dr. Mark Hoddle
Dr. S. Hollis Woodard

The Dissertation of Ryan Kevin Perry is approved:

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_____
Committee Chairperson

University of California, Riverside

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Dedication

To my mother, Tania, and father, Kevin, for giving my brother and I the gifts of curiosity and love for the natural world.

ABSTRACT OF THE DISSERTATION

A Combined Molecular and Morphological Revision of Cirrospilini LaSalle (Hymenoptera: Eulophidae) with a Focus on *Zagrammosoma* Ashmead and *Cirrospilus* Westwood

by

Ryan Kevin Perry

Doctor of Philosophy, Entomology
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Dr. John M. Heraty, Chairperson

The tribe Cirrospilini (Hymenoptera: Chalcidodea: Eulophidae) is revised in a combined molecular and morphological phylogenetic context, using ribosomal (18S, 28S, ITS2) and mitochondrial (COI) data, and scoring specimens for morphological characters. Twenty genera are now recognized in the tribe. *Colpoclypeus* Lucchese and *Trichospilus* Ferrière are included in Cirrospilini, while *Cirrospiloidelleus* Girault is removed. *Melittobiopsis* Timberlake is also removed from Cirrospilini, and raised to Melittobiopsini Perry **n. tribe**., sister to Eulophini Ashmead. *Cirrospilus* Westwood is revised and is split into 6 morphologically distinct genera: *Atoposoma* Masi **stat. rev.**, *Burkseus* Perry, *Cirrospilus* **str. s**., *Gyrolasella* Girault **stat. rev.**, *Pseudozagramma* Perry **n. gen.**, and *Vagus* Perry **n. gen.** The **new synonymy** of *Semielacher* Bouček under *Cirrospilus* is proposed. The first worldwide key to all genera is presented, as well as distribution maps, and extensive specimen, host, and host plant records. *Zagrammosoma*

Ashmead is molecularly revised using ribosomal (28S, ITS2) and mitochondrial (COI) data, with 24 species now recognized, including descriptions of 9 new species. A worldwide key, distribution maps, and image plates of all species are provided.

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Introduction

Chalcidoidea

Chalcidoidea (Hymenoptera) is an extremely large and diverse superfamily with approximately 22,000 described species, potentially over 500,000 morphologically distinct species yet to be described or discovered, and an even larger number of cryptic species (Heraty *et al.*, 2013; Noyes, 2019). There are currently 22 recognized families, in over 80 subfamilies, with 2,098 described genera (Heraty *et al.*, 2013; Noyes, 2019). The body length of these wasps can range in size from 0.13 mm (Heraty, *et al.*, 2013; Noyes, 2019) to 42 mm (Krogmann & Burks, 2009), but are more commonly between 1-4 mm. Phytophagous chalcidoids have been associated with over 44 plant species (Noyes, 2019), however, the majority of chalcidoids are parasitic and attack almost all insect orders, spiders, ticks, mites, pseudoscorpions and nematodes (Austin *et al.*, 1998; Gibson *et al.*, 1999; Heraty *et al.,* 2013), and show the greatest diversity among those families parasitizing the Hemiptera and Holometabola (Munro *et al.*, 2011; Noyes, 2019). This parasitic lifestyle makes Chalcidoidea the subject of much research and application in biological control, especially among the families Aphelinidae, Encyrtidae and Eulophidae (Clausen, 1956; Noyes & Hayat, 1994; Smith & Hoy, 1995; Heraty, 2009; Munro *et al.*, 2011).

Eulophidae

The globally distributed family Eulophidae Westwood, 1829, is one of the most species-rich and biologically diverse families within Chalcidoidea. The family

contains approximately 4500 described species described in five subfamilies (Burks *et al.*, 2011; Noyes, 2019). Some species are phytophagous (Bouček, 1988; Gibson *et al.*, 1997; Mifsud, 2012), however the majority are parasitic. Eulophids can be idiobionts or koinobionts, solitary or gregarious, primary or facultative hyperparasitoids, specialists or generalists, and egg, larval, or pupal parasitoids (Askew & Shaw, 1979; Boucek, 1988; Gibson *et al.*, 1997; Noyes, 2019). They attack almost all insect orders, and some attack spider eggs (Zhu *et al*., 2002), or even gall-making mites and nematodes (Taylor, 1909; Vereshchagina, 1961; Gauthier *et al.*, 2000; Burks *et al.*, 2011). The majority of eulophids are parasitic on concealed Diptera and Lepidoptera, such as leaf miners, leaf rollers, and gall makers (Bouček, 1988; Gibson *et al.*, 1997; Gauthier *et al.*, 2000; Noyes, 2019). Since these wasps tend to be niche-specific, rather than host-specific, eulophids often have a very broad host range (Askew & Shaw, 1974; Whitfield & Wagner, 1988; Gates *et al.*, 2002), making Eulophidae attractive for biological control programs targeting leaf miners (Clausen, 1978; Van Driesche & Bellows, 1996). In addition, Gates (2002) found 80% of leaf miner parasitoids in California belong to Eulophidae, increasing the family's potential value for biological control programs.

Leaf miners from different lineages have similar biology, allowing their parasitoids a "gateway" to transfer from one species to another, with minimal change to the wasps' normal parasitic behavior (Godfray, 1994). While classical biological control involves identifying the exotic pests' native range, searching for their native control agents, and successfully rearing these agents in appreciable

numbers (Van Driesche & Bellows, 1996), these niche-specific parasitoids allow for a different method of biological control: conservation of biodiversity. Conservation presumes that natural enemies already exist in localities, with a potential to suppress invasive pest populations without the introduction of foreign biological control agents (DeBach, 1964; Van Driesche & Bellows, 1996). Recognizing native leaf miner parasitoids from imported parasitoids allows evaluation of biological control efforts. This has the ability to showcase one benefit of biodiversity conservation methods, which is the conservation of potential biological control agents (Waage, 1991; LaSalle, 1993; Schauff *et al.*, 1998). Maintaining species with potential biological control value is a goal of sustainable agriculture, with the added benefit of providing a resource for future agriculture (Starý & Pike, 1999; Thrupp, 1996; Flint & Gouveia, 2001). Knowing the species composition and distribution of parasitoids may prove useful in determining which species or genera are better suited to particular climate zones and/or hosts. To have an effective Integrated Pest Management program it is imperative to know what natural enemies are present in a given system (Van Driesche & Bellows, 1996; Gates *et al.*, 2002).

Cirrospilini

Within Eulophidae, the tribe Cirrospilini LaSalle, 2000 (Eulophinae) contains some of the most important genera for both native and imported biological control of agricultural pests. For example, *Diglyphus* Walker are significant parasitoids of dipteran leaf miners such as *Liriomyza* Mik (Bouček, 1988; Zhu *et al.*, 2000; Sha

et al., 2007) and are available commercially for greenhouse and crop production. *Cirrospilus* Westwood and *Zagrammosoma* Ashmead parasitize lepidopteran, coleopteran, hymenopteran, and dipteran larvae (Clausen, 1978; Smith & Hoy, 1995, Gates, 2000; Gates *et al.*, 2002) and *Aulogymnus* Föster exclusively attack cynipid gall wasps (Askew, 1961; Bouček, 1988; Zhu, *et al.*, 1999; Gates & Schauff, 2005). Recent molecular (Gauthier *et al.*, 2000), morphological (Ubaidillah *et al.*, 2003) and combined (Burks *et al.*, 2011) analyses have supported a monophyletic Cirrospilini, with all genera except *Cirrospilus* monophyletic; these analyses used relatively few species, therefore, sampling on a larger scale is necessary to confirm monophyly.

Two genera in the tribe, *Cirrospilus* and *Zagrammosoma,* exemplify some of the major problems in developing a robust eulophid phylogeny and classification. These two genera are biologically and morphologically similar (Kerrich, 1969; Bouček, 1988; Ubaidillah *et al.*, 2003; Ubaidillah 2006), but exhibit some of the greatest variation in body coloration within the family, leading to confusion in defining species and higher level groups (Boucek, 1959; Kerrich, 1969; Bouček, 1988). Color patterns of the body found in *Zagrammosoma* are also found in *Cirrospilus* and *Aulogymnus*, as well as in other families in Chalcidoidea, warranting further investigation of these convergent patterns. If *Zagrammosoma* and *Cirrospilus* prove to be congeneric, then stronger cases can be made for synonymizing other biologically and morphologically similar genera in the tribe, such as *Diglyphus* with *Diaulinopsis* Crawford, and *Aulogymnus* with *Dichatomus*

Förster. If the two are deemed to be separate, then the focus becomes the enormous amount of color variation within and between species.

Integrative approaches, using more than one line of evidence (molecular, morphological, behavioral, etc.) have become important for inventories of biodiversity, where appropriate techniques may lead to increases in species and genera numbers within a region, sometimes with dramatic escalations (Janzen *et al.*, 2009; Vietes *et al.*, 2009). Undoubtedly, examination of thousands of specimens will likely lead to increases in both the number and distribution of cirrospiline species and genera. Additionally, specimen examination will provide an immense number of host associations for genera in the tribe, many of which will be reported for the first time, increasing the pool of potential biocontrol candidates. However, the host associations found will have little meaning if they are attributed to the wrong taxa.

This dissertation aims to solve the problems linked with extreme color and morphological variation within a tribe of economically important parasitic wasps. In a combined approach utilizing morphological and molecular data, I will explore generic limits and species boundaries across Cirrospilini. I will improve knowledge of biodiversity by systematically revising a tribe in much need of taxonomic work, with results that will be applicable to other problematic groups in the future. I will also explore the evolutionary trends concerning morphology, color variation and host association generalization with the tribe.

Objectives and Approaches

Chapter 1 focuses on color and morphological variation at the species level, using a highly color variable species, *Cirrospilus vittatus* Walker. This species is morphologically and molecularly confirmed as a cryptic species complex, comprised of at least 4 species. This species group is also morphologically and molecularly confirmed as distinct from *Cirrospilus,* and is raised to the new genus *Burkseus* Perry **n. gen.** A key to all described species of *Burkseus*, distribution maps of each species, and locality and host records are provided.

Chapter 2 builds on the information in chapter 1 and concentrates on color and morphological variation at the genus level. This chapter provides a worldwide revision of *Zagrammosoma*, which is confirmed as distinct from *Cirrospilus.* 21 out of 24 species of *Zagrammosoma* were sequenced and molecularly verified, of which 9 are described as new. All 24 species were morphologically scored and given new diagnoses and descriptions. A worldwide key to all species is provided, as well as extensive host and locality records. All species descriptions are accompanied by high-quality color plates.

Chapter 3 will apply the results and techniques of the first 2 chapters on the tribe as a whole. This is the first worldwide molecular and morphological revision to the genera of Cirrospilini. I performed a combined molecular and morphological analysis of representatives of all genera, which reveals Cirrospilini to be composed of 20 genera, 2 of which are described as new (*Pseudozagramma* Perry **n. gen.** and *Vagus* Perry **n. gen.**), 2 have their status revised (*Atoposoma* Masi and *Gyrolasella* Girault), and 2 are included in Cirrospilini for the first time

(*Colpoclypeus* Lucchese and *Trichospilus* Ferrière). The monospecific genus *Melittobiopsis* Timberlake is raised to the tribe Melittobiopsini Perry **n. tribe**, sister to Eulophini. A worldwide key to all genera is provided as well as image plates, extensive host and locality records, and distribution maps are provided for each genus.

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Chapter 1

A tale of two setae: how morphology and ITS2 help delimit a cryptic species complex in Eulophidae (Hymenoptera: Chalcidoidea)

Abstract

The Holarctic species *Cirrospilus vittatus* Walker, 1838 (Hymenoptera: Eulophidae) is an important parasitoid of lepidopteran, dipteran, coleopteran, and hymenopteran leaf miners. One of the defining characteristics of the species has been its presumed extensive color variation, with individuals ranging from almost completely dark metallic green or blue to completely yellow with no metallic markings. An integrative approach utilizing morphological and molecular data (28S-D2, COI, ITS2) reveals that *C. vittatus* sensu lato in North America is a species complex comprised of at least four distinct, sometimes sympatric, species that can attack the same host. This species complex emerges as a monophyletic group, separate from *Cirrospilus* s.s., which we designate *Burkseus* **gen. n.** The species *Burkseus vittatus* **comb. n.** is redefined and has a Holarctic distribution, and *B. flavoviridis* (Crawford) **comb. n**. is reinstated from synonymy with *B. vittatus*. The following combinations are also proposed: *B. elongatus* (Bouček) **comb. n.,** *B. pinicolus* (Askew) **comb. n.,** and *B. singa* (Walker) **comb. n.** The following species are described as new: *Burkseus sigillatus* **n. sp.** and *B. robustus* **n. sp.** Some of the species are sympatric at several locations, but they remain molecularly and morphologically distinct. The delimitation of these species impacts our ability to assess their potential as biological control candidates against Citrus Leafminer, *Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae), and future invasive leaf miner threats.

Introduction

Integrative approaches that utilize more than one line of evidence for species delimitation, such as DNA, morphology, geography, and bioacoustics, have proven effective in various eukaryotic groups (DeSalle *et al.* 2005, Jansen *et al.* 2011, Glaw *et al.* 2013, Derkarabetian and Hedin 2014, Hansson *et al.* 2015). The strength of integrative taxonomy is to provide a majority of evidence for a single hypothesis, either when all of the datasets are congruent, or if different, then to propose a single well-resolved hypothesis that can be used to test or discover reasons for incongruence between datasets.

Molecular techniques, particularly those using the barcoding region of cytochrome oxidase I (COI), have aided in overcoming identification difficulties and assist in our ability to recognize new or cryptic species (Hebert and Gregory 2005, Janzen *et al.* 2005, Floyd *et al.* 2009, Mottern and Heraty 2014). The use of several species delimitation programs can provide complementary evidence for describing species using single or multiple genes (Puillandre *et al.* 2012, Zhang *et al.* 2013, Yang 2015). Trusting only in molecular data for species delimitation has its criticisms: molecular information is a helpful tool, but is not a complete replacement for morphological taxonomic research (Will *et al.* 2005); conflicting inheritance patterns from mitochondrial and nuclear DNA can have contradictory results (Funk and Omland 2003, Floyd *et al.* 2009); or relying solely on one barcode region may not provide enough

resolution to differentiate species (Will *et al.* 2005, Rubinoff *et al.* 2006, Heraty *et al.* 2007, Floyd *et al.* 2009). In addition, there will always be a need for morphological characteristics to provide identification of historical collections where molecular tools are not accessible (Mottern *et al.* 2014). Morphological approaches have considerable benefits, however, in cryptic species or those displaying large amounts of variation, the integration of both morphological and molecular data to properly identify species can be essential for delimitation of species boundaries.

The need for integrative approaches is readily apparent in the Chalcidoidea (Hymenoptera), an extremely large and diverse superfamily of parasitic wasps with over 23,000 described species (Noyes 2018). Their minute size, usually 1–4 mm and elusive life histories have often made it challenging to accurately delimit species (Heraty 2009). Similar to many insect groups, taxonomic descriptions of chalcid wasps are usually based on external morphology, although working with such small and often desiccated (shriveled) soft-bodied organisms can lead to misidentification and therefore, an incorrect assessment of biodiversity. Integrative techniques have demonstrated their value in delimiting other chalcid groups, either by more accurately synonymizing or increasing species numbers (Baur *et al.* 2014, Gebiola *et al.* 2015, Hansson *et al.* 2015, Fusu 2017) or revealing cyptic species diversity (Heraty *et al.* 2007, Chesters *et al.* 2012, Mottern and Heraty 2014, Kenyon *et al.* 2015, Gebiola *et al.* 2017).

Although the ability to correctly identify species is intuitive for all entomological disciplines, 'no other aspect of applied entomology is more intimately dependent on sound systematics—more precisely, biosystematics, than is biological control' (Rosen 1978). Morphological characters can be useful to accurately identify species. However, cryptic species can render the traditional alphataxonomic practices irrelevant, necessitating molecular analyses to correctly delimit species (Fernando and Walter 1997; Beard 1999, Mottern and Heraty 2014). What may be defined as one species may, in fact, be a complex of multiple species, each potentially with their own life histories and therefore, variations in biological control potential (Rosen and DeBach 1973, Rosen 1986, Beard 1999, Heraty *et al.* 2007, Desneux *et al.* 2009). Herein we use an integrative approach to resolve the identify and relationships of an economically important group of parasitoids in the tribe Cirrospilini (Eulophidae).

Cirrospilini LaSalle, 2000

Cirrospilini LaSalle (Chalcidoidea: Eulophidae: Eulophinae) is a cosmopolitan tribe of parasitic wasps specializing in concealed larvae, especially leaf miners and leaf rollers, represented by 265 species in sixteen genera (Noyes 2018). Many early species descriptions of cirrospilines rely heavily on mesosomal color patterns to describe species, with little to no consideration to other morphological structure variation (Ashmead 1888,

Crawford 1913). Without examining type material, it is often difficult to interpret exactly what the original author was describing, placing an extra burden on the systematist to accurately describe new species (Riedel *et al.* 2013). In many cases within Cirrospilini, a typical color pattern was designated, but several variants would also be mentioned in the same paper (Walker 1838, Gordh 1978, Askew 1984). This has led to the synonymizing of many species over time based on color patterns, as described species were later proposed as color variants of single, previously described species (Gordh 1978, Askew 1984, Bouček 1988, Evans
1999, Huber and Moreau 2003).

Zagrammosoma Ashmead, 1904, had been previously regarded as a subgenus of *Cirrospilus* Westwood, 1832, (Bouček 1959, Kerrich 1969), but more recently as a separate genus (Gordh 1978, Bouček 1988, Yefremova 1996). The two genera are biologically and morphologically similar (Kerrich 1969, Bouček 1988, Ubaidillah *et al.* 2003, Ubaidillah 2006), but exhibit some of the greatest variation in body coloration within the family. Characters traditionally used to distinguish species in both genera usually involve color patterns of both the body and wings, which are highly variable even within a species. Beyond problems with defining the genera, species such as *Zagrammosoma multilineatum* (Ashmead), *Z. americanum* Girault, *Cirrospilus pictus* (Nees), and *C. variegatum* Masi have been particularly challenging to define morphologically.

While Bouček 'failed to find good differences' to separate *Cirrospilus* into separate genera (Bouček 1988), he did note that the genus clusters into two main species groups. These groups are based on morphological and biological characteristics, the easiest of which to discern is the presence (Fig. 1.1D and F) or absence (Fig. 1.1E and G) of a median carina on the propodeum. Those species having a median carina on the propodeum were placed in *Cirrospilus* in the strict sense, which includes the type species for the genus, *Cirrospilus elegantissimus* Westwood. *Cirrospilus vitattus* belongs to the group that lacks the median carina. Our preliminary molecular data consistently recover *Cirrospilus* as a polyphyletic genus within Cirrospilini, adding strength to the species groups speculation by Bouček (1988), leading to the idea that it is not a monophyletic group.

Within Cirrospilini, species of *Cirrospilus, Diglyphus* Walker, 1844, and *Semielacher* Bouček, 1988, have successfully been used in biological control projects targeting leaf miners (Parrella *et al.* 1989, Smith and Hoy 1995, Argov and Rössler 1996, Braham *et al.* 2007, Sha *et al.* 2007). Leaf miners from different lineages often have a similar biology, allowing parasitoids a 'gateway' to transfer from one species to another (Godfray 1994), making niche-specific parasitoids, such as Cirrospilini, attractive for conservation biological control programs. As these programs rely on accurate species delimitation for evaluation and implementation, it is essential to reevaluate species limits within the tribe.

Cirrospilus vittatus Walker, 1838

Cirrospilus vittatus has been described as a Holarctic ectoparasite of lepidopteran, dipteran, coleopteran, and hymenopteran leaf miner larvae (Ratzeburg 1852, Dowden 1941, Sundby 1957, Bouček and Askew 1968; Gordh 1978, Kamijo 1987, Noyes 2018). It is also known to be parasitic on gall makers (Askew 1984) and sawfly eggs (Kirkland and Paramonov 1962, Cingovski 1965, Bouček and Askew 1968; Huber and Moreau 2003), and hyperparasitic on hymenopteran species attacking leaf miners (Dowden 1941, Bouček 1959, Bouček and Askew 1968). This species is placed within the *vittatus* group of *Cirrospilus* that was defined by Askew (1984) using the following characters: two pairs of equally long setae on the mesoscutellum; fore wing with the cubital vein setae strongly curved to meet the basal vein setae; fore wing speculum narrow and linear; mesosoma yellow with dark longitudinal stripes (except in *C. curvineurus* Askew), and antenna inserted at or below the lower edge of the compound eyes.

Cirrospilus vittatus has been documented as having extreme color variation, with specimens either completely yellow, completely metallic dark green, or with varying yellow and dark metallic patterns on the body. Recent studies have considered this as a single highly polymorphic species (Bouček 1959, Askew 1984, Huber and Moreau 2003). In contrast, very slight differences in body banding patterns have been used to delineate

species within *Zagrammosoma* (Gordh 1978, De Santis 1983). Whether extreme or limited color variation within species in this tribe is a general pattern or restricted to only a few species greatly impacts species definitions across Cirrospilini, especially when species limits cannot be molecularly verified.

While examining specimens of *C. vittatus* from California, we found that the color variation of species was relatively discrete, with specimens assignable to distinct morphospecies based on their overall body color: mainly dark metallic or mainly yellow. This, coupled with the high number of synonymies, incited our suspicions concerning the validity of the species as currently delineated. Further prompting the study, *C. vittatus* may also prove an economically important biological control agent, as it parasitizes leaf miners on apple (Eveleens and Evenhuis 1968, Askew 1984), alfalfa (Lotfalizadeh *et al.* 2015), watermelons, tomatoes (Alba 2014), eggplants (Çikman 2006), citrus (Schauff *et al.* 1998, Urbaneja 2002), roses, and chrysanthemums (Askew 1984).

This study aims to help resolve the problems associated with color and morphological variation within a species complex of economically important parasitic wasps by utilizing integrative methods for efficient and precise species delimitation. In addition, the monophyly of the *vittatus* group and *Cirrospilus* was investigated, and the vitattus group is proposed as a new genus.

Material and Methods

Specimen Examination

A total of 1097 specimens were examined from the following collections: The Australian National Insect Collection, Canberra, Australia (ANIC), The Natural History Museum, London, England (BMNH); California Academy of Sciences, San Francisco, CA, United States (CASC); Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON, Canada (CNC); Essig Museum Entomology Collection, University of California, Berkeley, CA, United States (EMEC); Hope Department, Oxford University, Oxford, England (HDOU); Finnish Museum of Natural History, Helsinki, Finland (MZH); Narodni Muzeum v Praze, Prague, Czechoslovakia (NMP); Queensland Museum, Brisbane, Australia (QM); Texas A&M University, College Station, TX, United States (TAMU); Bohart Museum of Entomology, University of California, Davis, CA, United States (UCDC); Entomology Research Museum, University of California, Riverside, CA, United States (UCRC), and the United States National Museum of Natural History, Washington, DC, United States (USNM). All efforts were made to examine type material. Photographs of specimens were taken using a Leica Z16APO automontage microscope and Leica DFC 450C 5-megapixel camera system. Each photo consists of 20–40 images, stacked together using Leica APPLICATION SUITE v4.4, to create photos with extended depth of field. Locations of specimens are visualized using SIMPLEMAPPR (Shorthouse 2010). All locality and host information is

recorded in a FILEMAKER PRO version 17 database maintained at UC Riverside. All specimens receive a plastic barcode and identification number, and molecular vouchers have an additional DNA reference number (Dxxxx). For material examined, coordinates in italics were estimated using Google Earth. Data within brackets indicate, in order: sex, deposition location: specimen identification number, and D# (if applicable). Specimens on loan from MZH have localities recorded as coordinates using the Finnish Coordinate System Yhtenäiskoordinaatisto (YKJ) in Finnish, ex: 6771: 3391. When a single identification number indicates multiple specimens, more than one wasp was mounted on a single pin.

Molecular Methods

Thirty-two specimens from the Nearctic, Palearctic, and Neotropical regions exhibiting the full range of color variation within *Cirrospilus vittatus* were used in the molecular analyses. Ten specimens of four species of *Zagrammosoma,* four specimens of three species of *Diglyphus,* and four non-*vittatus Cirrospilus* specimens were used as outgroup taxa. *Zagrammosoma* species have traditionally been identified by color banding patterns on the mesosoma and gaster that are similar to *Cirrospilus vittatus*, and *Diglyphus* is consistently recovered in more comprehensive molecular analyses as a sister group to the rest of Cirrospilini (Perry unpublished), thus were appropriate choices to use in these analyses. Primary voucher specimens (nondestructively sequenced) were given unique specimen identification numbers, imaged, and deposited in

the Entomology Research Museum of the University of California, Riverside (UCRC), and other institutions as specified in Table 1.1.

The target genes include two nuclear ribosomal gene regions (28S D2 and D3–5), an internal transcribed spacer (ITS2), and the mitochondrial cytochrome oxidase (COI). All modified primers and references are listed in Table S1.1. Previous studies of Chalcidoidea have successfully utilized 28S D2–D5 for phylogenetic hypotheses (Gauthier *et al.* 2000, Gumovsky 2001, Burks *et al.* 2011, Munro *et al.* 2011, Heraty *et al.* 2013), and ITS2 has proven useful for species delineation in other genera exhibiting color variation or cryptic species (Porter and Collins 1991, Campbell *et al.* 1993, Collins and Paskewitz 1996, Stouthamer *et al.* 1999, Ercan *et al.* 2011). The barcoding region of COI has proved difficult to amplify successfully (4% of specimens, 2/50), even in those specimens that successfully amplified 28S and ITS2. An alternative 390 bp, non-barcoding region of COI has been used (NJ-MD) (Simon *et al.* 1994, Dowton and Austin 1997), resulting in a much higher amplification success rate (44%, 22/50).

DNA was extracted nondestructively using Qiagen DNeasy

Blood and Tissue kits (Qiagen, San Diego, CA). After extraction, specimens were removed from the extract solution, received a hexamethyldisilazane (HMDS) treatment for preservation (Swearingen *et al.* 1997, Heraty and Hawks 1998), and pinned for use as primary vouchers. Gene regions were amplified via PCR using a Qiagen Taq PCR Core Kit, with the following reagents for each

reaction/specimen: 11.2 µl deionized water, 2.0 µl 10x PCR buffer, 0.4 µl dNTPs, 0.5 µl forward and 0.5 µl reverse primers,

µl Q-Solution (replaced by 4.0 µl water in products intended for amplifying COI), and 0.5 µl Taq. The thermal cycler profile for 28S and ITS2 products is: 94°C for 3 min, 34 cycles of 94°C for 1 min, 55°C for 1 min, 72°C for 1 min, and ending with 72°C for 7 min. The thermal cycler profile for COI is: 93°C for 3 min, 34 cycles of 93°C for 15 s, 46°C for 45 s, 68°C for 45 s, and ending with 68°C for 7 min. After amplification, PCR products were purified using GeneClean purification kits (Q-BIOgene) and sequences at either the Genomics Core Facility at the University of California, Riverside, or Retrogen Inc. (San Diego, CA).

Chromatograms were analyzed and verified in MESQUITE (Maddison and Maddison 2018) using Chromaseq (Maddison and Maddison 2017) with the PHRED/PHRAP plug-in (Green and Ewing 2002; Green 2009). Sequences were aligned using the MAFFT v7.3 online server (Katoh 2013), with the E-INS-i alignment algorithm, which has been proven to be more accurate with alignments containing several gaps (Notredame 2007, Morrison 2009, Munro *et al.* 2011, Klopfstein *et al.* 2013), such as ITS2 in this study. Default settings were used, except the scoring matrix for nucleotide sequences was changed from 200PAM/K=2 to 1PAM/K=2, as this is preferred when aligning closely related sequences. COI sequences were translated to amino acids to identify any internal stop codons, of which there were none. Gene regions were

concatenated using SEQUENCEMATRIX v1.7.8 (Vaidya *et al.* 2011). Sequences were uploaded to GenBank with accession numbers reported in Table 1.1.

To investigate the utility of the various gene regions for species delimitation, separate analyses were run on individual gene regions, with 28S D2 and D3-5 combined as one, followed by a concatenated analysis of all gene regions. For any analysis utilizing COI, this gene was partitioned as COI codon positions 1 and 2, and COI codon position 3. Maximum likelihood (ML) analyses were performed using RAxML v8.2.9 (Stamatakis 2014) online via the CIPRES portal (Miller *et al.* 2010, http://www.phylo.org). Molecular data were analyzed using a GTRCAT substitution model. In the combined molecular and morphological analyses, the morphological data, 28S D2, D3–5, and ITS2 regions were treated as separate partitions, and the morphological data analyzed using the Mk substitution model (Lewis 2001). Phylogenetic trees were visualized using FIGTREE v1.4.3 (Rambaut 2016). *Diglyphus* was used to set the root for all trees.

To help identify putative species recovered in the ML analyses, two species delimitation programs were used to establish potential species limits. The ML tree of the combined molecular dataset was used in an online Poisson tree processes program, bPTP (Zhang *et al.* 2013). This program bases delimitation on branch lengths, adding Bayesian posterior probabilities to the

resulting tree. The tree was rooted with *Diglyphus* and the number of MCMC generations was set to 100,000 with a 10% burn-in. The COI sequences were analyzed online in Automatic Barcode Gap Discovery (ABGD, http://wwwabi.snv.jussieu.fr/public/abgd/abgdweb.html), which examines intraspecific divergence, infers a confidence limit for a species, then identifies the first significant 'gap' beyond this limit and partitions the species accordingly (Puillandre *et al.* 2011). The distance method was set to Jukes-Cantor (JC69), Pmin = 0.001, Pmax = 0.1, steps = 10, and relative gap width = 1.0. It is important to note that these two programs are not intended to identify candidate species on their own, but rather to be used for preliminary hypotheses to supplement other datasets in an integrative approach.

Morphological Methods

Mesosomal color patterns were highly variable within putative species recovered in the combined molecular analysis, while the sculpturing, mesosomal setae patterns, and fore wing color patterns were much more conserved within four main morphospecies designated as *C. vittatus*, *C. robustus*, *C. sigillatus*, or *C. flavoviridis* Crawford. The *Cirrospilus vittatus* and *C. flavoviridis* designations were based on examination of a paralectotype of *C. vittatus* (BMNH) and paratypes of *C. flavoviridis* (USNM). Dorsal views of the mesosoma of all specimens used in the morphological analyses can be found in Figs 1.4–1.6.

All 50 voucher specimens were scored for 23 morphological

characters and 16 variable color characters on the mesosoma, legs, and gaster to identify any overlooked characters that might differentiate species groups not based solely on mesosomal color patterns. A combined morphology matrix (color + morphology, Table S1.2) was used as a separate partition in the combined morphological and molecular ML analyses, while three separate analyses using the morphological and color matrices were performed in TNT (Goloboff and Catalano 2016): morphological characters only, color characters only, and combined morphological and color characters. All characters were parsimony informative. All settings were kept at their default values, characters were not weighted a priori, and a New Technology search was performed, using the Sectorial Search, Ratchet, Drift, and Tree Fusing algorithms. Majority-Rule consensus trees were created with the shortest retained trees. The morphological characters were mapped on the combined molecular and morphological tree using MacClade v 4.08 (Maddison and Maddison 2005) to trace unambiguous character state changes on the combined molecular and morphological tree.

Morphological Characters

Head

1. **Vertex (vtx):** 0 = not vaulted (Fig. 1.1B), 1 = vaulted (Fig. 1.1A). After Ubaidillah *et al.* (2003, char. 7).
2. **Paired large setae (set) on vertex:** 0 = absent, 1 = present (Fig. 1.1C).

After Ubaidillah *et al.* (2003, char. 10).

3. **Scape (scp) length in regard to vertex:** 0 = short, not reaching vertex, 1 = extending to vertex, 2 = long, extending past vertex. Citation: modified from Ubaidillah *et al.* (2003, char. 24).
4. **1st funicular (fu_1) length:** 0 = longer than wide (>1.1x) (Fig. 1.1I), 1 = subequal (0.9–1.1x), 2 = wider than long (<0.9x). Citation: modified from Heraty *et al.* (2013, char. 4).
5. **2nd funicular (fu_2) length:** 0 = wider than long (<0.9x), 1 = subequal (0.9–1.1x), **2** = longer than wide (>1.1x) (Fig. 1.1I).
6. **Shape of 1st claval segment (clv_1):** 0 = longer than wide (>1.1x) (Fig. 1.1I), 1 = subequal (0.9–1.1x), 2 = wider than long (<0.9x).
7. **Shape of 2nd claval segment (clv_2):** 0 = longer than wide (>1.1x), 1 = subequal (0.9–1.1x) (Fig. 1.1I), 2 = wider than long (<0.9x) (Fig. 1.1I).

Mesosoma

8. Transverse row of paired setae, with visible setal sockets, on posterior margin of pronotum (no) (Fig. 1.1C): 0 = absent, 1 = 1 pair, 2 = 2 pairs, 3 = 3 or more pairs.
9. **Sculpturing on mesoscutum (msc)**: 0 = shallow-reticulate, thin-ringed cells with shallow cavities (Fig. 1.1D, F, and G), 1 = deep-reticulate thicker-ringed cells with deeper cavities (Fig. 1.1E).
10. **Axilla advancement (axl):** 0 = not beyond anterior margin of scutellum, 1 = less than 75% longitudinal length anterior to margin of

scutellum (Fig. 1.1D and E), 2 = greater than 75% longitudinal length anterior to margin of scutellum (Fig. 1.1F and G). Citations: modified from Burks *et al.* (2011, char. 16); Heraty *et al.* (2013, char. 95).

11. **Condition of notaulus (not):** 0 = incomplete or absent (Fig. 1.1G), 1 = extend to mesoscutellum (Fig. 1.1D and E), 2 = curve to axillae, not reaching mesoscutellum (Fig. 1.1F). Modified from Schauff (1991, char. 14); Ubaidillah *et al.* (2003, char. 30); Burks *et al.* (2011, char. 14); Heraty *et al.* (2013, char. 89).

12. **Large, paired bristle-like setae (set) on mesoscutum (msc):** 0 = absent, 1 = one pair (Fig. 1.1D), 2 = two pairs (Fig. 1.1F and G), 3 = three or more pairs (Fig. 1.1E). Modified from Ubaidillah *et al.* (2003, char. 32); Burks *et al.* (2011, char. 15); Heraty *et al.* (2013, char. 86). Bristles refer to enlarged, paired setae that are noticeably larger and longer than nearby setae, similar to those on the mesoscutellum. These bristles also have large, well-defined setal sockets, which are darker than the surrounding color.

13. **Small, unpaired setae (sss) on mesoscutum:** 0 = absent (Fig. 1.1D, E, and G), 1 = present (Fig. 1.1F). These are not homologous to character 12. Citation: modified from Ubaidillah *et al.* (2003, char. 33).

14. **Non-paired bristle-like setae (set) on mesoscutum:** 0 = absent, 1 = present. These are non-paired bristles, similar but independent of the paired bristles. These have visible setal sockets.

15. **Submedian grooves (smg) on scutellum (sct):** 0 = absent, 1 = present (Fig. 1.1D, E, F, and G). Citations: modified from Graham (1987, char. 31); Ubaidillah *et al.* (2003, char. 34); Burks *et al.* (2011, char. 18); Heraty *et al.* (2013, char. 99).

16. **Paired mesoscutellar setae length comparison:** 0 = not applicable, only one pair, 1 = two pairs, subequal in length, 2 = two pairs, posterior pair distinctly longer.

17. **Median carina (mc) on propodeum (ppd):** 0 = absent (Fig. 1.1D, E, and G), 1 = present (Fig. 1.1F). Citations: modified from Schauff (1991, char. 26); Ubaidillah *et al.* (2003, char. 36).

Metasoma

18. **Female cercal setae:** 0 = equal in length, 1 = one seta thicker/ longer/darker than others. Citations: modified from Graham (1987, char. 60); Ubaidillah *et al.* (2003, char. 55); Heraty *et al.* (2013, char. 221).

Wings

19. **Submarginal vein setae:** 0 = thin and short (Fig. 1.2A and B), 1 = thicker and longer (Fig. 1.2C and D).

20. **Admarginal setae (ams):** 0 = present (Fig. 1.2A, B, and D), 1 = present, but shifted to margin (Fig. 1.2C). Citations: modified from Ubaidillah *et al.* (2003, char. 45); Heraty *et al.* (2013, char. 157).

21. **Uncus (unc) position:** 0 = at or near apex of stigma (separated from apex by less than or equal to length of uncus) (Fig. 1.2A–D). 1 = shifted

basally more than length of uncus. Citations: modified from Ubaidillah *et al.* (2003, char. 49); Heraty *et al.* (2013, char. 163).

22. **Hind tibial spurs (tbs)**: 0 = shorter than basitarsus, 1 = subequal. Citations: modified from Ubaidillah *et al.* (2003, char. 51).

23. **Hind basitarsus (bst):** 0 = shorter than 2nd tarsomere (bst:2nd = <0.95) (Fig. 1.1H), 1 = subequal (bst:2nd 0.96–1.04), 2 = longer than 2nd tarsomere (bst:2nd = >1.05). Citations: modified from Ubaidillah *et al.* (2003, char. 52). Measurements taken from midpoint of the apex of each tarsomere.

24. **Metallic coloration present on body:** 0 = present, 1 = absent. Metallic coloration is defined in this study as dark metallic blue, green, or copper/brown, present anywhere on the wasp. Dark markings (spot, stripe, band) may refer to either dark metallic or dark nonmetallic blue, green, or copper/brown. Fore wing color pattern variation is pooled together as absent or present, as there are few species in this study that exhibit any patterns on the fore wings, and there is no need to further refine the exact shape and placement of the coloration on the wings.

25. **Coloration of scape:** 0 = all yellow/light-colored, 1 = dark spot, stripe, or banding present, 2 = all dark.

26. **Width of longitudinal yellow stripe that is lateral to a dark median stripe on the mesoscutum (char. 28), running parallel to the notaulus**: 0 = wide (Fig. 1.1D), 1 = narrow/barely visible (Fig. 1.1E), 2 = all yellow (no

stripe), 3 = all dark (Fig. 1.1G). These stripes are defined as the area between a dark, median stripe if present, and the notauli.

27. **Coloration on prepectus:** 0 = mostly yellow, 1 = mostly dark.

28. **Dark, longitudinal stripe on body:** 0 = absent due to body being completely yellow or dark (Fig. 1.1G), 1 = broken (Fig. 1.1F), 2 = complete (Fig. 1.1D and E). This character refers to the dark, median strip on the thorax, running from the mesoscutum through the mesoscutellum. This refers strictly to the completeness or incompleteness of the longitudinal stripe and, therefore, if no stripe is present due to the body being completely yellow or dark, it cannot be accurately scored, and both forms can be scored as absent.

29. **Propodeum coloration:** 0 = all yellow, 1 = yellow with dark markings, 2 = all dark.

30. **Coloration on scutellum**: 0 = all yellow, 1 = wide yellow stripes, with thin dark color between (Fig. 1.1D and F), 2 = thin yellow stripes, with wide dark color between (Fig. 1.1E), 3 = all dark, no yellow (Fig. 1.1G), 4 = yellow center, dark outer margins (in this study only *Zagrammosoma mirum* Girault 1916a, displays this state).

31. **Fore wing disc coloration**: 0 = hyaline, without markings (Fig. 1.2A–C), 1 = with dark markings (Fig. 1.2D).

32. **Submarginal vein setal coloration:** 0 = yellow (Fig. 1.2A and B), 1 = dark colored (Fig. 1.2C and D).

33. **Stigma darkened in color, or infuscation surrounding stigma (stg):** 0 = absent (Fig. 1.2A and B), 1 = present (Fig. 1.8C and D).

34. **Profemur color**: 0 = uniformly yellow, 1 = dark spot present, 2 = longitudinal stripe present, 3 = band encircling femur present.

35. **Mesofemur color**: 0 = uniformly yellow, 1 = dark spot present, 2 = longitudinal stripe present, 3 = band encircling femur present.

36. **Metafemur color**: 0 = uniformly yellow, 1 = dark spot present, 2 = longitudinal stripe present, 3 = band encircling femur present.

37. **Hind coxa**: 0 = all yellow/light, 1 = anterior dark only, 2 = all dark colored.

38. **Female gaster coloration**: 0 = completely yellow, or mainly yellow with dark markings between terga (Fig. 1.8B–E), 1 = mainly dark (Fig. 1.8A).

39. **Male gaster coloration:** 0 = completely yellow or with very faint markings present between sclerites (Fig. 1.8E, H–J), 1 = dark, distinct and unbroken spot begins on 2nd tergum (Fig. 1.8G), 2 = dark, distinct and unbroken spot begins on 3rd tergum (Fig. 1.8F), 3 = no spot, but markings between the majority of terga, similar to females of *C. vittatus* and *C. robustus* (Fig. 1.8B–C). Character state 3 is only found on males of the outgroup species *Cirrospilus* sp. A and *Zagrammosoma* sp.

Higher-level relationships

To better assess the placement of the *vittatus* group, a complementary, four-gene ML analysis with seven additional non-*vittatus* group *Cirrospilus*

specimens was performed. Since Bouček (1988) separated *Cirrospilus* into two main groups, with the presence of a median carina on the propodeum being a character defining *Cirrospilus* s.s., four of these additional specimens possess the median carina, in contrast to all of the *Cirrospilus* specimens used in our previous analyses. These specimens were not scored morphologically as this analysis was performed solely to determine monophyly of *Cirrospilus,* and not for species delimitation within the *vittatus* group.

Nomenclature

This paper and the nomenclatural act(s) it contains have been registered in Zoobank (www.zoobank.org), the official register of the International Commission on Zoological Nomenclature. The LSID (Life Science Identifier) number of the publication is: urn:lsid:zoobank. org:pub:C737CD6B-04C1-439C-8A5C-C7B55E146ECD.

Results

Summary

Zagrammosoma renders *Cirrospilus* paraphyletic in the expanded higher-level analysis (Fig. S1.1). *Cirrospilus* emerges in multiple groups, two of which are each monophyletic and morphologically definable: *Cirrospilus* s.s. and the *vittatus* group. *Cirrospilus* s.s. is identified by the presence of a median carina on the propodeum (char. 17: state 1), which is absent in all other *Cirrospilus*

groups (char. 17: state 0). The type species for *Cirrospilus* s.s., *Cirrospilus elegantissimus* (examined), possesses a median carina on the propodeum. While no specimens were available for molecular analyses, this carina allows for clear distinction between *Cirrospilus* s.s. and the other species groups. The third group is paraphyletic in all molecular analyses and is designated as *incertae sedis*. The *vittatus* group is separated from *Cirrospilus incertae sedis* by two pairs of equal-length setae on the mesoscutellum (char 16: state 1), whereas *Cirrospilus incertae sedis* have a posterior pair longer in length than the anterior pair (char. 16: state 2). In addition, the *vittatus* group possesses a scape that extends to the vertex (char. 3: state 1), whereas the scape in *C. incertae sedis* does not extend to the vertex (char. 3: state 0). Notably, in our unpublished molecular analyses of the Cirrospilini that include additional genera, *C. incertae sedis* and the *vittatus* group are more distantly placed from *Cirrospilus* s.s. As there is morphological and molecular support distinguishing the *vittatus* group from *Cirrospilus* s.s. and *Cirrospilus incertae sedis*, we herein elevate the *vittatus* group to the genus *Burkseus* **gen. n.** (see taxonomy for description of genus and new species).

There are currently 15 synonyms of *Cirrospilus,* some proposed as subgenera and species groups, therefore, it was necessary to determine whether *Burkseus* conforms to any of these synonyms. The differences between *Burkseus* and the synonyms are listed below (see Supp Material for type information):

1. *Cirrospilus* Westwood, 1832 - the type, *Cirrospilus elegantissimus* (lectotype examined), possesses a median carina on the propodeum, and the anterior pair of setae on the mesoscutellum are shorter than the posterior pair.
2. *Atoposoma* Masi, 1907 - the type, *Atoposoma variegatus*, has a vaulted vertex which is not found in *Burkseus*.
3. *Atoposomoidea* Howard, 1910 - Some *Burkseus* species were placed in the subgenus *Atoposomoidea,* however, the type, *Atoposomoidea ogimae* (holotype examined), possesses a median carina on the propodeum, and was synonymized by Kamijo (1987) under *Cirrospilus pictus* (Nees, 1834).
4. *Gyrolasella* Girault, 1913a - the type, *Gyrolasella fasciatus* (holotype examined), possesses a mesoscutellum with the anterior pair of setae shorter than the posterior pair.
5. *Achrysocharelloidea* Girault, 1913a - the type species, *Achrysocharelloidea pax*, was placed in the *Gyrolasella* species group by Bouček (1988).
6. *Cirrospilomella* Girault, 1913a - the type species, *Cirrospilomella fasciatus* (holotype examined), possesses interlacing carinae on the propodeum, a character not found in *Burkseus*.
7. *Pseudiglyphomyia* Girault, 1913a - type species, *Pseudiglyphomyia biguttata* (holotype examined), possesses a rugose propodeum, a

character not found in *Burkseus*.

8. *Gyrolasella* Girault, 1913b - Girault forgot he already described this genus, and named *Gyrolasella consobrinus* (holotype examined) as the type species, even though he originally described *Gyrolasella fasciatus* as the type for *Gyrolasella. Gyrolasella consobrinus* possesses a mesoscutellum with an anterior pair of setae that are shorter than the posterior pair.
9. *Cirrospilopsis* Girault, 1915 - the type species, *Cirrospilopsis nigrivariegatus* (holotype examined), possesses a median carina on the propodeum.
10. *Parzagrammosoma* Girault, 1916c - the type species, *Zagrammosoma pulchra,* is described with a propodeum that is 'tricarinate', and there is no carinae on the propodeum in *Burkseus*.
11. *Giraultia* Gahan and Fagan, 1923 - replacement name for *Cirrospilopsis.*
12. *Austrolynx* Girault, 1929 - the type, *Austrolynx flavitibia* (paratypes examined), does not possess two pairs of equallength setae on the Mesoscutellum.
13. *Ootetrastichoides* Ii, 1936 - the type, *Ootetrastichoides habachi* Ii, is described with the anterior pair of setae on the mesoscutellum as longer than the posterior pair, which is not found in *Burkseus*. The illustration in the original description also shows a median carina on

the propodeum. The species was later synonymized under *Winnemama* Crawford by Domenichini (1966) and Graham (1975).

14. *Plesiospilus* Ferriere, 1953 - the type, *Eulophus unistriatus* Förster, is described with a median carina on the propodeum, and synonymized (Delucchi, 1958) under *Cirrospilus elegantissimus.*
15. *Winnemama* Crawford, 1911 - the type species, *Winnemama argei* (paratypes examined), possesses a median carina on the propodeum.

Molecular—*Burkseus*

A combined analysis of all four genes plus morphology recovers the proposed four morphospecies in the *vittatus* group (Fig. 1.3). *Burkseus robustus* **n. sp**. is recovered as sister to the rest of the *genus*, while *B. sigillatus* **n. sp.** is recovered as sister to *B. vittatus* **comb. n.** + *B. flavoviridis* **comb. n.** The *B. vittatus* specimens from California were nested amongst the Palearctic and Canadian specimens. Genetic distances within *B. flavoviridis*, *B. sigillatus*, and *B. vittatus* are minimal, even between Nearctic and Palearctic specimens of *B. vittatus*. In *B. robustus*, these are more substantial, with the Colombian and New Mexico specimens more distant from the remaining Nearctic specimens. Despite this, there are no substantial morphological characters that separate the *B. robustus* specimens. The illustrations of the mesosoma on the combined molecular and morphological tree (Fig. 1.3) are purposely

absent of any color patterns of the morphospecies (Figs 1.4–1.6) to focus solely on the mesosomal setae patterns that quickly differentiate the taxa.

The 28S D2 + D3–5 ML analysis recovers *B. sigillatus* and *B. flavoviridis* together as monophyletic (Fig. S1.2). ITS2 recovers the four hypothesized groups of ingroup species that were based on morphology (*B. sigillatus* is only represented by one specimen in this analysis). *Burkseus sigillatus* (D4738) is recovered as sister to *B. vittatus* + *B. flavoviridis* (Fig. S1.3). In the COI analysis, *Burkseus vittatus, B. flavoviridis*, and *B. sigillatus* are monophyletic, but *C. robustus* is paraphyletic; *B. sigillatus* (D4738) is sister to *B. vittatus* (Fig. S1.4). An analysis of all four gene regions resulted in the two *B. sigillatus* specimens (lacking ITS2 or COI) identical to *B. flavoviridis* (Fig. S1.5). The third *B. sigillatus* specimen (D4738) was recovered as sister to *B. vittatus*. Removing the two *B. sigillatus* specimens lacking COI and ITS2 and performing an additional four-gene analysis results in four monophyletic morphospecies, with *B. sigillatus* placed as the sister group of *B. vitattus* although with no bootstrap support (Fig. S1.6).

The bPTP analysis of all four gene regions, with D5324 and D5325 removed, proposed additional lineages not found in other molecular analyses (Fig. S1.7). As expected, *Burkseus vittatus* and *B. flavoviridis* emerge as the only monophyletic species, while *B. robustus* was recovered monophyletic but as three species. The single *B. sigillatus* D4738 specimen with ITS2 and COI

was proposed as a species sister to *B. vittatus*. With ABGD, the COI NJ-MD region results recognized four species (Fig. S1.8).

Morphology—Burkseus

The results of a TNT parsimony analysis of only morphological characters was unresolved, with only slightly greater resolution achieved on a majority-rule consensus (Fig. S1.9). *Burkseus vittatus* is supported by the presence of small, scattered on the mesoscutum (char. 13: state 1), and *B. robustus* is supported by an absence of admarginal setae on the fore wing (char. 20: state 1). The results of the color character analysis of recovered only *B. sigillatus* as monophyletic (Fig. S1.10) based on the wing pattern character (char. 31: state 1). The morphology + color analysis is the most resolved, with only *B. robustus* recovered as monophyletic, while *B. flavoviridis*, *B. sigillatus*, and *B. vittatus* are recovered as paraphyletic (Fig. S1.11).

Diagnostic character state changes are shown on a combined molecular and morphological tree, highlighting changes of the morphospecies (Fig. S1.12). Each species is supported by at least one unambiguous character state change. *Burkseus flavoviridis* is supported by a number of characters: mesoscutum with deep-reticulate sculpturing (char. 9: state 1), mesoscutum with three pairs of bristles (char. 12 state 3), hind basitarsus longer than 2nd tarsomere (char. 23: state 2), thin yellow stripes running parallel to the notaulus (char. 26: state 1), propodeum all dark (Char. 29: state 2), and thin yellow stripes on the mesoscutellum (char. 30: state 2)—note that the state changes

for characters 5 and 37 are also found in *B. robustus*. *Burkseus robustus* is supported by the presence of large, paired setae on the vertex (char. 2: state 1) and the admarginal setae shifted to the margin on the fore wing (char. 20: state 2). *Burkseus sigillatus* is the only species to possess banding on the fore wing (Fig. 1.2D, char. 31 state 1). *Burkseus vittatus* is the only species to exhibit random, small setae that do not have well-defined setal sockets (char. 13, state 1).

There are two state changes mapped onto the tree supporting *Burkseus* as distinct from *Cirrospilus incertae sedis*, scape extending to the vertex (char. 3 state: 1) and mesocutellum with setae equal in length (char. 16: state 1).

Taxonomy

Burkseus **Perry gen. n.**

Type species: *Cirrospilus vittatus* Walker, 1838: 308. Lectotype ♀, Designated by Graham, 1991: 8. Locality: England. Depository: BMNH type No. 5.2666/NHMUK 010353603.

(Zoobank LSID: urn:lsid:zoobank.org:act:258A9AB0-B0C1-4AE09D94-94285B5CDEC8)

Diagnosis

The combination of characters used to differentiate *Burkseus* from other *Cirrospilus* are: mesosoma yellow with dark longitudinal stripes of varying

widths (Figs 1.4–1.6, 1.9A, C), except in *B. singa* (Walker), which is completely metallic green (Fig. 1.9B); mesoscutellum always with two pairs of equally long setae (Figs 1.4–1.6); propodeum with median carina absent (Figs 1.1E, G, 1.4–1.6, and 1.9A–C); fore wing with the cubital line of setae curved to meet the basal line of setae, and speculum narrow and linear (Fig. 1.2).

Description

Head: malar sulcus present (Fig. 1.1A); occipital carina absent; upper ocular sulcus present; vertex not vaulted (Fig. 1.1B); vertex with paired large setae present (Fig. 1.1C) or absent (Fig. 1.1A and B); vertex with unpaired short setae present (Fig. 1.1A and B); tentorial pits indistinct.

Antenna (Fig. 1.1A, B, and I): dorsal margin of torulus above ventral margin of compound eye; scape with setae present; scape extending to vertex; pedicel longer than wide; pedicel with setae present; pedicel with dorsal and ventral carinae absent; two funiculars; clava longer than wide.

Body (Figs 1.4–1.6): Mesosoma: pronotum bell-shaped in dorsal view, subequal in w:l; pronotal collar carina absent; pronotum with bristles on lateral sides present. Propleura separated posteriorly, exposing prodiscrimen (Fig. 1.1B). Notaulus extending to mesoscutellum. Lateral lobe of mesoscutum with one bristle and with smaller, nonbristle seta. Axilla advanced, but less than 75% of longitudinal length beyond anterior margin of mesoscutum. Mesoscutellum with submedian grooves distinct and curved posteriorly to

margin; two pairs of setae, all equal in length. Propodeum with median carina or plicae absent. Propodeal spiracle rim complete and exposed. Legs: Hind tibial spur shorter than basitarsus (Fig. 1.1H). Metasoma: female cercal setae equal in length.

Fore wing (Fig. 1.2): speculum narrow and linear; four to six setae on submarginal vein; submarginal vein smoothly joining parastigma; setae on costal cell present; basal setal line setae present; cubital setal line complete to basal line of setae and curved anteriorly.

Sexual Dimorphism

During examination of pinned specimens, it became evident that males and females of *Burkseus flavoviridis*, *B. robustus*, *B. sigillatus*, and *B. vittatus* exhibit both sexual dimorphism and extreme variation with regards to coloration on the gaster. Figure 8 depicts the color pattern variations found within males and females of these four species. While male *Burkseus flavoviridis* and *B. vittatus* possess a yellow gaster with a dark spot on the dorsal surface, the size and location of these spots differ between the two species. In *B. vittatus* males, the spot begins on tergum 3 and ends on tergum 5, never extending past tergum 6, while in *B. flavoviridis*, the spot is larger, beginning on tergum 2 and extending to terga 6 or 7 (Fig. 1.8). The spots are wider in *B. flavoviridis*, extending closer to the lateral margins when viewed from above. Similar to the mesosomal color patterns, *B. vittatus* displays the

largest amount of gaster color pattern variation within a species. Gaster coloration is variable, especially among females, and therefore should not be used as a primary identifying feature of a species. It should be noted that the male *B. sigillatus* coloration is based on the sole male specimen examined (UCRCENT485698; D5325) and may not be indicative of any variation present in the species.

Comments

Askew (1984) included *Cirrospilus curvineurus* Askew in his original description of the *vittatus* group. The species is similar in coloration to *Burkseus singa*, however, *C. curvineurus* possesses small, scattered setae on the mesoscutum whereas *C. singa* does not. In addition, *C. curvineurus* has a distinct median carina on the propodeum, unlike any other examined *Burkseus* species. We, therefore, place *C. curvineurus* in *Cirrospilus* s.s. (examined 4♀ BMNH: NHMUK010371839 (Fig. 1.9D) and ANIC: UCRCENT238811–238813). A full list of described *Burkseus* species is provided in Table 1.2.

Distribution: Nearctic, Neotropic, Palearctic (Fig. 1.7)

Etymology: Named in honor of Dr. Roger A. Burks, who has been a vital source of information and advice regarding the systematics of Eulophidae.

Key to *Burkseus*

1. Median carina on propodeum present ..... *Cirrospilus s.s.*

   Median carina on propodeum absent 2

2... Mesoscutellum with anterior pair of setae shorter than posterior pair .....

   ..... *Cirrospilus* (*incertae sedis*)

   Mesoscutellum with both pairs of setae equal in length ..... *Burkseus,* 3

3. Body metallic green, with no yellow patterns (Fig. 1.9B) .....

   .....*Burkseus singa* (Walker)

   Body with yellow coloration 4

4. Fore wing with three faint, dark bands (Fig. 1.2D) ... *Burkseus sigillatus* n. sp.

   Fore wing hyaline (Fig. 1.2A–C) 5

5. Admarginal setae present but shifted to ventral surface of marginal vein (Fig. 1.2C); stigma infuscate (Fig. 1.2C); vertex with paired, large setae (Fig. 1.1C)

   ..... *Burkseus robustus* n. sp.

   Admarginal setae present; stigmal vein without darkening (Fig. 1.2A, B, D); vertex lacking paired, large setae (Fig. 1.1A & B) 6

6. Midlobe of mesoscutum with one, or rarely two, pairs of bristle-like setae (Figs 1F, 1.6); unpaired, smaller setae also present ..... *Burkseus vittatus* (Walker)

   Midlobe of mesoscutum with three or four pairs of bristle-like setae, without smaller additional setae (Figs 1.1G, 1.9A, C) 7

7. Mesoscutum with shallow-reticulate sculpturing (Fig. 1.1D, F, G); propodeum coloration yellow with dark markings, but never completely dark; female gaster mostly yellow in color (Fig. 1.9A) ..... *Burkseus elongatus* (Bouček)
   Mesoscutum with deep-reticulate sculpturing (Figs 1E, 1.9C); propodeum completely dark metallic in color; female gaster mostly dark in color (Figs 1.8A, 1.9C) 8
8. Midlobe of mesoscutum with 4 pairs of bristles (Fig. 1.9C); occiput & pronotum with many unpaired setae; Palearctic ..... *Burkseus pinicolus* (Askew)
   Midlobe of mesoscutum with 3 pairs of bristles (Fig. 1.4A–L), with occasional supernumerary bristle that is never paired (Fig. 1.1G); occiput and pronotum not very setose; Nearctic & Neotropical ..... *Burkseus flavoviridis* (Crawford)

***Burkseus elongatus* (Bouček), 1959 comb. n.**

(Fig. 1.9A)

Cirrospilus elongatus Bouček, 1959: 185. Holotype ♀ (examined high-quality image). Locality: České středohoří, Bohemia, Czech Republic. Depository: National Museum, Prague, Cat. no. 3457.

Cirrospilus (*Atoposomoidea*) *elongatus* Boucek. Subgeneric proposal by Bouček, 1959: 185.

Diagnosis. Similar in appearance to *Burkseus vittatus*, sharing the characters of multiple small, unpaired setae on mesoscutum and no infuscation on wing

or stigmal vein, however in *B. elongatus,* when compared to *B. vittatus,* the propodeum is longer (l:w = 0.26–0.28 vs. 0.17–0.24) and fore wings more slender (l:w = 3.8–4.1 vs. 2.7– 3.8). The variable female gaster coloration is similar to *B. vittatus*, however, the medial dark line may be absent on specimens (Fig. 1.9A), a feature only observed in *B. vittatus* females that are completely yellow and lack any metallic coloration on the body; based on material examined and the original description, *Burkseus elongatus* always has metallic coloration present on the mesosoma. Only a photo of the holotype (provided by H. Cao) and two pinned specimens, one of which was collected and identified by Bouček, were available to examine, and as such, *B. elongatus* may prove to be a synonym of *B. vittatus*.

Distribution. Palearctic: (Fig. 1.7) Czech Republic and United Kingdom.

Material examined. Holotype: Czech Republic: Bohemia (now Ústí nad Labem), Středohoří, Raná Hill, 390 m, 50°24′30″N, 13°46′26″E, Z. Bouček [1♀, NMP: Cat. No 3457-examined

Additional material. Czech Republic: Svaty kopeček, 49°37′40″N, 17°20′12″E, 7.vii.1952, Hoffer [1♂, BMNH: NHMUK10371809]. **United Kingdom:** England: Bald Hill (near Lewknor), 269 m, 51°39′19″N, 0°56′48″W, 16.vi.1970, Z. Bouček [1♀, BMNH: NHMUK10371808].

***Burkseus flavoviridis* (Crawford), 1913 stat. rev. and comb. n.**

(Figs 1.1B, I, 1.2B, 1.4, and 1.8)

Cirrospilus flavoviridis Crawford, 1913: 317. Holotype presumably ♀ (examined, gaster missing). Locality: Salt Lake City, UT, United States. Depository: USNM, No. 15556.

Cirrospilus vittatus; synonymy by Huber and Moreau, 2003: 669.

Diagnosis: Females of *B. flavoviridis* can be separated from the other Nearctic species, *B. vittatus, B. robustus,* and *B. sigillatus,* by the deep-reticulate sculpturing on mesoscutum (char. 9: state 1), midlobe of the mesoscutum possessing three pairs of bristles with visible setal sockets (char. 12: state 3), occasionally with a supernumerary bristle that is never paired (char. 14: state 1), and hind basitarsus longer than the second tarsomere (char. 23: state 2). The color pattern variations unique to *B. flavoviridis* are the mesoscutum with narrow, yellow stripes (char. 26: state 1), prepectus mostly dark (char. 27: state 1), propodeum completely dark metallic (char. 29: state 2), and hind coxa dark metallic (char. 37: state 2).

Male *Burkseus flavoviridis* are as above except for color pattern variations consisting of a prepectus that is all dark metallic or with some yellow (char. 27: states 0 and 1) and hind coxae that are completely dark metallic or with metallic coloration on basal quarter (char. 37: states 1 and

2). Males can be differentiated from *B. vittatus, B. robustus,* and *B. sigillatus* by a dark spot beginning on the second gastral tergum and extending to the seventh (Fig. 1.8; char. 39: state 1).

Discussion. Huber and Moreau (2003) synonymized *B. flavoviridis* Crawford with *B. vittatus* based on comparisons of their reared Canadian specimens with types of both species. Digital images of specimens originally designated as *B. flavoviridis* were sent to Bouček, and he agreed that the different mesosomal color patterns of the specimens fell within the variation of *B. vittatus* (Huber and Moreau 2003). While some mesoscutal color patterns are similar between the two species, they can be separated by the patterns of the mesoscutal setae.

Hosts, from material examined. (Supplemental Material contains a full list of specimens and their recorded hosts.) **Coleoptera**: **Apionidae**: *Apion proclive* LeConte on *Lupinus arboreus* (Fabaceae). **Diptera**: **Agromyzidae**: *Liriomyza pusilla* (Meigen) on *Vigna unguiculata* (Fabaceae); *Liriomyza sativae* Blanchard; *Liriomyza* sp. **Lepidoptera**: **Gelechiidae**: *Coleotechnites milleri* Busck. **Gracillariidae**: *Cameraria* sp. on *Quercus vaccinifolia* (Fagaceae); *Marmara gulosa* Guillèn and Davis on *Citrus maxima* (Rutaceae); *Phyllocnistis citrella* Stainton on *Citrus* × *paradise* and *Citrus* × *limon* (Rutaceae);

Phyllonorycter elmaella Gerasimov on *Malus* sp. (Rosaceae). **Nepticulidae**: *Stigmella* sp. on *Prunus* sp. (Rosaceae).

Distribution. Nearctic: Canada (BC), Mexico (CH, MO), United States (AZ, CA, CO, ID, NV, OR, UT, WA, WY).

Material examined (see Supplemental Material for full list of non-type material, including molecular vouchers used in analyses). **Allotype: United States: Utah:** Salt Lake Co., Salt Lake City, 1,302 m, 40°42′40″N, 111°52′32″W, 13.vii.1911, host: *Liriomyza pusilla*, host plant: *Vigna unguiculata* [1♂, USNM: UCRCENT471305]. **Paratypes. United States:** Same data as allotype except: 1911 [1♀, USNM: UCRCENT471304]. 30.vii.1912, [1♂, USNM: UCRCENT471306]. 23.vii.1912 [2♀, USNM: UCRCENT471307, 471308].

***Burkseus pinicolus* (Askew), 1984 comb. n**.

(Fig. 1.9C)

Cirrospilus pinicolus Askew, 1984: 67–68. Holotype ♀ (examined).

Locality: Freshfield, Lancashire, England. Depository: BMNH, Type HYM No. 5.3037/NHMUK 10838529.

Diagnosis. Recognized by midlobe of mesoscutum with four pairs of bristles, head and pronotum posteriorly with many unpaired setae, lateral lobes of mesoscutum with three adnotaular setae, and lateral lobes dark metallic, a characteristic found only on completely dark forms of *B. flavoviridis*. The color patterns on the mesoscutum are similar to *B. flavoviridis*, however, *B. pinicolus* is only found in the Palearctic, and the mesosoma setal patterns are distinct from each other.

Hosts, from material examined. Lepidoptera: Yponomeutidae: *Ocnerostoma piniariella* Zeller on *Pinus* sp. (Pinaceae).

Distribution. Palearctic: Cyprus, England

Material examined. Paratype: **United Kingdom**: England: Abbots Moss, 53°13′04″N, 2°36′25″W, 28.iv–vi.1952, R.R. Askew, host: *Ocnerostoma piniariella* [1♀, BMNH: NHMUK10371840].

Additional material. Cyprus: Limmasol, Pentakomo, Governors Beach, 29 m, 34°43′01″N, 33°16′13″E, 16.viii.1979, B. Gustafsson [1♀, BMNH: NHMUK10264103].

***Burkseus robustus* Perry n. sp.**

(Figs 1.1C, D, 1.2C, 1.5A–H, and 1.8)

(Zoobank LSID: urn:lsid:zoobank.org:act:C3ED4EB6-2DEA-40C49F62-90C6AD6A649D)

Diagnosis: Three features separate this species from other *Burkseus*: vertex with large, paired setae present (char. 2: state 1), fore wing with admarginal setae present but shifted to ventral surface of marginal vein (char. 20: state 1), and stigma dark (char. 76: state 1), all of which are not found in any other *Burkseus* species. This species is similar morphologically to *B. sigillatus*, as the midlobe of the mesoscutum has only two pairs of bristle-like setae, all with well-defined setal sockets (char. 36: state 2). These setae however, tend to be longer and more robust than those on *B. sigillatus*. Similar to *B. sigillatus*, the submarginal vein setae are also thick and long (char. 19: state 1).

Description. Female: Body length 1.27–1.75 mm.

Head: Vertex with paired large setae present. Antenna: funiculars both longer than wide; first claval segment variable in length: subequal, wider than long, or longer than wide; second claval segment length variable: wider than long or subequal. Pronotum with two pairs of large setae on posterior margin. Mesoscutum: shallow reticulate sculpturing present, two pairs of large bristle-like setae present; small, unpaired setae absent; all bristle sockets well-defined. Mesoscutellum with no supernumerary bristles

observed. Hind tibial spurs shorter than basitarsus. Hind basitarsus shorter than second tarsomere (basitarsus: 2nd 0.74–0.85). Fore wing: admarginal setae present but shifted to ventral surface of marginal vein; uncus originating on stigma by its own length from stigmal apex. Scape with ventral spot present or absent. Mesoscutum with wide, longitudinal yellow stripes. Prepectus mostly yellow. Dark longitudinal stripe from pronotum to mesoscutellum complete or broken. Mesoscutellum with wide yellow stripes. Propodeum all dark or partly dark and yellow. Hind coxa yellow and dark basally, or all yellow. Profemur and mesofemur with stripe or no stripe. Metafemur with dark spot basally or no spot. Fore wing disc hyaline, without markings. Submarginal vein setae dark. Gaster yellow with dark markings between terga (Fig. 1.8).

Male as above, except: body length 0.79–1.52 mm; pro-, meso-, or metafemur with no stripe or spot; gaster coloration usually lighter, with dark markings narrower than those found in females (Fig. 1.8).

Hosts. Parasitoid of lepidopteran leaf miner larvae and hyperparasitoid of *Cotesia* (Hymenoptera: Braconidae).

Hymenoptera: **Braconidae**: *Cotesia* sp. **Lepidoptera**: **Gelechiidae**: *Coleotechnites milleri* Busck on *Pinus contorta var. murrayana* (Pinaceae). *Coleotechnites* sp. on *Pinus radiata* (Pinaceae); *Recurvaria* sp. Nepticulidae:

Stigmella sp. on *Chrysolepis* sp. (Fagaceae). **Yponomeutidae**: *Argyresthia pilatella* Braun.

Distribution. Nearctic: Canada (AB, BC, ON), Mexico (OAX), United States (AZ, CA, ID, NM). Neotropical: Chile (Elquí), Colombia (Boyacá), Costa Rica (Alajuela).

Etymology. Named for the long and thick, paired 'robust' bristle-like setae on the mesoscutum.

Material examined (see Supplemental Material for all records of non-type material, including molecular vouchers not listed as type material).

Holotype: United States: California: San Bernardino Co., San Gabriel Mts., Cucamonga Wilderness Area, btwn Cucamonga and Etiwanda Peaks, 35°13′35″N, 117°34′44″W, 26.viii.1989, J.D. Pinto [1♀, UCRCENT485745]; **deposited in UCRC**. **Paratypes: CANADA: Ontario:** Constance Bay, 64 m, 45°29′10″N, 76°04′24″W, 10–23. vii.1983, M. Sanborne, host: *Recurvaria*, host plant: *Pinus contorta* [1♀, CNC: CNC00508552]. **COLOMBIA: Boyacá:** SFF Iguaque Cerro Pan de Azucar, 3,380 m, 5°25′0″N, 73°27′0″W, 10–28.vi.2001, P. Reina, malaise trap, M.1834 [1♀, TAMU: UCRCENT426806; D4591]. **United States: Arizona: Coconino Co.**, Jacob Lake, 13 mi. S, 2,682

m, 36°33′47″N, 112°10′14″W, 26.vi.1993, J.D. Pinto, sweep [1♀, CNC: CNC00508646; D4680]. **California: San Luis Obispo Co.**, Cambria, Kenneth S. Norris Rancho Marino Res., 41–112 m, 35°32′15″N, 121°05′4″W, 2–3.vii.2016, S.V. Triapitsyn, sweep, host plant: *Pinus radiata* [1♂, UCRC: UCRCENT485699; D5326]. **Tuolumne Co.**, Tuolumne Meadows, Yosemite Natl. Park, 2,617 m, 37°52′34″N, 119°22′16″W, vii–ix.1955, G.R. Struble, 34029L, host plant: *Pinus contorta* [1♀, USNM: UCRCENT471408]. Tuolumne Meadows, Yosemite Natl. Park, 2,617 m, 37°52′34″N, 119°22′16″W, vii–ix.1955, G.R. Struble, 34029M, host plant: *Pinus contorta* [1♂, USNM: UCRCENT471409]. **New Mexico: Otero Co.**, Sacramento Mtns, High Rolls, 2,123 m, 32°57′0″N, 105°49′0″W, 1–10.v.2004, M.E. Irwin, dry wash, malaise trap [1♂ 1♀, UCRC: UCRCENT357532; D3674, 00357533; D3675].

***Burkseus sigillatus* Perry n. sp.**

(Figs 1.2D, 15I–L, and 1.8)

(Zoobank LSID: urn:lsid:zoobank.org:act:95C43510-C58E-4E278E53-759CA9CCB290)

Diagnosis. The distinguishing character of this species is the presence of three dark bands perpendicular to the anterior margin of the fore wing (char. 31: state 1), which has not been observed in other *Burkseus* species. *Burkseus*

sigillatus is most similar to *B. robustus,* sharing the characteristics of the thick and long submarginal vein setae (char. 19: state 1), and the midlobe of the mesoscutum having only two pairs of bristles, although the sole male observed has one only pair (char. 12: state 1 and 2). This male (D5324, Fig. 1.5I) is extremely small and may not be indicative of all males in the species. Similar to *B. vittatus*, the propodeum is yellow with dark metallic markings medially on dorsal surface, and the hind coxae are yellow (char. 37: state 0).

Description. Female: Body length 1.04–1.23 mm.

Head: Vertex with paired large setae absent. Antenna: first funicular longer than wide; second funicular wider than long; first claval segment variable in length: subequal or wider than long; second claval segment length variable: wider than long, subequal, or longer than wide. Pronotum with two pairs of large setae on posterior margin. Mesoscutum: shallow-reticulate sculpturing present; two pairs of large setae present; small, unpaired setae on mesoscutum absent; all bristle sockets well-defined. Mesoscutellum with no supernumerary bristles observed. Hind basitarsus shorter than 2nd tarsomere (basitarsus:2nd = 0.74–0.83). Fore wing: admarginal setae present; uncus originating on stigma by its own length from stigmal apex. Scape with dark dorsal spot present. Body with metallic coloration. Mesoscutum with wide, longitudinal yellow stripes. Prepectus mostly yellow. Dark longitudinal stripe from pronotum to mesoscutellum complete or broken. Mesoscutellum with

wide yellow stripes. Propodeum partly dark and yellow. Hind coxae all yellow. Pro-, meso-, and metafemur without markings. Gaster yellow with four dark, horizontal stripes. Male as above, except: body length 0.68 mm; mesoscutum with one pair of bristles; gaster with two dark, horizontal stripes (Fig. 1.8).

Hosts. Unknown, but most likely leaf miners.

Distribution. Nearctic: United States (Northern CA).

Etymology. Sigillatus is Latin for banding, and this species is named for the three faint bands found on the fore wing.

Material examined

Holotype: **United States: CA:** Contra Costa Co., Tilden Regional Park, off Nimitz trail, 323 m, 37°54′49″N, 122°15′07″W, 5–6. vii.2002, A. Owen and T. Kim, Oak Scrub, YPT [1♀, UCRC: UCRCENT478935; D4738], **deposited at UCRC**. **Paratypes**: **United States: CA:** Contra Costa Co., Tilden Regional Park, off Nimitz trail, 323 m, 37°54′49″N, 122°15′07″W, 5–6.vii.2002, A. Owen and T. Kim, Oak Scrub, YPT [1♀ 1♂, UCRC: UCRCENT485697; D5324, 485698; D5325]. Sonoma Co., Bodega Marine Reserve, Bodega Headlands, 3 m, 38°19′20″N, 123°03′31″W, 5.v.2001 [1♀, UCDC: UCRCENT477908]. Humboldt Co., Petrolia, 519 m, 40°19′30″N,

124°17′10″W, 9.vi.1984, J.D. Pinto [1? (gaster missing), UCRC: UCRCENT485742].

***Burkseus singa* (Walker), 1838 comb. n.**

(Fig. 1.9B)

Cirrospilus singa Walker, 1838: 383. Syntype ♀ [examined]. Locality: London, England. Depository: BMNH NHMUK10202163. Noyes (2018) mentions a lectotype, but no lectotype designation was given.

Cirrospilus (*Atoposomoidea*) *singa* Walker. Subgeneric proposal by Bouček, 1959: 183.

Diagnosis. This species can be differentiated from other *Burkseus* species as the body and most of head are metallic green, with very faint or no yellow or light stripes on body. There are two pairs of bristles on midlobe of mesoscutum, and no unpaired setae on midlobe of mesoscutum. The wings are hyaline.

Distribution: Palearctic: Bulgaria, Czech Republic, Estonia, Finland, Germany, Ireland, Moldova, Netherlands, Slovakia, Sweden, United Kingdom.

Material examined (see Supplemental Material for records of material examined).

***Burkseus vittatus* (Walker) comb. n.**

(Figs 1.2A, 1.6, and 1.8)

Cirrospilus vittatus Walker, 1838: 308. Lectotype ♀ (examined), designated by Graham, 1991: 8. Type locality: England. Depository: BMNH Type HYM No. 5.2666/NHMUK 10353603.

Cirrospilus (*Atoposomoidea*) *vittatus* Walker, 1838. Subgenus of *Cirrospilus, Atoposomoidea* Howard, treated as valid by Bouček, 1959: 172–173.

Atoposomoidea vittata: treatment as genus by Briolini, 1960: 239–269.

Eulophus lineatus Förster, 1841. Holotype ♀ (examined

high-quality images). Locality: Germany. Depository: NHMW, Vienna. Synonymy by Bouček and Askew, 1968: 37.

Entedon lineatus; combination by Ratzeburg, 1852: 209.

Cirrospilus lineatus; combination by Erdös, 1956: 9.

Zagrammosoma nigrolineata Crawford, 1913: 257. Syntypes 2 ♂ (examined). Locality: Compton, California. Depository: USNM, No. 15362. Synonymy by Bouček, 1988: 616.

Gyrolasella nigrolineata; unjustified combination by Girault, 1916b: 125.

Zagrammosoma nigrolineatum; justified emendation by Peck, 1951: 460.

Cirrospilus nigrolineatus; combination by Herting, 1975: 16.

Atoposomoidea pulcherrima Mercet, 1916: 77. Lectotype ♀ (examined), designated by Bouček, 1994: 117. Locality: Cercedilla, Spain. Depository: Museo Nacional de Ciencias Naturales, Spain. Synonymy by Askew, 1984: 63 and Bouček, 1994: 117.

Cirrospilus pulcherrimus; combination by Lemarie, 1958: 221–230.

Cirrospilus (*Atoposomoidea*) *pulcherrimus*; status revised and subgenus placement by Bouček 1959: 184.

Zagrammosoma sanguinea Girault, 1916b: 133. Holotype ♀ (examined). Locality: Colorado, United States. Depository: USNM, No. 19651, UCRCENT 00471474. Synonymy under

Z. nigrolineatum by Gordh, 1978: 356.

Zagrammosoma sanguineum Girault, 1916b. Justified emendation of *Zagrammosoma sanguinea* by Peck, 1951: 460.

Cirrospilus donatellae Mariani, 1942: 12. Holotype presumably ♀ (not examined). Locality: Italy. Synonymy under *C. vittatus* by Askew, 1984: 63, 66.

Atoposoma hytomyzae Ishii, 1953: 3–4. Lectotype ♀, designated by Kamijo, 1978: 457–458. Type locality: Japan. Depository: National Institute of Agricultural Sciences, Japan. Synonymy under *C. vittatus* by Kamijo, 1987: 48.

Cirrospilus (*Zagrammosoma*) *hytomyzae*; combination and subgenus placement by Bouček and Askew, 1968: 38.

Cirrospilus hytomyzae; synonymy of *Atoposoma hytomyzae* by Kamijo, 1978: 458.

Cirrospilus vittatus novickyi Bakkendorf, 1955: 149. Type locality: Iceland. Described from a single female borrowed from the NHMW, Vienna. Depository: unknown. Synonymy by Bouček and Askew, 1968: 37.

Diagnosis: Female. Body length 0.76–1.64 mm. *Burkseus vittatus* can be differentiated morphologically from *B. flavoviridis* by the mesoscutum with shallow-reticulate sculpturing (char. 9: state 0) as opposed to deep-reticulate sculpture in *B. flavoviridis* (char. 9: state 1), midlobe of the mesoscutum with one or rarely two pairs of bristles (char. 12: states 1 and 2) and with smaller, unpaired setae (char. 13: state 1), and hind basitarsus shorter than second tarsomere (bst: 2nd = <0.93) (char. 23: state 0).

Burkseus vittatus displays the largest amount of color variation within the genus, with some specimens having similar dark patterns to *B. flavoviridis* and some specimens completely yellow with no metallic markings anywhere. Similar to *B. robustus* and *B. sigillatus, B. vittatus* generally have wide, yellow stripes running longitudinally on the mesosoma (char. 26: state 0). As well, the propodeum is either yellow, yellow with metallic markings medially on dorsal surface, or rarely, completely dark metallic (char. 29 states 0, 1, and 2). The fore wing is hyaline with no darkening of the stigma (char. 31: state 0), and the hind coxa is yellow (char. 37: state 0).

Males are as above except: body length 1.1–1.24 mm, and dark spot beginning on third gastral tergum and not extending past sixth (Fig. 1.8; char. 39: state 2).

Discussion: *Old World: Burkseus vittatus* was first described by Walker (1838) from specimens collected in the United Kingdom. He described seven different color forms, a testament to the high degree of color variation found in this species; however, descriptions of mesosomal setal patterns and propodeum structures are absent. A dark form, *Cirrospilus vittatus novickyi*, was described from Iceland, whereas *C. pulcherrimus* from Spain was determined to be a lighter form of *Burkseus vittatus* (Askew 1984). This information, along with examination of additional European specimens, led to speculation that color variation in this species is a result of clinal differences, with darker specimens found in higher elevations and latitudes and lighter specimens found at lower elevations and latitudes (Bouček 1959, Askew 1984); however, both authors mention that specimens of one form or the other have been found in areas where the opposite form would be expected. Askew (1984) noted that no 'structural' features appear to distinguish one form from the other and concluded that the forms were conspecific. The illustrated color patterns of *Cirrospilus vittatus novickyi* vary between Bakkendorf (1955, Fig. 11) and Askew (1984, Fig. 1.2), with Bakkendorf's illustration more resembling *Burkseus flavovoridis* and Askew's resembling

B. vittatus, and without examining the type it is difficult to determine the validity of this synonymy. Several other species, *Cirrospilus donatellae* Mariani, *C. lineatus* (Förster), and *C. hytomyzae* (Ishii), were synonymized as color variants of *B. vittatus* (Bouček 1959, Kamijo 1987). We agree with synonymizing *Cirrospilus donatellae* with *Burkseus vittatus*, as the mesoscutal setae pattern is consistent with *B. vittatus*, with no markings on the wings or stigmal vein, and the hind coxae completely yellow. The examined *Cirrospilus donatellae* specimen from the BMNH (NHMUK010371806) is a lighter form of *C. vittatus* that falls within the range found in the specimens in the molecular analysis.

New World. Crawford (1913) described *Zagrammosoma nigrolineatum* based on color patterns on the body from two male specimens collected in California, noting that the wings are hyaline and the propodeum not entirely metallic green. Gordh (1978) redescribed *Z. nigrolineatum* from male and female specimens exhibiting a large range in color variation, from yellow with few dark markings to specimens with a predominantly metallic blue-green mesosoma, and as possessing 2 or 3 pairs of bristles (=setae in Gordh 1978) on the mesoscutum. *Burkseus flavoviridis* is the only Nearctic species that has three pairs of setae, and never just two pairs. Therefore, we suspect he was encountering more than one species and describing them as such. He mentions a series of specimens from one collecting event

exhibiting a large degree of color variation, concluding they were conspecific. In this analysis, there are several instances of multiple species found in the same location, and even the same collection event (see Fig. 1.3 and Supplemental Material). Bouček (1988) synonymized *Z. nigrolineatum* with C*irrospilus vittatus*, noting that *Zagrammosoma* can be distinguished from *Cirrospilus* by the extension of the notauli to the axillae, rather than to the mesoscutum. Examination of the type of *Z. nigrolineatum* (1♂ USNM: type No. 15632-USNMENT 01025272) reveals it as *Burkseus vittatus*, since the specimen possesses hyaline wings with no coloration of the stigmal vein, and gaster coloration that conforms to that of *B. vittatus*. This adds further evidence that Gordh examined more than one species when redescribing *Z. nigrolineatum*. Examination of the type of *Zagrammosoma sanguineum* Crawford (1♀ USNM: type No. 19651/UCRCENT 00471474) determined it to be a light form of *B. vittatus*, as it possesses only one pair of bristles and unpaired setae on the midlobe of the mesoscutum, a feature not found in any other New World *Burkseus* species.

Huber and Moreau (2003) examined a number of specimens with considerable color variation, and ultimately synonymized *B. flavoviridis* under *B. vittatus*. However, examination of the specimens used in their paper and housed at the BMNH, CNC, and USNM, proved to be three different species: *B. flavoviridis, B. robustus,* and *B. vittatus*. In their

paper, a specimen loaned from the USNM is identified as *Cirrospilus vittatus* (Fig. 8 in Huber and Moreau) and recovered from *Coleotechnites* (*Recurvaria* on label) *milleri* in Yosemite National Park by J.S. Yuill. Examination of the specimens on loan from all institutions used in this paper recovered from *Coleotechnites milleri* in Yosemite by J.S. Yuill are both *B. flavoviridis* (USNM: UCRCENT 471399) and *B. robustus* (USNM: UCRCENT 471400–471403), highlighting the sympatry of *Burkseus* species.

Hosts: *Burkseus vittatus* emerged from hymenopteran, lepidopteran, dipteran, and coleopteran leaf miner hosts. This is the only species that also emerged from sawfly eggs, which has been recorded before in both the Nearctic and Palearctic (Kirkland and Paramonov 1962, Cingovski 1965, Bouček and Askew 1968, Huber and Moreau 2003).

Although egg parasitism of sawfly eggs seems a very different niche compared to leafminer parasitism, there are some general similarities that allow for the possibility of a generalist switch. The larvae of sawflies in the genera *Anoplonyx* and *Neodiprion* are free-living and much more mobile than their leaf miner counterparts; however, the female will oviposit beneath the epidermis of the leaf or needle, making egg parasitism of this species an easier endeavor for *B. vittatus*, as this biology is physically similar enough to fit into the leaf miner 'niche'. It should be noted that another species of sawfly

with free-living larvae documented as a host but not directly recorded as being parasitized in the egg stage, *Caliroa cerasi* L. (Diprionidae), also oviposits into leaf tissue. The biology of *Fenusa pusilla* (Lepeletier) (Tenthredinidae), the birch leaf miner, is typical of the leaf-mining habit, with the larva forming blotch mines under the epidermis of leaves, which is the life stage more likely to be parasitized. True to their namesake of being niche-specific parasites, *B. vittatus* will parasitize almost any species concealed in plant tissue.

The diversity of plant hosts for *B. vittatus* reflects the diversity of insect hosts, with hosts found in 27 families and 13 orders of plants. Table S1.3 (online only) summarizes those plant groups. This table accounts only for the label information from the specimens examined in this analysis and may not represent the true breadth of host plant diversity for *B. vittatus.* For a comprehensive list of hosts in the Palearctic, see Bouček and Askew (1968) and Askew (1984).

Hosts. From material examined (see Supplemental Material Examined for details): **Coleoptera:** *Rhynchaenus* sp. on *Betula* (Betulaceae). **Diptera**: **Agromyzidae**: *Agromyza demeijeri* Hendel on *Laburnum anagyroides* (Fabaceae); *Aulagromyza hendeliana* (Hering) on *Lonicera* sp. (Caprifoliaceae); *Phytomyza* sp.; unidentified leaf miner pupae on *Cynara cardunculus* (Asteraceae). **Cecidomyiidae**: *Rhabdophaga rosaria* (Loew).

Hymenoptera: **Tenthredinidae**: *Anoplonyx destructor* Benson (eggs) on *Larix* sp. (Pinaceae). *Caliroa cerasi* Linnaeus. *Fenusa pusilla* (Lepeletier). *Heterarthrus nemoratus* (Fallén) **Diprionidae**: *Neodiprion abietis* (Harris) (eggs) on *Abies balsamea* (Pinaceae); *Neodiprion annulus* Schedl (eggs) on *Pinus resinosa* Sol. ex Aiton (Pinaceae). **Lepidoptera**: **Gelechiidae**: *Chrysoesthia sexguttella* Thunberg on *Chenopodium album* (Amaranthaceae); *Coleotechnites gibsonella* (Kearfott). *Recurvaria* sp. on Cedar; Coleophoridae: *Coleophora* sp. **Heliozelidae**: *Coptodisca arbutiella* Busck. **Lyonetiidae**: *Leucoptera laburnella* (Stainton) on *Laburnum anagyroides* (Fabaceae). **Gracillariidae**: *Marmara arbutiella* Busck; *Marmara gulosa* on *Citrus* sp. (Rutaceae); *Phyllocnistis citrella* Stainton on *Citrus* × *paradise, Citrus* × *limon* (Rutaceae); *Phyllocnistis populiella* Chambers; **Nepticulidae**: *Nepticula* sp., on *Salix* sp. (Salicaceae); *Stigmella Please* (Stainton). **Yponomeutidae**: *Argyresthia thuiella* (Packard) on *Thuja* sp. (Cupressaceae); *Ocnerostoma copiosella* Frey; *Ocnerostoma piniariella* Zeller. Unidentified leaf miner on *Thuja occidentalis* (Cupressaceae) and *Xanthium* (Asteraceae).

Distribution (Fig. 1.7): **Palearctic:** Austria, Croatia, Czech Republic, England, Finland, Germany, Hungary, India, Iraq, Ireland, Japan, Kyrgyzstan, Morocco, Norway, Russia, Scotland, Spain, Sweden, Switzerland, Turkey, Wales**.** **Nearctic:** Canada (AB, BC, NB, NL, NS, ON, PE, QC, YT), United States (AK, AZ, CA, CO, HI, ID, ME, MT, NH, NV, NY, OR, UT, VA, WA, WI).

Material examined (see Supplemental Material for all records of non-type material, including molecular vouchers used in analyses). **Paralectotypes:** 2♀, 'near London, Isle of Wight, Wales, Ireland', United Kingdom, 1838 [BMNH: NHMUK10353599, 10353600].

Discussion

The combined analysis (Fig. 1.3) recovered four Nearctic *Burkseus* species. Although the 28S regions were nearly identical (D2) or invariant (D3), there was variation in COI and ITS2 that corresponded with the recognized species as depicted in Fig. 1.3. The only single-gene analysis to clearly delimit the four proposed species was ITS2. 28S D2 was nearly identical for the four *Burkseus* species analyzed in this paper and not useful for species recognition. *Burkseus sigillatus* and *B. flavoviridis* differ by only a single base pair in D2, while 28S D3–5 was invariant for all four representatives of the *Burkseus*.

For one specimen of *B. flavoviridis* (D4741), only ITS2 amplified successfully. This specimen was placed in the correct morphological group in the ITS2-only (Fig. S1.2) and the combined morphological and molecular analyses (Fig. 1.3). The sole *B. sigillatus* specimen that had ITS2 amplified is consistently recovered as a separate species in the ITS2 and combined morphological and molecular analyses. The lack of ITS2 data in the other specimens was overcome with the combined use of morphological data, as the combination of molecular and morphological data allowed proper placement of

the two *B. sigillatus* specimens lacking ITS2 sequences (Fig. 1.3). The ITS2-only analysis (Fig. S1.2) consistently recovers the Nearctic specimens of *B. vittatus* nested among the Palearctic specimens. This demonstrates the value of ITS2 for discerning between both species and populations in closely related species of Eulophidae. Yao *et al.* (2010) have recommended ITS2 as the universal bar code marker rather than the COI barcode region, which seems a better option, at least for Eulophidae, since amplifying the barcoding region of COI proved less effective than ITS2.

Distribution

Only one *Burkseus* species is Holarctic in distribution, *B. vittatus*, while only one species, *B. robustus*, is found in both the Nearctic and Neotropic regions. The first record of *B. vittatus* in the Palearctic is from 1838 in England, and the earliest Nearctic record of the species, examined in this study, is the type of *Zagrammosoma nigrolineata*, from 1913 in California; however, this may just be an artifact of more collecting and sampling efforts in the Old World compared to the New World.

Burkseus vittatus has been considered an important native biological control agent in agriculture and horticulture, being recovered from crops such as alfalfa (Lotfalizadeh *et al.* 2015), apple (Eveleens and Evenhuis 1968), artichoke, citrus, carnations, and pear (examined material). This general host plant preference gives the species the ability to rapidly spread

around the world as global trade has increased. The distribution of *B. vittatus* in the Nearctic may actually be due to human migration and the spread of agricultural products. A label on one examined *B. vittatus* specimen (UCRC: UCRCENT471324) reads 'in mined leaf, Carnation, from Italy by plane [1950]' exemplifying this global mobilization. *Burkseus robustus* displays the largest New World distribution, being found from Canada to Chile. If the *B. vittatus* distribution is true, then there is little doubt that a closely related species may also have an equally expansive distribution. The sampling for this distribution analysis was extensive, due to the large number of pinned specimens examined in this study (worldwide 1,000+), and there is little doubt as to the validity of the species' distributions.

Biocontrol

A substantial number of *Burkseus flavoviridis* and *B. vittatus* were recovered in the Nearctic. Records for *B. sigillatus* and *B. robustus* are not as numerous, suggesting that these species are not as widely distributed, and may not have such a large and general host range as *B. flavoviridis* and *B. vittatus. Burkseus robustus* has only been recovered from native host plants and has not been found on Citrus Leaf Miner, a species from which both *B. vittatus* and *B. flavoviridis* have emerged. In a survey of native parasitoids of plant leaf miners in California, Gates *et al.* (2002) assessed their potential to add to the

parasitoid reserve prior to the expected introduction of Citrus Leaf Miner, *Phyllocnistis citrella* (Lepidoptera: Gracillariidae), in California. Interestingly, no *Burkseus vittatus* was reared from native California plants, only *B. flavoviridis* was recovered. As stated in their manuscript, 'all specimens from MWG/JMH rearings are deposited at UCRC'. The deposited specimens at UCRC reared for the survey conform to *B. flavoviridis*, however, 'many reared chalcidoid leafminer parasitoids were not preserved and are no longer retrievable' (Gates *et al.* 2002) making confirmation of the complete records in that study difficult. Although *B. vittatus* was not recovered in the Gates *et al.* (2002) survey, it has since been recovered as a native parasitoid of Citrus Leaf Miner.

Conclusions

Species delimitation was most easily accomplished in this study using ITS2, followed by COI. Whereas 28S has long been useful in higher-level phylogenies, it proves too conserved for accurate species delimitation between closely related species in the *vittatus* group. While COI may be useful for delimitation, within Cirrospilini, ITS2 may be a superior choice in that it not only delimits species that can be morphologically separated, but it also has a higher success rate for amplification than COI. The combination of ITS2 with a morphological matrix is sufficient to delimit species within Cirrospilini and may prove adequate for other eulophid genera.

The lack of ITS2 and/or COI in our molecular delimitation analysis

was overcome by combining with morphological data, as subtle differences in morphology previously deemed as variations, appear to be informative for species delimitation. Characters on the wing and mesosoma have proven the most helpful in delimitation. Historically, many eulophid species descriptions were based on color patterns of the body. However, color was not as helpful as structural characters for delimitation. Sympatric species, and specimens collected in the same collecting event may exhibit similar color patterns and emerge from the same hosts, but examination of subtle morphological characters reveals separate species.

To have an effective Integrated Pest Management program, it is imperative to know what natural enemies are present in a given system (Van Driesche and Bellows 1996, Gates *et al.* 2002). Confusion over the identification of one species over the other may also lead to an incorrect assessment of the native pool of parasitoids in a given system. It is the combination of various methods that can help to resolve these differences, and in this case, provides straightforward morphological features that can be used to accurately discriminate species.

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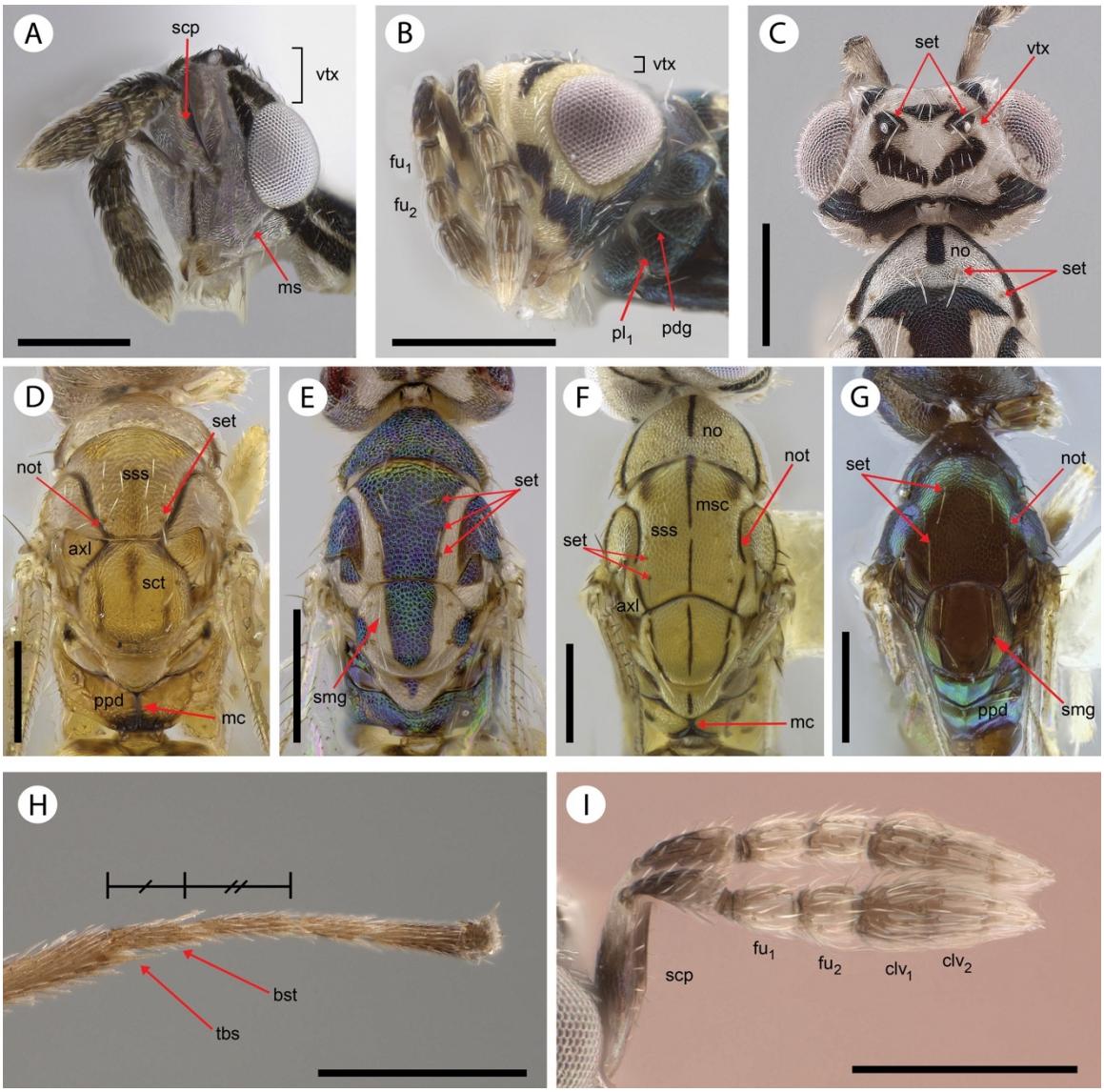

Fig. 1.1. Morphological characters. (A-C) head: (A) *Zagrammosoma mirum,* (B) *Burkseus flavoviridis*, (C) *Burkseus robustus*. (D-G) dorsal view of mesosoma: (D) *Cirrospilus* sp. D3867, E) *Cirrospilus* sp. D3865, (F) *Zagrammosoma americanum*, (G) *Diglyphus begini*. (H) *Burkseus robustus* hind leg. (I) *Burkseus flavoviridis* antennae. Scale bar in all photos = 0.2 mm. axl = axilla, bst = basitarsus, clv = clava, fu = funicular, mc = median carina, ms = malar sulcus, msc = mesoscutum, no = pronotum, not = notaulus, pdg = prodiscrimen groove, pl_1 = propleura, ppd = propodeum, scp = scape, sct = mesoscutellum, set = setae (bristle-like setae), smg = submedian groove, sss = small scattered setae, tbs = tibial spur, vtx = vertex.

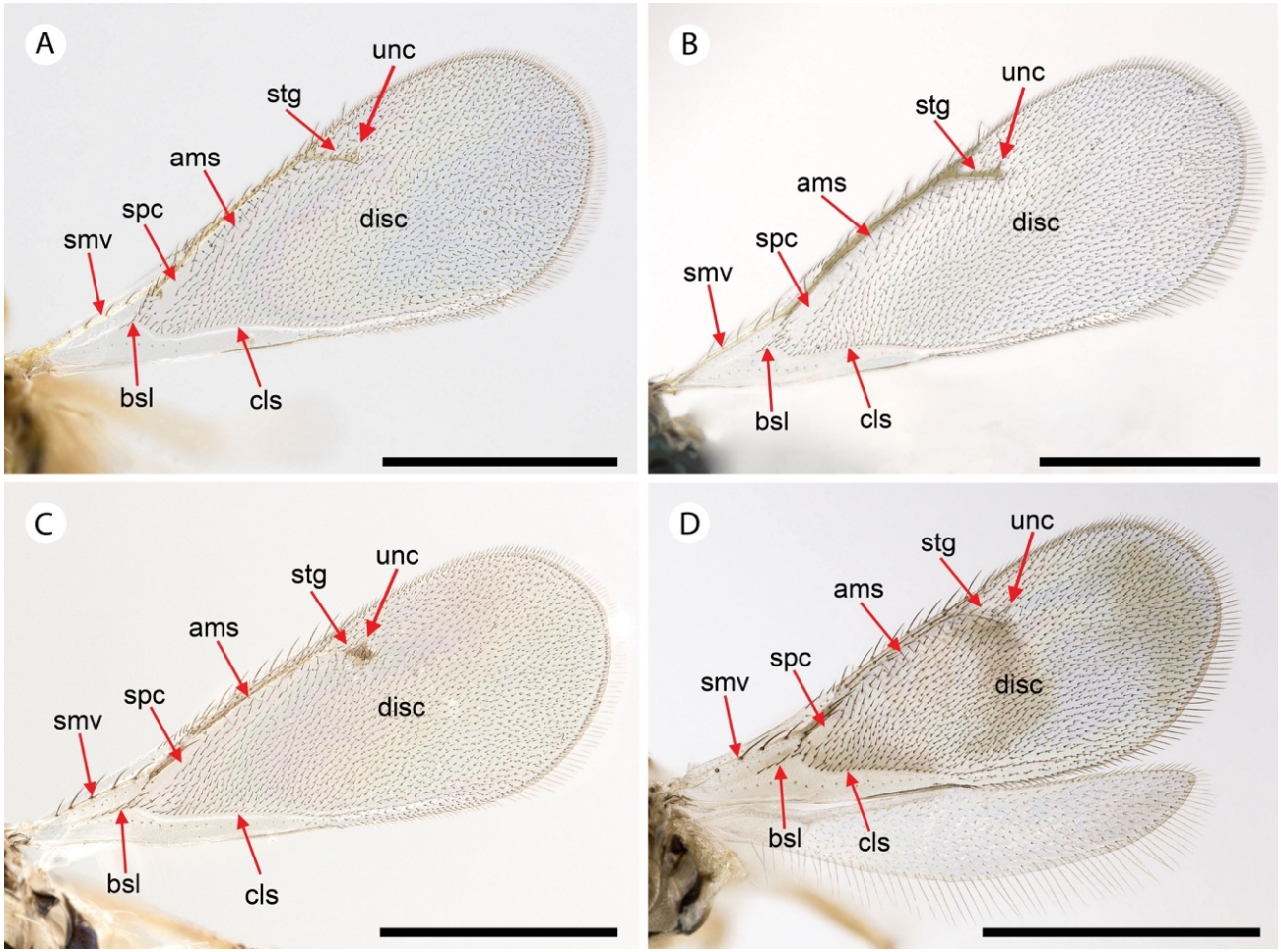

Fig. 1.2. Fore wings, dorsal view: A) *Burkseus vittatus* comb. n., B) *B. flavoviridis* comb. n., C) *B. robustus* **n. sp**., D) *B. sigillatus* **n. sp**. The photographs of *B. robustus* and *B. sigillatus* were taken after DNA extraction, displaying how the dark colors on the submarginal vein setae (*B. robustus* & *B. sigillatus*), stigmal vein and uncus (*B. robustus*), and banding patterns (*B. sigillatus*) are resilient enough to remain visible after extraction. Scale bar = 0.5 mm. ams = admarginal setae, bsl = basal setal line, csl = cubital setal line, disc = fore wing disc, spc = speculum, smv = submarginal vein, stg = stigmal vein, unc = uncus.

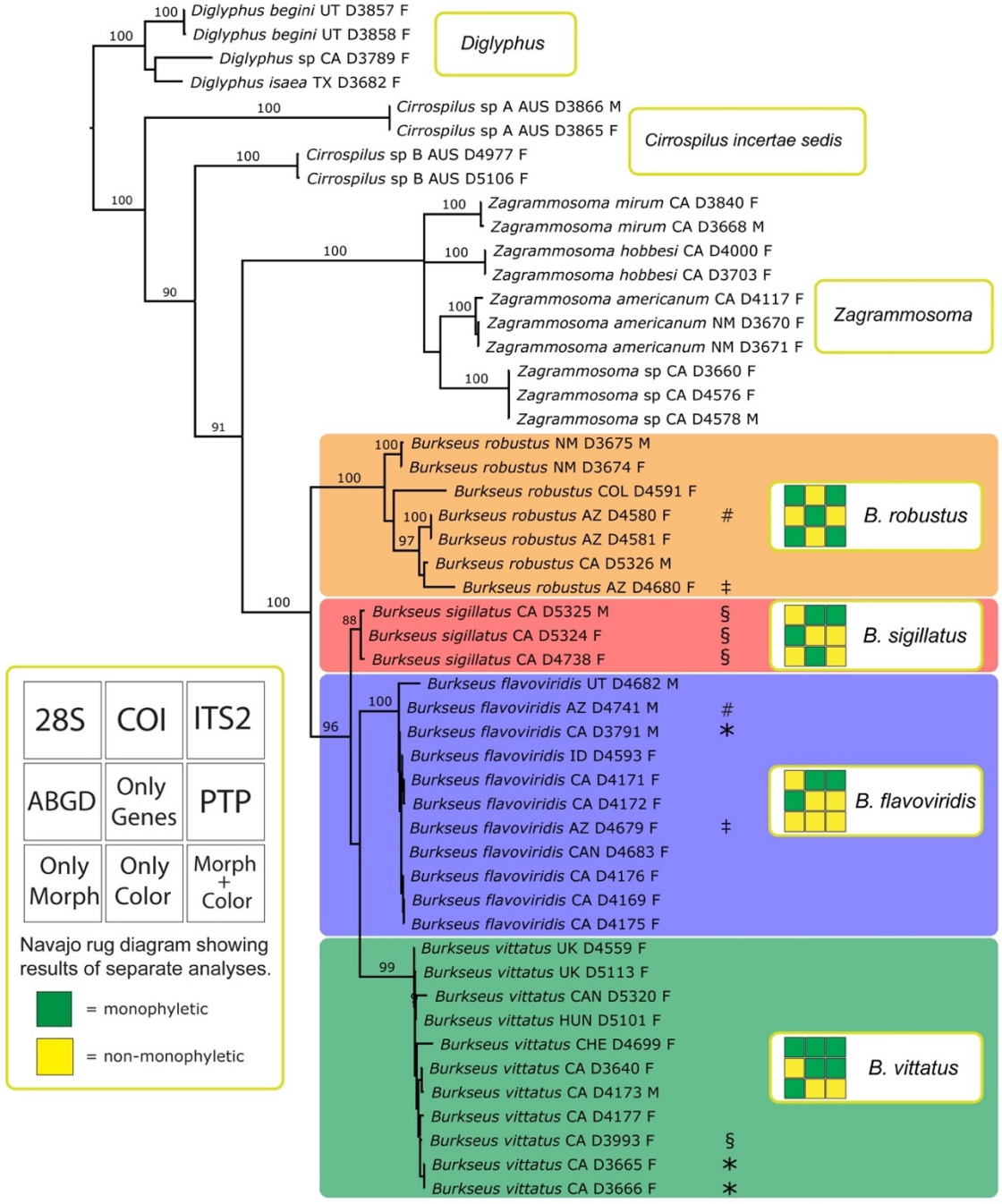

Fig. 1.3. Combined molecular and morphological maximum likelihood tree. The different symbols correspond with specimens collected at the same location. Each specimen of these groups was collected during the same collecting event, with the exception of D3665, D3666, and D3791, collected at the same location but two weeks apart.

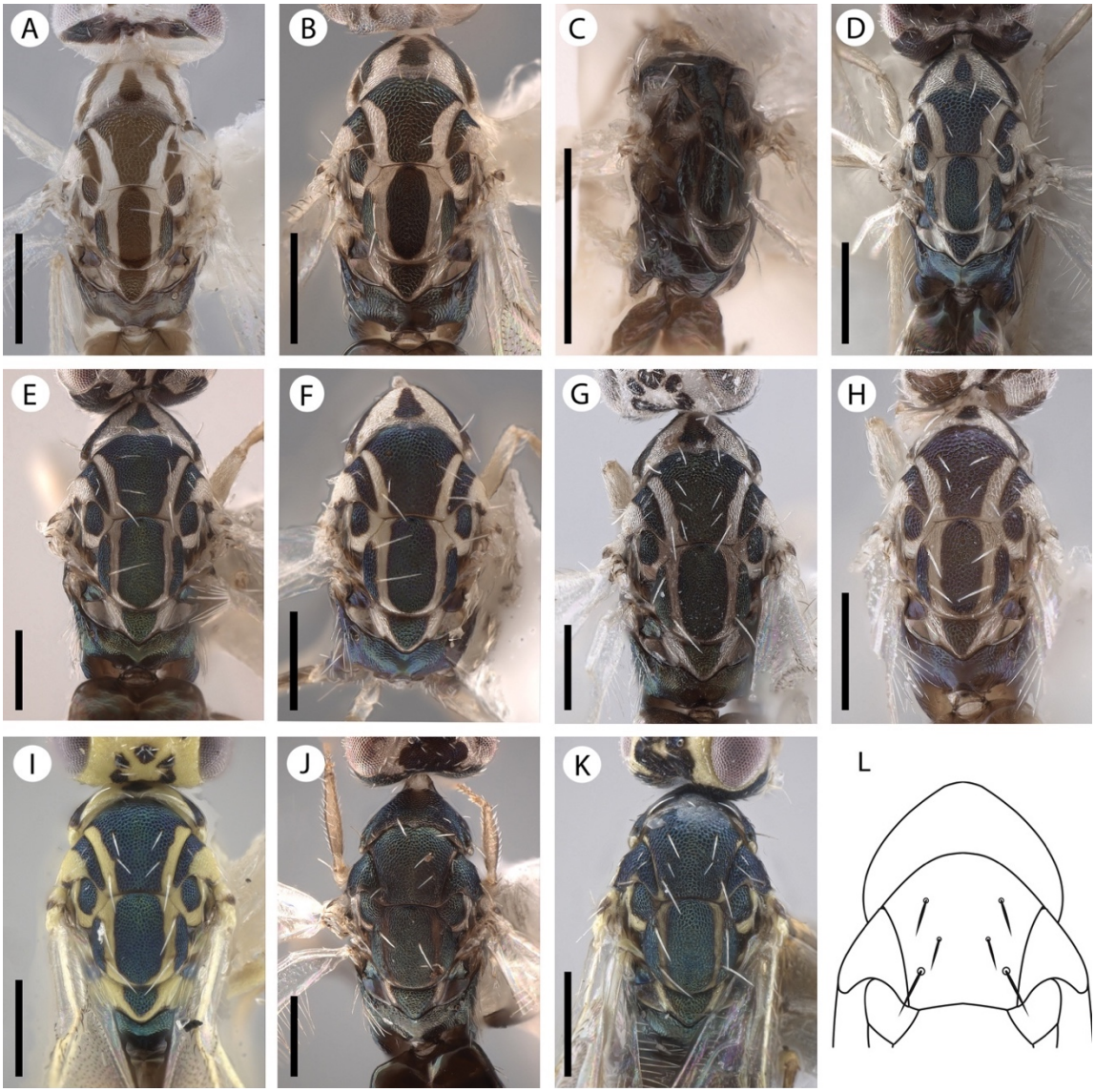

Fig. 1.4. Mesosomal color variation in *Burkseus flavoviridis*: A) D4682, B) D4741, C) D3791 (specimen collapsed while drying), D) D4593, E) D4171, F) D4172, G) D4679, H) D4683, I) D4176, J) D4169, K) D4175, L) illustrated view. Scale bar = 0.2mm.

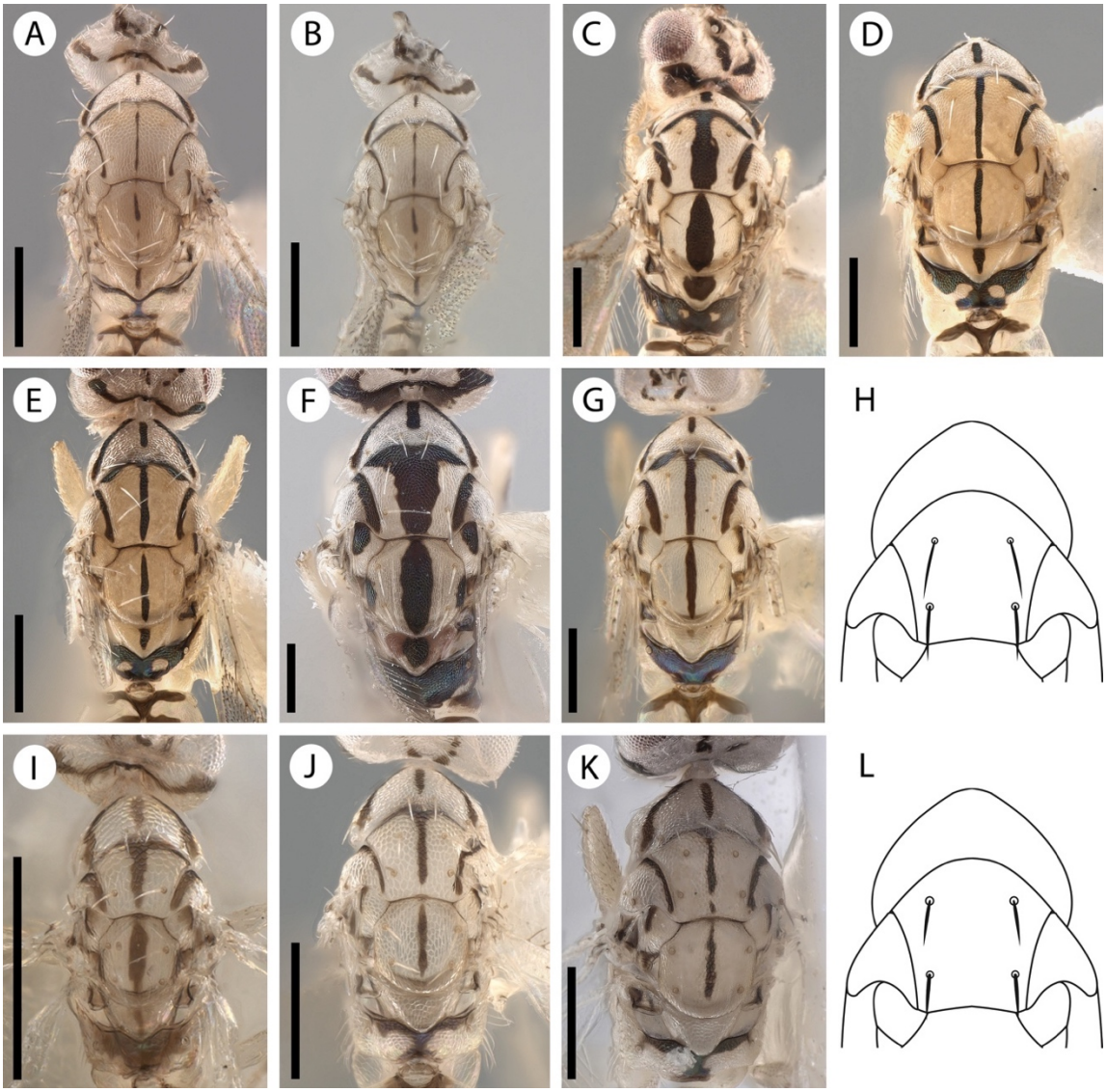

Fig. 1.5. Mesosomal color variation. A-H) *Burkseus robustus*: A) D3674, B) D3675, C) D4591, D) D4580, E) D4581, F) D4680, G) D5326, H) illustrated view. I-L) *B. sigillatus*: H) D5325, I) D5324, J) D4738, L) illustrated view. Scale bar = 0.2mm.

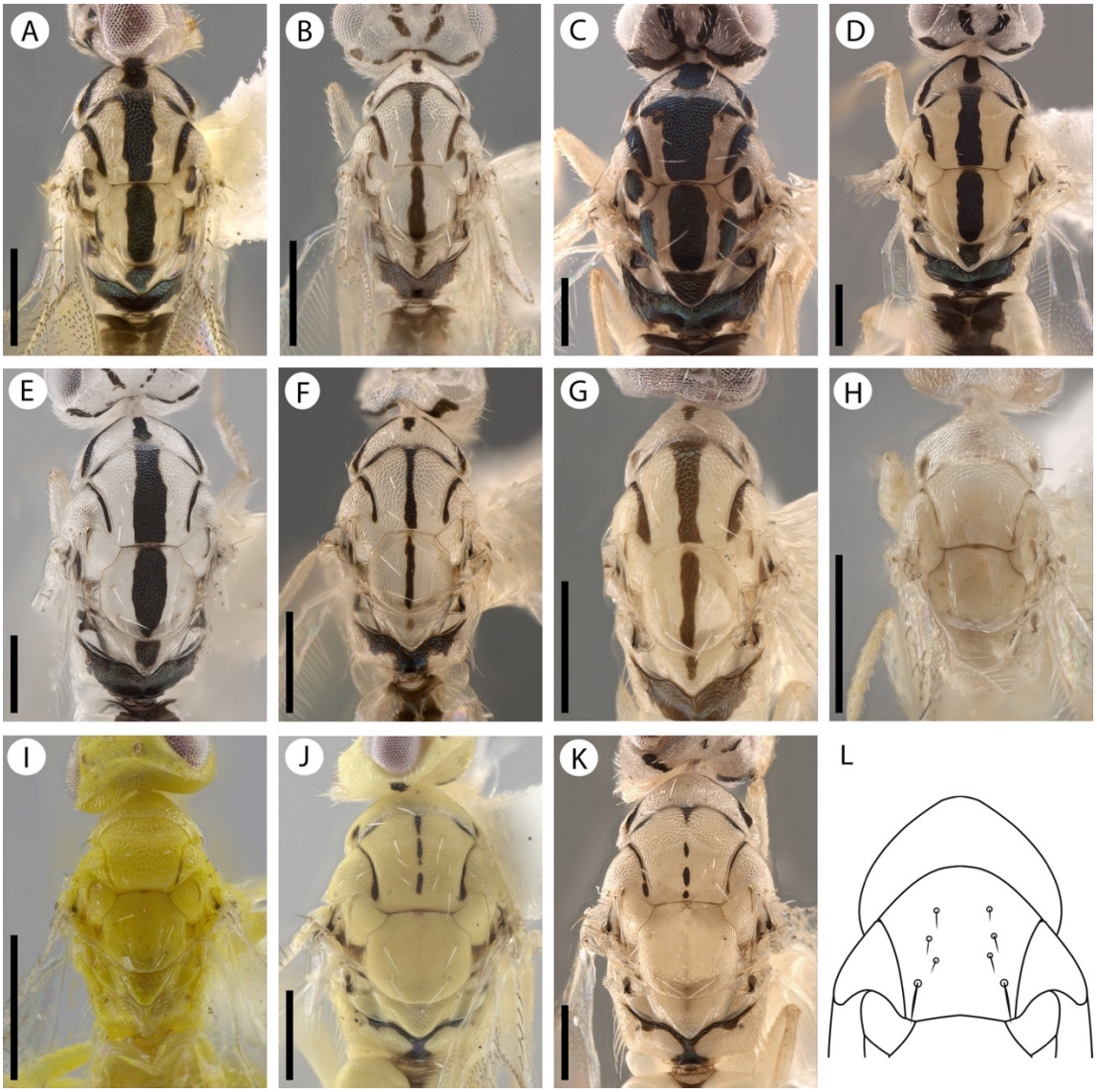

Fig. 1.6. Dorsal view of mesosomal color variation in *Burkseus vittatus*: A) D4559, B) D5320, C) D5113, D) D5101, E) D4699, F) D3640, G) D4173, H) D3665, I) D3666, J) D4177, K) D3993, L) illustrated view. Scale bar = 0.2mm.

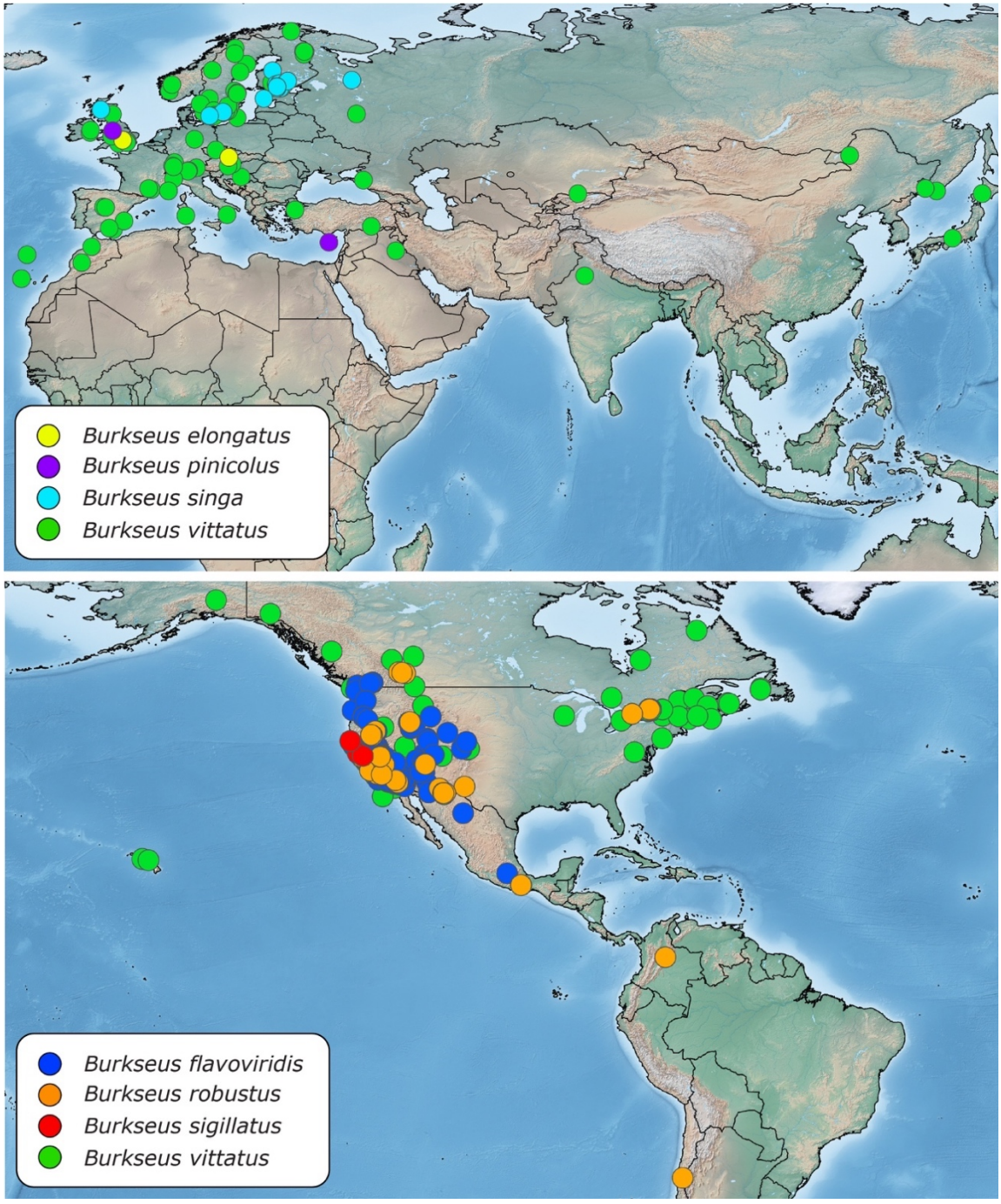

Fig. 1.7. Geographic distribution of *Burkseus*.

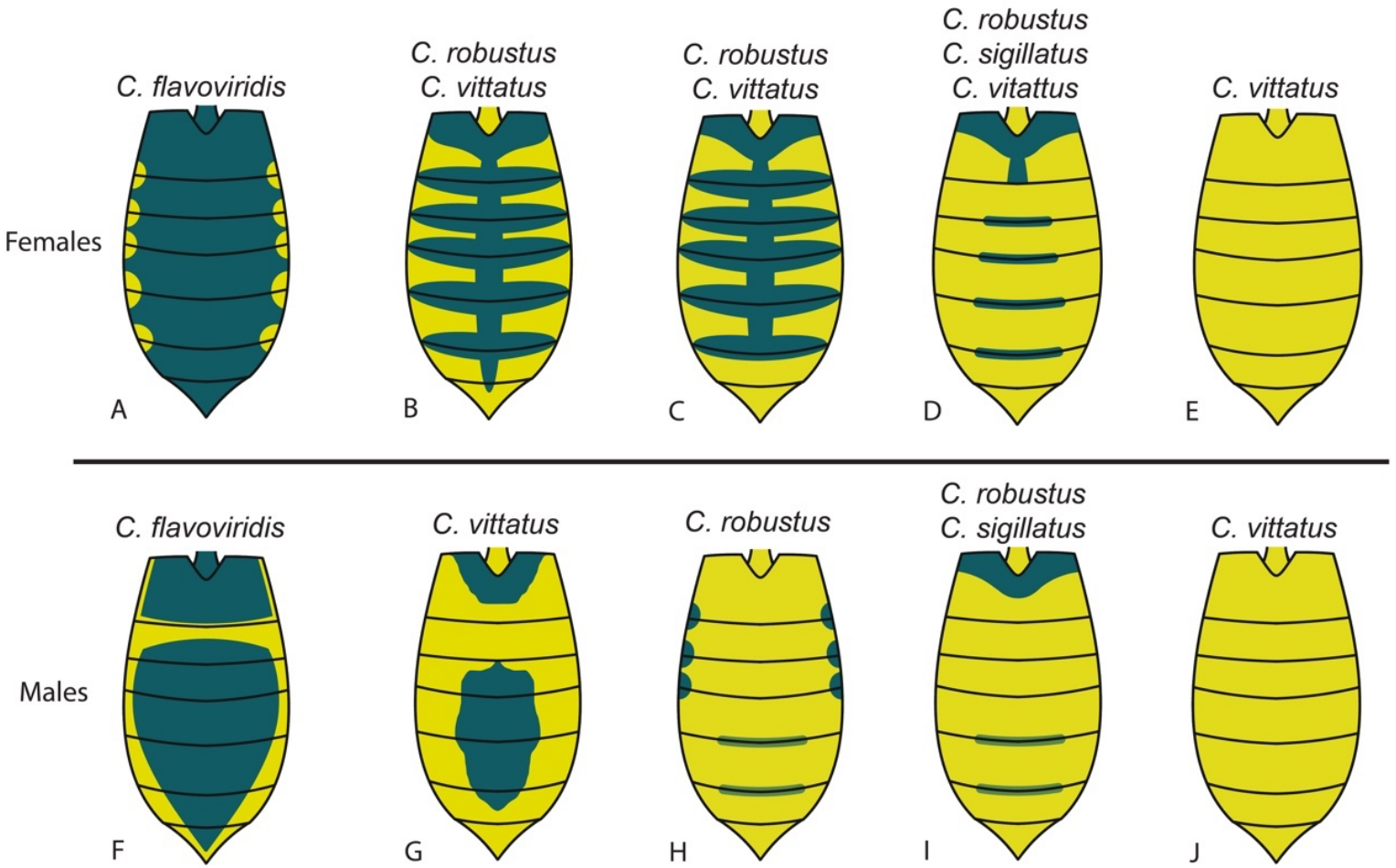

Fig. 1.8. Gaster color variation within females (A–E) and males (F–J) of the four Nearctic *Burkseus* species.

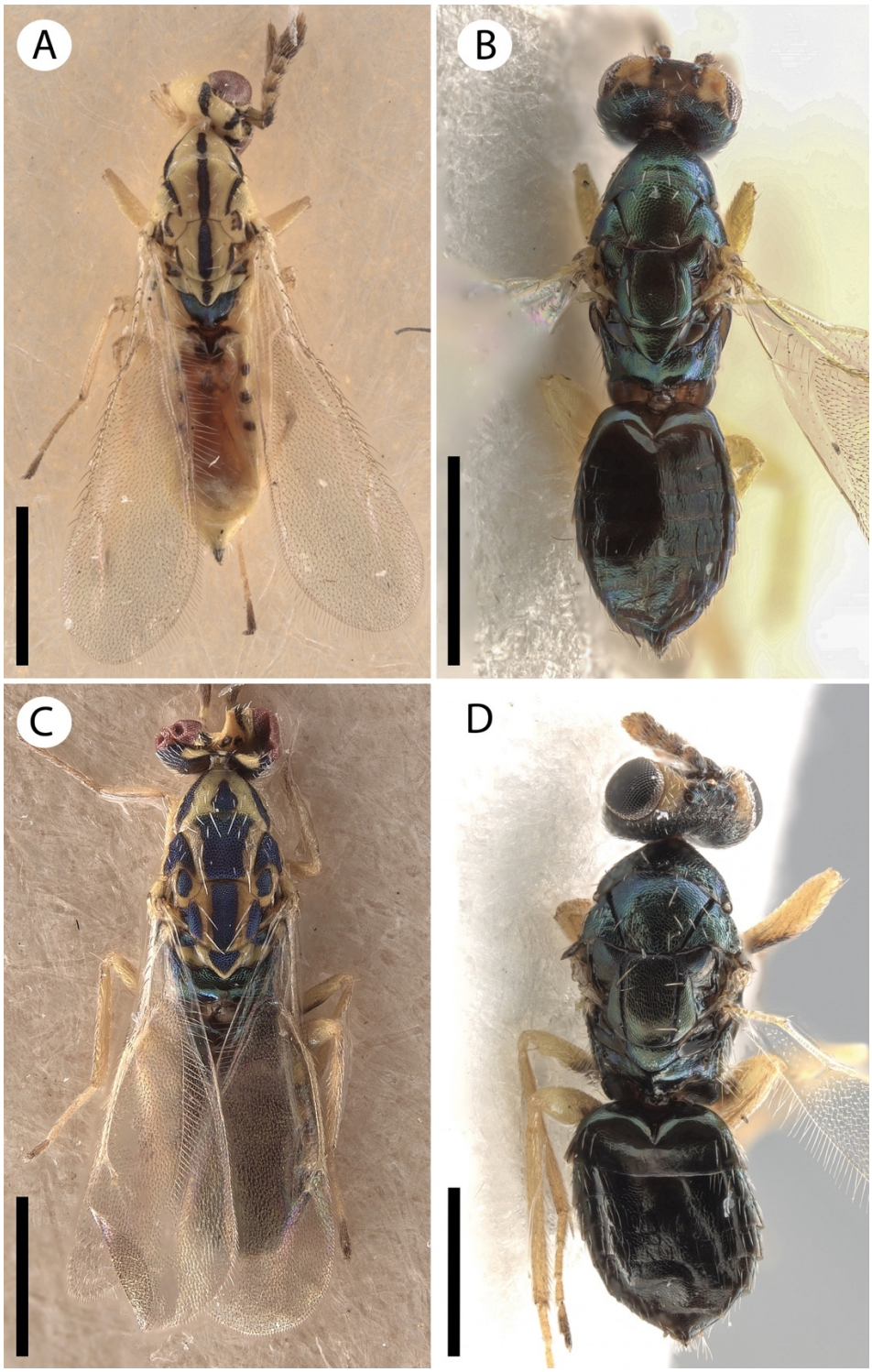

Fig. 1.9. Habitus: (A) *Burkseus elongatus* [BMNH: NHMUK 10371836], (B) *B. singa* [MZH: UCRCENT 513243], (C) *B. pinicolus* [BMNH: NHMUK 10371840], (D) *Cirrospilus curvineurus* [MZH: UCRCENT 513242].

Table 1.1. List of taxa used in molecular analyses, with GenBank accession numbers and deposition location.

Taxon	Locality	Voucher number	D#	Deposition	D2	D3-5	ITS2	COI
Burkseus flavoviridis	USA: AZ	CNC 508645	D4679	CNC	MH814407	MH814359	MH818329	MH825620
Burkseus flavoviridis	USA: AZ	UCRCENT 426807	D4741	TAMU	-	-	MH818330	-
Burkseus flavoviridis	USA: CA	UCRCENT 410529	D3791	UCRC	MH814408	MH814360	MH818331	MH825621
Burkseus flavoviridis	USA: CA	UCRCENT 237313	D4169	UCRC	MH814409	MH814361	MH818332	-
Burkseus flavoviridis	USA: CA	UCRCENT 491705	D4171	UCRC	MH814410	MH814362	MH818333	MH825622
Burkseus flavoviridis	USA: CA	UCRCENT 491706	D4172	UCRC	MH814411	MH814363	MH818334	-
Burkseus flavoviridis	USA: CA	UCRCENT 491707	D4175	UCRC	MH814418	MH814370	MH818335	-
Burkseus flavoviridis	USA: CA	UCRCENT 491708	D4176	UCRC	MH814412	MH814364	MH818336	MH825623
Burkseus flavoviridis	Canada	CNC 508648	D4683	CNC	MH814413	MH814365	-	-
Burkseus flavoviridis	USA: ID	UCRCENT 416558	D4593	UCRC	-	-	MH818337	MH825624
Burkseus flavoviridis	USA: UT	CNC 508647	D4682	UCRC	MH814414	MH814366	-	-
Burkseus robustus	USA: AZ	UCRCENT 426798	D4580	TAMU	MH814430	MH814382	MH818338	MH825625
Burkseus robustus	USA: AZ	UCRCENT 426804	D4581	TAMU	MH814431	MH814383	MH818339	-
Burkseus robustus	USA: AZ	CNC 508646	D4680	CNC	MH814432	MH814384	MH818340	MH825626
Burkseus robustus	USA: CA	UCRCENT 485699	D5326	UCRC	MH814433	MH814385	-	-
Burkseus robustus	Colombia	UCRCENT 426806	D4591	TAMU	MH814434	MH814386	MH818341	-
Burkseus robustus	USA: NM	UCRCENT 357532	D3674	UCRC	MH814435	MH814387	MH818342	MH825627
Burkseus robustus	USA: NM	UCRCENT 357533	D3675	UCRC	MH814436	MH814388	MH818343	-
Burkseus sigillatus	USA: CA	UCRCENT 478935	D4738	UCRC	MH814415	MH814367	MH818344	MH825628
Burkseus sigillatus	USA: CA	UCRCENT 485697	D5324	UCRC	MH814416	MH814368	-	-
Burkseus sigillatus	USA: CA	UCRCENT 485698	D5325	UCRC	MH814417	MH814369	-	-

Burkseus vittatus	USA: CA	UCRCENT 355648	D3640	UCRC	MH814419	MH814371	MH818348	MH825629
Burkseus vittatus	USA: CA	UCRCENT 357523	D3665	UCRC	MH814420	MH814372	MH818349	-
Burkseus vittatus	USA: CA	UCRCENT 357524	D3666	UCRC	MH814421	MH814373	-	-
Burkseus vittatus	USA: CA	UCRCENT 414587	D3993	UCRC	MH814422	MH814374	MH818350	MH825630
Burkseus vittatus	USA: CA	UCRCENT 275023	D4173	UCRC	MH814423	MH814375	MH818351	-
Burkseus vittatus	USA: CA	UCRCENT 275099	D4177	UCRC	MH814424	MH814376	MH818352	MH825631
Burkseus vittatus	Canada	CNC 508574	D5320	CNC	MH814425	MH814377	-	-
Burkseus vittatus	Switzerland	CNC 508649	D4699	CNC	MH814426	MH814378	MH818353	MH825632
Burkseus vittatus	Hungary	NHMUK 10734422	D5101	BMNH	MH814427	MH814379	MH818354	-
Burkseus vittatus	United Kingdom	UCRCENT 416918	D4559	UCRC	MH814428	MH814380	MH818355	-
Burkseus vittatus	United Kingdom	NHMUK 10734424	D5113	BMNH	MH814429	MH814381	MH818356	-
Cirrospilus cinctithorax	USA: CA	UCRCENT 414586	D3879	UCRC	MK388821	MK388835	-	MK388831
Cirrospilus margiscutellum	Australia	UCRCENT 426766	D4662	TAMU	MK388822	MK388836	-	-
Cirrospilus sp.	Argentina	UCRCENT 395935	D3751	UCRC	MK388823	MK388837	-	-
Cirrospilus sp.	Australia	UCRCENT 414583	D3867	UCRC	MK388824	MK388838	-	-
Cirrospilus sp.	Australia	UCRCENT 312386	D4154	UCRC	MK388825	MK388839	MK388828	MK388832
Cirrospilus sp.	Australia	CNC 508556	D5100	CNC	MK388826	MK388840	MK388829	MK388833
Cirrospilus sp.	United Kingdom	NHMUK 10734436	D5965	BMNH	MK388827	MK388841	MK388830	MK388834
Cirrospilus sp. A	Australia	UCRCENT 414581	D3865	UCRC	MH814453	MH814405	-	-
Cirrospilus sp. A	Australia	UCRCENT 414582	D3866	UCRC	MH814454	MH814406	MH818345	-
Cirrospilus sp. B	Australia	CNC 509134	D4977	CNC	MH814441	MH814393	MH818346	MH825639
Cirrospilus sp. B	Australia	CNC 508561	D5106	CNC	MH814442	MH814394	MH818347	-
Diglyphus begini	USA: UT	UCRCENT 414573	D3857	UCRC	MH814437	MH814389	MH818357	-

Diglyphus begini	USA: UT	UCRCENT 414574	D3858	UCRC	MH814438	MH814390	MH818358	-
Diglyphus isaea	USA: TX	UCRCENT 357540	D3682	UCRC	MH814439	MH814391	MH818359	MH825640
Diglyphus sp.	USA: CA	UCRCENT 410527	D3789	UCRC	MH814440	MH814392	MH818360	MH825641
Zagrammosoma americanum	USA: CA	UCRCENT 312379	D4117	UCRC	MH814443	MH814395	-	MH825633
Zagrammosoma americanum	USA: NM	UCRCENT 357528	D3670	UCRC	MH814444	MH814396	MH818361	MH825634
Zagrammosoma americanum	USA: NM	UCRCENT 357529	D3671	UCRC	MH814445	MH814397	MH818362	MH825635
Zagrammosoma hobbesi	USA: CA	UCRCENT 395931	D3703	UCRC	MH814446	MH814398	MH818363	MH825636
Zagrammosoma hobbesi	USA: CA	UCRCENT 414594	D4000	UCRC	MH814447	MH814399	MH818364	MH825637
Zagrammosoma sp.	USA: CA	UCRCENT 357518	D3660	UCRC	MH814450	MH814402	MH818365	-
Zagrammosoma sp.	USA: CA	UCRCENT 312427	D4576	UCRC	MH814451	MH814403	MH818366	-
Zagrammosoma sp.	USA: CA	UCRCENT 312429	D4578	UCRC	MH814452	MH814404	MH818367	-
Zagrammosoma mirum	USA: CA	UCRCENT 357526	D3668	UCRC	MH814448	MH814400	MH818368	-
Zagrammosoma mirum	USA: CA	UCRCENT 410536	D3840	UCRC	MH814449	MH814401	MH818369	MH825638

Table 2. List of all described *Burkseus* species.

Species	Distribution
Burkseus elongatus (Bouček), 1959	Palearctic
Burkseus flavoviridis (Crawford), 1913	Nearctic
Burkseus pinicolus (Askew), 1984	Palearctic
Burkseus robustus Perry, 2019 n. sp.	Nearctic, Neotropic
Burkseus sigillatus Perry, 2019 n. sp.	Nearctic
Burkseus singa (Walker), 1838	Palearctic
Burkseus vittatus (Walker), 1838	Nearctic, Palearctic

Chapter 2

Read between the lineata: A revision of the tattooed wasps, *Zagrammosoma* Ashmead (Hymenoptera: Eulophidae), with descriptions of nine new species

Abstract: The genus *Zagrammosoma* Ashmead (Hymenoptera: Eulophidae) is revised. Twenty-four species are recognized, of which 21 have been molecularly verified in a phylogenetic context using 28S, ITS2, and COI. *Zagrammosoma* is recovered as monophyletic, worldwide in distribution, and morphologically distinct from *Cirrospilus* Westwood. The following species is elevated from synonymy: *Zagrammosoma interlineatum* Girault **stat. rev.** The following synonymies are proposed: *Zagrammosoma mirum* Girault under *Zagrammosoma flavolineatum* Crawford **n. syn.**, *Zagrammosoma dulanense* Cao & Zhu under *Zagrammosoma talitzkii* Bouček **n. syn.** The following species are described as new: *Zagrammosoma calvini* **n. sp.** (Argentina, Chile)*, Zagrammosoma deliae* **n. sp.** (Peru), *Zagrammosoma galapagoense* **n. sp.** (Ecuador: Galapagos Islands)*, Zagrammosoma headricki* **n. sp.** (Nearctic)*, Zagrammosoma metallicum* **n. sp.** (Nearctic), *Zagrammosoma occidentale* **n. sp***.* (Nearctic, Neotropical)*, Zagrammosoma trifurcatum* **n. sp.** (Nearctic, Neotropical)*, Zagrammosoma villosum* **n. sp.** (Nearctic, Neotropical)*, Zagrammosoma yanegai* **n. sp.** (Thailand). The following new combination is proposed: *Cirrospilus variegatus* (Masi) **n. comb**, from *Zagrammosoma***.** Descriptions, distribution maps, a summary of host associations, and key to all species are provided.

Keywords: Chalcidoidea, Eulophidae, morphology, phylogenetic, leaf miner

Introduction

With its spectacular body and wing color patterns, *Zagrammosoma* Ashmead, 1904, is one of the most visually striking genera within Eulophidae (Hymenoptera: Chalcidoidea). Species are found worldwide, with the greatest concentration in the Nearctic. *Zagrammosoma* are niche-specific, primary external parasitoids of leaf-rolling and leaf-mining Lepidoptera, leaf-mining Diptera (Bouček, 1988; LaSalle, 1989; Ubaidillah *et al.*, 2000; examined material), and sometimes leaf-mining Coleoptera (Peck, 1951; Turnbow & Franklin, 1981) and Hymenoptera (Nystrom & Evans, 1989; Digweed, 1998). As species attack leaf miners on a wide variety of agricultural and ornamental crops, the genus includes a number of potential biological control candidates.

Zagrammosoma was proposed by Ashmead (1904) as a replacement for *Hippocephalus* Ashmead, 1888, a junior primary homonym of *Hippocephalus* Swainson, a genus of fish. Gordh (1978) produced a revision of Nearctic *Zagrammosoma*, describing two new species and redescribing five species. He synonymized *Z. sanguineum* Girault under *Z. nigrolineatum* Crawford, however, these are now both considered as junior synonyms (Perry & Heraty, submitted) of *Burkseus vittatus* (Walker, 1838). Gordh (1978) provides a key to seven Nearctic species, and Cao *et al.* (2014) a key to Asian species, however no worldwide key to *Zagrammosoma* has been produced.

Zagrammosoma had been previously regarded as a subgenus of *Cirrospilus* (Bouček, 1959; Kerrich, 1969), but more recently as a separate genus

(Gordh, 1978; Bouček, 1988; Yefremova, 1996). A few morphological characters are shared between species in each genus, such as a vaulted vertex and similar body and wing patterns, and the biology of both genera is extremely similar, complicating efforts to accurately delimit the genera. Recent morphological (Ubaidillah *et al.*, 2003) and molecular (Gauthier *et al.,* 2000; Burks, *et al.,* 2011; Heraty *et al.*, 2013) analyses have utilized species of *Zagrammosoma*, however, these analyses used few specimens, and were not sufficient enough to assess both species limits and their relationships. Species of *Zagrammosoma* have been challenging to delimit due to diverse host relationships, worldwide distributions, and conserved and varying color patterns of the body and wings between species, necessitating molecular analyses to accurately describe species. This study uses molecular and morphological data to establish *Zagrammosoma* as monophyletic, distinct from *Cirrospilus*, and properly define species limits in the genus.

Material and methods

Specimen examination

A total of 1415 *Zagrammosoma* specimens were examined and used for this study. A summary of localities is provided for each species; locality information not directly from material examined is indicated by a reference. Museum abbreviations used in this paper are defined below; curators assisting with loans are noted in parentheses:

ANIC The Australian National Insect Collection, Canberra, Australia (N. Fisher & J. Rodriguez)

BMNH The Natural History Museum, London, England (J. Noyes & N. Dale-Skey)

CASC California Academy of Sciences, San Francisco, CA, USA (C. Grinter & N. Penny)

CNC Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON, Canada (G. Gibson, J. Huber, S. Cardinal)

EMEC Essig Museum Entomology Collection, University of California, Berkeley, CA, USA (R. Zuparko)

FSCA Florida State Collection of Arthropods, Gainesville, FL, USA (K. Williams)

MBBP Museum Zoologicum Bogoriense, Bogor, Indonesia

MLPA Museo de la Plata, Universidad Nacional de La Plata, La Plata, Argentina (D. Aquino & M. Cecilia)

NMPC National Museum Natural History, Prague, Czech Republic

QM Queensland Museum, Brisbane, Queensland, Australia (S. Wright)

SANC South Africa National Collection of Insects, Pretoria, South Africa (W. Strumpher)

TAMU Texas A&M University, College Station, TX, USA (J. Woolley)

UCDC Bohart Museum of Entomology, University of California, Davis, CA, USA (S. Heydon)

UCRC Entomology Research Museum, University of California, Riverside Riverside, CA, USA (S. Triapitsyn & D. Yanega)

USNM United States National Museum of Natural History, Washington, DC, USA (M. Gates)

Photographs of pinned specimens were taken using a Leica Z16 APO automontage microscope and Leica DFC 450C 5-megapixel camera system, using

Leica Application Suite v4.4, to create stacked images. Measurements were taken using a micrometer on a Leica M205C microscope with a Leica PLANAPO 0.63X lens attached.

Specimen localities are visualized using SIMPLEMAPPR (Shorthouse, 2010). The map for the species of *Zagrammosoma* in the Galapagos Islands was created using Google Earth to provide a higher resolution display of the distributions across the archipelago. All locality and host information were recorded in a Filemaker Pro version 17 database maintained at UC Riverside. All specimens received a plastic barcode and identification number, and voucher number (Dxxxx) if applicable. For material examined, coordinates in italics were estimated using Google Earth. Data within brackets indicate, in order: sex (a "?" indicates a specimen that is missing the metasoma and sex determination is not possible), deposition location: specimen identification number. When a single identification number indicates multiple specimens, more than one wasp was mounted on one pin. The locality information for one specimen each of *Zagrammosoma latilineatum* Ubaidillah, and *Zagrammsoma trifurcatum* Perry **n**. **sp**. are from citizen science websites as they provide new locality data that warrant mentioning; there is no ambiguity regarding the identification, as the photos are clear and display the distinguishing characters of the species.

Molecular methods

76 specimens were used in the molecular analysis. Sixty-three *Zagrammosoma* specimens were used as the ingroup. Four specimens each of *Burkseus* Perry,

Cirrospilus Westwood, and *Diglyphus* Walker were used as outgroup taxa. Two 28S D2 sequences produced by Gauthier *et al.* (2000) were downloaded from GenBank: *Zagrammosoma buselus* Walker (AJ274447) and *Zagrammosoma crowei* (Kerrich) (AJ274448). Primary voucher specimens (non-destructively sequenced) were given unique specimen identification numbers (Dxxxx) and deposited at UCRC, or their respective home institutions. All voucher specimens are listed in Table 2.1.

The genes used in this study are two nuclear ribosomal gene regions (28S D2 & D3–5), an internal transcribed spacer (ITS2), and mitochondrial cytochrome oxidase (COI). All modified primers and their references are listed in Table 2.2. 28S has been used to test phylogenetic hypotheses of chalcids (Gauthier *et al.*, 2000; Gumovsky, 2001; Burks *et al.*, 2011; Munro *et al.*, 2011; Heraty *et al.*, 2013), and ITS2 is useful for species delimitation (Porter & Collins, 1991; Campbell *et al.*, 1993; Collins & Paskewitz, 1996; Stouthamer *et al.,* 1999; Ercan *et al.*, 2011; Perry & Heraty, 2019). The barcoding region of COI has proven difficult to successfully amplify in cirrospilines (Perry and Heraty, 2019), therefore, a non-barcoding region of COI, NJ-MD (Simon *et al.,* 1994; Dowton & Austin, 1997), was used. Extraction, sequencing, amplification, and chromatogram verification methods follow those of Perry and Heraty (2019). Gene regions were concatenated using SEQUENCEMATRIX v1.7.8 (Vaidya *et al.*, 2011).

Maximum likelihood (ML) analyses were performed using RAXML v8.2.9 (Stamatakis, 2014) online via the CIPRES portal (Miller *et al.*, 2010), using a

GTRCAT substitution model. The 28S D2 and D3–5 regions were treated as one partition, while COI was partitioned as COI codon positions 1 and 2, and COI codon position 3. The resulting phylogenetic trees was visualized using FIGTREE v1.4.3 (Rambaut, 2014). *Diglyphus* was set as the root.

Morphological methods

Morphological terminology and abbreviations follow Gibson *et al.* (1997), except for the intermediate setae (**ims**)**,** prodiscriminal groove (**pdg**) (Fig. 2.1B), and the six bands of color found on the wings, which are designated for this study (see below).

Species of *Zagrammosoma* have traditionally been described based on color patterns of the body and wings alone, however, the patterns on the body can vary within species, a trait found in closely related species of *Cirrospilus* and *Burkseus* (Perry & Heraty, 2019). Authors have noted this issue before (Gordh, 1978; Ubaidillah *et al.,* 2000) and therefore non-color morphological characters are necessary for species delimitation in these genera. Several morphological characters requiring measurements are defined here.

1. The first **(fu_1)** and second funicular **(fu_2)** (Fig. 2.1I) can be: wider than long (w:l >1.05), subequal (w:l = 0.95–1.05), or longer than wide (w:l < 0.95).
2. The pronotum (**no_1**) (Fig. 2.1F) can be twice as wide as long (w:l > 2.0), “bell-shaped” (1.05 < w:l < 2.0), subequal (w:l = 0.95–1.05), or longer than wide (w:l < 0.95); measurements taken medially from the anterior to

posterior margins and transversely at the widest two points on the lateral margins.

3. The mesoscutellum (**sct**) (Fig. 2.1D) wider than long (w:l >1.05), subequal (w:l = 0.95–1.05), or longer than wide (w:l < 0.95); measurements taken medially from anterior to posterior margins and transversely at the widest two points on the lateral margins.
4. The hind basitarsus **(bst)** (Fig. 2.1C) can be longer than the second tarsomere (bst:2^{nd} > 1.05), subequal (bst:2^{nd} 0.95–1.05), or shorter than the second tarsomere (bst:2^{nd} < 0.95); measurements taken from the midpoint at the base and apex of each tarsomere.

Bristle-like setae (**set**) refer to enlarged, paired setae that are noticeably larger and longer than nearby setae on the mesosoma (Fig. 2.1 E, G). These setae also have large, well-defined setal sockets, which are generally darker in color than the surrounding cuticle except in those species that have a dark body. These sockets are similar in size and color to the setal sockets on the mesoscutellum. There are also small, unpaired setae **(sss)** on the mesoscutum (Fig. 2.1F) that are not considered as homologous to the bristle-like setae. An intermediate form of setae **(ims)** is found on the mesoscutum of some species (Fig. 2.1E), which are smaller and thinner than the bristle-like setae but larger than the scattered setae. This intermediate form also possesses visible setal sockets, which are smaller and less distinct to those found with the bristle-like setae.

Metallic coloration is defined, in this study, as black with an iridescent luster, present anywhere on the wasp. Spots, stripes, or bands refer to dark brown or black, non-metallic coloration, unless otherwise noted as yellow. The varying dark fore wing patterns of the species necessitate standardization; therefore, the patterns are divided into six bands (Fig. 2.1H), defined for this study as:

1. Basal band (along basal setal line) - **bb**.
2. Cubital band (along cubital line of setae) - **ctb**.
3. Parastigmal band (transverse darkening from junction of parastigmal and marginal veins) - **psb**.
4. Stigmal band (transverse darkening of stigmal vein and uncus) - **stb**.
5. Postmarginal band (transverse banding posterior of postmarginal vein) - **pmb.**
6. Apical band (along apical margin) - **apb**.

The extent of the parastigmal, stigmal, and postmarginal bands is defined by their relation to the apex of the stigmal vein. If a line parallel to the marginal vein and intersecting with the apex of the stigmal vein is drawn/visualized/imagined, the bands can extend below, to, or past the apex. Additionally, the basal, parastigmal, stigmal, and postmarginal bands can be “connected” to each other by darkened patterns (Fig. 2.1H).

To determine if the dark patterns of species of *Zagrammosoma* darken over time after eclosion, which may account for within-species variation of the patterns, time-lapse photographs were taken of a specimen of *Z. americanum* Girault

emerging from its pupal case using a Canon: 7D DSLR camera, 100mm f/2.8 macro lens, and MT-24EX macro twin ring lite flash; photos were automatically taken every 60 seconds. The specimen, recovered from Citrus Leaf Miner, *Phyllocnistis citrella* Stainton, was placed between two microscope cavity slides facing one another, creating an enclosed chamber simulating a leaf mine environment, while allowing a clear view for photography.

Results

Molecular

Zagrammosoma is recovered as a monophyletic group, sister to *Cirrospilus,* in the maximum likelihood analysis (Fig. 2.2). Twenty-one out of 24 species were recovered, indicated by the varying lines of color on the tree (not all species were sequenced due a lack of fresh, or properly preserved material). Sixteen specimens only had ITS2 successfully amplified (Table 2.1), demonstrating the value of this gene region for both species and generic delimitation. While the majority of species are found in the Nearctic, no Nearctic or New World clade is recovered; Old World species are recovered as sister to Australasian and Neotropical species. The backbone of the tree is poorly supported, making biogeographical assessments difficult as no region is recovered as monophyletic, however, support is high for the monophyly of the genus.

Time-lapse photography

The dark patterns on the head and body are fully developed before or at the time of emergence, and do not darken over time (Fig. 2.3). Furthermore, the vaulted vertex is completely formed in the pupal case prior to eclosion and does not inflate or extend to provide extra assistance for emergence, as is found in Diptera utilizing the ptilinum to open the puparium. The time-lapse reveals a total time of emergence of approximately 25 minutes, however this is based on only one specimen.

Taxonomy

Zagrammosoma Ashmead

Hippocephalus Ashmead, 1888: 7. Type species: *Hippocephalus multilineatus* Ashmead; by monotypy.

Zagrammosoma Ashmead, 1904: 354. Replacement name for *Hippocephalus* Ashmead, preoccupied by *Hippocephalus* Swainson, 1839, later recognized as a junior synonym of *Percis* Scopoli, 1777 (Scorpaeniformes: Agonidae).

Zagrammatosoma Schulz, 1906: 142. Unjustified emendation. Corrected by Bouček, 1959: 172.

Mirzagrammosoma Girault, 1915: 279. Type species *Mirzagrammosoma lineaticeps* Girault; by monotypy. Synonymy by LaSalle, 1989: 232.

Diagnosis

Zagrammosoma is characterized by a combination of three characters: a vaulted vertex that extends above the compound eyes (Fig. 2.1A), notaulus curving to meet the axilla and never reaching or approaching the posterior margin of the mesoscutum (Fig. 2.1F), and median carina on the propodeum present (Fig. 2.1F). Species that are mostly yellow in color generally have dark lines between sclerites, especially along the notaulus, axilla, mesoscutellum, and prepectus.

Within Cirrospilini, *Zagrammosoma* is most similar, in terms of morphology and color patterns, to *Cirrospilus* and *Burkseus*; however, these other genera both possess a notaulus that is complete and extends to the posterior margin of the mesoscutum (Fig. 2.1D, G). *Burkseus* also lacks a median carina on the propodeum (Fig. 2.1G). A few species of *Cirrospilus* possess a vaulted vertex, however, the notauli extend to the posterior margin of the mesoscutum. *Pseudiglyphus* Girault and *Cirrospilus ambiguus* Hansson & LaSalle both have a notaulus that curves to meet the axilla, but they lack a vaulted vertex.

Description

Body length: female 0.75–2.9 mm; male 0.63–1.62 mm. Overall body coloration variable: mainly yellow heads and bodies, with varying degrees of dark lines and bands present, or mainly dark heads and bodies, with yellow markings either on the head or dorsal side of mesosoma. Metallic body coloration absent, except for *Zagrammosoma metallicum* **n. sp**. Lower face (**lof**) with dark, median stripe absent

(Figs 2.8A, 2.22A) or present (Fig. 2.2.1A). Occiput yellow with dark, vertical stripes or bands present or absent. Pronotum and mesoscutum dorsally variable: completely yellow (Fig. 2.2.42D, E), completely dark (Fig. 2.2.20D), with interrupted median line (Fig. 2.2.1E, F), or with uninterrupted median line (Figs 2.10D, 2.12D, 2.22D). Fore wing with or without dark patterns on wing disc. Dark coloration at junctions between parastigmal vein and marginal vein, and between marginal vein and postmarginal vein always present. Hind wing hyaline, rarely with infuscation along apical margin. Procoxa, mesocoxa, and metacoxa color variable: all yellow, basally dark, or completely dark. Profemur yellow. Mesofemur usually all yellow, rarely dark basally. Metafemur coloration variable: all yellow (Fig. 2.35B), yellow with uninterrupted dark stripe on dorsal margin curving posterolaterally on outside of femur (Fig. 2.17B), yellow with interrupted dark stripe - resulting in a “spot” on outside of femur (Fig 4B, 29B), with a wide dark band encircling femur (Fig. 2.15B), or completely dark (Fig. 2.27B). Metasoma color variable: all yellow, yellow with varying lateral and longitudinal dark stripes or bands, or all dark brown or black.

Head: malar sulcus (**ms**) present (Fig. 2.1A). Tentorial pits indistinct and not enlarged. Upper ocular sulcus (**uos**) variable: present (Figs 2.4A, 2.6A) or absent (Fig. 2.45A). Vertex (**vtx**) vaulted, forming angular apex of head, creating distinct demarcation of frons and occiput. Anterior ocellus positioned on occiput adjacent to apex of vertex (Fig. 2.?); posterior ocelli positioned lower on occiput (Fig. 2.?)

(in dried specimens, the vertex will sometimes collapse, making the anterior ocellus appear at the vertex, or on frons). Vertex with scattered, short setae present (Fig. 2.1A); paired large setae absent. Occipital carina absent.

Antenna: dorsal margin of torulus above lower margin of compound eye (Fig. 2.?). Scape (**scp**) and pedicel (**pdl**) setose; scape not extending to vertex; pedicel length variable, longer than wide or subequal. Pedicel lacking carinae. Funiculars with linear sensilla (**ls**) (Fig. 2.?). Two funiculars (**fu**), always cylindrical, with variable width to length ratio. Clava (**clv**) longer than wide, consisting of three clavomeres (Fig. 2.1I).

Body: pronotum (**no$_1$**) shape variable. Pronotal collar carina absent; bristle-like seta laterally. Propleura separated posteriorly, exposing a visible prodiscriminal groove (Fig. 2.1I). Midlobe of mesoscutum (**msc**) sculpturing evenly reticulate (Fig. 2.1F) or linearly reticulate (Fig. 2.45D–F); one pair of bristle-like setae present posterolaterally, originating posteriorly to anterior margin of axilla (Fig. 2.1E). Lateral lobe of mesoscutum with one bristle-like seta and small, scattered setae (Fig. 2.1F). Notaulus (**not**) complete and curved to meet anterior margin of axilla (**axl**). Axilla advanced, more than 75% of longitudinal length, beyond posterior margin of mesoscutum (Fig. 2.1F). Mesoscutellum (**sct**) with two pairs of bristle-like setae; posterior pair longer than anterior; additional, unpaired bristle rarely found between anterior and posterior bristles (Fig. 2.6D); submedian grooves (**smg**) absent (Fig. 2.6D, E) or present. Dorsellum not enlarged. Median carina

(**mc**) on propodeum (**ppd**) present, sometimes faint, and posteriorly expanded; plicae and costula absent. Propodeal spiracle (**spr**) rim complete and exposed (Fig. 2.1D or F). Paraspiracular sulcus and carina absent. Gaster sessile.

Legs: Profemur and mesofemur with preapical bristle on anterior surface present. Metafemur with preapical bristle on anterior surface absent. Hind tibial spur (**tbs**) shorter than or equal to basitarsus (**bst**) in length (Fig. 2.1C). Hind basitarsus length variable: shorter than second tarsomere, subequal, or longer than second tarsomere.

Fore wing: Submarginal vein smoothly joining parastigmal; 3–9 setae dorsally. Costal cell setose. Admarginal setae (**ams**) present in one (Fig. 2.1H), or, rarely, two rows. Uncus (**unc**) position variable: originating on stigma by less than, more than, or its own length from stigmal apex (Fig. 2.1H). Postmarginal vein present. Basal fold setose, sometimes with only one or two setae. Cubital fold setose, with setal line complete to basal vein or absent anteriorly.

Remarks

There is no single morphological character that defines *Zagrammosoma* as distinct from *Cirrospilus*, as characters are shared between the two genera. This is best exemplified by *Cirrospilus coachellae* Gates and *C. variegatus* (Masi) **n. comb.**, both possessing a vaulted vertex and varying dark color patterns on the body and

wings. However, the notaulus in these species extends to the posterior margin of the mesoscutum, a character not found in *Zagrammosoma*.

While many species of *Zagrammosoma* have little or no variation of body color patterns, there are a number of species that exhibit considerable intraspecific variation in mesosoma and metasoma color patterns. These variations are usually differences in shading of the patterns, either lighter or darker, however, patterns may be completely absent in individuals of a species that generally have a fixed, visible pattern. Wing patterns appear to be highly conserved within species and can be used as primary diagnostic characters when confirming the identity of a species.

A general color pattern of the metafemur was observed during this study. In species that possess a metasoma that is mainly yellow and with or without dark markings on the dorsal side, a dark stripe occurs on the dorsal margin of the metafemur that curves posterolaterally towards the ventral margin on the outside of the yellow femur. Species that possess a dark metasoma have a metafemur that is completely dark, or with a wide, dark band (Figs 2.6B, 2.15B, 2.18B, 2.20B, 2.27B, 2.31B).

Hosts

Zagrammosoma parasitizes leaf miners and leaf rollers in Diptera, Coleoptera, Hymenoptera, and Lepidoptera (Table 2.3). Gordh (1978) states that *Zagrammosoma* has been recovered as a hyperparasite of hymenopteran leaf-

miner parasitoids, however he was referring to *Z. nigrolineatum*, as the hyperparasitic species, a synonym of *Burkseus vittatus* (Perry & Heraty, submitted). Nystrom & Evans (1989) and Digweed (1998) record *Z. multilineatum* and *Z.* sp., respectively, emerging from hymenopteran Birch leafminers (Tenthredinidae). While it is difficult to determine the actual species recovered without direct examination of the specimens, it is accurate to record *Zagrammosoma* as a parasitoid of hymenopteran leaf miners.

There are several host records of *Z. americanum* emerging from Hemiptera (Table 2.3), but more evidence is needed to prove this concretely. If this is true, these individuals may be acting as hyperparasitoids, as *Zagrammosoma* has not previously been recorded parasitizing non-holometabolous insects. This could also be *Zagrammosoma* emerging in bulk samples of hemipterans, which may have contained concealed or unnoticed leaf miners in the collected plant material.

Zagrammosoma is recovered in a large number of agricultural crops, including alfalfa, apple, citrus, coffee, cotton, corn, jojoba, muscadine, potato, and tomato, as well as plants grown for ornamental and timber purposes, including aspen, oak, poplar, pine, and willow. See Table 2.3 for full list of host and host plants by species based on the material examined and publications with species of *Zagrammosoma* that are not easily misidentified.

Distribution

The majority of *Zagrammosoma* is found in the Nearctic, with only a few species found in each of the remaining ecozones: Afrotropical (1), Australasian (1), Indo-Malay (2), Nearctic (15), Neotropical (9), Oceania (1), and Palearctic (1) (number of species in each ecozone noted in parentheses). Five of the nine species found in the Neotropical region (*Z. lineaticeps, Z. multilineatum, Z. occidentale, Z. trifurcatum, Z. villosum*) are also found in the Nearctic, while *Z. flavolineatum* is found in both Oceania (Hawaii) and the Nearctic. Coupled with the results from the ML analysis (Fig. 2.2), this may suggest origins of *Zagrammosoma* in the Nearctic with independent lineage dispersals, either natural or anthropogenic, into the rest of the world.

Etymology

The original designation for the genus, *Hippocephalus,* means “horse head” and accurately describes the shape of the head in lateral view. Ashmead (1904) did not specify why he named *Zagrammosoma* as he did, but it translates from Greek to mean “body with a lot of writing.” This is as appropriate a name as could be given to describe a group of “tattooed wasps,” which is the official common name for *Zagrammosoma*, approved by the Entomological Society of America, April 2019. As *Zagrammosoma* is neuter, adjectival species names must also be neuter in gender.

Key to species

1. Notaulus absent, present anteriorly, or complete and extending medially to anterior margin of mesoscutellum (Fig. 2.1D, G); if notaulus extends to advanced axilla, vertex not vaulted (Fig. 2.1B) ..... most Cirrospilini

– Notaulus complete and curving laterally to meet advanced axilla (Fig. 2.1E, F) and vertex vaulted (Fig. 2.1A, I) ..... *Zagrammosoma*, 2

2. Female metasoma completely dark brown or black with no patterns (Figs 2.6D, 2.15D, 2.18D); male metasoma all dark or if yellow and black, then mesoscutellum either black with yellow center band (Fig. 2.15E) or yellow with two black stripes converging posteriorly and with wide, black center band (Fig. 2.41E)..... 3

– Female and male metasoma completely yellow or yellow with varying dark color patterns and mesoscutellum not as above (Figs 2.4, 2.8, 2.10, 2.29, 2.35, 2.39) 9

3. Metallic luster present on body (Fig. 2.31). *Zagrammosoma metallicum* **n. sp.**

– Metallic luster absent on body 4

4. Hind wing with infuscation on apical margin (Fig. 2.27E); fore wing with basal, cubital, parastigmal, stigmal, postmarginal, darkened and connected; apical band darkened (Fig. 2.27C) ..... *Zagrammosoma lineaticeps*

– Hind wing hyaline (Figs 2.4B, 2.25B); fore wing pattern different than above ... (Figs 2.6C, 2.18C, 2.20C) 5

5. Mesoscutellum all yellow (Fig. 2.6D, E); Galapagos Islands .....
..... *Zagrammosoma buselus*

– Mesoscutellum all or mostly black (Figs 2.18D, E, 2.20D, E), black laterally (Fig. 2.15D, E) or yellow with black bands (Fig. 2.41E) 6

6. Procoxa and mesocoxa yellow (Fig. 2.15B)..... 7

– Procoxa and mesocoxa dark (Figs 2.18B, 2.20B) 8

7. Hind basitarsus shorter than 2nd tarsomere; mesoscutellum black with yellow center band; male metasoma with 50% of dorsal side darkened (Fig. 2.15E)
.....*Zagrammosoma flavolineatum*

– Hind basitarsus longer than 2nd tarsomere; mesoscutellum black with yellow lateral margin; male metasoma with median band from Gt_2–Gt_6 (Fig. 2.41E)
..... *Zagrammosoma trifurcatum* **n. sp.**

8. Hind basitarsus longer than 2nd tarsomere; occiput black with median yellow stripe (Fig. 2.20D); propodeum all black (Fig. 2.20D, E)..... *Zagrammosoma hobbesi*

– Hind basitarsus subequal in length with 2nd tarsomere; occiput all black, or with 5 stripes radiating from occipital foramen (Fig. 2.18D); propodeum dark with yellow markings laterally (Fig. 2.18D, E) ..... *Zagrammosoma headricki* **n. sp.**

9. Funiculars asymmetrical; linear-reticulate sculpturing on mesoscutum and mesoscutellum (Fig. 2.45E) .....*Zagrammosoma yanegai* **n. sp.**

– Funiculars symmetrical (Fig. 2.1I); evenly reticulate sculpturing on mesoscutum and mesoscutellum (Fig. 2.1E, F) 10

10. Mesosoma with one wide, dark band extending from pronotum through mesoscutellum (Figs 2.10D, 2.22D, 2.33D) 11

– Body pattern not as above - wide band absent (Fig. 2.42D), or with single or multiple thinner stripes (Figs 2.4D, 2.8D, 2.22D) 13

11. Metasoma with wide dark band continuing along entire dorsum in female (Fig. 2.10D), brief interruption at base of metasoma in males (Fig. 2.10E); fore wing disc with wide dark band running parallel to anterior margin; postmarginal band complete across entire width of fore wing (Fig. 2.10C) .... *Zagrammosoma centrolineatum*

– Metasoma with dark lateral stripes in females (Figs 2.25D, 2.37D) and dark spots dorsally in males (Figs 2.25E, 2.37E); fore wing disc hyaline, postmarginal band absent (Figs 2.25C, 2.37C) 12

12. Fore wing with darkening on apical margin (Fig. 2.37C); propodeum mostly yellow, with dark areas medially and laterally (Fig. 2.37D, E); Neotropical ..... *Zagrammosoma seini*

– Fore wing with no darkening on apical margin (Fig. 2.25C); propodeum black, with small yellow patches laterally (Fig. 2.25D, E); Australasia and Indo-Malay .....*Zagrammosoma latilineatum*

13. Mesoscutum and mesoscutellum completely yellow with no longitudinal dark stripes (Fig. 2.42D, E) ..... *Zagrammosoma velerii*

– Mesoscutum with medial longitudinal stripe present, interrupted or uninterrupted; mesoscutellum with dark stripes or bands (Figs 2.8D, 2.33D, 2.35D) 14

14. Head, pronotum, mesoscutum, and metasoma heavily setose (Figs 2.8, 2.43) 15

– Setae density not as above (Figs 2.4, 2.12, 2.22, 2.25, 2.29, 2.35, 2.39) 16

15. Occiput with three dark stripes, sometimes faint (Fig. 2.8A); mesosoma with three darks stripes in lateral view (Fig. 2.8); South American... *Z. calvini* **n. sp.**

– Occiput with two dark stripes; mesosoma with two dark stripes in lateral view (Fig. 2.43D, E); North American ..... *Zagrammosoma villosum* **n. sp.**

16. Lower face with transverse stripe present (Fig. 2.12A); female metasoma with no median stripe connecting transverse stripes (Fig. 2.12D); male metasoma with one transverse, interrupted stripe (Fig. 2.12E); Afrotropic ..... *Zagrammosoma crowei*

– Lower face with transverse stripe absent (Figs 2.4A, 2.22A, 2.35A, 2.39A); metasoma with median stripe connecting transverse stripes (Figs 2.14D, 2.22D, 2.39D); male as female, or with multiple, interrupted transverse stripes (Figs 2.22E, 2.24E, 2.29F); Nearctic, Neotropical, or Palearctic 17

17. Prepectus and metacoxa completely yellow (Fig 2.35B, 2.39B) 18

– Prepectus yellow with dark dorsal margin (Figs 2.17B, 2.29B); metacoxa yellow, dark basally 19

18. Hind basitarsus shorter than second tarsomere; parastigmal band present (Fig. 2.35C); Nearctic ..... *Zagrammosoma occidentale* **n. sp.**
– Hind basitarsus longer than second tarsomere; parastigmal band absent (Fig. 2.39C); Palearctic..... *Zagrammosoma talitzkii*
19. Fore wing with broad medial patch (Fig. 2.24C); female metasoma with solid dark area dorsomedially (Fig. 2.24D)..... *Zagrammosoma intermedium*
– Fore wing without broad medial patch (Figs 2.17C, 2.29C, 2.33C); female metasoma pattern not as above - yellow or yellow with median and transverse stripes (Figs 2.4D, 2.17D, 2.22D, 2.33D) 20
20. Pronotum, in dorsal view, subequal (w:l = 0.95–1.05); basal fold asetose or with one or two setae dorsally (Fig. 2.29C) ..... *Zagrammosoma melinum*
– Pronotum, in dorsal view, bell shaped (1.05 < w:l < 2.0); basal fold setose with more than two setae dorsally (Figs 2.4C, 2.17C, 2.33C) 21
21. Anterior margin of mesoscutum with dark, transverse stripe extending towards notaulus (sometimes hidden under posterior margin of pronotum) (Figs 2.4D, 2.17D) 22
– Anterior margin of mesoscutum with dark, transverse stripe absent or not extending towards notaulus (Figs 2.14D, 2.22D) 24
22. Anterior margin of mesoscutum with dark, transverse stripe reaching notaulus (sometimes hidden under posterior margin of pronotum); second funicular longer than wide..... *Zagrammosoma multilineatum*

– Anterior margin of mesoscutum with dark, transverse stripe not reaching notaulus (Figs 2.4D, 2.17D); second funicular wider than long 23

23. Posterior margin of mesoscutum with dark, transverse stripe present (Fig. 2.17D, E); mesoscutellum with submedian grooves absent; Neotropical .... *Zagrammosoma galapagoense* **n. sp.**

– Posterior margin of mesoscutum with dark, transverse stripe absent (Fig. 2.4D, E); mesoscutellum with submedian grooves present, sometimes faint; Nearctic ..... *Zagrammosoma americanum*

24. Second funicular subequal in width: length; parastigmal band extending well past apex of stigmal vein, curving posteriorly and almost connecting with stigmal band (Fig. 2.14C); Neotropical ..... *Zagrammosoma deliae* **n. sp.**

– Second funicular longer than wide; parastigmal band extending just past apex of stigmal vein, not closely approaching stigmal band (Fig. 2.22C); Nearctic ..... *Zagrammosoma interlineatum* **stat. rev.**

1. *Zagrammosoma americanum* Girault

Fig. 2.4.

Zagrammosoma americana Girault, 1916a: 126. Holotype ♀ [examined]. Locality: USA, Colorado, Boulder. Depository: USNM type no. 19642.

Zagrammosoma americanum Girault. Justified emendation by Peck, 1951: 459.

Diagnosis: The most distinguishing character for this species is the transverse, dark stripe across the anterior margin of the mesoscutum that extends from both ends towards, but not reaching the notaulus (Fig. 2.4D, E). This character is also found in *Z. galapagoense,* however, the wing patterns are different between the species (Figs 2.4C versus 2.17C). *Zagrammosoma occidentale* has similar color patterns on the body but the mesoscutum lacks the transverse stripe along the anterior margin.

Description: Female - body length 1.11–1.98 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent or present. Vertex with 2 stripes above compound eye. Gena posteriorly with one or two dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum and mesoscutum with median stripe, either interrupted or complete; laterally with 2 black stripes. Prepectus yellow with dorsal margin dark. Mesoscutellum yellow with three dark stripes. Propodeum yellow with black: median carina, anterior margin, lateral spot. Procoxa and mesocoxa yellow.

Metacoxa yellow, sometimes with dark spot basally. Profemur and mesofemur yellow. Metafemur with interrupted or uninterrupted stripe dorsally. Fore wing: basal band lacking; cubital band present; parastigmal and stigmal bands present, with perpendicular extension greater than length of stigmal vein; postmarginal band present, with perpendicular extension extending across 75% or more of fore wing width; apical margin hyaline; connection from stigmal band to postmarginal band absent or present. Hind wing hyaline. Metasoma completely yellow or yellow with a dark median band and transverse stripes or bands.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.58–0.86); second longer than wide to wider than long (w:l = 0.7–1.24).

Pronotum, in dorsal view, bell-shaped, wider than long (w:l = 1.5–1.93); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; scattered setae and intermediate setae present. Mesoscutellum wider than long (w:l = 1.13–1.33); submedian grooves present, sometimes faint. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere or subequal (bst:2^{nd} = 1.0–1.14).

Fore wing l:w = 2.25–2.45. Submarginal vein with 5–6 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.78–1.22 mm; mesoscutum with intermediate setae present or absent; cubital band absent or present; parastigmal

band present, with perpendicular extension less than or greater than that of stigmal apex; postmarginal band present, with perpendicular extension greater than that of stigmal apex, but not across 75% or more of fore wing width.

Remarks: This is a commonly collected species from the western part of North America (Fig. 2.5). The infuscation of the cubital line of setae is faint and may be difficult to observe. The postmarginal band width is occasionally thinner than the band shown in Fig. 2.4C but is always present. Gordh (1978) mentions *Z. americanum* being recovered from *Asphondylia* (Diptera) galls, however the only specimens examined that were recovered from this host are *Z. occidentale*.

Hosts: Recovered from lepidopteran leaf miners and leaf rollers. Several specimens were recovered from hemipteran hosts, but these records require substantiation. See Table 2.3. **Hemiptera**: Aphididae, Psyllidae. **Lepidoptera**: Coleophoridae, Elachistidae, Gelechiidae, Gracillariidae, Lyonetiidae.

Distribution: Nearctic: Canada (AB, SK), Mexico (CO, GR, EM, OA), USA (CA, CO, ID, NM, DV, TX, UT, WA) (Fig. 2.5).

Material Examined: Holotype: USA: Colorado: Boulder Co., Boulder, 1760m, *40°00'56"N, 105°17'55"W*, xii.1913, Cockerell, host plant: *Sarcobatus* [1♀, USNM: USNM type no. 19642].

Additional material examined: CANADA: Alberta: Banff, *51°10'41"N*, *115°34'4"W*, 13.viii.1949, J.H. McLeod, host: *Recurvaria milleri* [1♀, CNC: CNC508856]. **Saskatchewan:** Big River, 488m, *53°49'48"N*, *107°02'0"W*, 26.iii.1968, 67-82, host: *Phyllonorycter* sp. [1♀, CNC: CNC508559]. **MEXICO: Coahuila:** Parras, 1514m, *25°26'50"N*, *102°10'15"W*, 28.viii.1985, D. Gonzales [2♂ 6♀, UCRC: UCRCENT499025–32]. **Estado de Mexico:** Coatepec-Harinas, 2267m, *18°55'28"N*, *99°46'5"W*, 10.x.1997, M. Hoddle, avocado, beat [1♂, UCRC: UCRCENT491739]. **Guerrero:** Taxco, *18°33'17"N*, *99°36'21"W*, host: *Leucoptera coffeella* [1♂ 3♀, USNM: UCRCENT471602–471605]. **Oaxaca:** 1.1 mi. W. El Tule, 1645m, *17°02'58"N*, *96°36'12"W*, 17.vii.1987, J.B. Woolley & G. Zolnerowich, 87/048 [1♂, TAMU: UCRCENT473167 (**D5909**)]. 5.0 Km NW Jct. 135/195, 1783m, *17°19'8"N*, *96°55'39"W*, 20.vii.1987, J. Heraty, Oak-Acacia woodland [1♀, UCRC: UCRCENT499035]. **USA: Arizona: Cochise Co.**, 4 mi. NW SWRS, *31°54'31"N*, *109°15'4"W*, 13.xi.1960, M.A. Cazier [1♀, USNM: UCRCENT471606]. 4 mi. NW SWRS, *31°54'31"N*, *109°15'4"W*, 8.xii.1960, M.A. Cazier, host: coleophorid leaf miner, host plant: *Ceanothus integerrimus* [1♀, USNM: UCRCENT471607]. **California: Contra Costa Co.**, Lafayette, 94m, *37°53'5"N*, *122°07'0"W*, 11.ix.1964, A.P. Gutierrez, host: *Cacopsylla pyricola* [1♀, EMEC: EMEC84299]. Redwood Reg. Park, 185m, *37°48'39"N*, *122°08'42"W*, 15.ii.1981, J.B. Whitfield [1♀, UCRC: UCRCENT491732]. **Inyo Co.**, China Lake Naval WC, Coso Mtns., Silver Peak Springs Westside, 1998m, *36°08'54"N*, *117°43'6"W*, 27.vii.1999, M.

Gates [1♀, UCRC: UCRCENT061994]. Olancha, *36°16'57"N*, *118°00'21"W*, 16.ix.1995, J. Heraty [1♀, UCRC: UCRCENT491738]. **Los Angeles Co.**, Elizabeth Canyon Rd., 10006m, *34°39'47"N*, *118°23'14"W*, 7.vii.1939, E. I. Schlinger [1♀, UCRC: UCRCENT312339]. Lancaster, 720m, *34°41'26"N*, *118°08'40"W*, 26.v.1961, D. Ferrell [1♀, FSCA: UCRCENT424531]. Pasadena, Eaton Canyon, 325m, 34°11'11"N, 118°06'2"W, 20.vi.2014, J. Heraty *et al*., swp [1♀, UCRC: UCRCENT312207]. San Dimas Cyn. Rd., 2 mi. N. Foothill Blvd., *34°08'51"N*, *117°46'33"W*, 18.xii.1977, D. Bramlet [2♀, UCRC: UCRCENT491720, 491731]. Wrightwood, *34°21'33"N*, *117°38'9"W*, 28.vi.1938, C. Dammers, host: *Coelopoeta glutinosi* [1♀, USNM: UCRCENT471527]. **Mariposa Co.**, Merced Lake, Yosemite N.P., 2206m, *37°44'22"N*, *119°24'26"W*, 1935, Salman & Hensill, Hopk. U.S. 21259Y, host plant: *Pinus jeffreyi* [2♀, USNM: UCRCENT471520, 471521]. Porcupine Flat, Yosemite Natl. Park, 2469m, *37°48'29"N*, *119°33'59"W*, 1935, Salman & Hensill, Hopk. U.S. 21258Y, host plant: *Pinus contorta* [2♀ 1?, USNM: UCRCENT471513–471515]. Tenaya Lake, 2497m, *37°50'0"N*, *119°27'54"W*, 10.vii.1953, J.H. McLeod, host: *Recurvaria milleri*, host plant: *Pinus contorta* [1♀, CNC: CNC508865]. Yosemite National Park, 2514m, *37°48'48"N*, *119°31'49"W*, vi–viii.1937, J.S. Yuill, Hopk. U.S. 32255R, host: *Recurvaria milleri* [1♂, USNM: UCRCENT471523]. **Mono Co.**, Mammoth Lakes Dist., Inyo Natl. For., *37°38'46"N*, *118°58'16"W*, 22.vii.1958, R.C. Hall, Hopk. No. 37531, host plant: *Pinus jeffreyi* [1♀, USNM: UCRCENT471655]. Sentinel Meadow, Inyo Natl. Fst., 2731m, *37°48'20"N*, *118°49'5"W*, 12.viii.1958, A. Telford, host plant: *Pinus contorta* var.

murrayana [1♂, EMEC: EMEC84309]. Sentinel Meadow, Inyo Natl. Fst., 2731m, *37°48'20"N*, *118°49'5"W*, 13.viii.1969, A. Telford & S. MacDonald, host plant: *Populus tremuloides* [1♀, EMEC: EMEC84274]. Sentinel Meadow, Inyo Natl. Fst., 2731m, *37°48'20"N*, *118°49'5"W*, vii.1958, A. Telford, host plant: *Pinus contorta* var. *murrayana* [2♂ 2♀, EMEC: EMEC84307, 84310, 84311, 84313]. Sentinel Meadow, Inyo Natl. Fst., *37°48'20"N*, *118°49'5"W*, 3.ix.1958, A. Telford, host plant: *Populus tremuloides* [1♀, USNM: UCRCENT471525]. **Monterey Co.**, King City along Salinas River, 86m, *36°11'53"N*, *121°08'16"W*, 10.vi.1985, J.D. Pinto [1♀, CNC: CNC508843]. **Napa Co.**, Lake Hennessey, 6km E. St. Helena, 44m, *38°30'17"N*, *122°23'24"W*, 7.vii.1990, S.L. Heydon [1♀, UCDC: UCRCENT477948]. **Nevada Co.**, Sagehen Crk, 1990m, *39°25'28"N*, *120°14'34"W*, 8.vi.1970, E.E. Grissell [1♀, UCDC: UCRCENT477949], 20.vii.1970, E.E. Grissell [1♀, UCDC: UCRCENT477952], 22.vii.1970, E.E. Grissell [1♀, UCDC: UCRCENT477953]. **Riverside Co.**, BC Grove, UCR, 320m, 33°58'21"N, 117°19'12"W, 4.x.2012, E. Gordon, Citrus grove, EG12-04 [1♀, UCRC: UCRCENT491730]. Garner Valley T6S R3E S15, 1349m, *33°39'12"N*, *116°39'40"W*, 1.v.1987, J.A. Calderwood [1♀, UCRC: UCRCENT312322]. Hwy. 71 Temecula River Bridge, 304m, *33°28'28"N*, *117°08'25"W*, 1.xi.1961, R. van den Bosch, #61-11-2g, host: *Chaitophorus salicicola*, host plant: *Salix* sp. [2♀, EMEC: EMEC84305, 84306]. Lake Skinner, NE end, 487m, 33°36'7"N, 117°02'5"W, 21.v–4.vi.1996, J.D. Pinto, coastal sage scrub, malaise trap, MET B11 BURNED [1♀, UCRC: UCRCENT491733]. Whitewater Canyon Rd., 546m, 33°57'30"N,

116°38'50"W, 18.vi.2013, R.K. Perry, sweep, RP13-008 [1♂ 1♀, UCRC: UCRCENT312378 (**D4116**), 312379 (**D4117**)]. **San Bernardino Co.**, 1.0 mi. N. Jct. 2N93 and 38, 2378m, *34°10'55"N*, *116°45'2"W*, 24.vi.1997, J. Heraty, H97-20 [1♀, UCRC: UCRCENT491734]. 1/2 mi. NW Faunskin, *34°16'31"N*, *116°57'13"W*, 16.v.1997, M. Gates, host: upper blotch mine, host plant: *Ceanothus integerrimus* [3♂ 2♀, UCRC: UCRCENT499033, 499034, 499036–499038]. 2N93 at Green Spring Creek, 2266m, 34°13'7"N, 116°48'18"W, 9.vi.2005, J.D. Pinto [1♂ 1♀, UCRC: UCRCENT120406, 120550]. I15 5.6 mi. SW Baker, Zzyzx Rd. exit, *35°11'39"N*, *116°08'28"W*, 30.iii.1989, J.D. Pinto, *Larrea, Bebbia*, & *Ambrosia*, sweep [1♀, CNC: CNC508860]. Running Springs, Snow Valley (San Bernardino Mts.), 2050m, 34°13'23"N, 117°02'34"W, 20.vi.1977, R. Luck, host: *Coleotechnites* spp., host plant: *Pinus jeffreyi* [6♂, UCRC: UCRCENT499267, 499268, 499270, 499272, 499274, 499275]. S. of Barton Flats, 2090m, 34°09'42"N, 116°52'23"W, 27.vi–6.viii.2007, F. Reuter, MT [1♀, UCRC: UCRCENT217426]. Cajon Pass, 5 mi. E. Hwy 15 on route 138,1200m, 34°19'38"N, 117°24'59"W, 27.x.1998, A. Aw-Wahaibi, host: leaf miner, host plant: *Prunus ilicifolia* [1♀, UCRC: UCRCENT491735]. Van Dusen Cyn. Rd. 0.5 mi. N. Big Bear City, 2104m, *34°16'28"N*, *116°51'16"W*, 23.vi.1989, R.K. Velton [1♂, CNC: CNC508867]. **San Diego Co.**, Cuyamaca Ranch State Park, 1394m, *32°55'45"N*, *116°34'5"W*, 28.v.2006, M.S. Hoddle [1♀, UCRC: UCRCENT491737]. Pauma, Rutz grove, 305m, *33°20'14"N*, *116°58'57"W*, 7.viii.2008, R. Luck, #58-1, host: *Phyllocnistis citrella*, host plant: Valencia [1♀, UCRC: UCRCENT275094 (**D5937**)]. Pauma,

Rutz grove, 374m, *33°20'14"N*, *116°58'57"W*, 10.viii.2009, R. Luck, # 95, host: *Phyllocnistis citrella*, host plant: Lemon [1♀, UCRC: UCRCENT275030 (**D5938**)]. San Elijo Lagoon, 0.25 mi. from El Camino Real entrance, 7m, *34°00'42"N*, *117°16'22"W*, 7.viii.1996, M. Gates, host: upper surface leaf mine, host plant: *Salix lasiolepis* [1♀, USNM: UCRCENT471526]. **Tulare Co.**, Sequoia National Park, *36°31'21"N*, *118°46'13"W*, 20.vii.1917, J.M. Miller, Hopk. U.S. 13986b, host plant: *Pinus jeffreyi* [6♂ 3♀ 2?, USNM: UCRCENT471502–471512]. Sequoia National Park, 862m, *36°31'21"N*, *118°46'13"W*, 21.viii.1953, B.E. Wickman, host: *Recurvaria milleri*, host plant: *Pinus contorta* [2♂, CNC: CNC508857, 508858]. **Tuolumne Co.**, Tuolumne Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, 1.vii.1959, A.D. Telford, host plant: *Pinus contorta* var. *murrayana* [2♀, EMEC: EMEC84308, 84312]. Tuolumne Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, 1.vii.1959, A.D. Telford & S. MacDonald, host: *Recurvaria* sp., host plant: *Pinus contorta* var. *murrayana* [1♀, EMEC: EMEC84304]. Tuolumne Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, 21.viii.1959, A.D. Telford & S. MacDonald, host: *Recurvaria milleri*, host plant: *Pinus contorta* var. *murrayana* [1♀, EMEC: EMEC84314]. Tuolumne Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, vii–ix.1955, G.R. Struble, Hopk. U.S. 34029K, host plant: *Pinus contorta* [2♂ 3♀, USNM: UCRCENT471477, 471516–471519]. **Ventura Co.**, Ventura, Limoneira ranch Blk. 14, 88m, *34°20'0"N*, *119°08'0"W*, 30.x.2008, R. Luck, #53, host: *Phyllocnistis citrella*, host plant: citrus [1♀, UCRC: UCRCENT292438]. **Idaho: Idaho Co.**,

Lucile, 499m, *45°32'7"N*, *116°18'47"W*, 13.vi.1951, H.C. Manis, host: leaf roller, host plant: Sumac [1?, USNM: UCRCENT471608]. **Twin Falls Co.**, E. Cassia Division, Minidoka N.F. (Now Sawtooth N.F.), 2064m, *42°11'29"N*, *114°17'2"W*, 15.viii.1949, J.H. McLeod, host: *Recurvaria milleri*, host plant: *Pinus contorta* [1♂, CNC: CNC508855], 16.viii.1950, 618, host: *Recurvaria milleri* [1♀, CNC: CNC508851], 18.vii.1950, J.H. McLeod, host: *Recurvaria milleri* [1♂, CNC: CNC508853], 21.vii.1950, J.H. McLeod, host: *Recurvaria milleri* [1♀, CNC: CNC508854], 26.viii.1950, 618, host: *Recurvaria milleri* [1♀, CNC: CNC508852], 9.vii.1950, L. Worn, 51-2983, host: *Recurvaria milleri*, host plant: Lodgepole Pine [1♂, USNM: UCRCENT471524]. **Nevada: Washoe Co.**, 6 km E. Washoe City, 2400m, 39°20'0"N, 119°52'10"W, 29.vi.2001, S.L. Heydon [2♀, UCDC: UCRCENT477950, 477951]. **New Mexico: Otero Co.**, Sacramento Mtns, High Rolls, 2123m, 32°57'0"N, 105°49'0"W, 1–10.v.2004, M.E. Irwin, dry wash, malaise trap [2♀, UCRC: UCRCENT357528 (**D3670**), 357529 (**D3671**)]. **Sandoval Co.**, Bandelier Natl. Monument, 2010m, *35°47'3"N*, *106°16'46"W*, viii.1980, W. Pippin, host: *Phyllonorycter* sp., host plant: Aspen [2♂ 12♀ 1?, USNM: UCRCENT471530, 471531, 471585–471597]. **Texas: Cameron Co.**, Brownsville, 9m, *25°54'6"N*, *97°29'51"W*, 9.iii.1937 [1♀, USNM: UCRCENT471522]. **Val Verde Co.**, Seminole Cyn. St. Pk., 426m, *29°41'12"N*, *101°19'3"W*, 15.iv.1989 [1♀, UCRC: UCRCENT491736]. **Utah: San Juan Co.**, Abajo Mts., 4.2 mi. SE Indian Creek, 2621m, *37°53'41"N*, *109°28'11"W*, 27.vi.1993, J.D. Pinto, sweep [1♀, CNC: CNC508866]. **Wayne Co.**, 6 mi. W. Caineville along Freemont River, *38°16'29"N*,

111°04'49"W, 29.vi.1993, J.D. Pinto, swp [1♂ 1♀, CNC: CNC508677, 508678 (**D5906**)]. **Washington: Chelan Co.**, Wenatchee, *47°25'27"N*, *120°18'50"W*, vi.1985, B. Barrett, host: *Phyllonorycter elmaella* [1♀, USNM: UCRCENT471529]. **Stevens Co.**, Chewelah, *48°16'37"N*, *117°42'59"W*, 8.vi.1970, R.C. Lood, host: *Coleophora laricella* [1♀, USNM: UCRCENT471528].

2. *Zagrammosoma buselus* (Walker)

Fig. 2.6.

Cirrospilus buselus Walker, 1839: 96. Lectotype ♀ designated by LaSalle & Schauff 1992: 23. Type locality: Ecuador, Galapagos Islands, coll. C. Darwin, 1835. Type depository: BMNH: NHMUK010370942.

Zagrammosoma buselus. Combination by LaSalle & Schauff 1992: 23.

Diagnosis: *Zagrammoma buselus* is characterized by a completely dark metasoma, yellow mesoscutellum, and a medial, dark band on the mesoscutum that tapers to a point before reaching the mesoscutellum (Fig. 2.6D, E). This species is most similar to *Z. flavolineatum* but can be differentiated by the yellow mesoscutellum, whereas *Z. flavolineatum* has the mesoscutellum black laterally, with a yellow band in the center (Fig. 2.15D, E). Male *Z. buselus* have a dark metasoma whereas male *Z. flavolineatum* have posteriorly a dark medial patch on Gt_3 – Gt_6 (Fig. 2.15E). The wing patterns of each species are distinctive (Figs 2.6C versus 2.15C).

Description: Female - body length 0.97–1.86 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe. Vertex with 2 stripes above compound eye. Gena posteriorly with broad dark band below compound eye, sometimes with central yellow spot. Occiput yellow with dark median band, sometimes band is bisected by a faint yellow stripe. Pronotum dorsally with broad median stripe, either interrupted or complete; laterally with 2 black stripes. Prepectus yellow with dorsal margin dark. Mesoscutellum yellow with broad median stripe tapering posteriorly. Propodeum all dark. Procoxa and mesocoxa yellow. Metacoxa mostly yellow, basally dark. Profemur and mesofemur yellow. Metafemur dark except at tips. Fore wing: basal band lacking; cubital band present; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than length of stigmal vein; apical band absent; connection from parastigmal band to stigmal band present; connection from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma dark.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.67–0.77); second subequal or wider than long (w:l = 1.0–1.11).

Pronotum, in dorsal view, bell-shaped, wider than long (w:l = 1.46–1.52); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; without scattered setae; intermediate setae present. Mesoscutellum wider than long (w:l = 1.08–

1.24); submedian grooves absent. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere (bst:2^{nd} = 1.11–1.2).

Fore wing l:w = 2.12–2.58. Submarginal vein with 5–6 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by its own length or less from stigmal apex, or by more than length of uncus.

Male - as female except: body length 0.8–0.97 mm.

Remarks: This endemic species is the most abundant of the three species of *Zagrammosoma* recovered in the Galapagos archipelago, with 236 specimen records compared to 22 of *Z. multilineatum,* and 9 of the other endemic species, *Z. galapagoense*. The body and wing patterns *Z. buselus* make this one of the most distinctive species of *Zagrammosoma*.

Hosts: unknown.

Distribution: Neotropical: Ecuador: Galapagos Islands (Fig. 2.7)

Etymology: Walker (1839) named species in his monograph after ancient Greek, Roman, and Macedonian figures, some real, some mythological. The name Buselus is found in the “Orations of Demosthenes, against Macartus” (Demosthenes 43).

Material Examined: Lectotype: ECUADOR: Galapagos: Santiago Island, 405m, *0°14'26"S*, *90°42'54"W*, 8–17.x.1835, C. Darwin [1♀, BMNH: NHMUK010370942].

Additional material examined: ECUADOR: Galapagos: Fernandina Island, 10 km NE Cabo Hammond, 400m, *0°25'9"S*, *91°34'52"W*, 9.v.1991, J. Heraty, transition, H91-027 [1♀, UCRC: UCRCENT485706]. **Isabela Island**, Alcedo, 14km S. NE Playa, 1100m, *0°36'39"S*, *90°40'2"W*, 23.vi.1991, J. Heraty, scrub/pampa, H91-109 [2♂ 9♀, UCRC: UCRCENT447809–447819]. Cerro Azul, 3km E. Caleta Iguana, 200m, *0°59'56"S*, *91°24'48"W*, 25.v.1991, J. Heraty, decid. forest, H91-061 [1♀, UCRC: UCRCENT447807]. Cerro Azul, 3km E. Caleta Iguana, 300m, *0°57'40"S*, *91°26'23"W*, 20.v.1991, J. Heraty, pampa, H91-045 [3♂ 7♀, BMNH: NHMUK10370148, 10370151, UCRC: UCRCENT444411–444416, 498885, 498887]. Cerro Azul, 4 km E. Caleta Iguana, 300mm, *0°56'7"S*, *91°27'30"W*, 24.v.1991, J. Heraty, pampa transition, H91-060 [2♂ 3♀, UCRC: UCRCENT414295, 447764–447767]. Cerro Azul, 5km E. Caleta Iguana, 400m, *0°59'15"S*, *91°24'25"W*, 24.v.1991, J. Heraty, pampa/grass, H91-059 [4♂ 11♀, UCRC: UCRCENT337750, 447750, 447792–447800, 447803–447806]. Cerro Azul, 7km E. Caleta Iguana, 600–700m, *0°58'10"S*, *91°25'6"W*, 23–24.v.1991, J. Heraty, pampa, H91-053 [4♂ 12♀, UCRC: UCRCENT447768–447782, USNM: UCRCENT471434]. Cerro Azul, 7km E. Caleta Iguana, 600m, *0°58'15"S*,

91°25'12"W, 20–25.v.1991, J. Heraty, pampa, Pan Trap, H91-055 [1♀, UCRC: UCRCENT447808]. Cerro Azul, 7km E. Caleta Iguana, 600m, *0°58'15"S*, *91°25'12"W*, 22.v.1991, J. Heraty, grass pampa, H91-052 [2♂ 3♀, ANIC: UCRCENT238225, CNC: CNC508704, UCRC: UCRCENT414294, 447801, 447802]. Cerro Azul, 7km E. Caleta Iguana, 700m, *0°58'10"S*, *91°24'55"W*, 20.v.1991, J. Heraty, pampa, H91-046 [10♂ 3♀, UCRC: UCRCENT444417–444427, USNM: UCRCENT471433, 471435]. Cerro Azul, 8km E. Caleta Iguana, 850m, *0°57'13"S*, *91°25'28"W*, 24.v.1991, J. Heraty, crater/grass, H91-054 [1♂ 9♀, ANIC: UCRCENT238222, BMNH: NHMUK10370146, CNC: CNC508705, 508706, UCRC: UCRCENT447783–447788]. Cerro Azul, 8km E. Caleta Iguana, 850m, *0°57'40"S*, *91°24'59"W*, 22.v.1991, J. Heraty, Crater/grass, H91-051 [1♂ 12♀, UCRC: UCRCENT447751–447763]. Cerro Azul, Caleta Iguana, 0m, *0°57'31"S*, *91°26'24"W*, 19–25.v.1991, J. Heraty, arid, Pan Trap, H91-058 [3♀, UCRC: UCRCENT447789–447791]. Sierra Negra, 991m, *0°48'56"S*, *91°05'16"W*, 15–27.iv.1986, S. Agedrabbo [1♀, CNC: CNC508703]. **Santa Cruz Island**, 3 km N. Santa Rosa, 600m, *0°39'38"S*, *90°20'39"W*, 1.v.1991, J. Heraty, H91-011 [2♀, UCRC: UCRCENT444387–8]. 4km N. Bellavista, Media Luna, 620m, *0°39'31"S*, *90°19'28"W*, 14.v–13.vii.1985, S. & J. Peck, Miconia zone, 158 [2♂ 8♀, CNC: CNC508693–702]. 6 km N. Puerto Ayora, 125m, *0°42'40"S*, *90°18'39"W*, 31.v.1991, J. Heraty, Low Transit, H91-068 [1♀, UCRC: UCRCENT444403]. Cerro Crocker, hill top, 860m, *0°38'33"S*, *90°19'32"W*, 8.ii.1989, B.J. Sinclair, sweep [1♀, UCRC: UCRCENT410521]. Horneman Farm, 220m, *0°41'21"S*, *90°19'28"W*,

3.iii.1964, D.Q. Cavagnaro [1♂ 1♀, CASC: UCRCENT485710, 485711]. Los Gemelos, 620m, *0°37′28″S*, *90°23′1″W*, 1.v.1991, J. Heraty, Scalesia, H91-012 [1♂ 5♀, ANIC: UCRCENT238223, UCRC: UCRCENT444389–444393]. Los Gemelos, 620m, *0°37′28″S*, *90°23′1″W*, 17.v.1991, J. Heraty, Scalesia, H91-038 [4♂ 5♀, UCRC: UCRCENT444394–444402]. Media Luna to Puntudo, 600–700m, *0°38′1″S*, *90°20′19″W*, iv.1989, S. Peck, pampas, sweeping [1♀, CNC: CNC508735 (**D4692**)]. Media Luna, 450m, *0°39′56″S*, *90°17′59″W*, 31.v.1991, J. Heraty, Cinchona zone, H91-069 [1♀, UCRC: UCRCENT444277]. Media Luna, 450m, *0°40′9″S*, *90°19′25″W*, 31.v.1991, J. Heraty, Cinchona zone, H91-069 [3♂ 1♀, UCRC: UCRCENT444404–444407]. Media Luna, 500–600m, *0°39′20″S*, *90°18′19″W*, 31.v.1991, J. Heraty, Miconia zone, H91-070 [1♀, ANIC: UCRCENT238226]. Media Luna, 500–600m, *0°39′32″S*, *90°19′44″W*, 31.v.1991, J. Heraty, Miconia zone, H91-070 [1♂ 1♀, UCRC: UCRCENT444408, 444409]. Media Luna, fern/Sed. pampa, 650m, *0°39′20″S*, *90°18′19″W*, 31.v.1991, J. Heraty, H91-071 [1♂, ANIC: UCRCENT238227]. **Santiago Island**, 10km SE Playa Espumilla, 600m, *0°14′43″S*, *90°47′26″W*, 4.vi.1991, J. Heraty, humid forest, H91-076 [7♂ 6♀, UCRC: UCRCENT444369–444381]. 11Km E. Playa Espumilla, 600m, *0°13′23″S*, *90°46′11″W*, 9.vi.1991, J. Heraty, humid forest, H91-083 [1♂ 7♀, UCRC: UCRCENT444268–444275]. 12 km E. Playa Espumilla, 725m, *0°13′54″S*, *90°46′3″W*, 5.vi.1991, J. Heraty, elfin forest, H91-078 [4♂ 11♀, UCRC: UCRCENT128538–128541, 444278–444287, 498886]. 13km E. Playa Espumilla, 800m, *0°13′23″S*, *90°46′11″W*, 9.vi.1991, J. Heraty, grass pampa, H91-082 [1♂

3♀, UCRC: UCRCENT444383–444386]. 15Km E. Playa Espumilla, 900m, *0°12'43"S*, *90°47'4"W*, 5.vi.1991, J. Heraty, grass pampa, H91-079 [8♂ 25♀, UCRC: UCRCENT444235–444267]. 8Km SE Playa Espumilla, 400–500m, *0°13'28"S*, *90°47'47"W*, 8.vi.1991, J. Heraty, humid forest, H91-081 [1♂ 1♀, ANIC: UCRCENT238224, UCRC: UCRCENT444276]. 9 km SE Playa Espumilla, Aguacate camp, 550m, *0°14'1"S*, *90°47'22"W*, 4.vi.1991, J. Heraty, humid forest, H91-075 [4♂ 9♀, UCRC: UCRCENT444222–444234]. 9km SE Playa Espumilla, Aguacate camp, 550m, *0°15'4"S*, *90°45'59"W*, 4.vi.1991, J. Heraty, humid forest, H91-077 [1♂, UCRC: UCRCENT444382]. Playa Espumilla, *0°12'4"S*, *90°49'42"W*, 4.iv.1992, S. Peck, arid zone, Cordia woodland, U.V. light, 92-98 [1♀, UCRC: UCRCENT410518].

3. *Zagrammosoma calvini* Perry n. sp.

Fig. 2.8.

Diagnosis: *Zagrammosoma calvini* is the only species to display three dark lines on the occiput, one vertical and the other two converging at the base of the occiput (Fig. 2.8A). The fore wing also has a conspicuous asetose fold posterior to the cubital line of setae (Fig. 2.8C). This species most resembles *Z. villosum*, which only has two vertical stripes on the occiput, and two dark lines laterally on the mesosoma (Fig. 2.43B) whereas *Z. calvini* possesses three lines on the occiput and laterally on the mesosoma.

Description: Female - body length 0.84–2.02 mm. Metallic luster on body absent. Scape all yellow, or with dark stripe dorsally. Lower face without median stripe. Vertex with 2 stripes above compound eye. Gena posteriorly with wide, dark band below compound eye. Occiput yellow with 3 dark, vertical stripes. Pronotum with median stripe; laterally with three stripes. Mesoscutum with interrupted median stripe. Prepectus yellow with dorsal margin dark. Mesoscutellum with three dark lines, sometimes faint. Propodeum yellow with black: median carina, lateral spot. Procoxa and mesocoxa yellow. Metacoxa yellow, basally with dark spot. Profemur and mesofemur yellow. Metafemur yellow, or with spot laterally. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal band present, with perpendicular extension less than or greater than that of stigmal apex; postmarginal band absent or present with perpendicular extension less than that of stigmal apex. Hind wing hyaline. Metasoma yellow with dark median and transverse stripes or bands.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first subequal or wider than long (w:l = 1.0–1.31); second wider than long (w:l = 1.18–1.51).

Pronotum, in dorsal view, bell-shaped or more than twice as wide as long (w:l = 1.75–2.75); 5–6 pairs of setae on posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae present. Mesoscutellum wider than long (w:l = 1.06–1.11); submedian grooves present. Hind tibial spur distinctly

shorter than basitarsus. Hind basitarsus shorter than second tarsomere (bst:2nd = 0.85–0.89).

Fore wing l:w = 2.27–2.58. Submarginal vein with 5–7 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by its own length or less from stigmal apex, or by more than length of uncus.

Male - as female except: body length 0.63–0.97 mm; occiput with 3 stripes, sometimes with a very faint medina stripe; stigmal band present, with perpendicular extension only to apex of stigma; submarginal vein with 5 setae dorsally; uncus originating on stigma by its own length or less from stigmal apex.

Remarks: This is the only described species found in the southern half of South America.

Hosts: unknown.

Distribution: Neotropical: Argentina, Chile (Fig. 2.9).

Etymology: Named in memory of my academic great uncle Dr. John LaSalle, who described *Zagrammosoma hobbesi*, which he named after Hobbes the tiger from Calvin & Hobbes. The characteristic number of setae present on the head and body of *Z. calvini* is reminiscent of Calvin's spiked hair.

Type Material: Holotype: ARGENTINA: Tucuman: road N. of Tapia, 700m, 26°33'59"S, 65°17'22"W, 7.iv.2014, J. Heraty, swp, H14-042 [1♀, UCRCENT485707 (**D5939**)]. Deposited in UCRC.

Paratypes: ARGENTINA: Formosa: Estancia Guaycolec 25km N. Formosa, 185m, 25°59'0"S, 58°12'0"W, 17–20.xii.1998, S.L. Heydon, screen sweep [2♂ 4♀, UCDC: UCRCENT477911–16]. Las Lomitas, 274m, 24°45'28"S, 63°29'28"W, 25.iii.2003, J. Heraty [2♀, UCRC: UCRCENT445300, 445307]. **CHILE: Chacabuco: Colina**, El Portezuelo, 603m, *33°12'15"S*, *70°40'23"W*, 15.iv–15.v.1988, L.E. Peña, MT [1♂ 1♀, CNC: CNC508578, 508654 (**D5884**)].

4. *Zagrammosoma centrolineatum* Crawford

Fig. 2.10.

Zagrammosoma centrolineata Crawford, 1913: 256. Holotype ♀ [examined]. Type locality: USA, California, Los Angeles Co. Type depository: USNM type no. 15931- UCRCENT471417.

Zagrammosoma centrolineatum; justified emendation by Peck, 1951: 459.

Diagnosis: This is the only species that possesses a wide, dark band dorsally that is continuous from the pronotum to the apex of the metasoma. Both *Z. latilineatum* (Fig. 2.25) and *Z. seini* (Fig. 2.37) have wide bands on the mesosoma, but these bands are not as wide as those on *Z. centrolineatum* and do not extend onto the metasoma. The hind basitarsus is longer than the second tarsomere in *Z.*

centrolineatum, and shorter than the second tarsomere in both *Z. latilineatum* and *Z. seini*.

Description: Female - body length 1.31–2.25 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with wide median band complete; laterally with 2 black stripes. Mesoscutum with wide median band complete. Prepectus yellow with dorsal margin dark. Propodeum yellow with wide median band. Procoxa and mesocoxa yellow. Metacoxa yellow or, rarely, basally with dark spot. Profemur and mesofemur yellow. Metafemur variable: yellow, with uninterrupted stripe or interrupted stripe dorsally. Fore wing: basal band absent; cubital band present; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal band present, with perpendicular extension greater than that of stigmal apex; postmarginal band present, with perpendicular extension across 75% or more of fore wing width, often across entire width; connection from cubital band to stigmal band present, in a wide, linear band. Hind wing hyaline. Metasoma yellow with wide, dark band dorsally.

Upper ocular sulcus absent. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l 0.56–0.75); second longer than wide (w:l = 0.7–0.72).

Pronotum, in dorsal view, bell-shaped, wider than long (w:l = 1.39–1.45); 5 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present.; intermediate setae absent. Mesoscutellum wider than long (w:l = 1.09–1.14); submedian grooves absent. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere (bst:2^{nd} = 1.13–1.28).

Fore wing l:w = 2.51–2.77. Submarginal vein with 7 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.79–1.47 mm; body yellow, with wide dark band present only on mesosoma; metasoma with interrupted median band, and transverse bands across Gt_4–Gt_5 (Fig. 2.10E).

Remarks: This species is easy to identify due to the unique body and fore wing pattern and is widespread in the western Nearctic.

Hosts: Recovered from lepidopteran leaf miners and an unknown gall. See Table 2.3. **Lepidoptera**: Gracillariidae, Heliozelidae.

Distribution: Nearctic: Canada (BC), USA (AZ, CA, NM, OR, TX, UT) (Fig. 2.11).

Etymology: Named for the dark, broad median band that extends from the anterior margin of the pronotum to the tip of the metasoma.

Material Examined: Paratypes: USA: California: Los Angeles Co., Los Angeles, 100m, *34°02'41"N*, *118°15'13"W*, viii, Koebele, host: *Gracilaria elongata* [1?, USNM: UCRCENT425337]. **Sonoma Co.**, 31m, *38°17'23"N*, *122°27'37"W*, Koebele, host: *Lithocolletis mediodorsella* [1♀, USNM: UCRCENT425338].

Additional material examined: CANADA: British Columbia: Victoria, 31m, *48°25'44"N*, *123°21'12"W*, 28.viii.1961 [1♀, CNC: CNC508690]. Victoria, 31m, *48°25'44"N*, *123°21'12"W*, 31.viii.1961 [1♀, CNC: CNC508691]. **USA: Arizona: Cochise Co.**, Huachucha Mts., Ash Canyon Rd. 0.5 mi. W. Hwy 92, 1582m, *31°23'12"N*, *110°14'17"W*, viii.1993, N. McFarland, MT [1♀, CNC: CNC508692]. Portal, 1451m, *31°54'51"N*, *109°08'26"W*, 16.iv.1962, H. Willis, ex: gall [1♀, FSCA: UCRCENT424529]. **California: Alameda Co.**, Cedar Mtn., 1125m, *37°33'36"N*, *121°36'22"W*, 3.iii.1968, host plant: *Quercus durata* [1♀, CASC: UCRCENT417567]. **Contra Costa Co.**, Mt. Diablo, 1144m, *37°52'51"N*, *121°54'56"W*, 7.ii.1977, D.S. Green, host: *Cameraria* sp., host plant: *Quercus chrysolepis* [1?, EMEC: EMEC84276]. **Glenn Co.**, 5 mi. N. Elk Creek, 193m, *39°40'44"N*, *122°31'38"W*, 7.vi.1984, J.D. Pinto [1♂, UCRC: UCRCENT312277]. **Humboldt Co.**, 5.3 mi. SE Ettersburg, 314m, *40°05'25"N*, *123°55'25"W*, 4.vi.1987, R.K. Velten [1♀, BMNH: NHMUK10370163]. **Kern Co.**, Monolith, 1210m, *35°07'16"N*, *118°22'20"W*, 15.ix.1968, P. Opler, host: *Coptodisca* sp., host plant: *Quercus lobata* [1♀, EMEC: EMEC84275]. **Los Angeles Co.**, 188m, *34°05'9"N*,

118°12'28"W, 24.vii.1940, R.H. Smith, Acc. 237, host: *Phyllonorycter felinella* [1♀, UCRC: UCRCENT312274]. **Mariposa Co.**, Yosemite National Park, 2514m, *37°48'48"N*, *119°31'49"W*, 2.vii.1918, C. Heinrich, Hopk. U.S. 13405d1 [1♀, USNM: UCRCENT416899]. **Napa Co.**, 3 mi. SSW Spanish Flat, 225m, *38°29'51"N*, *122°15'11"W*, 11.vi.1984, J.D. Pinto [1♀, UCRC: UCRCENT485705]. Lake Hennessey, 11km ESE St. Helena, 44m, *38°29'19"N*, *122°20'54"W*, 17.xii.1991, S.L. Heydon, *Bacharis* [1♀, UCDC: UCRCENT415863]. **Orange Co.**, 228m, *33°35'31"N*, *117°30'46"W*, 11.v.1968, E.I. Schlinger, host plant: *Platanus* sp. [1♀, UCRC: UCRCENT312272]. Modjeska Canyon, 390m, *33°42'30"N*, *117°38'8"W*, 28.ii.1977, D.S. Green, host: *Cameraria agrifoliella*, host plant: *Quercus agrifolia* [1♀, EMEC: EMEC84281]. **Placer Co.** State Insectary 105', 1018m, 39°01'41"N, 120°47'52"W [1♀, UCRC: UCRCENT312273]. **Riverside Co.**, Hwy 74, San Bernardino Natl. Forest., 635m, 33°43'52"N, 116°48'39"W, 20.vi.2014, R.K. Perry, Riparian, Sweep, RP14/009 [1♀, UCRC: UCRCENT312349 (**D4112**)]. Idyllwild Park, 1596m, *33°44'37"N*, *116°43'26"W*, 17.vii.1996, M. Gates, LM96-940, host: leaf miner, host plant: *Quercus chrysolepis* [1♀, UCRC: UCRCENT312269]. Idyllwild Park, 1596m, *33°44'37"N*, *116°43'26"W*, 17.vii.1996, M. Goeden, host: upper surface blotch mine, host plant: *Quercus chrysolepis* [1♀, UCRC: UCRCENT312270]. Pinyon Flats, E. Side of Santa Rosa Mtns., 1227m, *33°35'5"N*, *116°27'24"W*, 18.iii.1997, M.W. Gates, LM97-2366, host: upper surface blotch mine, host plant: *Quercus turbinella* [1♀, UCRC: UCRCENT312271]. Sage, 704m, *33°34'56"N*, *116°55'59"W*, 12.vi.1977, D.S.

Green [4♀ 1?, EMEC: EMEC84280, 84282, 84297, 84298, 84316]. Sage, 704m, *33°34'56"N*, *116°55'59"W*, 12.vi.1977, D.S. Green, host plant: *Quercus* [4♀ 1?, EMEC: EMEC84280, 84282, 84297, 84298, 84316]. Sage, 704m, *33°34'56"N*, *116°55'59"W*, 12.vi.1977, D.S. Green, host plant: *Quercus john-tuckeri* [4♀ 1?, EMEC: EMEC84280, 84282, 84297, 84298, 84316]. Sage, 704m, *33°34'56"N*, *116°55'59"W*, 12.vi.1977, D.S. Green, host: *Cameraria* sp., host plant: *Quercus lobata* [4♀ 1?, EMEC: 84280, 84282, 84297, 84298, 84316]. Sage, 704m, *33°34'56"N*, *116°55'59"W*, 12.vi.1977, D.S. Green, host: *Phyllonorycter* sp., host plant: *Quercus keloggii* [4♀ 1?, EMEC: EMEC84280, 84282, 84297, 84298, 84316]. Santa Rosa Plateau Res., 590m, 33°31'0"N, 117°14'0"W, 11.vii.2001, *Quercus* sp., fogging [1♀, UCRC: UCRCENT55218]. **San Diego Co.**, Mount Laguna 1/2 mile E. Mount Laguna Fire Station off SI, 1846m, *32°51'28"N*, *116°24'50"W*, 27.viii.1996, M.W. Gates, LM96-1361, host: miner, host plant: *Quercus keloggii/Rhamnus californica* [1♀, UCRC: UCRCENT312276]. **San Mateo Co.**, San Bruno Mtns., 338m, *37°41'19"N*, *122°26'5"W*, 21.iii.1968, P. Opler, host plant: evergreen [1♀, EMEC: EMEC84277]. **Santa Barbara Co.**, Santa Cruz Island, *34°00'12"N*, *119°44'40"W*, vi.1999, B. Fox [1♀, UCDC: UCDC00415798]. Santa Cruz Island, Cañada de la Cuesta, *34°01'14"N*, *119°50'11"W*, 15.iii.1969, J. Powell, host plant: *Pinus muricata* [1♀, UCRC: UCRCENT312275]. **Siskiyou Co.** 5 mi. SW Mt. Shasta City, 1115m, *41°18'32"N*, *122°18'19"W*, 22.vii.1969, P. Opler, host: *Cameraria* sp., host plant: *Notholithocarpus densiflorus* [1♂ 2♀, CASC: UCRCENT417566, EMEC:

EMEC84278, 84279]. **Solano Co.**, 11 km W. Winters, 70m, *38°30'50"N*, *122°06'1"W*, 22.viii.1990, S.L. Heydon [1♀, UCDC: UCDC00415799]. 9 km N. Winters, 49m, *38°36'21"N*, *121°58'16"W*, 15.iv.1990, S.L. Heydon [1♀, UCDC: UCRCENT415862]. **Sonoma Co.**, Healdsburg, 32m, *38°36'37"N*, *122°52'10"W*, 13.iii.1970, T. Griswold [1?, CASC: UCRCENT417565]. **New Mexico: Sandoval Co.**, Bandelier Natl. Monument, 2010m, *35°47'3"N*, *106°16'46"W*, viii.1980, W. Pippin, host: *Phyllonorycter* sp., host plant: Aspen [1♀, USNM: UCRCENT425339]. **Oregon: Wasco Co.**, Rowena, 42m, *45°40'20"N*, *121°16'5"W*, 13.viii.1982, P. Hanson [3♀, USNM: UCRCENT416894–96]. Tygh Valley, 338m, *45°14'51"N*, *121°10'33"W*, 6.v.1938, ID. Lot. No. 40-2913 [1?, USNM: UCRCENT416897]. **Texas: Comal Co.**, New Braunfels, Landa Pk., 192m, *29°42'46"N*, *98°07'56"W*, 16.iii.1884, T.P. & L. Friedlander & G. Steck [1♀, TAMU: UCRCENT426728]. **Utah: Salt Lake Co.**, Salt Lake, 1360m, *40°46'34"N*, *111°53'4"W*, 11.viii.1913, Timberlake, 445B [4♀, UCRC: UCRCENT312252, 312266, 312267, 414301]. Salt Lake, 1360m, *40°46'34"N*, *111°53'4"W*, 11.viii.1913, Timberlake, 445B, host: *Cameraria macrocarpella* [4♀, UCRC: UCRCENT312252, 312266, 312267, 414301]. Salt Lake, 1360m, *40°46'34"N*, *111°53'4"W*, 15.viii.1913, Timberlake, 445B [1♀, UCRC: UCRCENT312268]. Salt Lake, 1360m, *40°46'34"N*, *111°53'4"W*, 2.viii.1913, Timberlake, 445B [1♀, UCRC: UCRCENT414302]. **Washington Co.**, Springdale, *37°11'20"N*, *112°59'55"W*, 14.vi.1970, host: *Phyllonorycter* sp., host plant: *Populus* [1♂, USNM: UCRCENT416898].

5. *Zagrammosoma crowei* (Kerrich)

Fig. 2.12.

Cirrospilus crowei Kerrich, 1969: 195. Holotype ♀ [examined]. Locality: Kenya, Ruiru, coll. T. Crowe. Depository: BMNH: NHMUK010838528.

Zagrammosoma crowei (Kerrich). Combination by Yefremova, 1995: 52.

Zagrammosoma crowee (Kerrich). Misspelling by Yefremova, 2002: 568.

Diagnosis: This is the only species that possesses a dark transverse stripe on the lower and upper face. It also has three transverse stripes on the metasoma that are not connected by a longitudinal stripe, which is the norm in other species of *Zagrammosoma* (in Fig. 2.12D the metasoma has collapsed, and the visible brown longitudinal stripe is the ovipositor). *Zagrammosoma crowei* has similar body patterns to *Z. americanum*, *Z. multilineatum*, *Z. occidentale*, and *Z. talitzkii*, however the fore wing is hyaline in *Z. crowei*, with only the stigmal vein darkened (Fig. 2.12C), and the other four species all have distinct dark patterns on the fore wings (Fig. 2.4C, Fig. 2.33C, Fig. 2.35C, Fig. 2.39C).

Description: Female - body length 1.1–1.73 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with

median stripe complete; laterally with 2 dark stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe complete. Mesoscutellum with three dark stripes. Propodeum yellow with black: median carina, anterior and posterior margins. Procoxa and mesocoxa yellow. Metacoxa yellow, basally with dark spot. Profemur and mesofemur yellow. Metafemur with uninterrupted stripe dorsally. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal band present, extending to apex of stigma; postmarginal band absent; Hind wing hyaline. Metasoma yellow, dorsally with three dark, transverse stripes.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.54–0.56); second longer than wide (w:l = 0.7–0.75).

Pronotum, in dorsal view, more than twice as wide as long (w:l = 2.16–2.45); 3 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum wider than long (w:l = 1.2–1.26); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus shorter than second tarsomere (bst:2^{nd} = 0.83–0.89).

Fore wing l:w = 2.35–2.66. Submarginal vein with 6 setae. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 1.02–1.6 mm; occiput with vertical stripes absent; band present, extending to apex of stigma; metasoma with one or two broken, transverse stripes.

Remarks: This is the only Afrotropical species, being found in East Africa and Réunion Island. The two transverse stripes across the lower and upper face, from the inner boundary of one compound eye to the other, are very similar to those found in the eulophine *Paraolinx* Ashmead, however the area between the stripes is white, where they are yellow in *Z. crowei*. This species was imported into Spain for biological control trials against citrus leaf miner, however, did not successfully reproduce in the lab (Garcia-Marí et. al. 2004).

Hosts: Recovered from lepidopteran leaf miners, including coffee and citrus leaf miner. See Table 2.3. **Lepidoptera:** Gracillariidae, Lyonetiidae.

Distribution: Afrotropic: Kenya**,** Réunion Island, South Africa, Zimbabwe (Fig. 2.13).

Material Examined: Paratypes: KENYA: Kiambu Co., Ruiru, 1514m, *1°08′48″S*, *36°57′55″E*: 23.ii.1960, T.J. Crowe, host: *Leucoptera meyricki* [4♂ 1♀, BMNH: NHMUK10370143, 10370194, 10370212, 10370223, 10370226], 5.i.1960, T.J. Crowe, host: *Leucoptera meyricki* [1♀, BMNH: NHMUK10370153], 7.ii.1966, D.E.

Evans, host: *Leucoptera meyricki* [1♂ 3♀, BMNH: NHMUK10370127, 10370137, 10370185, 10370193], 8.ix.1960, T.J. Crowe, host: *Leucoptera meyricki* [1♀, BMNH: NHMUK10370134].

Additional material examined: ETHIOPIA: Oromia: Koka, 1700m, 8°22'0"N, 39°13'0"E, 28.x.1980, W.M. Amde, host: *Phyllocnistis citrella*, host plant: *Citrus* sp. [2♀, ANIC: UCRCENT238221, BMNH: NHMUK10370128]. **KENYA: Kiambu Co.**, Ruiru, 1514m, *1°08'48"S*, *36°57'55"E*, 14.i.1974, W.M. Mathenge, host: *Leucoptera meyricki* [1♂, BMNH: NHMUK10370164]. Ruiru, 1514m, *1°08'48"S*, *36°57'55"E*, 22.x.1965, D.E. Evans, host: leafminer [2♀, BMNH: NHMUK10370140, 10370141]. **REUNION ISLAND:** Bassin Plat, 129m, *21°20'0"S*, *55°29'40"E*, 26.iv.1995, S. Quilici, host: *Phyllocnistis citrella*, host plant: Citrus sp. [1♂ 2♀, ANIC: UCRCENT238218–238220]. Bassin Plat, 141m, *21°19'58"S*, *55°29'44"E*, 30.iii.1995, S. Quilici, *Citrus*, host: *Phyllocnistis citrella* [1♀, SANC: SANC-HYMC00003070]. **SOUTH AFRICA: Limpopo: Vhembe**, Levubu, *23°05'4"S*, *30°16'57"E*, host: *Leucoptera coffeella*, host plant: Coffee [SANC: SANC-HYMC00003123]. **ZIMBABWE: Manicaland:** Chipinga Dist., 1076m, *20°11'25"S*, *32°37'41"E*: 2.i.1975, R. Hill, Suction Trap [1♀, BMNH: NHMUK10370130], 20.vii.1990, host: *Leucoptera meyricki* [1♀, ANIC: UCRCENT238233], 3.i.1975, R. Hill, Suction Trap [1♀, BMNH: NHMUK10370159].

6. *Zagrammosoma deliae* Perry n. sp.

Fig. 2.14.

Diagnosis: The most distinguishing character for *Z. deliae* is the extension of the parastigmal band towards the apex of the wing, almost connecting with the stigmal band. This character is sometimes found in *Z. multilineatum*, however the setal density and location on the fore wing varies between the species. In *Z. deliae*, setae are present adjacent to the admarginal setae, whereas the setae do not approach the admarginal setae in *Z. multilineatum.* In addition, the speculum is barer in *Z. multilineatum* than in *Z. deliae*.

Description: Female - body length 1.18–1.4 mm. Metallic luster on body absent. Lower face with median stripe present. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput with two dark, vertical stripes. Pronotum with median stripe complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe complete. Mesoscutellum with one or three dark lines. Propodeum yellow with black: median carina, anterior and posterior margins, diagonal line connecting anterior and posterior margins. Procoxa and mesocoxa yellow. Metacoxa yellow; basally with black stripe. Profemur and mesofemur yellow. Metafemur yellow with uninterrupted or interrupted stripe dorsally. Fore wing: basal band absent; cubital band absent or present; parastigmal, stigmal, and

postmarginal bands present, with perpendicular extension greater than that of the stigmal apex; connection from parastigmal band to stigmal band absent or present. Hind wing hyaline. Metasoma yellow with dark median stripe and transverse stripes.

Upper ocular sulcus absent. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.54–0.83); second subequal (w:l = 1.0).

Pronotum, in dorsal view, bell-shaped (w:l = 1.24–1.46); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum wider than long (w:l = 1.07–1.2); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus subequal or longer than second tarsomere (bst:2^{nd} = 1.0–1.29).

Fore wing l:w = 2.24–2.43. Submarginal vein with 5–6 dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.87–1.02mm

Remarks: This is the only species recovered from Peru. There can be slight variations on the mesoscutum (dark lines along anterior margins of notaulus and axilla) and mesoscutellum (one or three stripes) in *Z. deliae* (Fig. 2.14D, E), however the head and wing patterns are consistent throughout all specimens examined.

Hosts: Recovered from lepidopteran and dipteran leaf miners. See Table 2.3. **Diptera**: Agromyzidae. **Lepidoptera**: Gracillariidae.

Distribution: Neotropical: Peru (Fig. 2.9).

Etymology: Named after my Peruvian grandmother, Delia Oliden Martinez.

Type Material: Holotype: PERU: Cañete Prov.: *13°04'59"S*, *76°22'58"W*, v–vi.1941, P. Berry, host plant: Cotton buds [1♀, UCRCENT471609]. Deposited at USNM.

Paratypes: PERU: Callao-CICIU, 15m, *12°03'9"S*, *77°07'34"W*, 12.xii.1976, C.I.E. A9571, host: *Liriomyza* sp., host plant: *Medicago sativa* [1♂, BMNH: NHMUK10353783]. Lima, *12°02'36"S*, *77°01'42"W*, 1943, E.J. Hambleton, 43-9315-270, host: *Acrocercops* sp., host plant: *Cordia rotundifolia* [2♂ 3♀, USNM: UCRCENT471612–471615, 471658]. Lima, *12°02'36"S*, *77°01'42"W*, 27.iv.1967, K. Raven, host: *Phytobia* sp. [1♀, USNM: UCRCENT471610].

7. *Zagrammosoma flavolineatum* Crawford

Fig. 2.15.

Zagrammosoma flavolineata Crawford, 1913: 255. Holotype ♀ [examined]. Locality: USA, Colorado. Depository: USNM type no. 15390.

Zagrammosoma flavolineatum Crawford. Justified emendation by Peck, 1951: 459.

Zagrammosoma mira Girault, 1916b: 119. Holotype ♀ [examined]. Locality: USA, California, Claremont. Depository: USNM type no. 20089. **n. syn.**

Zagrammosoma mirum Girault. Justified emendation by Peck, 1951: 459.

Cirrospilus mirus (Girault). Incorrect combination by Herting, 1975: 29.

Diagnosis: *Zagrammosoma flavolineatum* is characterized by a wide yellow band, extending from the center of the pronotum through the mesoscutellum (Fig. 2.15D, E) in an otherwise almost entirely black dorsum. On the pronotum, a median dark band within the broad yellow band tapers to a point at the posterior margin. *Zagrammosoma buselus* is similarly colored (Fig. 2.6), however, the median dark band extends onto the mesoscutum, and the mesoscutellum is completely yellow, as opposed to yellow flanked by black in *Z. flavolineatum*. The wing patterns also differ between the species (Figs 2.5C versus 2.15C).

Description: Female - body length 1.18–2.12 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe present. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with one wide dark, band vertically. Pronotum with median stripe complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe

absent. Mesoscutellum black with yellow, median band. Propodeum all black. Procoxa and mesocoxa yellow. Metacoxa yellow, basally black. Profemur and mesofemur yellow. Metafemur with black banding encircling femur. Fore wing: basal band absent; cubital band present; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connection from parastigmal band to stigmal band absent or present; connection from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma all black.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.8–0.93); second subequal or wider than long (w:l = 1.0–1.53).

Pronotum, in dorsal view, bell-shaped (w:l = 1.28–1.5); 3–6 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum wider than long (w:l = 1.053–1.11); submedian grooves absent. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus shorter than second tarsomere (bst:2^{nd} = 0.75–0.93).

Fore wing l:w = 2.07–2.55. Submarginal vein with 5–7 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.72–0.97 mm; occiput with 2 dark, vertical stripes; propodeum all back, or with faint yellow markings; metafemur with uninterrupted stripe dorsally, or with black banding encircling femur; uncus

originating on stigma by length of uncus or less from stigmal apex; metasoma yellow, with large dark spot dorsoapically on Gt_3 – Gt_6.

Remarks: Crawford (1913) described *Z. flavolineatum* based on one female specimen from Colorado. Gordh (1978) mentions the degree of similarity between *Z. flavolineatum* and *Z. mirum*, and personal examination of the holotypes reveals that the only difference is that *Z. flavolineatum* has a pale propodeal callus, whereas *Z. mirum* has a completely dark propodeum including the callus. The colors on the propodeum can be variable within species in other *species of Zagrammosoma* and related genera (Perry & Heraty, submitted), and I see no reason to separate the two species. The majority of examined specimens were identified as *Z. mirum*, which is understandable as the differences are slight.

Hosts: Recovered from lepidopteran and dipteran leaf miners. See Table 2.3. **Diptera**: Agromyzidae. **Lepidoptera**: Gelechiidae, Gracillariidae, Tischeriidae.

Distribution: Nearctic: USA (CA, CO, WA). **Oceania:** USA (HI) (Fig. 2.16).

Etymology: Flavolineatum is Latin for “having a yellow line,” describing the wide, yellow band dorsally on the mesosoma.

Additional material examined: USA: California: Contra Costa Co., 2.5 mi. SE Brentwood, 17m, *37°53'47"N*, *121°39'53"W*, 23.iii.1987, L. Varela [1♀, USNM: UCRCENT471549]. **El Dorado Co.**, nr. Auburn, 446m, *38°52'58"N*, *121°01'36"W*, 3.ix.1982, D.L. Wagner, JAP No. 82J11, host: *Tischeria* sp. [1♀, USNM: UCRCENT471551]. **Fresno Co.**, 5 mi. SE Clovis, *36°45'53"N*, *119°38'29"W*, 15.viii.1986, L. Varela [2♀, EMEC: EMEC84283, USNM: UCRCENT471548]. **Los Angeles Co.**, Alhambra, 145m, *34°05'34"N*, *118°07'29"W*, ix.1921, M. Campbell [1♀, UCRC: UCRCENT485729]. "mountains near Claremont", 500m, *34°08'37"N*, *117°43'23"W* [1♀, USNM: USNM type no. 20089-**Holotype** of *Zagrammosoma mirum* Girault]. Pasadena, 255m, *34°09'13"N*, *118°09'45"W*, viii.1913, J.E. Graf, Chittenden No. 22300, host: *Phthorimaea operculella* [1♀, UCRC: UCRCENT312370]. Pasadena, 255m, *34°09'13"N*, *118°09'45"W*, viii.1915, J.E. Graf, Chittenden No. 22300, host: *Phthorimaea operculella* [1♂, USNM: UCRCENT471550]. Shinn Rd. at Lower San Antonion USFS Sta. Angeles National Forest, 760m, *34°10'44"N*, *117°40'32"W*, 31.xii.1977, D. Bramlet [1♀, UCRC: UCRCENT312371]. **Mendocino Co.**, Ukiah, *39°08'54"N*, *123°12'32"W*, 3.x.1960, L.W. Shainberg, host: *Liriomyza munda* [2♀, UCDC: UCRCENT477956, 477957]. **Nevada Co.**, 17 mi. N. Truckee, *39°31'55"N*, *120°18'19"W*, 23.vii.1970, E.E. Grissell [1♀, UCDC: UCRCENT477954]. Boca, 1692m, *39°23'10"N*, *120°05'39"W*, 22.vii.1970, E.E. Grissell, Great Basin Desert [2♀, FSCA: UCRCENT424530, UCRC: UCRCENT477963]. Sagehen Crk, 1990m, *39°25'28"N*, *120°14'34"W*, 22.vii.1970, R.M. Bohart [1♀, UCDC: UCRCENT477919]. Sagehen Crk, 1990m,

39°25'28"N, *120°14'34"W*, 8.vi.1970, E.E. Grissell [2♀, UCDC: UCRCENT477920, 477921]. **Orange Co.**, Santa Ana, 34m, *33°44'38"N*, *117°51'59"W*, 13.viii.1936, J.C. Elmore & A.F. Howland, host plant: tomato [4♀, UCRC: UCRCENT312285–88]. **Placer Co.**, Auburn, *38°53'56"N*, *121°04'54"W*, viii.1952, K.S. Hagen, host: *Phyllonorycter crataegella* [8♀, EMEC: EMEC84284–84291]. Auburn, 400m, *38°53'56"N*, *121°04'54"W*, viii.1952, H.K. Madsen, host: *Phyllonorycter crataegella* [1♂ 2♀, USNM: UCRCENT471544–471546]. Ophir, 223m, *38°53'28"N*, *121°07'25"W*, 26.viii.1952, W.H. Lange, host: *Phyllonorycter crataegella* [1♂ 4♀, USNM: UCRCENT471539–471543]. **Riverside Co.**, Bautista Canyon, 855m, *33°39'0"N*, *116°48'42"W*, 10.x.1989, J. Hazen [3♀, ANIC: UCRCENT238600–02]. Corona, 229m, *33°52'10"N*, *117°33'45"W*, 31.x.1931, A.J. Barnig, host: *Keiferia lycopersicella* [1♀, UCRC: UCRCENT312293]. Corona, 231m, *33°52'10"N*, *117°33'41"W*, 23.x.1932, A.J. Basinger, host: *Keiferia lycopersicella* [1♀, UCRC: UCRCENT312368]. Hwy 74, Garner Vly., Fobes Ranch Rd., 1372m, 33°38'41"N, 116°37'34"W, 20.vi.2014, R.K. Perry, Sweep, RP14/010 [1♀, UCRC: UCRCENT312350 (**D4111**)]. Lake Skinner, NE (Met B11), 482m, 33°36'7"N, 117°02'5"W, 7–21.v.1996, J. D. Pinto, burned coastal sage scrub, malaise trap [1♀, UCRC: UCRCENT312316]. Lake Skinner, NE end, 487m, 33°36'7"N, 117°02'5"W, 21.v–4.vi.1996, J.D. Pinto, coastal sage scrub, malaise trap, MET B11 BURNED [2♀, UCRC: UCRCENT312289, 312290]. Santa Rosa Plat. Res., 590m, 33°31'0"N, 117°14'0"W, 18.vii.2001, sweep, *Quercus* sp. [1♂, UCRC: UCRCENT56360]. Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W,

31.viii–7.ix.2008, G. Pratt, malaise trap [1♂ 1♀, UCRC: UCRCENT357526 (**D3668**), 395941]. Whitewater Canyon Rd., 546m, 33°57'30"N, 116°38'50"W, 18.vi.2013, J. Mottern, sweep, M13-025 [1♀, UCRC: UCRCENT410536 (**D3840**)]. **Sacramento Co.**, Sacramento, 4m, *38°34'11"N*, *121°30'6"W*, 13.viii.1951, W.H. Lange, host: *Tischeria* sp. [1♂ 1♀, USNM: UCRCENT471535, 471536]. Sacramento, 4m, *38°34'11"N*, *121°30'6"W*, 18.viii.1951, W.H. Lange, host: *Tischeria* sp. [1♀, BMNH: NHMUK10370161]. Sacramento, 4m, *38°34'11"N*, *121°30'6"W*, 23.viii.1951, W.H. Lange, frequenting strawberries [3♀, USNM: UCRCENT471532–471534]. Sacramento, 4m, *38°34'11"N*, *121°30'6"W*, 5.viii.1951, W.H. Lange, host: *Tischeria* sp. [1♂, USNM: UCRCENT471538]. Sacramento, 4m, *38°34'11"N*, *121°30'6"W*, 6.viii.1951, W.H. Lange, host: *Tischeria* sp. [1♂, USNM: UCRCENT471537]. **San Bernardino Co.**, 6 mi. NW Fawnsksin, 2086m, *34°19'9"N*, *117°00'36"W*, 16.v.1997, M. Gates, LM97-3006, host: upper blotch mine, host plant: *Ceanothus greggii* [1♀, UCRC: UCRCENT312291]. Ironwood Cpgrd., 2130m, 34°18'15"N, 117°00'44"W, 22.vii.1999, M. Gates [1♀, UCRC: UCRCENT102517]. Mill Creek Canyon, Hwy 38, 996m, 34°05'59"N, 117°01'59"W, 23.xi.2008, A.J. Ballman, EW08/021 [1♀, UCRC: UCRCENT183659]. Mill Creek Canyon, Hwy 38, 996m, 34°05'59"N, 117°01'59"W, 27.ix.2008, A.J. Ballman, EW08/003 [1♂, UCRC: UCRCENT183573]. Mill Creek Hwy 38, 970m, 34°06'2"N, 117°01'28"W, 30.ix.2012, J. Herreid [1♂, UCRC: UCRCENT498899]. Mill Creek, Hwy 38, 962m, 34°10'14"N, 117°02'43"W, 30.ix.2012, E. Gordon [3♂ 2♀, UCRC:

UCRCENT498894–498898]. Mill Creek, 1220m, *34°05'50"N*, *116°58'57"W*, 12.viii.1945, Timberlake [1♀, UCRC: UCRCENT312367]. Mill Creek, Hwy 138, 970m, 34°06'2"N, 117°01'28"W, 30.ix.2012, R. Perry [1♀, UCRC: UCRCENT498900]. Mojave River Forks ~9 mi. S. Hesperia, 966m, *34°19'51"N*, *117°15'48"W*, 2.v.1985, J.D. Pinto [1♀, ANIC: UCRCENT238211]. Oak Glen, 1462m, *34°02'59"N*, *116°56'53"W*, 20.iv.1986, M. Smith [1♀, UCDC: UCRCENT477958]. S. Bern. Mtns. Barton Flat Radford Camp Rd at Santa Ana Riv., 1649m, *34°11'7"N*, *116°54'13"W*, 3.vii.1984, J. LaSalle [1♀, ANIC: UCRCENT238212]. **San Diego Co.**, Torrey Pines State Park, 105m, *32°55'8"N*, *117°14'57"W*, 19.vi.1996, M. Gates & D. Hawks, host: *Nealyda* sp., host plant: *Abronia maritima* [1♂, UCRC: UCRCENT498884]. **Santa Barbara Co.**, Sedgwick Reserve, 45km NW. Santa Barbara, *34°44'28"N*, *120°01'18"W*, 28.v.1997, E. Schlinger, Malaise Trap [1♂, UCDC: UCRCENT477962]. **Shasta Co.**, 10km N. Lakehead, 353m, *40°54'19"N*, *122°22'40"W*, 6.ix.1995, L.A. Baptiste, Solidago, sweep [3♂, UCDC: UCRCENT477959–477961]. **Solano Co.**, Cold Canyon Reserve, 11 km W. Winters, 98m, *38°30'28"N*, *122°05'49"W*, 25.iv.1993, S.L. Heydon, off *Eriodictyon* sp. [1♀, UCDC: UCRCENT477955]. **Sonoma Co.**, Cloverdale, 110m, *38°48'9"N*, *123°01'22"W*, 15.viii.1926, D.H. [1♀, UCRC: UCRCENT312292]. **Tulare Co.**, 398m, *36°34'21"N*, *119°11'45"W*, 19.xi.2009, S. Kharrat, host: *Phyllocnistis citrella*, host plant: Pummelo [1♀, UCRC: UCRCENT292445]. Carson Ave/1/4 mile Rd 228, 511m, 36°21'49"N, 119°03'18"W, 3.xii.2009, S. Kharrat, Kaffir lime, host: *Marmara gulosa*, host plant:

Citrus [1♂, UCRC: UCRCENT237326]. **Ventura Co.**, 7 mi. W. of Ojai, *34°25'15"N*, *119°20'28"W*, host plant: mallow [1♀, UCRC: UCRCENT312369]. **Yolo Co.**, Coyote Gulch Exper. Ecosystem, 2km SW Davis, 17m, *38°31'38"N*, *121°46'59"W*, 24.ix–7.x.2001, MT [1♀, UCDC: UCRCENT477918]. **Hawaii: Honolulu Co.**, Eva Beach, 2m, *21°18'55"N*, *158°00'7"W*, ii.1960, J.W. Beardsley, T.H. light trap [2♀, ANIC: UCRCENT238213, 238214]. **Washington: Chelan Co.**, Wenatchee, *47°25'27"N*, *120°18'50"W*, vi.1985, B. Barrett, host: *Phyllonorycter elmaella* [1♀, USNM: UCRCENT471547].

8. *Zagrammosoma galapagoense* Perry, n. sp.

Fig. 2.17.

Diagnosis: The most visible character defining *Z. galapagoense* is the dark, transverse stripe running along the posterior margin of the mesoscutum (Fig. 2.17D, E). The mesosomal patterns are very similar to *Z. multilineatum* and *Z. deliae*, however the wing patterns are slightly different between the species, and *Z. galapagoense* is the only species of the three to possess two rows of admarginal setae, compared to one in the other two species (Figs 2.17C versus 2.14C, 2.33C), The submedian grooves are absent in *Z. galapagoense* and present in the other two species. The second funicular in *Z. multilineatum* is longer than wide, but wider than long in *Z. galapagoense*.

Description: Female - body length 1.12–1.57 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe present. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median stripe complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe complete. Mesoscutellum yellow with three dark stripes. Propodeum yellow with black: median carina, anterior and posterior margins, diagonal line connecting anterior and posterior margins. Procoxa and mesocoxa yellow. Metacoxa yellow; basally with black stripe. Profemur and mesofemur yellow. Metafemur with uninterrupted stripe dorsally. Fore wing: basal band absent; cubital band present; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than that of the stigmal apex; connection from parastigmal band to stigmal band absent; connection from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow with dark median and transverse stripes present.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide or subequal (w:l = 0.83–1.0); second wider than long (w:l = 1.2–1.5).

Pronotum, in dorsal view, bell-shaped (w:l = 1.34–1.57); 4–5 pairs of setae on posterior margin. Mesoscutum reticulate; small, scattered setate present; intermediate setae present. Mesoscutellum wider than long (w:l = 1.12–1.18);

submedian grooves absent. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere, (bst:2^{nd} = 1.11–1.24).

Fore wing l:w = 2.07–2.55. Submarginal vein with 5–6 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.83mm (only one male examined); submarginal vein with 5 setae dorsally.

Remarks: One of two endemic species in the Galapagos Islands, *Z. galapagoense* is much more rarely encountered than the other two species found in the archipelago, *Z. buselus* and *Z. multilineatum*. Only ITS2 was successfully amplified in one specimen (**D5888**), and emerges distinct from the other two species in the archipelago (Fig. 2.2)

Hosts: unknown.

Distribution: Neotropical: Ecuador (Galapagos) (Fig. 2.7).

Etymology: Named after the Galapagos Islands.

Type Material: Holotype: ECUADOR: Galapagos: Isabela Island, Cerro Azul, 3km W. Caleta Iguana, 300m, *0°57′22″S*, *91°26′36″W*, 20.v.1991, J. Heraty, pampa, H91-045 [1♀, UCRCENT491716]. Deposited at UCRC.

Paratypes: ECUADOR: Galapagos: Isabela Island, Alcedo, 7km SW NE Playa, 600m, *0°26′25″S*, *91°02′58″W*, 25.vi.1991, J. Heraty, H91-118 [1♂, UCRC: UCRCENT491719]. Alcedo, NE Playa, 0m, *0°20′40″S*, *91°02′50″W*, 26.vi.1991, J. Heraty, arid ravine, H91-120b [1♀, UCRC: UCRCENT491729]. Cerro Azul, Caleta Iguana, 300mm, *0°56′7″S*, *91°27′30″W*, v.1991, John Heraty, pampa transition, H91-060 [1♀, UCRC: UCRCENT491717]. **Pinzon Island**, 2.5 km SE Pl. Escondido, 395m, *0°36′39″S*, *90°40′2″W*, 27.vi.1991, J. Heraty, scrub, H91-122 [2♀, UCRC: UCRCENT410533, 491718]. **Rabida Island**, NE Coast, SE of beach, 250m, *0°24′38″S*, *90°42′16″W*, 2.vi.1991, J. Heraty, H91-072 [1♀, UCRC: UCRCENT491723]. **Santiago Island**, 7 km SE Playa Espumilla, *0°15′18″S*, *90°47′42″W* [1♀, UCRC: UCRCENT410534]. **Santa Cruz Island,** Bellavista agric. zone, 160m, *0°42′12″S*, *90°19′36″W*, 1–9.iv.1989, Peck & Sinclair, field, FIT, 89-205 [1♀, UCRC: UCRCENT444410]. Los Gemelos, 600m, *0°37′35″S*, *90°23′0″W*, 13.vi–15.vii.1985, S. & J. Peck, *Scalesia* Forest, FIT & MT, 85-188b [1M♂ 1F♀, CNC: CNC508658 (**D5888**), 508659].

9. *Zagrammosoma headricki* Perry n. sp.

Fig. 2.18.

Diagnosis: *Zagrammosoma headricki* is characterized by a dark metasoma, and mesosoma that is almost the color inverse of other *Zagrammosoma*. The dark mesosoma displays yellow lines that follow the interior margins of the notaulus and axillae. The mesoscutellum is also dark, except for the outer margins, which are light yellow (Fig. 2.18D, E). The parastigmal band also connects with the cubital band (Fig. 2.18C), and the cubital band is occasionally wide enough to reach the posterior margin of the fore wing. The face is similar to *Z. hobbesi*, with the "tiger stripes" present, but the wing patterns are different (Fig. 2.18C vs 20C), and there is no yellow found on the mesoscutellum of *Z. hobbesi* (Fig. 2.20D, E).

Description: Female - body length 0.77–1.6 mm. Metallic luster on body absent. Scape yellow, dorsally with black stripe. Two vertical stripes on lower face present. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput dark, with no yellow stripes, or with 5 dark stripes radiating outwards from occipital foramen (Fig. 2.18D). Pronotum dark, dorsally with yellow stripes on lateral margins; laterally with 2 dark stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum dark, with yellow along notaulus; median stripe rarely visible (Fig. 2.18D). Mesoscutellum all black, or with three faint dark stripes that are difficult to distinguish from surrounding dark coloration. Propodeum dark with yellow on lateral margins. Procoxa yellow or dark. Mesocoxa all yellow, all dark, or yellow and basally dark. Metacoxa yellow or dark. Profemur

yellow. Mesofemur all yellow or yellow with dark spot dorsally. Metafemur yellow or dark, or with dark banding encircling femur. Fore wing: basal band absent; cubital band present; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than that of the stigmal-parastigmal band reaching cubital band and posterior margin of wing; connection from parastigmal band to stigmal band absent; connection from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma all dark, or with faint yellow on base of Gt_1.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first wider than long (w:l = 1.25–1.29); second wider than long (w:l = 1.55–2.08).

Pronotum, in dorsal view, more than twice as wide as long (w:l = 2.12–2.38); 3–5 pairs of setae on posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae absent. Mesoscutellum wider than long (w:l = 1.14–1.23); submedian grooves absent. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus shorter than second tarsomere (bst:2^{nd} = 0.7–0.83).

Fore wing l:w = 2.2–2.52. Submarginal vein with 5–6 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present in one or two rows. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.8–1.01 mm; scape all yellow, or yellow with black stripe dorsally; occiput with 2 dark, vertical stripes present or absent (Fig. 2.18E).

Remarks: The dark coloration on the mesoscutum is sometimes faint enough to see the median dark stripe (Fig. 2.18D) that is present in the majority of other *species of Zagrammosoma*.

Hosts: Recovered from a coleopteran leaf miner and a variety of leaf miners of unknown orders. See Table 2.3. **Coleoptera**: Chrysomelidae: *Monoxi* sp.

Distribution: Nearctic: Mexico (SL), USA (AZ, CA, TX) (Fig. 2.19).

Etymology: This is the first new species of *Zagrammosoma* that I discovered, and it is named in honor of Dr. David Headrick, my first graduate school advisor and my inspiration to pursue a Ph.D. in entomology.

Type Material: Holotype: USA: Oregon: Lane Co., H.J. Andrews Exp. For. Frissell Point, 1479m, *44°12'57"N*, *122°06'3"W*, 15.viii.1984, M.E. Schauff & E.E. Grissell, meadow [1♀, UCRCENT471443]. Deposited at USNM.

Paratypes: MEXICO: San Luis Potosi: 28.5 mi. S. Huizache, 1510m, *22°35'32"N*, *100°35'36"W*, 4.vii.1985, J.B. Woolley & G. Zolnerowich, 85/024 [1♀, TAMU: UCRCENT426799 (**D4573**)]. **USA: Arizona: Yavapai Co.**, W. of Seligman, 1600m, 35°20'0"N, 112°54'50"W, 27.vii.2008, S. Triapitsyn [1♀, UCRC: UCRCENT250517]. **California: Coconino Co.**, Williams area, 2065m, 35°14'58"N, 112°11'27"W, 26.vii.2008, S. Triapitsyn [1♀, UCRC:

UCRCENT249860]. **Riverside Co.**, Lake Skinner (NE end), 33°36'7"N, 117°02'5"W, 21.v–4.vi.1996, J. D. Pinto, Coastal Sage Scrub, malaise trap [1♀, UCRC: UCRCENT312323]. **Sonoma Co.**, 2 mi. S. Plantation, 278m, *38°34'19"N*, *123°17'47"W*, 19.vi.1986, host: *Monoxia* sp [1♀, USNM: UCRCENT471439]. **Oregon: Lane Co.**, H.J. Andrews Exp. For. Frissell Point, 1479m, *44°12'57"N*, *122°06'3"W*, 15.viii.1984, M.E. Schauff & E.E. Grissell, meadow [1♂, USNM: UCRCENT471445]. **Texas: Brewster Co.**, Big Bend Natl. Pk., Croton Spr., 914.4m, *29°20'40"N*, *103°20'47"W*, 6.vii.1986, J. Heraty [1♀, UCRC: UCRCENT312352]. **Hidalgo Co.**, Bentsen-Rio Grande Park; Resaca Vieja Trail, 33m, 26°10'51"N, 98°22'57"W, 16.iv.2010, J. Mottern, sweep, M10-024 [1♀, UCRC: UCRCENT414577 (**D3861**)]. **Jim Wells Co.**, 8 mi. W. Ben Bolt La Copita Res. Station, 85m, *27°38'5"N*, *98°12'26"W*, 20.v.1987, J. B. Woolley, 87/004 [1♂, UCRC: UCRCENT312326].

Additional material examined: USA: Arizona: Cochise Co., Chiricahua Mts., SWRS swimming pool, 1525m, *31°53'1"N*, *109°12'19"W*, 5.v.1980, V. Roth [1♀, CNC: CNC508716]. **Coconino Co.**, 5 mi. W. Williams, 2013m, *35°13'57"N*, *112°17'23"W*, 14.viii.1983, G. Gordh [1♀, UCRC: UCRCENT312325]. **California: Fresno Co.**, Coalinga, 200m, *36°08'35"N*, *120°21'5"W*, 1.v.1951, C.G. Kennett, host plant: *Erodium cicutarium* [1♀, EMEC: EMEC84300]. **Inyo Co.**, 22 mi. W. Panamint Springs, 1433m, *36°20'1"N*, *117°44'13"W*, 7.v.1961, D.Q. Cavagnaro [1♀, CNC: CNC508717]. **Marin Co.**, Mill Valley, Richardson Bay, *37°53'52"N*, *122°31'29"W*, 30.vi.1979, salt marsh [1♀, UCRC: UCRCENT498997]. **Orange**

Co., Newport Beach, *33°37'24"N*, *117°55'23"W*, 23.vii.1984, H. Andersen [1♀, UCRC: UCRCENT485741]. **Riverside Co.**, 43455 Sage St., Temecula, 393m, *33°30'39"N*, *117°04'52"W*, 24.iv.1997, M. Johnson, host plant: *Lycium* sp. [1♀, UCRC: UCRCENT312351]. Thousand Palms, 66m, *33°48'47"N*, *116°23'31"W*, 20.xi.1955, W.R. Richards [1♀, UCRC: UCRCENT312324]. **San Bernardino Co.**, 14 mi. N. 29 Palms on Mesquite Spring Rd., 552m, *34°14'39"N*, *116°04'50"W*, 12.iv.1984, J.T. Huber [1♀, CNC: CNC508715]. Yermo, *34°54'23"N*, *116°50'10"W*, 28.iii.1972, E.L. Paddock, host plant: *Atriplex* [1♀, USNM: UCRCENT471447]. **Sonoma Co.**, 2 mi. S. Plantation, 278m, *38°34'19"N*, *123°17'47"W*, 19.vi.1986, host: *Monoxia* sp [1♀, USNM: UCRCENT471440]. **Stanislaus Co.**, Del Puerto Canyon Road 3.6 road miles west of Diablo Grande Parkway up canyon north of creek, 150m, 37°28'29"N, 121°14'19"W, 30.vi.2009, R.L. Zuparko, host plant: grass [1♀, EMEC: EMEC84317]. **Colorado: Boulder Co.**, 1 km SW Allenspark, 2800m, *40°11'21"N*, *105°32'13"W*, 12.vii.1993, S.L. Heydon [1♀, UCDC: UCRCENT415802]. **Nevada: Lander Co.**, 7.5 km ESE Austin, 2185m, 39°27'47"N, 116°59'52"W, 6.viii.1998, L. Baptiste & T. Gonsalves, Sweep [1♀, UCDC: UCRCENT415801]. **Oregon: Lane Co.**, H.J. Andrews Exp. For. Frissell Point, 1479m, *44°12'57"N*, *122°06'3"W*, 15.viii.1984, M.E. Schauff & E.E. Grissell, meadow [2♀, USNM: UCRCENT471442, 471444]. H.J. Andrews Exp. For. Frissell Point, 1479m, *44°12'57"N*, *122°06'3"W*, 15.viii.1984, M.E. Schauff & E.E. Grissell, roadside vegetation [1♀, USNM: UCRCENT471446]. **Utah: Box Elder Co.**,

Garland, *41°44'22"N*, *112°09'36"W*, 28.ix.1929, M.F. Bowen, host plant: beets [1♀, USNM: UCRCENT471441].

10. *Zagrammosoma hobbesi* LaSalle

Fig. 2.20.

Zagrammosoma hobbesi LaSalle, 1989: 231–236. Holotype ♀ [examined]. Locality: USA, California, Summit Valley, 14.v.1985, G. Gordh, host plant: *Eriodictyon*. Depository: USNM, UCRCENT471571.

Diagnosis: The main diagnostic characters for *Zagrammosoma hobbesi* are the combination of an all-black body and black “tiger stripes” on the yellow face (Fig. 2.20A). This is very similar to *Z. headricki* (Fig. 2.18A), however, the funiculars of *Z. hobbesi* are both longer than wide, whereas they are both wider than long in *Z. headricki.* As well, the parastigmal band does not reach the cubital fold of the fore wing in *Z. hobbesi* (Fig. 2.20C).

Description: Female - body length 1.37–2.9 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with dark median band. Vertex with 2 stripes above compound eye. Gena dark, with yellow spot at ventral margin. Occiput black with median yellow stripe. Pronotum black; no stripes laterally. Mesoscutum black. Propodeum black. Procoxa, mesocoxa, and metacoxa dark. Profemur and mesofemur yellow. Metafemur yellow with dark banding encircling

femur. Fore wing: basal band absent; cubital band absent; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connections from parastigmal band to stigmal band, and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma dark.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.61–0.73); second longer than wide (w:l = 0.88–0.93).

Pronotum, in dorsal view, bell-shaped (w:l = 1.61–1.8); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum subequal or wider than long (w:l = 1.0–1.14); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus subequal in length to 2nd tarsomere (bst:2nd = 1.0).

Fore wing l:w = 2.44–2.47. Submarginal vein with 5–8 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 1.11–1.5 mm; metasoma black or with faint yellow medially (Fig. 2.20E).

Remarks: This is a commonly collected species in the mountains in San Bernardino County, California, and should be easily distinguished from the other species of *Zagrammosoma* by the wing patterns and face markings.

Hosts: Recovered from lepidopteran leaf miners. See Table 2.3. **Lepidoptera**: Gelechiidae.

Distribution: Nearctic: USA (CA) (Fig. 2.21).

Etymology: Named after the tiger “Hobbes” from the Calvin & Hobbes comic, as this species has yellow and black stripes on the face, similar to a tiger.

Material Examined: Paratypes: USA: California: San Bernardino Co., Mojave River Forks ~9 mi. S. Hesperia, 966m, *34°19'51"N*, *117°15'48"W*, 2.v.1985, J.D. Pinto [5♂ 5♀, ANIC: UCRCENT238204–238209, BMNH: NHMUK10370160, 10370166, CNC: CNC508713, 508714]. Summit Valley, 1040m, *34°19'14"N*, *117°23'2"W*, 14.v.1985, G. Gordh, host plant: *Eriodictyon* sp. [3♂ 9♀, UCRC: UCRCENT312253–312264]. Summit Valley, 1040m, *34°19'14"N*, *117°23'2"W*, 14.v.1985, G. Gordh, host plant: *Haplopappus* sp. [3♂ 9♀, UCRC: UCRCENT312253–312264]. Summit Valley, 1040m, 34°19'14"N, 117°23'4"W, 14.v.1985, G. Gordh [3♀, USNM: UCRCENT425340–425342]. Verdemont, 544m, *34°11'50"N*, *117°21'10"W*, 25.iv.1946, A.L. Melander, host: *Coelopoeta* sp., host plant: *Phacelia* sp. [1?, USNM: UCRCENT425345]. **Sonoma Co.**, 1 mi. SE Bodega Bay, 14m, *38°19'20"N*, *123°02'9"W*, 20.v.1983, D.L. Wagner, JAP No. 83D109, host: *Coelopoeta* sp., host plant: *Phacelia* sp. [3♀, USNM: UCRCENT425343, 425344, 425428].

Additional material examined: USA: California: San Bernardino Co., jct. 138 & Lone Pine Canyon rd., 1002m, 34°18'57"N, 117°29'43"W, 18.v.2008, D. Yanega [1♀, UCRC: UCRCENT226454]. Mill Creek Cyn. X Hwy 38 & Forest Falls turnoff, 1400m, 34°05'45"N, 116°57'11"W, 8.v.1996, M. Gates, host plant: *Eriodictyon trichocalyx* [1♀, UCRC: UCRCENT414305]. Mojave River Forks ~9 mi. S. Hesperia, 966m, *34°19'51"N*, *117°15'48"W*, 2.v.1985, J.D. Pinto [1♂, ANIC: UCRCENT238210]. Mormon Rocks, Hwy 138, 1034m, *34°19'10"N*, *117°30'16"W*, 8.v.2013, R. Perry, sweep [1♀, UCRC: UCRCENT395931 (**D3703**)]. San Bernardino Natl. Forest, 985m, 34°06'2"N, 117°01'29"W, 7.iv.2014, R. Perry, sweep, RP14/005 [1♀, UCRC: UCRCENT414594 (**D4000**)].

11. *Zagrammosoma interlineatum* Girault stat. rev.

Fig. 2.22.

Zagrammosoma interlineata Girault, 1916a: 125–126. Holotype ♀ [examined]. Locality: USA, Washington D.C., 6.x.1880. Type depository: USNM type no. 19641 - UCRCENT471659.

Zagrammosoma interlineatum Girault, 1916. Justified emendation by Peck, 1951: 459.

Cirrospilus interlineatus (Girault, 1916). Unjustified combination and spelling by Herting 1975: 28.

Diagnosis: Specimens of *Zagrammosoma interlineatum* have usually been identified as *Z. americanum* and *Z. multilineatum*, as the differences between the species are slight. *Zagrammosoma interlineatum* lacks any dark coloration between the notaulus and anterior margin of the mesoscutum (Fig. 2.22D, E), unlike both *Z. americanum* (Fig. 2.4D, E) and *Z. multilineatum* (Fig. 2.33D, E). *Zagrammosoma americanum* also possesses a dark, transverse stripe underneath the posterior margin of the pronotum. The fore wing of *Z. interlineatum* has a subcircular dark patch posterior to the stigmal vein (Fig. 2.22C), and the pattern in *Z. multilineatum* resembles a "w" in shape (Fig. 2.33C). A median stripe on the lower face is present in *Z. multilineatum* and absent in *Z. interlineatum*.

Description: Female - body length 1.8–2.02 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median strip complete; laterally with 2 dark stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe complete. Mesoscutellum yellow with three dark stripes. Propodeum yellow with black: median carina, anterior and posterior margins, diagonal line connecting anterior and posterior margins. Procoxa and mesocoxa yellow. Metacoxa yellow with black stripe basally. Profemur and mesofemur yellow. Metafemur yellow with interrupted stripe dorsally. Fore wing: basal and cubital bands absent; parastigmal band

present, with perpendicular extension less than or equal to that of stigmal apex; stigmal band present, with perpendicular extension greater than that of the stigmal apex; postmarginal band present, with perpendicular extension across 75% or more of fore wing width; connections from parastigmal band to stigmal band absent, and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow with dark median and transverse bands.

Upper ocular sulcus present. Pedicel longer than wide or subequal. Funiculars symmetrical: first longer than wide (w:l = 0.57–0.7); second longer than wide (w:l = 0.8).

Pronotum, in dorsal view, bell-shaped (w:l = 1.37–1.5); 4–5 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae present. Mesoscutellum wider than long (w:l = 1.05–1.16); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus subequal or longer than second tarsomere (bst:2^{nd} = 1.04–1.14).

Fore wing l:w = 2.37–2.48. Submarginal vein with 7–8 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 1.07–1.62 mm; occiput yellow, or yellow with 2 dark, stripes; postmarginal band present, with perpendicular extension greater than that of stigmal apex, but not across 75% or more of fore wing width; metafemur yellow; metasoma with markings fainter than those in females.

Remarks: Gordh (1978) synonymized *Z. interlineatum* with *Z. multilineatum* due to a lack of structural characters to differentiate the two species and the color patterns falling within the range of *Z. multilineatum*. Girault (1916a) also mentions a metallic line on the metasoma, however, there are no metallic markings on this species. *Zagrammosoma interlineatum* was not successfully sequenced, but the color characters are informative, most notably in the wing and mesosoma patterns, and the species status is revised.

Girault (1916a) did not designate paratypes for *Z. interlineatum*, but there are a series of specimens housed at the USNM with type labels bearing the number 9641 (UCRCENT471478–471481). Girault (1916a) mentions that the holotype number is 19641, and the specimens from the 9641 series agree with the holotype.

Hosts: Recovered from coleopteran, dipteran, and lepidopteran leaf miners. See Table 2.3. **Coleoptera**: Curculionidae. **Diptera**: Agromyzidae. **Lepidoptera**: Cosmopterigidae, Gelechiidae, Gracillariidae, Heliozelidae, Tischeriidae.

Distribution: Nearctic: Canada (ON), USA (AR, CA, CT, FL, IN, KS, KY, MA, MD, MS, NC, OH, PA, SD, TN, VA, Washington D.C.) (Fig. 2.23).

Material Examined: Paratypes: USA: Washington D.C.: 3m, *38°52'41"N*, *77°00'44"W*, 5.viii.1905, Quaintance, No. 1198, host: *Coptotriche malifoliella* [4♀, USNM: UCRCENT471478–471481].

Additional material examined: CANADA: Ontario: Campbellford, 145m, *44°18'12"N*, *77°47'58"W*, 15.viii.1957, host: *Cameraria hamadryadella* [1♀, BMNH: NHMUK10370157]. Campbellford, 145m, *44°18'12"N*, *77°47'58"W*, 8.viii.1957, host: *Cameraria hamadryadella* [1♀, CNC: CNC508711]. Port Colborne, 179m, *42°53'4"N*, *79°15'6"W*, 10.x.1934, D. Gray [1♀, CNC: CNC508710]. Sioux Lookout, 50°05'47"N, 91°54'50"W, 21.iv.1968, host: *Lithocolletis* sp [1♀, CNC: CNC508664]. Vineland, 116m, *43°09'2"N*, *79°23'37"W*, 11.viii.1925, W.G. Garlick [1♀, CNC: CNC508709]. **USA: Arkansas: Johnson Co.**, 205m, *35°32'27"N*, *93°25'55"W*, 1957, L.O. Warren, host plant: Pine [1♀, USNM: UCRCENT471468]. **Connecticut: New Haven Co.**, East River, 7m, *41°17'9"N*, *72°38'55"W*, ix.1911, C.R. Ely, host: *Antispila nysaefoliaella* [1♂ 1♀ 1?, USNM: UCRCENT471470–72]. **Florida: Leon Co.**, Tallahassee, *30°26'18"N*, *84°16'50"W*, x.1985, P. Stilling, host: *Stilbosis quadricustatella* [1♀, USNM: UCRCENT471455]. **Indiana: Tippecanoe Co.**, West Lafayette, 190m, *40°25'52"N*, *86°54'33"W*, 17.viii.1966, host: *Cameraria*, host plant: Oak [1♀, USNM: UCRCENT471469]. **Kansas: Douglas Co.**, 2 mi. N. Baldwin, 295m, *38°48'40"N*, *95°11'9"W*, 14.x.1978, L. Masner & G. Gibson [1♂, CNC: CNC508707]. **Riley Co.**, Manhattan, 326m, *39°10'41"N*, *96°34'34"W*, 28.vii.1933,

L.M. Copenhafer, Q1, host: *Ornix* sp. [1♀, USNM: UCRCENT471464]; 30.vii.1933, L.M. Copenhafer, Q2, host: *Ornix* sp. [1♀, USNM: UCRCENT471465]. **Kentucky: Lincoln Co.**, Crab Orchard, 290m, *37°27'51"N*, *84°30'23"W*, vi.1960, Wooten-Gibson, host: *Odontopus calceatus* [1♀, USNM: UCRCENT471486]. **Maryland: Montgomery Co.**, Glen Echo, *38°58'8"N*, *77°08'33"W*, 14.v.1922, J.R. Malloch [1♀, UCRC: UCRCENT498998]. **Massachusetts: Worcester Co.**, Harvard & Bolton, 157m, *42°28'7"N*, *71°35'41"W*, 20.vii–8.viii.1944, M.E. Tomlinson, host: *Phyllonorycter blancardella* [1♀, BMNH: NHMUK10370144]. **Mississippi: Forrest Co.**, Petal, *31°20'43"N*, *89°15'25"W*, 23.ix.1983, J.D. Pinto [1♂, UCRC: UCRCENT499018]. **North Carolina: Buncombe Co.**, Asheville, 651m, *35°35'26"N*, *82°33'3"W*, 19.v.1937, B.H. Wilford, Lot No. 37-16724, host plant: *Pinus echinata* [1♀, USNM: UCRCENT471483]. **Forsyth Co.**, Winston-Salem, 289m, *36°08'3"N*, *80°14'44"W*, 27.viii.1915, Sherman, host: *Cameraria* sp., host plant: *Quercus* sp. [1♀, USNM: UCRCENT471572]. **Lincoln Co.**, *35°28'30"N*, *81°12'56"W*, 15.v.1988, J. Walgenbach, host: *Phyllonorycter blancardella* [2♀, USNM: UCRCENT471466, USNM: UCRCENT471467 (**D6859**)]. **McDowell Co.**, 37°00'0"N, 81°30'0"W, 9–24.ix.1987, Brc Hym Team, Oak-Rhododendron, FIT [1♂, CNC: CNC508673]. **Ohio:** 302m, *40°06'19"N*, *82°49'47"W*, 1695 - “A beauty?” [1♀, USNM: UCRCENT471475]. **Licking Co.**, *40°06'16"N*, *82°27'28"W*, 10.vi.1962, F.W. Mead, host plant: *Quercus* sp. [1♀, FSCA: UCRCENT424532]. **Union Co.**, Milford Center, 300m, *40°10'46"N*, *83°26'6"W*, 12.vi.1930, J.S. Houser [3♂ 12♀ 1?, BMNH: NHMUK10370129, USNM: UCRCENT471487–501].

Pennsylvania: Butler Co., Butler, 325m, *40°51'40"N*, *79°53'40"W*, 1.viii.1968, L. Forer [1♀, USNM: UCRCENT471485]. **South Dakota: Union Co.**, Elk Point, 345m, *42°41'2"N*, *96°40'55"W*, 31.ix.1911, C.N. Ainslie, Webster No. 8870, host: *Agromyza* sp. [1♂, USNM: UCRCENT471476]. **Tennessee: Campbell Co.**, Jellico, 417m, *36°34'58"N*, *84°07'35"W*, 2.vi.1982, J.E. Corrigan [1♀, UCRC: UCRCENT414298]. **Knox Co.**, Knoxville, 304m, *35°58'4"N*, *83°54'38"W*, 13.v.1957, W.R.M. Mason [1♀, CNC: CNC508708]. **Virginia:** Falls Church, *38°52'56"N*, *77°10'16"W*, 26.vi.1913, C. Heinrich, Hopk. U.S. 11155a, host: *Cameraria quercivorella* [1♀, USNM: UCRCENT471573]. **Louisa Co.**, 4 mi. S. Cuckoo, *37°53'52"N*, *77°53'50"W*, 12–25.iv.1988, J. Kloke & D.R. Smith, malaise trap [1♂, USNM: UCRCENT471484]. **Rockingham**, Timberville, 308m, *38°38'18"N*, *78°46'32"W*, iii–iv.1948, C.M. Beckham, host: *Recurvaria nanella*, host plant: Apple [1♀, BMNH: NHMUK10370169]. **Shenandoah Co.**, nr. Mt. Jackson & Timberville, 312m, *38°41'45"N*, *78°42'9"W*, iii–iv.1946, C.M. Beckham, Lot. 46-4830, host: *Phyllonorycter crataegella*, host plant: Apple [8♀, USNM: UCRCENT471456 - USNM: UCRCENT471463]. **Washington D.C.:** *38°52'41"N*, *77°00'44"W*, 12.ix.1905, Quaintance, No. 1374 [1♂ 3♀ 3?, USNM: UCRCENT425421–425427]. 3m, *38°52'41"N*, *77°00'44"W*, 2.vii.1905, A.A. Girault, No. 1210 [1♀ 1?, USNM: UCRCENT471448, 471449]. 3m, *38°52'41"N*, *77°00'44"W*, 20.x.1905, Quaintance, No. 1645 [1♀, USNM: UCRCENT471454]. 3m, *38°52'41"N*, *77°00'44"W*, 5.vii.1905, A.A. Girault, No. 1618 [1♂ 3♀, USNM:

UCRCENT471450–471453]. 3m, *38°52'41"N*, *77°00'44"W*, 5.viii.1905, Quaintance, No. 1198 [1♀, USNM: UCRCENT471482].

12. *Zagrammosoma intermedium* Gordh

Fig. 2.24.

Zagrammosoma intermedium Gordh, 1978: 248–250. Holotype ♀ [examined]. Locality: USA, California, Palo Alto, 35m, 1947, J.W. Tilden, host: *Cameraria nemoris* (Walsingham) (Lepidoptera: Gracillariidae). Type depository: USNM type no. 75663.

Diagnosis: The color pattern on the female metasoma of *Zagrammosoma intermedium* is unlike any other species (Fig. 2.24D). The pattern is similar to *Z. centrolineatum*, however, the margins of the band are not completely straight, as they are in *Z. centrolineatum* (Fig. 2.10D). The wing patterns of *Z. buselus* and *Z. centrolineatum* are also similar, however the mesosoma color patterns of both males and females of these two species are very different (Figs 2.6D, E, 2.10D, E).

Description: Female - body length 1.65–2.31 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with

median stripe complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe complete or incomplete. Mesoscutellum yellow with three dark stripes. Propodeum yellow with black: median carina, anterior and posterior margins, spots laterally. Procoxa and mesocoxa yellow. Metacoxa yellow with darkening basally. Profemur and mesofemur yellow. Metafemur yellow, or with uninterrupted stripe dorsally. Fore wing: basal and cubital bands absent; parastigmal band present, with perpendicular extension less than or equal to that of stigmal apex; stigmal and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connections from parastigmal band to stigmal band and from stigmal band to postmarginal band absent; broad, medial patch present. Hind wing hyaline. Metasoma yellow, with wide longitudinal, dark band present dorsally.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.5–0.57); second longer than wide (w:l = 0.66–0.68).

Pronotum, in dorsal view, bell-shaped (w:l = 1.41–1.6); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae absent or present; intermediate setae present. Mesoscutellum wider than long (w:l = 1.13–1.26); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere or subequal (bst:2^{nd} = 1.0–1.18). present.

Fore wing l:w = 2.41–2.54. Submarginal vein with 5–7 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male – as female except: body length 1.44mm (only one male examined); mesoscutum with median stripe interrupted; mesoscutum with small, scattered setae absent; metasoma with black spots laterally, median stripe on Gt_3–Gt_6, and transverse stripes on posterior margins of Gt_4 and Gt_5 (Fig. 2.24E).

Remarks: Gordh (1978) described the species from one female specimen, reared from *Cameraria nemoris* (Wasingham) (family). While only five other specimens have been examined, *Z. intermedium* is valid, as the wing and mesosoma patterns are unique to the species, and is molecularly distinct, recovered sister to *Z. centrolineatum* (Fig. 2.2).

Hosts: Lepidoptera: Gracillariidae: *Cameraria nemoris* (Walsingham) on *Vaccinium ovatum* (Ericaceae).

Distribution: Nearctic: USA (CA) (Fig. 2.21).

Etymology: Intermedius is Latin for intermediate.

Additional material examined: USA: California: Marin Co., Inverness, *38°06'6"N*, *122°51'36"W*, host: *Cameraria nemoris*, host plant: *Vaccinium ovatum* [3♀ 1?, EMEC: EMEC84292–95]. **Riverside Co.**, Hwy 74, Garner Vly., Fobes Ranch Rd., 1372m, 33°38'41"N, 116°37'34"W, 20.vi.2014, R.K. Perry, Sweep, RP14/010 [1♂, UCRC: UCRCENT312377 (**D4115**)].

13. *Zagrammosoma latilineatum* Ubaidillah

Fig. 2.25.

Zagrammosoma latilineatum Ubaidillah, 2000: 223–225. Holotype ♀. Locality: Indonesia, West Java, Pangalengan, Bandung, coll. A. Rauf, 11.xi.1988, host: *Liriomyza huidobrensis* (Diptera: Agromyzidae), host plant: potato. Depository: Museum Zoologicum Bogoriense, Bogor, Indonesia.

Diagnosis: *Zagrammosoma latilineatum* has a wide, dark band dorsally on the mesosoma, which is similar to the band found in *Z. centrolineatum* and *Z. seini.* The band is wider in *Z. centrolineatum* and also continues through the metasoma (Fig. 2.10D, E). The band is wider than the band in *Z. seini*, and there is darkening of the apical margin of the fore wing in *Z. seini* (Fig. 2.37 C), which is absent in *Z. latilineatum.*

Description: Female - body length 0.84–1.6 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent.

Vertex with 2 stripes above compound eye. Gena posteriorly with wide, dark band below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median band complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with wide, dark band complete. Mesoscutellum with median band complete. Propodeum dark. Procoxa, mesocoxa, and metacoxa yellow. Profemur and mesofemur yellow. Metafemur with interrupted stripe dorsally. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal band present, with perpendicular extension less than that of stigmal apex; postmarginal band absent; connections from parastigmal band to stigmal band and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow with dark median and transverse stripes present.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide to wider than long (w:l = 0.65–1.08); second subequal or wider than long (w:l = 1.0–1.38).

Pronotum, in dorsal view, bell-shaped or more than twice as wide as long (w:l = 1.3–2.24); 3–4 pairs of bristles along posterior margin. Mesoscutum reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum wider than long (w:l = 1.06–1.11); submedian grooves present . Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus shorter than second tarsomere (bst:2nd = 0.78–0.85).

Fore wing l:w = 2.41–2.63. Submarginal vein with 4–5 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.85–1.29 mm; metasoma yellow with dark lateral margin and two median spots on $Gt_{3–4}$ and $Gt_{5–6}$.

Remarks: One of two species in the Australasian and Indo-Malayan regions, and the only species found in Australia, where it is incredibly widespread, even being found in the center of the country in the Amadeus Basin.

Hosts: Recovered from dipteran and lepidopteran leaf miners. See Table 2.3. **Diptera**: Agromyzidae. **Lepidoptera**: Gracillariidae.

Distribution: Australasia: Australia (ACT, NSW, NT, QLD, SA, WA). **Indo-Malay:** Indonesia (Fig. 2.26).

Etymology: Latilineatum is Latin for “having a wide line,” describing the dark band on the dorsum of the mesosoma.

Material Examined: Paratypes: AUSTRALIA: QLD: Emerald, at Nogoa River, 181m, *23°31'55"S*, *148°09'54"E*, 13.iv.1988, J.D. Pinto & G. Gordh [1♀, ANIC: UCRCENT238203]. **INDONESIA: West Java: Bandung**, Pangalengan, 1600m,

7°10'27"S, *107°36'20"E*, 20–28.xi.1997, host: *Liriomyza huidobrensis*, host plant: potato [1♀, BMNH: NHMUK10370158].

Additional material examined: AUSTRALIA: Australian Capital Territory: Canberra, Black Mtn., 686m, *35°16'0"S*, *149°06'0"E*, 16.iv.1968, light trap [1♀, ANIC: UCRCENT238664]. Yarralumla, 568m, *35°18'19"S*, *149°05'55"E*, 10–15.ii.1976, H. Cameron, host: *Phyllonorycter messaniella*, host plant: *Quercus* sp. [1♀, ANIC: UCRCENT238230]. **New South Wales:** Fowler's Gap Res. Stn., *31°05'16"S*, *141°42'24"E*, 29.xi–2.xii.1981, J.C. Cardale [3♀, ANIC: UCRCENT238216, 238667, 238671]. Hermidale, 226m, *31°32'43"S*, *146°43'17"E*, 20.x.1975, K.J. Hedqvist [1♀, BMNH: NHMUK10370171]. **Northern Territory:** Amadeus Basin, 502m, *24°12'39"S*, *131°09'16"E*, 20.vi.1962, P. Ranford [1♂, ANIC: UCRCENT238665]. **Queensland:** 3.5–8 km N. Chillagoe, Rd to Chillagoe Crk. xing, 314m, *17°05'47"S*, *144°30'47"E*, 27.iii.1992, E.C. Dahms & G. Sarnes [1♀, QM: UCRCENT491644]. 4 km SSE HS Noonbah Station, (NB3 M), 188m, 24°08'31"S, 143°11'46"E, 19.i–7.ii.2009, A. Emmott, sandy plain, ghost gums, MT [1♀, QM: UCRCENT241931 (**D5332)**]. Gordonvale, 16m, *17°06'0"S*, *145°47'15"E*, 3.i.1986, G. Gordh [1♂, UCRC: UCRCENT312317]. Karumba, 4m, *17°29'20"S*, *140°50'13"E*, 18.iv.1983, J.F. Donaldson [1♀, QM: UCRCENT491660]. Thursday Island, 15m, 10°35'01"S,142°13'08"E, 4.viii.2018, photographed by E. Pirtle [1♀, https://www.inaturalist.org/observations/17578072]. **South Australia:** 12 km E. Penong, 55m, 31°56'0"S, 133°08'0"E, 16.ix.1981, I.D. Naumann & J.C. Cardale [1♀, ANIC: UCRCENT238217]. Brookfield Cons. Pk., 150m, 34°12'36"S,

139°19'12"E, 26.xi.1992, I.D. Naumann, J.C. Cardale, swp from saltbush [1♀, ANIC: UCRCENT238669]. Elliston, 7m, *33°38'54"S*, *134°53'50"E*, 14.xi.1992, L.S. & R.B. Kimsey [4♀, UCDC: UCDC00477672, 477674–477676]. Lake Tungketta, *33°45'45"S*, *135°06'9"E*, 30.xi.1992, I.D. Naumann & J.C. Cardale [1♀, ANIC: UCRCENT238668]. nr Moonabbie Range, 192m, 33°10'12"S, 137°06'0"E, 28.xi.1992, I.D. Naumann, J.C. Cardale [1♀, ANIC: UCRCENT238670]. **Victoria:** 15 km S. Yarrara, 72m, *34°32'25"S*, *141°24'38"E*, 18.x.1983, I.D. Naumann & J.C. Cardale [1♀, ANIC: UCRCENT238666]. Knoxfield, 78m, *37°52'49"S*, *145°15'0"E*, 11.xi.2001, M. Robinson, 12d (IHD), host: *Liriomyza chenopodii*, host plant: *Chenopodium album* [1♀, ANIC: UCRCENT238201]. Knoxfield, 78m, *37°52'49"S*, *145°15'0"E*, 21.xi.2001, M. Robinson, 18c (IHD), host: *Liriomyza chenopodii*, host plant: *Chenopodium album* [9♂ 9♀, ANIC: UCRCENT238181–238184, 238187–238200]. Knoxfield, 78m, *37°52'49"S*, *145°15'0"E*, 22.x.2001, M. Robinson, 5d (IHD), host: *Liriomyza chenopodii*, host plant: *Chenopodium album* [1♀, ANIC: UCRCENT238202]. **West Australia:** 60 km N. Tom Price on Hamersley Iron Rd., 600m, 22°18'48"S, 117°40'30"E, 20.iv.2003, F.D. Parker & M.E. Erwin, Flowering *Eucalyptus* [1♀, CNC: CNC508732 (**D4672**)]. Karijini Natl. Park: Johnson Gorge, 22°27'10"S, 118°27'18"E, 23.iv–15.iv.2003, C. Lambkin, near drying pool in rocky creek in Eucalyptus Acacia scrub, MT, ANIC 2069 [1♀, ANIC: UCRCENT238538 (**D5328**)]. **THAILAND: Chang Mai:** Don Pao Tambon, Amphur Mae Wang, 419m, *18°42'34"N*, *98°45'48"E*, 1–10.iv.1997, S. Sonthichai [1♀, UCDC: UCDC00477671].

14. *Zagrammosoma lineaticeps* (Girault)

Fig. 2.27.

Mirzagrammosoma lineaticeps Girault, 1915: 279–280. Holotype ♀ [examined]. Locality: Mexico, Jilotepec, 1915, coll. A.A. Girault. Depository: USNM type no. 19376.

Zagrammosoma lineaticeps (Girault). Combination by LaSalle, 1989: 232.

Diagnosis: *Zagrammosoma lineaticeps* is the only species to possess all six banding areas on the fore wing (Fig. 2.27C). This species is also the only described species to have the hind wing with infuscation along the apical margin (Fig. 2.27E). It is most similar to *Z. metallicum*, but does not possess any metallic coloration (the metasoma may appear shiny and reflective, however it is never metallic), and the wing patterns are different (Figs 2.27E versus 2.31C).

Description: Female - body length 1.16–2.1 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe present. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with dark median band. Pronotum black with yellow stripe along lateral margin. Prepectus, mesoscutum, mesoscutellum, and propodeum black. Procoxa yellow. Mesocoxa and metacoxa black. Profemur and mesofemur yellow. Metafemur entirely black. Fore wing: basal band present;

cubital band present; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; apical band present; connections from basal band to parastigmal band, from parastigmal band to stigmal band, and from stigmal band to postmarginal band present. Hind wing dark along apical margin. Metasoma dark

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.65–0.75); second longer than wide to wider than long (w:l = 0.87–1.11).

Pronotum, in dorsal view, longer than wide or subequal (w:l = 0.92–0.96); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae absent. Mesoscutellum longer than wide or subequal (w:l = 0.94–1.0); submedian grooves present, but faint and often difficult to distinguish. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere (bst:2^{nd} = 1.07–1.2).

Fore wing l:w = 2.45–2.67. Five setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - unknown.

Remarks: Girault (1915) described *Mirzagrammosoma* as different from *Zagrammosoma* based on the absence of submedian grooves on the mesoscutellum and a more elevated vaulted vertex. However, the submedian

grooves are present, but faint and difficult to see. The vertex is slightly more elevated than in other species but does not appear more elevated than the vertex found in *Z. centrolineatum*, *Z. multilineatum*, or *Z. trifurcatum* (Figs 2.10A, 2.33A, 2.41A). Girault also described the species as lacking bristle-like setae on the mesoscutellum, however, they are present but smaller and thinner than in other species (Fig. 2.27D). The molecular analysis (Fig. 2.2) recovers *Z. lineaticeps* within the genus confirming the combination (LaSalle, 1989).

Hosts: Recovered from dipteran and lepidopteran leaf miners. See Table 2.3. **Diptera**: Agromyzidae. **Lepidoptera**: Gelechiidae, Gracillariidae, Lyonetiidae.

Distribution: Nearctic: USA (AZ, CA, TX). **Neotropical:** Bahamas, Barbados, Colombia, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico (BS, GR, JA, MI, NL, SI, TM, VE), Trinidad & Tobago, USA (FL, PR) (Fig. 2.28).

Etymology: Lineaticeps is a combination of the Latin *linea* and New Latin suffix -*ceps* (-headed), therefore referring to lines on the face, lateral margins of the head, and occiput.

Additional material examined: BAHAMAS: Grand Bahama Island: Bahamanian Way, 6.4km NW Eight Mile Rock, 1m, *26°36'55"N*, *78°53'19"W*, 16.x.1982, D.M. LaSalle [1♀, CNC: CNC508734]. **Rum Cay:** 5m, *23°39'8"N*,

74°50'33"W, B. Brown, pan trap [1♀, CNC: CNC508689]. **BARBADOS:** St. John, 198m, *13°09'37"N*, *59°31'12"W*, 27.x.1978, field, host: Gracillaridae [1♀, BMNH: NHMUK10370139]. **COLOMBIA: Valle del Cauca:** Palmira, 1015m, 3°30'31"N, 76°19'11"W, 15.ix.1975, A. Saldarriaga, host: *Scrobipalpula* sp., host plant: *Solanum saponaceum* (now *bonariense?*) [4♀, USNM: UCRCENT425350–425353]. **CUBA: Havana:** Santiago de Las Vegas, 96m, *22°58'10"N*, *82°23'9"W*, 25.v.1919, P. Cardin, host: serpentine leaf miner, host plant: *Tropaeolum majus* [1♀, USNM: UCRCENT425359]. **DOMINICAN REPUBLIC:** Samana, Cayo Levantado, 5m, *19°09'59"N*, *69°16'44"W*, 13.iv.2009, A. & P. Ossipov [1♀, UCRC: UCRCENT252450 (**D5934**)]. **Duarte:** Pimentel, 40m, *19°11'10"N*, *70°06'24"W*, 8.viii.1978, R.O. Schuster [1♀, UCDC: UCRCENT415864]. **EL SALVADOR:** San Salvador, 690m, *13°42'29"N*, *89°12'25"W*, 18.v.1953, P.A. Berry, host: *Leucoptera coffeella* [1♀, USNM: UCRCENT425354]. **GUATEMALA: Suchitepéquez Dept.:** Chocolá, 824m, *14°37'3"N*, *91°25'29"W*, 18.ii.1965, K.G. Eveleens, host: *Leucoptera coffeella* [1♀, USNM: UCRCENT425358]. **Zacapa Dept.:** San Lorenzo, 1778m, *15°07'0"N*, *89°38'0"W*, ix.1986, M. Sharkey [1♀, CNC: CNC508685]. **HONDURAS: Francisco Morazan:** El Zamorano, 792m, *14°00'23"N*, *87°00'34"W*, 2.iv.1996, A. Guillen, host: *Phyllocnistis citrella* [3♀, UCRC: UCRCENT414299, 414623, 414624]. **MEXICO:** 26.viii.1985, H. Mirand (no other information provided on label) [1♀, CNC: CNC508687]. **Baja California Sur:** Las Barracas, 975m, *23°28'25"N*, *109°27'8"W*, 20.v.1985, P. DeBach, Pan trap [1♀, UCRC: UCRCENT312284]. Los Frailes, 12m, *23°22'24"N*, *109°26'1"W*,

18.iii.1953, P.H. Arnaud [1♀, CASC: UCRCENT417564]. **Guerrero:** Barra Vieja, 6m, *16°41'30"N*, *99°37'37"W*, 22.i.1985, J. Garcia, host: leaf miner, host plant: *Sida acuta* [1♀, USNM: UCRCENT425357]. **Jalisco:** San Buenaventura, 908m, 19°47'4"N, 104°03'32"W, 31.iii–5.iv.1997, Iblinam, B97/027 [1♀, TAMU: UCRCENT426730]. **Michoacan:** 3 mi. N. Nueva Italia, 907m, *19°04'44"N*, *102°04'59"W*, 8.v.1985, J. Woolley & G. Zolnerowich, 85/042 [1?, TAMU: UCRCENT426732]. **Nuevo Leon:** San Juan, Rio San Juan, 192m, *25°29'56"N*, *99°30'22"W*, 14.vii.1983, A. Gonzalez [4♀, UCRC: UCRCENT312248–312251]. **Sinaloa:** 11 mi. N. La Concha nr. Microondas La Muralla 2, 58m, *22°39'14"N*, *105°27'54"W*, 25.x.1982, J.T. Huber [1♀, UCRC: UCRCENT414304]. **Tamaulipas:** 1.1 mi. W. Gomez Farias, 71m, *22°53'9"N*, *99°02'48"W*, iii.1986, J.C. Schaffner [1♀, TAMU: UCRCENT426729]. **Vera Cruz:** 18.6 mi. S. Tampico, 1m, *22°10'2"N*, *98°08'0"W*, 13.viii.1972, E.E. Grissell, Roadside vegetation [1?, TAMU: UCRCENT426733]. **TRINIDAD:** Las Cuevas, *10°47'2"N*, *61°23'20"W*, 26.vi.1981, J. Heraty, swp [1♀, CNC: CNC508686]. **USA: Arizona: Pima Co.**, Sycamore Canyon, 1205m, *31°25'32"N*, *111°11'38"W*, 15.viii.1993, M. Sharkey [1♀, BMNH: NHMUK10370167]. **California: Orange Co.**, El Toro Rd, 2m East 133 hwy, 120m, *33°35'57"N*, *117°44'53"W*, 14.iv.1984 [1♀, UCRC: UCRCENT414300]. Laguna Canyon, 79m, *33°35'9"N*, *117°45'48"W*, 31.viii.1984, H. Andersen [20♀, UCRC: UCRCENT414599 - UCRC: UCRCENT414617, UCRC: UCRCENT414622]. **San Diego Co.**, 1 mi. E. Leucadia, Batequitos Lagoon, 8m, *33°05'15"N*, *117°17'15"W*, 8.viii.1979, C. Melton [6♀, UCRC: UCRCENT312278–312283]. Valley Center,

417m, *33°13'18"N*, *117°02'6"W*, 11.xi.1987, H. Andersen [3♀, UCRC: UCRCENT312243, 312244, 414593]. **Santa Barbara Co.**, Coal Oil Point Res., 10m, *34°24'30"N*, *119°52'40"W*, 22–29.vi.1981, K. Cheeseman [1♀, CNC: CNC508688]. **Florida: Miami-Dade Co.**, Dodge Island, 3m, *25°46'38"N*, *80°10'31"W*, 18.iv.1960, C.E. Stegmaier [1♀, BMNH: NHMUK10370168]. Hialeah, 2m, *25°51'18"N*, *80°16'42"W*, 22.ii.1963, C.E. Stegmaier, host: *Liriomyza archboldi* [1♀, USNM: UCRCENT425346]. **Monroe Co.**, Boot Key, 0m, *24°41'45"N*, *81°06'15"W*, 27–29.iv.1986, J. LaSalle [1♀, CNC: CNC508741]. **Palm Beach Co.**, Palm Beach, 2m, *26°42'37"N*, *80°02'13"W*: 19.ii.1900, host: *Gelechia* sp., host plant: *Crotalaria* sp. [1♀, USNM: UCRCENT425355]; 28.ii.1900, host: *Gelechia* sp., host plant: *Crotalaria* sp. [1?, USNM: UCRCENT425356]. **Puerto Rico:** Peñuelas, *18°03'39"N*, *66°43'32"W*, ix.1960, M. Santiago [2♀, USNM: UCRCENT425347, 425348]. **Texas: Cameron Co.**, Brownsville, 10m, *25°53'34"N*, *97°30'34"W*, 27.vi.1979, E.R. Oatman, host: *Keiferia lycopersicella,* host plant: Tomato [5♀, UCRC: UCRCENT312238–312241, 414303]. Brownsville, 10m, *25°53'34"N*, *97°30'34"W*, 27.vi.1979, J.D. Pinto, host plant: Tomato [1♀, UCRC: UCRCENT312242]. **Hidalgo Co.**, Mission-Edinburg, 30m, 26°08'24"N, 98°12'0"W, viii.1989, S. Neser, host: *Calcomyza lantanae*, host plant: *Lantana camara* [1♀, SANC: SANC-HYMC2889].

15. *Zagrammosoma melinum* Gordh

Fig. 2.29.

Zagrammosoma melinum Gordh, 1978: 350–352. Holotype ♀ [examined]. Locality: USA, California, Coalinga, viii.1939, coll. F.P. Roullard, host: *Bucculatrix* sp. (Lepidoptera: Bucculatricidae), host plant: Cottonwood. Depository: USNM type no. 75665.

Diagnosis: This species is characterized by an overall reduction in black color patterns on the body when compared to most other species of *Zagrammosoma*. The patterns of *Z. melinum* are most similar to *Z. americanum* and *Z. occidentale*, however, the wing patterns are unique to each species (Figs 2.29C versus 2.4C & 2.35C). In addition, the dark, transverse stripe on the anterior margin of the mesoscutum is absent or does not project posteriorly as it does in *Z. americanum* (Fig. 2.4D). The prepectus is all yellow and the second funicular is wider than long in *Z. occidentale*, whereas in *Z. melinum* there is a small, dark stripe on the dorsal margin of the prepectus and the second funicular is longer than wide.

Description: Female - body length 1.58–1.97 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median stripe complete or incomplete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe absent, complete, or incomplete. Mesoscutellum all yellow, yellow with two or three

dark stripes. Propodeum yellow with black: median carina, anterior and posterior margins, laterally with spot or stripe. Procoxa and mesocoxa yellow. Metacoxa yellow with black stripe basally. Profemur and mesofemur yellow. Metafemur with uninterrupted or interrupted stripe dorsally. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only, or with perpendicular extension less than or greater than that of stigmal apex; stigmal band present, with perpendicular extension less than or greater than that of stigmal apex; postmarginal band absent or present with perpendicular extension less than or greater than that of stigmal apex; connections from parastigmal band to stigmal band, and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow or yellow with median stripe and transverse stripes present.

Upper ocular sulcus present but very faint. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.61–0.68); second longer than wide (w:l = 0.86–0.88).

Pronotum, in dorsal view, more than twice as wide as long (w:l = 2.09–2.42); 4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae absent. Mesoscutellum wider than long (w:l = 1.15–1.34); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus subequal or shorter than second tarsomere (bst:2^{nd} = 0.9–1.0).

Fore wing l:w = 2.23–3.38. Submarginal vein with 5–8 setae dorsally. Basal fold setae present, but only one to three setae. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 1.4–1.6 mm; vertex with 1–2 stripes above compound eye; mesoscutellum yellow or yellow with three dark stripes; postmarginal band absent or present with perpendicular extension less than that of stigmal apex; metasoma all yellow or yellow with faint median and transverse stripes.

Remarks: *Zagrammosoma melinum* can be difficult to identify, as it shows the most color pattern variation of any species of *Zagrammosoma*. Gordh (1978) mentions this extreme variation when describing the species, and the molecular analysis supports both monophyly and extensive variation based on the specimens included. Generally, the species lacks a complete, median stripe on the mesosoma, and the mesoscutellum has only two dark stripes (Fig. 2.29D). The median stripe on the mesoscutellum, if present, extends posteriorly by varying degrees (Fig. 2.29F, E). The dark patterns on the female metasoma appear different at first but are the same with varying degrees of intensity.

Hosts: Recovered from lepidopteran leaf miners. See Table 2.3. **Lepidoptera**: Bucculatricidae, Gelechiidae, Gracillariidae.

Distribution: Nearctic: Canada (AB, BC, NB, SK, YK), USA (AK, AZ, CA, MT, NV, TX, UT) (Fig. 2.30).

Etymology: Melinus is Latin for yellow, describing the yellow body.

Material Examined: Paratypes: USA: California: Fresno Co., Coalinga, 200m, *36°08'35"N*, *120°21'5"W*, viii.1939, F.P. Roullard, Lot. No. 39 13005, host: *Bucculatrix* sp., host plant: Cottonwood [6♀ 1?, USNM: UCRCENT471552–58].

Additional material examined: CANADA: Alberta: Edmonton, Emily Murphy Park, 630m, *53°32'2"N*, *113°32'12"W*, 12.viii.1993, BPLM 4, host: *Phyllonorycter nipigon* [1♀, CNC: CNC508846]. Edmonton, Emily Murphy Park, 630m, *53°32'2"N*, *113°32'12"W*, 12.viii.1993, BPLM 6, host: *Phyllonorycter nipigon* [1♀, CNC: CNC508847]. **British Columbia:** Balfour, 545m, *49°37'28"N*, *116°57'50"W*, 3.viii.1949, D.B. Waddell, WL, host: leaf miner, host plant: *Salix* sp. [1♂, CNC: UCRCENT508844]. Cawston, 403m, *49°11'7"N*, *119°45'51"W*, 17.viii.1998, J. Cossentine, Lowe C-918 [1♀, CNC: CNC508848]. **New Brunswick: Gloucester Co.**, Nepisiguit River, 216m, *47°27'3"N*, *65°42'24"W*, 16.iii.1955, F.I. Survey 54-1891-01, host: *Phyllonorycter salicifoliella* [1♀, BMNH: NHMUK10370125]. **Northumberland Co.**, mi. 38 Nepisiguit Motor Rd, 216m, *47°22'51"N*, *66°04'25"W*, 21.iii.1956, F.I. Survey 55-0898-01, host: *Phyllonorycter salicifoliella*

[2♀, BMNH: NHMUK10370142, CNC: CNC508845]. **Saskatchewan:** Big River, *53°49'48"N*, *107°02'0"W*, 2.iv.1967, 67-82, host: *Phyllonorycter* sp [1♀, CNC: CNC508850]. **Yukon:** Champagne, 60°47'14"N, 136°26'9"W, 8.vii.2006, Goulet & Boudreault, plants along road, swp, #5 [1♀, CNC: CNC508665 (**D5895**)]. **USA: Alaska: Denali Borough**, Anderson, Hwy 3, 235m, 64°17'41"N, 149°05'4"W, 18.vii.2009, Goulet & Boudreault, fallow field on side of road, swp [1♀, CNC: CNC508670 (**D5898**)]. Cantwell, Denali Hwy. Rt 8 mi. 85–130, 701–915m, *63°02'59"N*, *145°55'51"W*, 24.vii.1984, S. & J. Peck, Car Net [1♀, CNC: CNC508849]. **Matanuska-Susitna Borough**, Sutton on Glen Highway, 188m, 61°42'39"N, 148°54'36"W, 22.vii.2009, Goulet & Boudreault, fallow field, swp [1♂ 1♀, CNC: CNC508666 (**D5896**), 508667 (**D5897**)]. **Arizona: Cochise Co.**, Foothills Rd, 1420m, 31°55'1"N, 109°07'41"W, 28.vi.2015, J. Heraty, *Chilopsis*, swp, H15-062 [1♀, UCRC: UCRCENT499455]. Ghost Town Trail, 1454m, 31°43'30"N, 109°48'42"W, 10.viii.2009, J. Mottern, dry wash, sweep, M09-037 [1♂ 2♀, UCRC: UCRCENT323379, 499460, 499461 (**D5932**)]. **California: Imperial Co.**, Hwy 98, nr. Sunrise Butte, 103m, 32°40'21"N, 115°50'57"W, 18.iii.2010, J. Mottern, desert scrub, sweep, M10-002 [1♂, UCRC: UCRCENT499459]. **Inyo Co.**, Panamint Valley, 1.5 mi. S. Indian Ranch, *36°07'28"N*, *117°12'49"W*, 20.v.1991, J.D. Pinto, *Prosopis* & *Aremopsis*, swp [1♀, CNC: CNC508671 (**D5899**)]. west side Eureka Valley 13km se Deep Springs, 1135m, *37°16'49"N*, *117°54'10"W*, 24.v.1994, S.L. Heydon [3♂ 2♀, UCDC: UCRCENT415803–07]. **Riverside Co.**, Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W, 31.viii–7.ix.2008, G.

Pratt, malaise trap [1♀, UCRC: UCRCENT357518]. **San Bernardino Co.**, Running Springs, Snow Valley (San Bernardino Mts.), 2050m, 34°13'23"N, 117°02'34"W, 20.vi.1977, R. Luck, host: *Coleotechnites* sp., host plant: *Pinus jeffreyi* [1♂, UCRC: UCRCENT499276]. **Montana: Gallatin Co.**, Bozeman, 1532m, *45°38'7"N*, *111°01'56"W*, 2–5.viii.2001, R. Wharton, host: leaf miner (Gracillariidae?), host plant: *Populus trichocarpa* [2♀, TAMU: UCRCENT473171 (**D5915**), 473172 (**D5916**)]. **Nevada: Clark Co.**, Valley of Fire State Park, 1 mi. W. West entrance, *36°24'41"N*, *114°32'58"W*, 30.iii.1989, J.D. Pinto, swp [1♀, CNC: CNC508675]. **Texas: Reeves Co.**, Balmorhea Lake, 970m, 30°58'27"N, 103°43'14"W, 26.vi.2015, J. Heraty, flowers, swp, H15-059 [1♂ 1♀, UCRC: UCRCENT499456 (**D5919**), 499457 (**D5920**)]. **Utah: Washington Co.**, Zion National Park, 1344m, *37°16'48"N*, *112°56'48"W*, vii–viii.1941, Hopk. No. 33608A, host plant: *Populus fremontii* [1♂ 2♀, USNM: UCRCENT471559, 471560, 471611].

16. *Zagrammosoma metallicum* Perry n. sp.

Fig. 2.31.

Diagnosis: This species is distinguished by the dark metallic luster on the body, almost appearing iridescent. No other described species of *Zagrammosoma* possess metallic luster (*Z. lineaticeps* occasionally has a shiny and reflective metasoma, however, it is not metallic). *Zagrammosoma metallicum* is most similar

in appearance to *Z. lineaticeps* but can be separated by the different wing patterns (Figs 2.27C versus 2.31C), and yellow stripes dorsally on the mesoscutum. In *Z. lineaticeps*, these stripes are thinner and only found on the pronotum (Fig. 2.27D), whereas the stripes in *Z. metallicum* are wider and extend from the pronotum to the posterior margin of the mesoscutum (Fig. 2.31D, E).

Description: Female – body length 1.38–2.48 mm. Metallic luster on body present. Scape yellow with black stripe dorsally. Lower face with median stripe present. Vertex with 2 stripes above compound eye. Gena posteriorly with wide, dark band below compound eye and small yellow spot/stripe adjacent to ventral margin of eye. Occiput yellow with wide, dark band. Pronotum black with yellow lateral stripe in dorsal view; laterally with one dark band. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum black with yellow lateral stripe in dorsal view. Mesoscutellum black. Propodeum black. Procoxa and mesocoxa yellow. Metacoxa yellow, basally dark; Profemur and mesofemur yellow. Metafemur black. Fore wing: basal band absent; cubital band present; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connections from parastigmal band to stigmal band and from stigmal band to postmarginal band present; Hind wing hyaline. Metasoma black.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.67–0.86); second subequal or wider than long (w:l = 1.0–1.15).

Pronotum, in dorsal view, bell-shaped (w:l = 1.12–1.34); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae absent. Mesoscutellum longer than wide (w:l = 0.89–0.94); submedian grooves absent. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus subequal or longer than second tarsomere (bst:2^{nd} = 1.0–1.17).

Fore wing l:w = 2.34–2.65. Submarginal vein with 5–7 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male – as female except: body length 0.84–1.04 mm; mesosoma and metasoma dark brown to black; connection from stigmal band to postmarginal band absent or present.

Remarks: This species is the exception to the rule regarding metallic coloration in the genus. The yellow is the same hue as that found in the other species of *Zagrammosoma* that are predominantly dark, so it remains unclear as why only this species is metallic.

Hosts: unknown.

Distribution: Nearctic: USA (CA, TX) (Fig. 2.32).

Etymology: Metallicus is Latin for metallic. The metallic luster makes this species the rockstar of the genus, with a name not unlike a certain rock band.

Type Material: Holotype: USA: Texas: Brewster Co., Big Bend Natl. Park, Rosillos Mtn., 1554–1600m, *29°31'55"N*, *103°14'37"W*, 16.iv.1991, J.B. Woolley, 91/023 [1♀, UCRCENT426797 (**D4569**)]. Deposited at TAMU.

Paratypes: USA: California: Orange Co., Laguna Canyon, 79m, *33°35'9"N*, *117°45'48"W*, 31.viii.1984, H. Andersen [1♂ 4♀, UCRC: UCRCENT414618–21, 414595]. **San Diego Co.**, Valley Center, 417m, *33°13'18"N*, *117°02'6"W*, 11.xi.1987, H. Andersen [3♀, UCRC: UCRCENT312245–312247]. **Texas: Brewster Co.**, Big Bend Natl. Park, Cottonwood Cpgd., 651m, *29°08'15"N*, *103°31'17"W*, 13–14.vii.1982, G.A.P. Gibson [4♂, CNC: CNC508681–84]. **Presidio Co.**, Presidio, *29°33'39"N*, *104°22'19"W*, xi.1954, J.H. Russell [1♀, USNM: UCRCENT471436].

17. *Zagrammosoma multilineatum* (Ashmead)

Fig. 2.33.

Hippocephalus multilineatus Ashmead, 1888: vii. Holotype ♀ [examined]. Locality: USA, Kansas, Riley Co., coll. C. Marlatt, host: *Phyllonorycter ornatella* (Lepidoptera: Gracillariidae). Depository: USNM type no. 27286.

Zagrammosoma multilineatum (Ashmead, 1888). Combination by Ashmead, 1904: 354. Preoccupied by *Hippocephalus* Swainson, 1839 (synonym of *Percis* Scopoli, 1777, Scorpaeniformes: Agonidae).

Zagrammosoma multilineata punicea Girault, 1911: 123. Subspecies lectotype designation by Frison, 1927: 221. Lectotype locality: Washington D.C., USA. Lectotype depository: INHS type no. 44,261. Synonymy by Burks, 1979: 985.

Zagrammosoma multilineatum puniceum Girault, 1911. Justified emendation by Peck, 1951: 460.

Zagrammosoma multilineatum multilineatum (Ashmead, 1888). Subspecies designation by Peck, 1963: 189.

Zagrammosoma multilineatus multilineatus (Ashmead, 1888). Incorrect spelling by Pottinger & Le Roux, 1971: 437.

Cirrospilus multilineatus (Ashmead, 1888). Combination by Kerrich, 1969: 198.

Cirrospilus (*Zagrammosoma*) *multilineatum* (Ashmead, 1888). Unjustified use of subgenus designation by DeSantis, 1979: 261.

Zagrammosoma zebralineata De Santis, 1983: 10. Holotype ♀ [examined]. Locality: Colombia, Pradera, coll. E. Flores, 1982. Depository: MLPA. Synonymy by Evans, 1999: 452.

Diagnosis: *Zagrammosoma multilineatum* possesses dark stripes or bands that extend from the posterior margin of the pronotum to the notaulus (Fig. 2.33D), a character not found in other species of *Zagrammosoma.* The remaining body and

wing patterns are similar to several species, however, the dark stripe between the notaulus and pronotum is absent in *Z. interlineatum* (Fig. 2.22D, E) and does not fully extend to the notaulus in *Z. americanum* (Fig. 2.4D, E) and *Z. galapagoense* (Fig. 2.17D, E). The metasoma color patterns are different in *Z. crowei* (Fig. 2.12) and *Z. interlineatum* (Fig. 2.22). The second funicular is subequal in *Z. deliae*, as opposed to longer than wide in *Z. multilineatum.* There is no median stripe on the lower face in *Z. interlineatum* (Fig. 2.22A), where this stripe is present in *Z. multilineatum* (Fig. 2.33A).

Description: Female – body length 1.4–1.98 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe present. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median stripe complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe complete. Mesoscutellum yellow with three dark stripes. Propodeum yellow with black: median carina, anterior and posterior margins, diagonal line connecting anterior and posterior margins. Procoxa and mesocoxa yellow. Metacoxa yellow with black stripe basally. Profemur and mesofemur yellow. Metafemur with interrupted or uninterrupted stripe dorsally. Fore wing: basal band absent; cubital band present; parastigmal, stigmal, and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connection from stigmal band to

postmarginal band absent. Hind wing hyaline. Metasoma yellow with dark transverse stripes and median stripe that bifurcates posteriorly on Gt_1.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.51–0.66); second longer than wide (w:l = 0.64–0.89).

Pronotum, in dorsal view, bell-shaped (w:l = 1.07–1.45) 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae absent. Mesoscutellum subequal or wider than long (w:l = 1.0–1.13); submedian grooves absent or present, but faint and shallow. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus subequal or shorter than second tarsomere (bst:2^{nd} = 0.83–1.0).

Fore wing l:w = 2.25–2.71. Submarginal vein with 5–6 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus shifted basally more than length of uncus.

Male – as female except: body length 0.82–1.25 mm; metafemur yellow or yellow with interrupted or uninterrupted stripe dorsally; cubital band absent or present; metasoma completely yellow or yellow with dark median stripe and transverse stripe on posterior margin of Gt_5.

Remarks: No other species has been as difficult to define as *Z. multilineatum,* as the color patterns on the body and wings can be similar to many species. Extensive examination of loaned material revealed *Z. multilineatum* as the dumping ground

for the genus, and at least six unique species have been identified from specimens identified as *Z. multilineatum* (*Z. americanum, Z. deliae, Z. galapagoense, Z. interlineatum, Z. intermedium, Z. talitzkii)*. Published records of *Z. multilineatum* are difficult to verify without direct examination of the specimens used in published papers, and therefore, I have not included additional host and locality records of specimens for species that I have not personally examined.

I have digitally examined the holotype of *Z. zebralineatum* and specimens collected by E. Flores from the same location and same host, coffee leaf miner (*Leucoptera coffeella*), as the holotype, and agree with the synonymy (Evans, 1999).

Hosts: Recovered from a large number of coleopteran, dipteran, and lepidopteran leaf miners. See Table 2.3 for a full list of hosts. **Coleoptera**: Buprestidae. **Diptera**: Agromyzidae. **Lepidoptera**: Bucculatricidae, Gelechiidae, Gracillariidae, Lyonetiidae, Pyralidae, Tischeriidae.

Distribution: Nearctic: Canada (BC), USA (AZ, CA, IA, KS, LA, MA, MD, MO, NC, NJ, NM, PA, TN, TX, VA, VI)**. Neotropical:** Bahamas**,** Jamaica, Colombia, Costa Rica, Ecuador (Galapagos), El Salvador, Guatemala, Haiti, Honduras, Venezuela (Fig. 2.34).

Etymology: Multilineatum is taken from Latin meaning having many lines.

Material Examined. Paratype: same as holotype [1♀, USNM: UCRCENT425376].

Additional material examined: BAHAMAS: Eleuthera: Rainbow Bay, 23m, *25°20'31"N*, *76°27'1"W*, 11.xi–19.xii.1986, J.R. Wiley, malaise [1♀, CNC: CNC508660 (**D5890**)]. **Exuma:** Simon's Point, 7m, 23°31'52"N, 75°47'49"W, 15–20.v.1986, T.L. McCabe [1♀, CNC: CNC508842]. **Grand Bahama Island:** Freeport, Xanadu Beach, *26°29'35"N*, *78°42'10"W*, 16.x.1982, D.M. LaSalle, sand dunes [1♀, ANIC: UCRCENT238603]. **CANADA: British Columbia:** Chase, Adams Rd, 388m, *50°55'18"N*, *119°37'45"W*, 12.vii.1986, H. Goulet, car-net [1♀, CNC: CNC508879]. **COLOMBIA: Caldas:** Naranjal, 1400m, *4°58'14"N*, *75°39'4"W*, 15.viii.1994, C. Lopez-Vaamonde, host: *Leucoptera coffeella* [1♂ 3♀, ANIC: UCRCENT238679–82]. **Valle del Cauca:** Palmira, 1015m, 3°30'31"N, 76°19'11"W, 15.ix.1975, A. Saldarriaga, host: *Scrobipalpula* sp., host plant: *Solanum saponaceum* (now *bonariense*?) [1♀, USNM: UCRCENT425392]. Valle Pradera, 1300m, *3°25'3"N*, *76°11'36"W*, 1981, E. Florez, #8106, host: *Leucoptera coffeella*, host plant: Coffee [4♂ 2♀, UCRC: UCRCENT414310, 499011–15]. Valle Pradera, 1982, E. Florez, host: *Leucoptera coffeella*, host plant: Coffee [MLPA-holotype of *Z. zebralineatum*]. **COSTA RICA: Guanacaste:** Area de Conservación Guanacaste, Murcielago, 75m, *10°56'28"N*, *85°40'52"W*, 24.i–4.ii.1996, J. Ugalde, malaise trap [1♀, ANIC: UCRCENT238683]. PN Santa Rosa, Sector Murcielago,

Playa Blanca, 10m, 10°56’0”N, 85°51’0”W, 21.xi.2007, J.S. Noyes [1♂, BMNH: NHMUK10734428]. Santa Rosa NP, 300m, *10°53’33”N*, *85°46’0”W*, 2.iii.1986–23.iii.1986, D.H. Janzen, SE-8-C [1♂, USNM: UCRCENT425375]. Santa Rosa NP Hacienda (2C), 300m, *10°53’33”N*, *85°45’59”W*, 21.ii–14.iii.1987, D. Janzen, I. Gauld [1♀, BMNH: NHMUK10734425 (**D5329**)]. **ECUADOR: Galapagos: Española Island**, North Playa, 5–20m, *1°20’57”S*, *89°41’51”W*, 27.iv.1991, J. Heraty, arid zone, H91-002 [1♂ 9♀, UCRC: UCRCENT436418–436427]. **Genovesa Island**, Bahia Darwin, *0°19’8”N*, *89°56’55”W*, 10–27.iii.1992, S. Peck, Bursera forest, FIT, 92-14 [1♀, UCRC: UCRCENT410517]. **Isabela Island**, Alcedo, NE Playa, 0m, *0°20’40”S*, *91°02’50”W*, 26.vi.1991, J. Heraty, arid ravine, H91-120b [2♀, UCRC: UCRCENT491727, 491728]. **Marchena Island**, Punta Espejo, *0°18’54”N*, *90°24’33”W* [1♀, UCRC: UCRCENT410522]. **Pinzon Island**, 2.5 km W. Pl. Escondida (5km on label), 280m, *0°36’14”S*, *90°40’13”W*, 19.vi.1991, J. Heraty, arid forest, H91-101 [3♀, UCRC: UCRCENT491724–26]. **Santa Cruz Island**, 1.5 km N. Bellavista, 280m, *0°40’55”S*, *90°19’25”W*, 1.vii.1991, J. Heraty, agricultural, H91-124 [1♀, UCRC: UCRCENT491721]. 13 km N. Santa Rosa, *0°34’6”S*, *90°20’43”W*, 1–30.iv.1992, S. Peck, arid zone, Bursera forest, FIT, 92-81 [1♀, UCRC: UCRCENT410519]. 6 km N. Los Gemelos, 300m, *0°34’37”S*, *90°20’42”W*, 17.v.1991, J. Heraty, low transition, H91-039 [1♀, UCRC: UCRCENT491722]. **Santiago Island**, 12 km E. Playa Espumilla, 725m, *0°13’54”S*, *90°46’3”W*, 5.vi.1991, J. Heraty, elfin forest, H91-078 [1♂ 1♀, UCRC: UCRCENT491714, 491715]. **EL SALVADOR:** San Salvador, 690m, *13°42’29”N*,

89°12'25"W, 18.v.1953, P.A. Berry, host: *Leucoptera coffeella* [2♀, USNM: UCRCENT425413, 425414]. **GUATEMALA:** West Guatemala, 460m, *14°33'2"N*, *91°26'10"W*, G. Manglitz, (Could be anywhere in "West Guatelama"), 51-6316, host: *Leucoptera coffeella* [6♂ 7♀, USNM: UCRCENT425379–91]. **Retalhuleu:** San Sebastian, 312m, *14°33'38"N*, *91°39'12"W*, ii–iii.1951, Oakley-Roberts, 51-2862, host: *Leucoptera coffeella*, host plant: Coffee [1♀, USNM: UCRCENT425416]. **HAITI:** *18°35'52"N*, *72°11'45"W*, 14.ii.1936, F. Sein Jr., Det. Lot No. 36-4880, host: *Leucoptera coffeella* [2♂ 8♀, USNM: UCRCENT425402–10, 425412]. **HONDURAS: Atlantida Dept.:** La Ceiba, *15°46'7"N*, *86°47'32"W*, 6.vi.1991, R. Cave, host: Gracillaridae, host plant: *Gliricidia sepium* [1♀, ANIC: UCRCENT238605]. **JAMAICA: Saint Andrew Parish:** College Common, 173m, *17°59'54"N*, *76°44'53"W*, 1984, CIBC Trinidad Lot 5, CIE A16067, host: *Leucoptera coffeella* [1♀, BMNH: NHMUK10370145]. **MEXICO: Baja California Sur:** Las Barracas, 975m, *23°28'25"N*, *109°27'8"W*: 15.iv.1984, P. DeBach, Pan trap [1♀, UCRC: UCRCENT499001]; 17.iv.1985, P. DeBach, Pan trap [1♀, UCRC: UCRCENT499004]; 20.v.1985, P. DeBach, Pan trap [1♀, UCRC: UCRCENT499002]; 29.iv.1985, P. DeBach, Pan trap [1♂, UCRC: UCRCENT499003]. San Dionisio, 484m, *23°33'22"N*, *109°51'43"W*, 8.iv.1984, P. DeBach [1♂, UCRC: UCRCENT499005]. **Baja California:** 1 mi. S. Bahía de los Ángeles, 18m, *28°55'59"N*, *113°33'7"W*, 26–27.iii.1979, J. LaSalle, *Larrea 212ivaricate* [1♀, ANIC: UCRCENT238604]. **Chiapas:** Cacahuatan (Finca El Encanto), 500m, *14°59'45"N*, *92°10'2"W*, 28.iii.2005, J.R. Lomeli [2?, TAMU:

UCRCENT426752, 426753]. Manuel Lazos (Finca La Gloria), 390m, *14°58'9"N*, *92°11'16"W*, 30.iii.2004, J.R. Lomeli [3?, TAMU: UCRCENT426754–426756]. Tapachula (INIFAP), 971m, *14°53'57"N*, *92°15'15"W*, 6.iv.2005, J.R. Lomeli [1?, TAMU: UCRCENT426758]. **Colima:** Colima, 505m, *19°14'43"N*, *103°43'19"W*, 31.i.1995, G. Gutierrez [1♂ 1♀, UCRC: UCRCENT499009, 499010]. Coquimatlán, *19°12'12"N*, *103°48'30"W*, 21.i.1994, M. Perales [1♂ 1♀ 1?, UCRC: UCRCENT499006–08]. **Guerrero:** Taxco, *18°33'17"N*, *99°36'21"W*, host: *Leucoptera coffeella* [1♀, USNM: UCRCENT425411]. **Nuevo Leon: Mun. Guadalupe**, Rincon de la Sierra, 552m, *25°38'4"N*, *100°11'59"W*, 11.vii.1983, A. Gonzalez H. [1♀, UCRC: UCRCENT498892]. **Oaxaca:** 5 mi. SW Oaxaca, *16°58'28"N*, *96°44'59"W*, R. Anderson [1♀, CNC: CNC508656 (**D5886**)]. **Quintana Roo:** Kohunlich Ruins 30 mi. E. Chetumal, *18°25'10"N*, *88°47'30"W*, 15.vii.1983, R. Anderson [1♂, CNC: CNC508876]. Xel-Há Resort, *20°19'10"N*, *87°21'28"W*, 7.xii.1993, L. Masner, trail in coastal forest, swp [1♀, CNC: CNC508662 (**D5892**)]. **Tamaulipas:** 18 mi. SE Manuel, 34m, *22°31'35"N*, *98°07'38"W*, 1.xi.1982, G. Gordh [1♀, UCRC: UCRCENT499000]. Rio Bravo, 28m, *25°59'52"N*, *98°07'0"W*, 30.ix.1986, L.A. Rodriguez, ex: sunflower leafminer [1?, TAMU: UCRCENT426748]. **Yucatan:** Chichen Itzá (ruins) second. For., *20°40'51"N*, *88°34'7"W*, 17.xii.1993, L. Masner, swp [2♀, CNC: CNC508663 (**D5893**), 508874]. **PUERTO RICO: Humacao:** nr. Naguabo, 58m, *18°12'58"N*, *64°44'44"W*, 12.v.1940, J.G. Needham, Lot No. 40-10681, host: *Tischeria* sp., host plant: *Melanthera* sp. [2♀, USNM: UCRCENT425415, 425417]. **TRINIDAD &**

TOBAGO: Tobago: 176m, *11°13’36”N*, *60°42’50”W*, 24.ii.1912, A. Busch [1♀, USNM: UCRCENT471581]. **USA: Arizona: Pima Co.**, Santa Rita Mtns.; Box Canyon, 1208m, *31°46’56”N*, *110°51’2”W*, 20.viii.1999, M. Gates [1♂, UCRC: UCRCENT077638]. **Pinal Co.**, Sacaton, 393m, *33°04’35”N*, *111°44’18”W*, 15.vi.1909, C.N. Ainslie [1♀, USNM: UCRCENT471580]. **Arkansas: Benton Co.**, Bentonville, 399m, *36°22’29”N*, *94°12’17”W*, ix.1918, Quantaince no. 16415, host: *Canarasia* sp. [1♀, USNM: UCRCENT425420]. **Washington Co.**, Fayetteville, 397m, *36°04’53”N*, *94°10’27”W*, Rolston, host: *Callisto geminatella* [1♀, USNM: UCRCENT425393]. **California: Riverside Co.**, 0.8 Mi. N. Jct. Deep Cr. & Horsethief Cr. T 7S, R 6E, S 6, 900m, *33°35’31”N*, *116°24’26”W*, 15.iii.1974, G.R. Ballmer, host: leaf miner, host plant: *Simmondsia chinensis* [1♀, UCRC: UCRCENT312329]. AG-OPS 3C ((Iowa), 305m, *33°58’20”N*, *117°20’21”W*, 16.x.2008, R. Luck, host: *Phyllocnistis citrella*, host plant: citrus [1♂, UCRC: UCRCENT292425]. Chino Canyon T3S, R4E, S33, 261m, *33°51’42”N*, *116°34’22”W*, 29.ii.1984, R.D. Goeden & D.W. Ricker, host plant: *Trixis californica* [1♀, UCRC: UCRCENT312373]. Hwy 74, San Bernardino Nat. Frst., 635m, 33°43’52”N, 116°48’39”W, 20.vi.2014, R.K. Perry, RP14-009 [1♀, UCRC: UCRCENT312348 (**D4113**)]. NE of Black Hill, T 6S, R 6E, S 19, 854m, *33°37’59”N*, *116°24’15”W*, 13.ii.1978, S. Frommer, host: *Periploca* sp. [1♂, UCRC: UCRCENT312327]. NE of Black Hill, T 6S, R 6E, S 19, 854m, *33°37’59”N*, *116°24’15”W*, 23.iii.1978, S. Frommer, beating, host plant: *Simmondsia chinensis* [1♂, UCRC: UCRCENT312328]. P.L. Boyd Des. Res. Center, 799m, *33°38’54”N*,

116°22’50”W, 23–31.i.1970, S. Frommer & L.F. LaPre, Malaise trap [1♀, UCRC: UCRENT00498901]. **San Bernardino Co.**, Mill Creek, Hwy 38, 962m, 34°10’14”N, 117°02’43”W, 30.ix.2012, E. Gordon [1♂ 1♀, UCRC: UCRCENT498890, 498891]. Oro Grande, 794m, *34°36’38”N*, *117°20’38”W*, 16.ix.1981, J.D. Pinto [1♀, UCRC: UCRCENT312372]. **San Diego Co.**, Pauma, Rutz grove, 374m, *33°20’14”N*, *116°58’57”W*, 11.ix.2008, T.Shea, host: *Phyllocnistis citrella*, host plant: citrus [1♀, UCRC: UCRCENT292464]. San Felipe Creek, St. 78, 2 mi. E. Jct. Rt. 52, 642m, *33°06’38”N*, *116°26’54”W*, 22.ii.1976, D.C. Frack, DCFR #76-26 [1♀, UCRC: UCRCENT498999]. San Ysidro T18S, R2W, S36, 67m, *32°33’27”N*, *117°02’11”W*, 16.iii.1971, R.D. Goeden & D.W. Ricker, host plant: *Ambrosia chenopodiifolia* [2♀, UCRC: UCRCENT312374, UCRC: UCRCENT312375]. **Florida: Collier Co.**, Immokalee, 7m, *26°24’21”N*, *81°24’59”W*, 1–8.xii.2000, Cowley, suction trap [1♀, FSCA: UCRCENT424524]. Immokalee (SWFREC), 10m, *26°27’36”N*, *81°26’19”W*, iii.1990, Cowley, host: *Liriomyza sativae* [1♀, FSCA: UCRCENT424521]. **Duval Co.**, Jacksonville, St. Johns Bluff, *30°23’2”N*, *81°29’55”W*, 30.viii.1976, Z. Bouček [1♀, BMNH: NHMUK10370155]. **Franklin Co.**, Apalachicola, 5m, *29°43’16”N*, *84°59’56”W*, 18.viii.1990, F.D. Bennett, host plant: ragweed [2♀, FSCA: UCRCENT424525, 424526]. **Gadsden Co.**, Quincy, 54m, *30°35’2”N*, *84°34’49”W*, 1987–1988, R. Mizell, MT, host: *Caloptilia azaleella* [1♀, FSCA: UCRCENT424522]. **Hendry Co.**, La Belle, 3m, *26°45’45”N*, *81°25’35”W*, 14.vi.1994, M. Packhioli [1♀, FSCA: UCRCENT424527]. **Highlands Co.**, Sebring, 33m, *27°28’46”N*, *81°26’16”W*, 20.iii.1955, H.V. Weems, Jr. [1♀,

FSCA: UCRCENT424520]. **Miami-Dade Co.**, Hialeah, 2m, *25°51'18"N*, *80°16'42"W*, 5.viii.1962, C.E. Stegmaier, host plant: *Eleusine indica* [1♀, FSCA: UCRCENT424528]. Homestead, 1m, *25°27'54"N*, *80°28'26"W*, 1994, R.E. Duncan, host: *Phyllocnistis citrella* [2♂ 3♀, ANIC: UCRCENT238685–89]. **Monroe Co.**, Big Pine Key, 1m, 24°42'34"N, 81°22'57"W, 8.vii.2011, J. Heraty, pine rockland, H11-071 [1♀, USNM: UCRCENT425360]. Big Pine Key, Watsons Hammock, 0m, *24°40'12"N*, *81°21'14"W*, 1–7.vi.1986, M. Kaulbars [1♀, CNC: CNC508883]. Boot Key, 0m, *24°41'45"N*, *81°06'15"W*, 27–29.iv.1986, J. LaSalle [2♀, CNC: CNC508672, 508740]. Key West, *24°33'18"N*, *81°46'59"W*, 14.iii.1945, Griswold, SS 25350, host: *Bucculatrix* sp., host plant: *Pluchea odorata* [1♀, USNM: UCRCENT425361]. **Orange Co.**, Orlando, *28°31'48"N*, *81°22'12"W*, G.G. Ainslie, Webster No. 7599C, host: *Agromyza parvicornis* [1♀, USNM: UCRCENT471584]. **Polk Co.**, Lake Alfred, CREC, 54m, *30°35'2"N*, *84°34'49"W*, 31.v.1995, H.W. Browning, swamp, host plant: *Vitis rotundifolia* [1♂, FSCA: UCRCENT424523]. Lakeland, *28°02'24"N*, *81°56'54"W*, G.G. Ainslie, Webster No. 7599AG, host: *Agromyza parvicornis* [1♀, USNM: UCRCENT425366]. Waverly, 35m, *27°58'43"N*, *81°36'35"W*, 30.xi.1994, H.W. Browning, host: *Phyllocnistis citrella*, host plant: *Citrus paradisii* [1♀, UCRC: UCRCENT414308]. Waverly, Rubash443, 41m, *27°58'10"N*, *81°36'42"W*, 12.xi.1994, Browning, host: *Phyllocnistis citrella*, host plant: Citrus [5♂, UCRC: UCRCENT498880–83, 498902]. **Georgia: Liberty Co.**, St. Catherine's Island, 31°40'0"N, 81°09'0"W, 6–10.iv.1995, A. Sharkov [1♀, UCRC: UCRCENT121842]. **St. Clair Co.**, Chapel View Prarie, 246m, *38°13'10"N*,

93°51’11”W, 29.vi.1999, M. Gates [2♀, UCRC: UCRCENT312330, 414309]. **Iowa: Winneshiek**, Plymouth Rock, 369m, 43°26’18”N, 92°00’16”W, 16.ix.2013, M.J. Hatfield, planted prairie, host: *Pachyschelus laevigatus*, host plant: *Desmodium canadense* [1♀, UCRC: UCRCENT498893]. **Kansas: Riley Co.**, 2 mi. S. Manhattan, 326m, *39°08’41”N*, *96°32’15”W*, 6.ix.1983, J.T. & D.E. Huber [1♀, CNC: CNC508880]. Manhattan, 326m, *39°10’41”N*, *96°34’34”W*, 24.viii.1933, L.M. Copenhafer, Q7, host: *Ornix* sp. [1♀, USNM: UCRCENT425368]. Manhattan, 326m, *39°10’41”N*, *96°34’34”W*, 30.vii.1933, L.M. Copenhafer, Q6, host: *Ornix* sp. [1♀, USNM: UCRCENT425369]. Manhattan, 326m, *39°10’41”N*, *96°34’34”W*, 7.ix.1933, L.M. Copenhafer, Q8, host: *Ornix* sp. [1♀, USNM: UCRCENT425367]. **Sumner Co.**, Wellington, 368m, *37°15’59”N*, *97°23’36”W*, T.H. Parks, Webster No. 5491, host: leaf miner, host plant: corn [1♀, USNM: UCRCENT425377]. **Louisiana: Plaquemine Par.**, 0m, *29°37’11”N*, *89°52’10”W*, 12.ix.1997, S. Johnson, host: *Phyllocnistis citrella* [1♀, USNM: UCRCENT425395]. 0m, *29°37’11”N*, *89°52’10”W*, 26.viii.1997, S. Johnson, host: *Phyllocnistis citrella* [1♀, USNM: UCRCENT425394]. **Maryland: Dorchester Co.**, Blackwater Natl Wildlife Refuge, 1m, *38°26’41”N*, *75°07’7”W*, 8–9.viii.1943, H.L. Dozier, 43-9392 [1♂, BMNH: NHMUK10370149]. **Howard Co.**, Clarksville, *39°12’20”N*, *76°56’46”W*, 29.vii.1986, E.E. Grissell, deciduous forest, malaise trap [1♂, USNM: UCRCENT471432]. **Massachusetts: Nantucket Co.**, Tawpeshaw, 07m, *41°15’32”N*, *70°05’15”W*, 25.vii–10.viii.2014, C.S. Eiseman, host: *Porphyrosela desmodiella*, host plant: *Lespedeza* sp. [1♀, UCRC: UCRCENT416915 (**D4601**)].

Missouri: Howard Co., 3 mi. E. Franklin, orchard, *39°00’42”N*, *92°41’49”W*, 9.i.1992, R.S. Gagne, host: *Phyllonorycter blancardella* (probably), host plant: *Malus domestica* [1♀, USNM: UCRCENT425365]. **Lafayette Co.**, Waverly, 247m, *39°12’32”N*, *93°31’4”W*, 10.vii.1990, B.A. Barrett, host: *Phyllonorycter blancardella* (probably), host plant: *Malus domestica* [4♂ 1♀, USNM: UCRCENT425370–425374]. **Wayne Co.**, Williamsville, *36°58’16”N*, *90°32’58”W*, x.1987, J. Becker, malaise trap [2♀, CNC: CNC508881, 508882]. **New Jersey: Cape May Co.**, Town Bank, 1m, *38°59’19”N*, *74°57’4”W*, 29.vii.1981, A.L. Norrbom [1♀, UCRC: UCRCENT414307]. **New Mexico: Colfax Co.**, Springer, *36°21’40”N*, *104°35’46”W*, C.N. Ainslie [1♀, USNM: UCRCENT471577]. **North Carolina: Lincoln Co.**, *35°28’30”N*, *81°12’56”W*, 15.v.1988, J. Walgenbach, host: *Phyllonorycter blancardella* [1♂ 4♀, USNM: UCRCENT425396–425400]. **Oklahoma: Lincoln Co.**, 1 mi. N. Davenport on I-40, 261m, *35°43’28”N*, *96°45’54”W*, 11.vi.1991, H.E. Andersen [1♀, UCRC: UCRCENT414306]. **Pennsylvania: Franklin Co.**, Quinsonia, 237m, *39°50’17”N*, *77°36’8”W*, 1914, F.L. Simanton, Quaintance No. 6231 [1♀, USNM: UCRCENT425419]. **Tennessee: Davidson Co.**, Nashville, *36°09’11”N*, *86°46’37”W*, G.G. Ainslie, Webster No. 0830F, host: *Liriomyza pusilla* [1♀, USNM: UCRCENT425363]. Nashville, *36°09’11”N*, *86°46’37”W*, G.G. Ainslie, Webster No. 9467E [1♀, USNM: UCRCENT425364]. **Humphreys Co.**, Hurricane Mills, 124m, *35°58’12”N*, *87°46’45”W*, G.G. Ainslie, Webster No. 8332 [1♀, USNM: UCRCENT471578]. **Texas: Brazos Co.**, College Station, Lick Creek Park, 4259m, 30°32’20”N,

96°09’36”W, 3.x.1992, J.S. Noyes [1♀, ANIC: UCRCENT238690]. Minter Park, 85m, *30°30’19”N*, *96°19’14”W*, 30.v.2002, A. Bader, ex: lepidopteran larvae in Oak leafmine [1?, TAMU: UCRCENT426749]. University Street, Texas A&M University, 99m, *30°37’35”N*, *96°20’7”W*, 28.v.2002, R. Diaz [1?, TAMU: UCRCENT426757]. **Cameron Co.**, Brownsville, 10m, *25°53’34”N*, *97°30’34”W*, 27.vi.1979, E.R. Oatman, host: *Keiferia lycopersicella* [2♂, UCRC: UCRCENT485727, 485728]. San Benito, 10m, *26°07’42”N*, *97°37’45”W*, 14.ix.1995, V.C. Legaspi & R. Saloana [1♂ 1♀, USNM: UCRCENT471582, 471583]. Southpoint Nursery 1mi S. Southmost Ranch, *25°52’7”N*, *97°22’58”W*, 5–6.vii.1982, G.A.P. Gibson [1♀, CNC: CNC508884]. **Grayson Co.**, Rock Creek, 5 mi. NW Gordonville, 235m, *33°48’2”N*, *95°55’0”W*, 22.vii.1972, E.E. Grissell, Ambrosia [1?, TAMU: UCRCENT426751]. **Jim Wells Co.**, 8 mi. W. Ben Bolt, La Copita Res. Sta., 81m, *27°38’32”N*, *98°13’34”W*, 20.v.1987, J.B. Woolley, 87/006 [7?, TAMU: UCRCENT426741–426747]. **Presidio Co.**, Big Bend Ranch State Natural Area, Aqua Adentro Spring, 15.8 mi. NE Rt. 170, 29°29’0”N, 104°06’0”W, 2.ix.1993, E.E. Grissell & R.F. Denno, on *Baccharis* sp. [1♂, USNM: UCRCENT425418]. **Val Verde Co.**, Eagle Creek, 292m, *29°22’8”N*, *100°53’4”W*, 19.vii.1986, J. Heraty [1♂, UCRC: UCRCENT414311]. **Walker Co.**, Ellis Prison Unit, 62 m, *30°52’30”N*, *95°27’38”W*, 24.v.1980, D.A. Dean, ex suction trap [1?, TAMU: UCRCENT426750]. **Willacy**, Raymondville, 9m, *26°28’56”N*, *97°46’49”W*, 28.iv.1942, Shiller Coll. 1780, host plant: *Sphaeralcea lindheimeri* [1♀, USNM: UCRCENT425401]. **U.S. Virgin Islands: St. John:** Central Rd (Center Line Rd), 311m, *18°20’26”N*, *64°44’10”W*,

29.vii.1981, L. Masner [2♀, CNC: CNC508872, CNC: CNC508875]. **Virginia: Fairfax Co.**, Vienna, *38°54'3"N*, *77°15'54"W*, 5.vii.1911, R.A. Cushman, Quaintance No. 7099, host: leaf miner, host plant: *Populus alba* [1♀, USNM: UCRCENT425378]. **Frederick Co.**, Winchester, 249m, *39°11'5"N*, *78°10'37"W*, 13.vi.1964, O. Peck [2♀, CNC: CNC508877, 508878]. **VENEZUELA: Monagas:** Maturin, *9°43'58"N*, *63°11'27"W*, xi.1996, host: *Phyllocnistis* sp. [1♂, ANIC: UCRCENT238684]. **Zulia:** El Tucuco, 2000m, *9°50'44"N*, *72°48'44"W*, 19.iv.1981, L. Masner, pasture meadow [1?, CNC: CNC508873].

18. *Zagrammosoma occidentale* Perry n. sp.

Fig. 2.35.

Diagnosis: *Zagrammosoma occidentale* is characterized by a reduction in color patterns on the body, similar to *Z. melinum* (Fig. 2.29). The metasoma patterns are unique to each species (Fig. 2.29D vs 35D), as are the wing patterns (Fig. 2.29C versus 2.35C). The metacoxa is completely yellow in *Z. occidentale* (Fig. 2.35B) and with a dark stripe basally in *Z. melinum* (Fig. 2.29B).

Description: Female – body length 1.03–1.72 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with

median stripe interrupted or uninterrupted; laterally with to black stripes. Prepectus all yellow. Mesoscutum with median stripe interrupted or uninterrupted. Mesoscutellum with three stripes, sometimes faint. Propodeum yellow with black: median carina, anterior and posterior margins, stripe. Procoxa, mesocoxa, and metacoxa yellow. Profemur, mesofemur, and metafemur yellow. Fore wing: basal and cubital bands absent; parastigmal band present, with perpendicular extension less than or equal to that of stigmal apex; stigmal and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connections from parastigmal band to stigmal band, and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow with dark median and transverse stripes.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide to wider than long (w:l = 0.88–1.25); second wider than long (w:l = 1.14–1.25).

Pronotum, in dorsal view, bell-shaped or more than twice as wide as long (w:l = 1.83–2.4); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae and intermediate setae present. Mesoscutellum wider than long (w:l = 1.08–1.13); submedian grooves present. Hind tibial spur shorter than or equal in length to basitarsus. Hind basitarsus shorter than second tarsomere (bst:2^{nd} = 0.73–0.83).

Fore wing l:w = 2.05–2.15. Submarginal vein with 4–7 setae dorsally. Basal fold asetose or with 1–2 setae. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male – as female except: body length 0.7–1.13 mm; occiput all yellow, or with two dark, vertical stripes; mesoscutum with small, scattered setae absent or present; postmarginal band absent or present with perpendicular extension less than or greater than that of stigmal apex.

Remarks: This is a commonly collected species in western North America. Many specimens of *Z. occidentale* were identified as *Z. americanum* or *Z. melinum*, however, there are sufficient morphological and color differences between the species, and the molecular analysis recovers all three as unique species (Fig. 2.2).

Hosts: Recovered from dipteran and lepidopteran leaf miners. See Table 2.3. **Diptera**: Cecidomyiidae. **Lepidoptera**: Gracillariidae.

Distribution: Nearctic: Mexico (PU), USA (AZ, CA, NV, TX), **Neotropical:** Mexico (BS) (Fig. 2.36).

Etymology: The name is from the Latin word occidentalis, named for the distribution in the western part of North America.

Type Material: Holotype: USA: California: San Bernardino Co., Wildhorse Mdws; Rd 2N93, 2630m, 34°12’3”N, 116°46’24”W, 13.v.2010, D. Yanega [1♀, UCRCENT330168]. Deposited at UCRC.

Paratypes: USA: Arizona: Santa Cruz Co., Casa Blanca Cyn., 1440m, 31°38’57”N, 110°45’28”W, 23.vi.2015, J. Heraty, mesquite, swp, H15-050 [1♀, UCRC: UCRCENT499454 (**D5917**)]. **California: Imperial Co.**, Hwy 98, nr. Sunrise Butte, 103m, 32°40’21”N, 115°50’57”W, 18.iii.2010, J. Mottern, desert scrub, sweep, M10-002 [2♂, UCRC: UCRCENT312429 (**D4578**), 499459 (**D5930**)]. **Inyo Co.**, Panamint Valley, 1.5 mi. S. Indian Ranch, *36°07’28”N*, *117°12’49”W*, 20.v.1991, J.D. Pinto, *Prosopis* & *Aremopsis*, swp [1♀, CNC: CNC508671]. **Riverside Co.**, Terwilliger Rd. S. of Anza, 1269m, 33°27’32”N, 116°38’10”W, 31.viii–7.ix.2008, G. Pratt, malaise trap [1♀, UCRC: UCRCENT312427 (**D4576**)]. **San Diego Co.**, Pauma, Rutz grove, 374m, *33°20’14”N*, *116°58’57”W*, 10.viii.2009, R. Luck, # 95, host: *Phyllocnistis citrella*, host plant: Lemon [1♂, UCRC: UCRCENT485718]. **Ventura Co.**, Ventura, Limoneira ranch, 88m, 34°20’0”N, 119°08’0”W, 12.x.2008, B. Faber, #77, host: *Phyllocnistis citrella*, host plant: Libson Lemon [1♀, UCRC: UCRCENT275016]. **Nevada: Clark Co.**, Valley of Fire State Park, 1 mi. W. West entrance, *36°24’41”N*, *114°32’58”W*, 30.iii.1989, J.D. Pinto, swp [1♀, CNC: CNC508675]. **Texas: Reeves Co.**, Balmorhea Lake, 970m, 30°58’27”N, 103°43’14”W, 26.vi.2015, J. Heraty, flowers, swp, H15-059 [1♂, UCRC: UCRCENT499456].

Additional material examined: MEXICO: Baja California Sur: Las Barracas, 975m, *23°28'25"N*, *109°27'8"W*, 1.vi.1984, P. DeBach, Pan trap [1♂, UCRC: UCRCENT499022], 1.vi.1985, Pan trap [1♀, UCRC: UCRCENT499023], 15.vi.1985, Pan trap [1♀, UCRC: UCRCENT499019], 16.v.1985, P. DeBach, Pan trap [1♂, UCRC: UCRCENT499020], 17.v.1985, P. DeBach, Pan trap [1♂, UCRC: UCRCENT499021], 29.iv.1985, P. DeBach, Pan trap [1♂, UCRC: UCRCENT499024]. **Puebla:** 4.4 mi. SW Acatepec, *16°43'11"N*, *98°27'9"W*, 21.vii.1984, J. Woolley [1♂, CNC: CNC508871]. **USA: Arizona: Cochise Co.**, 10 mi. W. Portal, *31°55'34"N*, *109°15'18"W*, 20.viii.1971, E.E. Grissell & R.F. Denno, on *Juniperus* [1♀, UCDC: UCRCENT477977]. 20 mi. N. of Portal, 1123m, *32°12'18"N*, *109°08'27"W*, 16.viii.1990, J.D. Pinto, screen sweeping [2♂, CNC: CNC508864, 508868]. 5 mi. W. Portal, *31°53'0"N*, *109°12'21"W*, 23.x–15.xi.1981, M. Huybensz [1♀, USNM: UCRCENT471570]. Foothills Rd, 1420m, 31°55'1"N, 109°07'41"W, 28.vi.2015, J. Heraty, *Chilopsis*, swp, H15-062 [1♀, UCRC: UCRCENT499455 (**D5918**)]. Ghost Town Trail, 1454m, 31°43'30"N, 109°48'42"W, 10.viii.2009, J. Mottern, dry wash, sweep, M09-037 [2♂ 5♀, UCRC: UCRCENT323433, 323453, 323460, 323486, 499277, 499460, 499461]. Hwy 80, E. of Douglas, 1336m, 31°41'58"N, 109°07'35"W, 2.viii.2003, J. Heraty, *Chilopsis* & weeds, H03-077 [1♀, UCRC: UCRCENT499278]. San Simon (San Simeon on label), 9m, *32°16'1"N*, *109°13'34"W*, 2.xi.1982, G. Gordh [2♂, UCRC: UCRCENT499292, 499293]. San Simon Rd., 1100m, *32°16'21"N*, *109°15'52"W*, 26.viii.1997, B.G. Carey, sweep, host plant: *Larrea, Parthenium, Sphaeralcea,*

Senecio [1♂, UCRC: UCRCENT499289]. SWRS nr. Portal, 1645m, *31°53'0"N*, *109°12'21"W*, 26.v.1981, M.E. Schauff, sweep [1♂ 1♀, USNM: UCRCENT471600, 471601]. **Graham Co.**, ~ 15 mi. S. of Safford, *32°36'36"N*, *109°42'0"W*, 26.vii.1997, M. Gates [1♀, USNM: UCRCENT471579]. **Pima Co.**, 1 mi. E. Ajo, *32°21'59"N*, *112°50'20"W*, 17.viii.1971, E.E. Grissell & R.F. Denno, *Larrea* [1♀, USNM: UCRCENT477971]. Tucson, 750m, 32°13'18"N, 110°55'35"W, 16.iv.1959, M. Adachi, host: *Asphondylia* gall, host plant: *Larrea divaricata* fruit [1♂, USNM: UCRCENT471598]. **Pinal Co.**, 10 mi. N. Catalina Mtns., 1327m, *32°37'26"N*, *110°46'41"W*, 24.v.1981, M.E. Schauff [1♂ 4♀, USNM: UCRCENT471564–68]. **California: Imperial Co.**, Algodones Dunes, S. Ruthven, 115m, 32°55'30"N, 114°59'34"W, 28.iv.2001, D. Yanega [2♂ 1♀, UCRC: UCRCENT221649, 221650, 221666]. Holtville, -3m, *32°48'40"N*, *115°22'49"W*, 17.iii.1904, R.A. Flock, host plant: *Larrea* [1♀, USNM: UCRCENT471656]. N. Glamis, 113m, *33°00'23"N*, *115°03'54"W*, 11.ii.1982, G. Gordh [2♀, UCRC: UCRCENT499295, 499297]. N. Glamis, 125m, *33°00'23"N*, *115°03'54"W*, 11.ii.1982, J. T. Huber [1♀, UCRC: UCRCENT499298]. Palo Verde, *33°25'49"N*, *114°43'41"W*, 8.iv.1970, E.E. Grissell [1♂, UCDC: UCRCENT477989]. **Inyo Co.**, 14 km NW Darwin, *36°19'51"N*, *117°42'52"W*, 25.v.1994, S.L. Heydon, white flowers [3♂ 2♀, UCDC: UCRCENT477964–68]. 22 mi. W. Panamint Springs, 1433m, *36°20'1"N*, *117°44'13"W*, 7.v.1961, D.Q. Cavagnaro [1♂, UCDC: UCRCENT477992]. 6 km E. Big Pine, 37°10'0"N, 118°13'0"W, 24.v.1994, S.L. Heydon [1♀, UCDC: UCRCENT477970]. Darwin Falls, 897m, *36°19'15"N*, *117°31'28"W*, 17.v.1970,

E.E. Grissell, on *Eriogonum inflatum* [7♂, UCDC: UCRCENT477978–84]. Darwin Falls, 897m, *36°19'15"N*, *117°31'28"W*, 17.v.1970, R.M. Bohart [3♂, UCDC: UCRCENT477985–87]. Darwin Falls, 897m, *36°19'15"N*, *117°31'28"W*, 9.iv.1972, R.M. Bohart [1♂, UCDC: UCRCENT477988]. Indian Ranch, Panamint Vly., 344m, *36°08'36"N*, *117°13'1"W*, 13.v.1980, G. Gordh [1♀, UCRC: UCRCENT499296]. Indian Ranch, Panamint Vly., 345m, *36°08'36"N*, *117°13'1"W*, 18.v.1980, G. Gordh, host plant: *Larrea* or *Prosopis* [1♂, UCRC: UCRCENT499294]. Panamint Vly. Near Indian Ranch, 449m, *36°05'48"N*, *117°12'24"W*, 29.iv.1975, J.D. Pinto [1♀, UCRC: UCRCENT499281]. Surprise Cyn., Panamint Mts., 1209m, *36°06'53"N*, *117°09'5"W*, 25.iv.1957, P. H. Timberlake, host plant: *Eriogonum inflatum* [1♀, UCRC: UCRCENT499288]. Surprise Cyn., Panamint Mts., 1229m, *36°06'53"N*, *117°09'3"W*, 27.iv.1981, G. Gordh [1♀, UCRC: UCRCENT499291]. **Kern Co.**, Red Rock Cyn., 786m, *35°22'24"N*, *117°59'10"W*, 2–3.iv.1981, G. Gordh [2♀, UCRC: UCRCENT499300, 499301]. **Los Angeles Co.**, Littlerock Recreation Area, 34°28'16"N, 118°01'16"W, 10.vi.1998, J. Heraty, H98-081 [2♀, UCRC: UCRCENT49013, 175197 (**D0111**)]. **Riverside Co.**, *36°50'56"N*, *117°05'2"W*, 14.iii.1968, G.C. & J. Wheeler, host: *Asphondylia* gall, host plant: *Larrea* sp. [1♀, USNM: UCRCENT471569]. AG-OPS 3C (Iowa), 305m, *33°58'20"N*, *117°20'21"W*, 1.xi.2008, R. Luck, host: *Phyllocnistis citrella*, host plant: Lemon [1♂, UCRC: UCRCENT485726]. AG-OPS 3C (IOWA), 305m, 33°58'20"N, 117°20'21"W, 13.ii.2008, R. Luck, # 31 A, host: *Phyllocnistis citrella*, host plant: Lemon [2♂, UCRC: UCRCENT485724, 485725]. Berdoo Canyon,

321m, *33°48’43”N*, *116°10’24”W*, 26.iv.1979, G. Gordh [4♀, UCRC: UCRCENT312318–312321]. Harford Springs Park, 623m, 33°48’6”N, 117°20’41”W, 26.iii.2010, D. Yanega, open scrub and grassland, sweep [1♀, UCRC: UCRCENT323181]. S. Pinyon Crest, 1305m, 33°35’54”N, 116°26’29”W, 13–14.vi.2009, D. Yanega [1♀, UCRC: UCRCENT325853]. Soboba, Ind. Res., 564m, 34°18’1”N, 117°30’24”W, 10.viii.2009, R. Luck, #96, host: *Phyllocnistis citrella*, host plant: Grapefruit [1♂, UCRC: UCRCENT485723], 18.xi.2008, R. Luck, #75, host: *Phyllocnistis citrella*, host plant: Grapefruit [2♀, UCRC: UCRCENT292660, 292687], 29.xi.2006, R. Luck, #24, host: *Phyllocnistis citrella*, host plant: Grapefruit [2♂, UCRC: UCRCENT485721, 485722], 29.xi.2006, R. Luck, #24, host: *Phyllocnistis citrella*, host plant: Grapefruit [2♂, UCRC: UCRCENT485721, 485722]. Terwilliger Rd. S. of Anza, 1269m, 33°27’32”N, 116°38’10”W, 31.viii–7.ix.2008, G. Pratt, malaise trap [1♀, UCRC: UCRCENT357518 (**D3660**)]. Thermal Plaza nursery, -44m, *33°28’5”N*, *116°06’4”W*, 29.xi.2006, R. Luck, host: *Phyllocnistis citrella*, host plant: Grapefruit [1♂, UCRC: UCRCENT485715]. Thousand Palms Oasis, 166m, *33°50’14”N*, *116°18’35”W*, 26.iii.1997, M. Gates, Sweep [1♀, UCRC: UCRCENT312360]. Thousand Palms, 66m, *33°48’47”N*, *116°23’31”W*, 20.xi.1955, W.R. Richards [1♀, UCDC: UCRCENT477976]. **San Bernardino Co.**, 29 Palms, 571m, *34°08’54”N*, *116°02’13”W*, 29.viii.1934, Timberlake Coll., host plant: *Wislizenia refracta* [2♀, UCRC: UCRCENT499279, UCRC: UCRCENT499280]. 29 Palms, JTNP, Oasis of Mara, 602m, 34°07’42”N, 116°02’19”W, 29.iv.2011, D. Yanega [5♀, UCRC:

UCRCENT336279, 336398, 336405, 337267, 337282]. 3 mi. E. Halloran Sprgs Rd. N. side I-15, 1084m, *35°23'23"N*, *115°50'48"W*, 30.iv.1998, Gates & Carey [1♀, UCRC: UCRCENT312359]. 0.5mi. N. jct. Kelbaker Rd & I-40, 942m, *34°43'41"N*, *115°40'43"W*, 17.v.1997, M. Gates [1♂ 2♀, UCRC: UCRCENT471561, 471562, 65500], 20.iv.1997, M. Gates [1♀, UCRC: UCRCENT312361], 20.v.1997, M. Gates [1♂, UCRC: UCRCENT065295], 27.ix.1998, Gates & Osborne, sandy wash [1♂ 1♀, UCRC: UCRCENT65449–50]. Baldy Mesa, 1071m, *34°27'14"N*, *117°27'4"W*, 29.v.1980, G. Gordh [5♀, UCRC: UCRCENT499302–499306]. Burns Pinon Ridge Reserve, 1260m, 34°08'57"N, 116°27'11"W, 23.v.2005, R.L. Zuparko, host plant: *Chilopsis linearis arcuata* [1♀, EMEC: EMEC66232]. Mitchell's Caverns, *34°56'27"N*, *115°30'52"W*, 25.ix.1984, D. Pinto [2♂ 2♀, UCRC: UCRCENT499284–499287]. Pearblossom (security trailer), 934m, 34°30'29"N, 117°53'32"W, 8.v.2013, R.K. Perry, swp, RP13/003 [1♀, UCRC: UCRCENT499462 (**D5933**)]. UC Granite Mtns. Reserve, Granite Cove, 1300m, *34°46'57"N*, *115°39'15"W*, 13–20.iv.1997, M.W. Gates, malaise trap [1♀, UCRC: UCRCENT065437]. **San Diego Co.**, Borrego Valley, 150m, *33°12'41"N*, *116°18'58"W*, 15.iv.1981, J.T. Huber [1♂, UCRC: UCRCENT312366]. Borrego Valley, 150m, *33°12'41"N*, *116°18'58"W*, 22.iv.1981, G. Gordh [1♂ 3♀, UCRC: UCRCENT312362–312365]. Borrego Valley, 187m, *33°15'41"N*, *116°22'52"W*, 10.vii.1981, G. Gordh [1♀, UCRC: UCRCENT499299]. Collins Valley, Coyote Canyon Rd., 411m, *33°22'55"N*, *116°26'59"W*, 23.iii.1997, M. Gates & D. Hawks [9♀, UCRC: UCRCENT312331–312338, 499282]. Coyote

Canyon. Anza Borrego, 333m, *33°21’57”N*, *116°24’56”W*, 15.iv.1981, G. Gordh [1♀, UCRC: UCRCENT312358]. Coyote Canyon. Anza Borrego, 333m, *33°21’57”N*, *116°24’56”W*, 22.iv.1981, G. Gordh [3♂ 2♀, UCRC: UCRCENT312353–312357]. Fallbrook, 40401 De Luz Rd, 268m, 33°04’0”N, 117°02’0”W, 17.x.2006, T. Shea, #12, host: *Phyllocnistis citrella*, host plant: Valencia [1♀, UCRC: UCRCENT292717]. Pala, 37020 Magee Rd, Flour Ranch, 395m, 33°23’17”N, 117°02’29”W, 1.xi.2006, T. Shea, #19, host: *Phyllocnistis citrella*, host plant: Grapefruit [1♀, UCRC: UCRCENT292903]. Pauma, Rutz grove, 305m, *33°20’14”N*, *116°58’57”W*, 7.viii.2008, R. Luck, host: *Phyllocnistis citrella*, host plant: Valencia [5♂ 7♀, UCRC: UCRCENT274989, 274990, 275072, 275083–275088, 275090, 275092–93]. Pauma, Rutz grove, 374m, 33°20’14”N, 116°58’57”W, 1.xi.2006, T. Shea, #20, host: *Phyllocnistis citrella*, host plant: Valencia [1♂, UCRC: UCRCENT292878]. Pauma, Rutz grove, 374m, *33°20’14”N*, *116°58’57”W*, 10.viii.2009, R. Luck, # 95, host: *Phyllocnistis citrella*, host plant: Lemon [11♂ 7♀, UCRC: UCRCENT274987, 275011, 275043, 275056, 275061, 275074, 275078, 292851, 292867, 292875, 292885, 292886, 292888, 292890, 485716, 485717, 485719, 485720]. San Elijo Lagoon, 0.25 mi. from El Camino Real entrance, 7m, *34°00’42”N*, *117°16’22”W*, 7.viii.1996, M. Gates [1♀, USNM: UCRCENT471599]. **Ventura Co.**, Oxnard/Central & Rose NE, 34m, *34°14’51”N*, *119°08’33”W*, 30.vii.2008, Tom Roberts, host: *Phyllocnistis citrella*, host plant: Eureka lemons, bulk rearing, #35 [2♀, UCRC: UCRENT1419, 1420]. Ventura, Limoneira ranch, 88m, 34°20’0”N, 119°08’0”W, 19.ii.2009, R. Luck, #82, host:

Phyllocnistis citrella, host plant: Lisbon Lemon [1♀, UCRC: UCRCENT292625], 15.i.2009, B. Faber, #78, host: *Phyllocnistis citrella*, host plant: Lemon [1♂ 1♀, UCRC: UCRCENT292645, 292749], 12.x.2008, B. Faber, #77, host: *Phyllocnistis citrella*, host plant: Lemon [2♂, UCRC: UCRCENT275019, 275032]. **Nevada: Nye Co.**, Mercury, 1153m, *36°39'39"N*, *115°59'40"W*, 1975, A. C. Cole Jr. [1♀, UCRC: UCRCENT499290]. **Texas: Brewster Co.**, Big Bend Natl. Pk., 12.5 mi. SE Panther Jct., 762m, *29°12'0"N*, *103°02'24"W*, 10–16.vii.1982, G. Gibson [1♀, CNC: CNC508861]. Big Bend Natl. Pk., 12.5 mi. SE Panther Jct., 762m, *29°12'0"N*, *103°02'24"W*, 29.vi.1982, G. Gibson, sweep [2♀, CNC: CNC508869, 508870]. Big Bend Natl. Pk., 2.7 km NE Castolon, 688m, *29°09'6"N*, *103°29'59"W*, 14.vii.1982, G. Gibson [1♀, CNC: CNC508862]. Big Bend Natl. Pk., Croton Spr., 914.4m, *29°20'40"N*, *103°20'47"W*, 6.vii.1986, J. Heraty [5♂ 2♀, UCRC: UCRCENT312340–312345, 414296]. Big Bend Natl. Pk., Government Spring, 1200m, *29°20'25"N*, *103°15'20"W*, 3.vii.1986, J. Heraty, H86301 [2♂, UCRC: UCRCENT312346, 312347]. **Culberson Co.**, 3.6 mi. S. Pine Spgs., old Guadeloupe Pass Hwy., 1584m, *31°51'50"N*, *104°50'13"W*, 20–22.vii.1982, G. Gibson [1♀, CNC: CNC508863]. **Jefferson Davis Co.**, 9 mi. SE Ft. Davis, *30°31'49"N*, *103°46'59"W*, 23.viii.1967, R.C. Gardner, C.R. Kovacic [1♂, UCDC: UCRCENT477993]. **Reeves Co.**, Balmorhea Lake, 970m, 30°58'27"N, 103°43'14"W, 26.vi.2015, J. Heraty, flowers, swp, H15-059 [1♀, UCRC: UCRCENT499457]. **Terrell Co.**, ~5 mi. W. Sanderson, 841m, *30°09'59"N*, *102°28'9"W*, 18.vii.1997, M. Gates [1♂ 1♀, UCRC: UCRCENT499283, 471563].

19. *Zagrammosoma seini* Wolcott

Fig. 2.37.

Zagrammosoma seini Wolcott, 1936: 525. Lectotype ♀ **present designation**. Locality: USA, Puerto Rico, Lares, 318m, xii.1934-ii.1935, F. Sein, "PR 14-35", host: *Leucoptera coffeella* (Lepidoptera: Lyonetiidae): [UCRCENT 416789]. Deposited at USNM.

Cirrospilus (*Zagrammosoma*) *seini* (Wolcott). Incorrect combination and subgenus designation by DeSantis 1979: 261.

Diagnosis: *Zagrammosoma seini* is characterized by the presence of both a wide, medial band dorsally on the mesoscutum and darkening of the fore wing apical margin. The mesosoma pattern is similar in *Z. latilineatum*, but the median band is thinner in *Z. seini* than in *Z. latilineatum* (Figs 2.37 D, E versus 2.25D, E), and *Z. latilineatum* lacks the apical band of the fore wing. *Zagrammosoma yanegai* also has similar color patterns of the wings and mesosoma (Fig. 2.45F), however *Z. yanegai* possesses asymmetrical funiculars (Fig. 2.45A) and a less developed median carina on the propodeum.

Description: Female - body length 1.62–1.99 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Dark stripe and band below compound

eye yellow. Occiput yellow with 2 dark, vertical stripes. Pronotum with median band complete; laterally with 2 dark stripes. Mesoscutum with median band complete. Prepectus yellow with black stripe along dorsal margin. Mesoscutellum yellow with median band. Propodeum yellow with black: median carina, diagonal line. Procoxa and mesocoxa yellow. Metacoxa yellow with black stripe basally. Profemur, mesofemur, and metafemur yellow. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal band present, with perpendicular extension greater than that of stigmal apex; postmarginal band absent; apical band present; connections from parastigmal band to stigmal band, and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow with median black stripe; black stripe laterally.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.43–0.46); second longer than wide (w:l = 0.61–0.7).

Pronotum, in dorsal view, bell-shaped (w:l = 1.4–1.94); 3 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae absent. Mesoscutellum wider than long (w:l = 1.15–1.25); submedian grooves absent. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus shorter than second tarsomere (bst:2^{nd} = 0.63–0.89).

Fore wing l:w = 2.24–2.26. Submarginal vein with 5–7 setae dorsally. Basal fold setae absent, or with one to two setae. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 1.05–1.37 mm; metasoma with median stripe not complete.

Remarks: Wolcott (1936) did not designate a holotype or depository when describing this species. The specimens he described were from “mines of *Leucoptera coffeella* Guerin on coffee at Lares (152-21, 14-35 generic determination by A.B. Gahan).” There are two female specimens housed at the USNM that are reared from *L. coffeella*, one with the Accession number 152-21 collected from Lares, and the other with “P.R. 14-35” collected from “Lares or Isabela.” The latter was collected by F. Sein. It is presumed that these are the specimens Wolcott used in his description of *Z. seini*, and therefore, a lectotype and paralectotype are assigned here.

Hosts: Recovered from lepidopteran leaf miners. See Table 2.3. **Lepidoptera**: Gracillariidae, Lyonetiidae, Pyralidae, Tischeriidae.

Distribution: Neotropical: Bahamas, Cuba, Dominica, Dominican Republic, USA (Puerto Rico) (Fig. 2.38).

Material examined: Paralectotype: USA: Puerto Rico: Lares, 383m, *18°17'29"N*, *66°50'13"W*, 14.vi.1921, G.N. Wolcott, host: *Leucoptera coffeella* [1♀, USNM: UCRCENT416893].

Additional material examined: BAHAMAS: Eleuthera: Rainbow Bay, 23m, *25°20'31"N*, *76°27'1"W*, 11.xi–19.xii.1986, J.R. Wiley, malaise [1♀, CNC: CNC508712]. **CUBA:** Artemisa, 51m, *22°48'53"N*, *82°45'23"W*, 3.x.1969, Hochmut, host: *Phyllocnistis* sp. [1♂, BMNH: NHMUK10353841]. **Pinar del Rio:** Vinales, 146m, *22°37'10"N*, *83°42'22"W*, 4.vii.1969, Hochmut, host: *Dioryctria horneana* [1♀, BMNH: NHMUK10353844]. **DOMINICA: St. Joseph Parish:** Grand Savae, 308m, *15°26'54"N*, *61°25'45"W*, 8.ix.1965, D.L. Jackson [1♂, USNM: UCRCENT471576]. **DOMINICAN REPUBLIC: La Altagracia:** Nisibon, 41m, *18°50'3"N*, *68°40'13"W*, 9.vi.1976, E.E. Grissell, host: Gracillaridae, host plant: *Gliciridia sepium* [5♀, USNM: UCRCENT416782–416785, 416891]. **La Romana:** Higueral, *18°30'5"N*, *69°00'46"W*, 11.vi.1976, E.E. Grissell, host: Gracillaridae, host plant: *Gliciridia sepium* [USNM: UCRCENT416892]. **USA: Puerto Rico:** 733m, *18°15'17"N*, *66°32'33"W*, M.R. Smith, P.R. No. 897, host: *Leucoptera coffeella* [6♂, USNM: UCRCENT416790–416795]. Adjuntas, 490m, *18°09'48"N*, *66°43'27"W*, 6.ii.1996, host: *Phyllocnistis citrella* [1♀, ANIC: UCRCENT238321]. Adjuntas, 490m, *18°09'48"N*, *66°43'27"W*, 7.ii.1996, host: *Phyllocnistis citrella* [1♀, ANIC: UCRCENT238232]. **Cidra**, *18°10'28"N*, *66°09'42"W*, 1940, F. Sein, Jr., host: Caterpillar, host plant: *Ananas comosus* [1♂, USNM: UCRCENT416890].

Humacao, Monkey Island, 1m, *18°09'25"N*, *65°44'1"W*, v.1940, J.G. Needham, Iden. Lot No. 40-8269, host: *Tischeria* sp., host plant: *Melanthera* sp. [1♀, USNM: UCRCENT416781]. **Mayagüez**, Mayagüez, 10m, *18°12'2"N*, *67°08'39"W*, xii.1904, host: *Leucoptera coffeella* [3♂, USNM: UCRCENT416786–416788].

20. *Zagrammosoma talitzkii* (Bouček)

Fig. 2.39.

Cirrospilus (*Zagrammosoma*) *talitzkii*, 1961: Bouček*,* 1961: 18. Holotype ♂. Locality: Moldova, Chișinău (Kishinev), host: *Phyllonorycter corylifoliella* (Lepidoptera: Gracillariidae), host plant: apple. Depository: National Museum Natural History, Prague, Czech Republic, No. 3579. New species and subgenus designation.

Cirrospilus talitzkii Bouček. Genus designation by Kerrich, 1969: 196.

Zagrammosoma talitzkii. New combination by Yefremova, 1995: 50–51.

Zagrammosoma talitzki (Bouček). Incorrect spelling by Yefremova, 2015: 18.

Zagrammosoma dulanense Cao & Zhu, 2014: 48. Holotype ♀. Locality: China, Qinghai Province, Dulan County. Type depository: Institute of Technology, Chinese Academy of Sciences, Beijing, China. **n. syn.**

Diagnosis: *Zagrammosoma talitzkii* is characterized by a large speculum, and basal vein fold that is asetose or at most with 1–2 setae (Fig. 2.39C). The species is most similar to *Z. americanum* and *Z. occidentale*, however the wing patterns

are unique to each species (Figs 2.4C, 2.35C, 2.39C). Only the stigmal band is present in *Z. talitzkii*, extending just past the stigmal apex, unlike the other two species, which have varying degrees of extension of the parastigmal, stigmal, and postmarginal bands.

Description: Female – body length 1.88–2.22 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median stripe complete; laterally with 2 black stripes. Prepectus all yellow. Mesoscutum with median stripe interrupted. Mesoscutellum yellow with three dark stripes. Propodeum yellow with black: median carina, posterior and sometimes anterior margins, stripe or spot laterally. Procoxa, mesocoxa, and metacoxa yellow. Profemur and mesofemur yellow. Metafemur with interrupted or uninterrupted stripe dorsally. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal band present, at junction of marginal and stigmal veins only, or with perpendicular extension less than or greater than that of stigmal apex; postmarginal band absent; connection from parastigmal band to stigmal band absent. Hind wing hyaline. Metasoma yellow with dark median and transverse stripes present.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.83–0.9); second wider than long (w:l = 1.06–1.11).

Pronotum, in dorsal view, bell-shaped (w:l = 1.65–2.0); 3–5 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae present; intermediate setae absent. Mesoscutellum wider than long (w:l = 1.06–1.2); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere, (bst:2^{nd} = 0.87–0.9).

Fore wing l:w = 2.1–2.27. Submarginal vein with 5–7 setae dorsally. Basal fold asetose or with 1–2 setae. Cubital fold asetose, with line of setae complete or incomplete to basal fold. Admarginal setae absent. Uncus originating on stigma by more than own length from stigmal apex.

Male – as female except: body length 1.24–1.3 mm; metasoma with transverse stripes and median spots.

Remarks: *Zagrammosoma dulanense* is synonymized with *Z. talitzkii* as the differences between the two species are within-species variation. Cao & Zhu (2014) remark that the black spots on gastral tergite six, are in a line in *Z. dulanense* and in a triangular configuration in *Z. talitzkii*, however, examination of a paratype and other specimens identified by Bouček, reveals variation of these black spots within *Z. talitzkii*. The black, transverse stripe along the anterior margin of the mesoscutum is present in *Z. talitzkii* but partially obscured by the posterior

margin of the pronotum. The mesosoma color pattern variation is less variable than that found in *Z. melinum* or *Z. occidentale*. A specimen from China that agrees with the description of *Z. dulanense* is recovered as *Z. talitzkii* in the molecular analysis (Fig. 2.2).

Distribution: Palearctic: Austria (Grabenweger *et al*., 2010), Bulgaria (Grabenweger *et al*., 2010), China, France (Grabenweger *et al*., 2010), Greece (Grabenweger *et al*., 2010), Hungary (Szőcs et al., 2015), Iran (Amiri *et al.*, 2008; Hesami *et al*., 2010), Israel, Italy (Radeghieri *et al*., 2002; Lupi, 2005), Kazakhstan (Petrova, 1970), Moldova, Russia (Bouček, 1965), Serbia (Stojanović & Marković, 2005), Turkey (Çikman & La Salle, 2011), Turkmenistan. **Afrotropic:** Oman, Saudi Arabia, United Arab Emirates.

(Fig. 2.40).

Hosts: Recovered from lepidopteran leaf miners. See Table 2.3. **Diptera:** Agromyzidae.

Lepidoptera: Gracillariidae.

Etymology: Bouček named this species in honor of his friend V.I. Talitzki.

Material Examined: Paratype: RUSSIA: Rostov Obl.: Taganrog, 41m, *47°14'28"N*, *38°51'57"E*, 26.vi.1921, C. Ahnger [1♀, BMNH: NHMUK10370162].

Additional material examined: CHINA: Xinjiang: N. of Wujiaqu, 430m, 44°29’46”N, 87°30’51”E, 12.vii.2016, S. Triapitsyn & H.-y. Hu group (Hu Hong-ying, Zhu Dan, Wang Chen-ri, Zhang Dong-kang, Jiang Ling-ling), desert, Code: 6, host plant: *Nitraria* sp. [1♀, UCRC: UCRCENT478936 (**D4739**)]. **ISRAEL:** Hefer Valley, 16m, 32°22’18”N, 34°55’58”E, 4.ix.2013, M. Kishenevsky, suction sampler [1♂ 1♀, UCRC: UCRCENT312395 (**D4545**), 312396 (**D4546**)]. **OMAN: Ash Sharqiyah:** 5–10 km S. Ibra, 423m, *22°40’24”N*, *58°32’7”E*, 30.iii.1986, M.J.E. Huber-Reacher [1♀, CNC: CNC508718]. **SAUDI ARABIA: Riyadh Prov.:** Al Kharj, 440m, *24°08’54”N*, *47°18’40”E*, 20.v.1979, Talhouk, host: *Phyllonorycter corylifoliella* [1♂ 2♀, ANIC: UCRCENT238657, BMNH: NHMUK10370147, 10370165]. Al Kharj, 440m, *24°08’54”N*, *47°18’40”E*, 20.vi.1979, host: *Phyllonorycter corylifoliella* [1♂, BMNH: NHMUK10370154]. Al Kharj, 440m, *24°08’54”N*, *47°18’40”E*, 20.vi.1979, Talhouk, host: *Phyllonorycter corylifoliella* [2♀, ANIC: UCRCENT238658, BMNH: NHMUK10370152]. Riyadh, 590m, *24°37’59”N*, *46°43’6”E*, 10.vi.1978, A.S. Talhouk, host: *Phyllonorycter corylifoliella* [1♂, BMNH: NHMUK10370126]. **TURKMENISTAN: Ahal: Gökdepe**, 200m, *38°09’22”N*, *57°57’53”E*, 10.vi.1986, N. Saparmamedova, host plant: Willow [1♂, UCRC: UCRCENT485713]; 5.viii.1986, N. Saparmamedova, host: *Parornix* [2♂, UCRC: UCRCENT485712, 485714]; 5.viii.1986, N. Saparmamedova, host: *Parornix* sp., host plant: Peach [2♂, UCRC: UCRCENT485712, 485714]. Babarap, 200m, *38°05’52”N*, *58°06’40”E*, 18.vi.1987, V.N. Kurashev, host: *Phyllonorycter*

corylifoliella, host plant: Apple [1♂, UCRC: UCRCENT416563]. Babarap, *38°05'52"N*, *58°06'40"E*, 25.viii.1986, N. Saparmamedova [1?, UCRC: UCRCENT416562]. **Balkan:** Kara Kala, 315m, *38°25'49"N*, *56°17'31"E*, 22.iv.1987, Kurashev & Myartseva [4♀, NMPC – not personally examined, locality information from Yefremova (1995)]. **UNITED ARAB EMIRATES:** Al Abjan, 96m, 24°21'36"N, 55°00'36"E, 21.viii–19.ix.2006, A. van Harten, malaise, UAE 10050 [1♀, CNC: CNC508739 (**D4988**)]. Al Abjan, 96m, 24°21'36"N, 55°00'36"E, 23.vii–21.viii.2006, A. van Harten, malaise, UAE 10053 [1♀, CNC: CNC506705 (**D4688**)].

21. *Zagrammosoma trifurcatum* Perry n. sp.

Fig. 2.41.

Diagnosis: This species has a unique mesosomal color pattern: dark stripes that trifurcate anteriorly from the posterior margin of the mesoscutellum, to the apex of the notaulus (Fig. 2.41D, E). *Zagrammosoma trifurcatum* also possesses a dark metacoxa with a transverse yellow band (Fig. 2.41B). The fore wing pattern is similar to *Z. flavolineatum* (Fig. 2.15C) and *Z. metallicum* (Fig. 2.31C), however, the mesoscutellum has a medial, yellow band in *Z. flavolineatum* (Fig. 2.31D, E), and metallic color is present in *Z. metallicum* (Fig. 2.31).

Description: Female - body length 1.78–2.82 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe present.

Vertex with 2 stripes above compound eye. Gena posteriorly with dark stripes below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median band complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median band posteriorly expanding. Mesoscutellum black with yellow along lateral margin, sometimes with additional yellow inverted “U” originating on anterior margin (Fig. 2.41D inset). Propodeum black. Procoxa and mesocoxa yellow. Metacoxa with transverse, yellow band. Profemur and mesofemur yellow. Metafemur with banding encircling femur. Fore wing: basal band absent; cubital band present; parastigmal band present, with perpendicular extension greater than that of stigmal apex; stigmal band present, with perpendicular extension greater than that of stigmal apex; postmarginal band present, with perpendicular extension greater than that of stigmal apex; connection from parastigmal band to stigmal band present; connection from stigmal band to postmarginal band absent or present. Hind wing hyaline. Metasoma dark.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.72–0.84); second longer than wide (w:l = 0.86–0.95).

Pronotum, in dorsal view, bell-shaped (w:l = 1.06–1.26); 3–4 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae and intermediate setae present. Mesoscutellum subequal or wider than long (w:l = 1.02–1.14); submedian grooves present. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus longer than second tarsomere, (bst:2^{nd} = 1.08–1.1).

Fore wing l:w = 2.46–2.55. Submarginal vein with 4–7 pairs of setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.79–1.46 mm. Propodeum black with yellow spot lateral to median carina; cubital band absent; parastigmal band present, with perpendicular extension less than that of stigmal apex; connections from parastigmal band to stigmal band and from stigmal band to postmarginal band absent; metafemur yellow or with spot dorsally; metasoma yellow with median band Gt2–Gt6.

Remarks: A rarely collected species, with significant sexual dimorphism of the metasoma color, similar to *Z. flavolineatum* (Fig. 2.15D, E). These are the only two species of *Zagrammosoma* where the female metasoma is completely black, and the male metasoma is yellow with a large dark spot dorsally. While no male *Z. trifurcatum* was successfully sequenced, this dimorphism is also seen in *Burkseus flavoviridis*, which, like *Z. flavolineatum*, had both males and females sequenced and confirmed as valid species (Perry & Heraty, submitted)

Hosts: unknown.

Distribution: Nearctic: USA (CA). **Neotropical:** Belize (Fig. 2.32).

Etymology: Taken from Latin for the trifurcating dark lines on the dorsal surface of the mesosoma that converge at the apex of the mesoscutellum.

Type Material: Holotype: USA: California: Kern Co., Cuddy Valley Rd., 1630m, 34°50'4"N, 119°02'17"W, 12.viii.2015, J. Heraty, H15-073, swp [1♀, UCRCENT416914 (**D4600**)]. Deposited at UCRC.

Paratypes: USA: California: Kern Co., Cuddy Valley Los Padres Natl. Frst., 1612m, *34°49'26"N*, *119°01'18"W*, 31.viii.1984, R.D. Goeden, reared from flower head of *Chrysopsis villosum* [4♂ 4♀, UCRC: UCRCENT312296, 312304, 312305, 312311, 312314, 414596, 414597, 485708]. Cuddy Valley Rd., 1630m, 34°50'4"N, 119°02'17"W, 12.viii.2015, J. Heraty, H15-073, swp [1♀, UCRC: UCRCENT416557 (**D4592**)].

Additional material examined: BELIZE: Cayo Dist.: Belmopan, 79m, *17°14'54"N*, *88°46'11"W*, 25.i.1952 [1♂, CNC: CNC508680]. **USA: California: Kern Co.**, Cuddy Valley Los Padres Natl. Frst., 1612m, *34°49'26"N*, *119°01'18"W*, 31.viii.1984, R.D. Goeden, reared from flower head of *Chrysopsis villosum* [9♂ 7♀, UCRC: UCRCENT312294, 312295, 312297–312303, 312306–312310, 312312, 312313]. **San Diego Co.**, Imperial Beach, 8m, *32°34'54"N,117°06'04"W,* 10.vii.2009, photographed by S. Snover, ypt [1♀, https://bugguide.net/node/view/325435/bgimage].

22. *Zagrammosoma velerii Yefremova*

Fig. 2.42.

Zagrammosoma velerii, 1995: Yefremova, 1995: 313–315. Holotype ♀. Locality: Cuba, Guanabo, coll. Kerzhner. Depository: Zoological Institute, St. Petersburg, Russia, antenna and fore wing on slides no. 3208 & 3209.

Diagnosis: *Zagrammosoma velerii* is the only species to exhibit both a yellow mesoscutellum and yellow mesoscutum with no dark, median stripe. The head and pronotum setae density are similar to *Z. calvini* (Fig. 2.8) and *Z. villosum* (Fig. 2.43), however the wing and body patterns are unique to *Z. velerii*. The first funicular is longer than wide in *Z. velerii*, where it is either subequal or wider than long in *Z. calvini*, and wider than long in *Z. villosum*.

Description: Female - body length 1.2–1.6 mm. Metallic luster on body absent. Scape all yellow. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Occiput yellow, sometimes with 2 faint, vertical stripes. Pronotum yellow; two black stripes laterally. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum yellow. Mesoscutellum yellow. Propodeum yellow with black: median carina, anterior and posterior margins, diagonal line connecting anterior and posterior margins. Procoxa, mesocoxa, and metacoxa yellow. Profemur, mesofemur, and metafemur yellow. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only;

stigmal and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connections from parastigmal band to stigmal band and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow with interrupted dark, median stripe; dark band laterally.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first longer than wide (w:l = 0.66–0.87); second longer than wide to wider than long (w:l = 0.88–1.17).

Pronotum, in dorsal view, bell-shaped (w:l = 1.59–1.77); 4–5 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum wider than long (w:l = 1.26–1.36); submedian grooves absent or present but faint and shallow. Hind tibial spur distinctly shorter than basitarsus or subequal. Hind basitarsus shorter than second tarsomere (bst:2^{nd} = 0.83–0.85).

Fore wing l:w = 2.2–2.86. Submarginal vein with 5–8 setae dorsally. Admarginal setae present. Basal fold setose. Cubital fold setose. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 1.14–1.6 mm; prepectus all yellow; stigmal and postmarginal bands present, with perpendicular extension less than that of stigmal apex.

Remarks: A seldom collected species, *Z. velerii* is easily identified by the color pattern of the body.

Hosts: unknown.

Distribution: Neotropical: Bahamas, Cuba (Yefremova, 1995), Mexico (BS) (Fig. 2.32).

Etimology: ???

Material Examined: BAHAMAS: Eleuthera: Rainbow Bay, 23m, *25°20'31"N*, *76°27'1"W*, 11.xi–19.xii.1986, J.R. Wiley, malaise [1♀, CNC: CNC508733 (**D4685**)]. **Exuma:** Simon's Point, 7m, 23°31'52"N, 75°47'49"W, 15–20.v.1986, T.L. McCabe [1♀, ANIC: UCRCENT238215]. **MEXICO: Baja California Sur:** Las Barracas, 975m, *23°28'25"N*, *109°27'8"W*, 5–22.v.1984, P. DeBach, Pan trap [1♀, UCRC: UCRCENT312399].

23. *Zagrammosoma villosum* Perry n. sp.

Fig. 2.43.

Diagnosis: This species is characterized by a heavily setose vertex, occiput, pronotum, and mesoscutum. This amount of setation is found only in one other species, *Z. calvini* (Fig. 2.8). Females are separated by the number of vertical lines on the occiput: two in *Z. villosum* (Fig. 2.43D, E), three in *Z. calvini* (Fig. 2.8A). In addition, both males and females of *Z. calvini* have three horizontal lines on the

pronotum in lateral view, whereas *Z. villosum* has two. These two species are found on different continents and molecularly confirmed as separate species (Fig. 2.2). *Zagrammosoma villosum* has similar body color patterns to *Z. americanum* (Fig. 2.4), but does not possess the dark, transverse stripe on the anterior margin of the mesoscutum found in *Z. americanum*.

Description: Female - body length 0.97–1.23 mm. Metallic luster on body absent. Scape yellow with black stripe dorsally. Lower face with median stripe absent. Vertex with 2 stripes above compound eye. Gena posteriorly with or without dark band below compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median stripe incomplete or complete; laterally with 2 black stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with median stripe interrupted or uninterrupted. Mesoscutellum yellow with three dark stripes. Propodeum yellow with black: median carina, anterior and posterior margins, spot laterally. Procoxa, mesocoxa, and metacoxa yellow. Profemur, mesofemur, and metafemur yellow. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal and postmarginal bands present, with perpendicular extension greater than that of stigmal apex; connections from parastigmal band to stigmal band and from stigmal band to postmarginal band absent. Hind wing hyaline. Metasoma yellow with median and transverse stripes.

Upper ocular sulcus present. Pedicel longer than wide. Funiculars symmetrical: first wider than long (w:l = 1.07–1.25); second wider than long (w:l = 1.38–1.6).

Pronotum, in dorsal view, bell-shaped or more than twice as wide as long (w:l = 1.75–2.23); 3–5 pairs of setae along posterior margin. Mesoscutum reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum wider than long (w:l = 1.08–1.25); submedian grooves present, sometimes faint and shallow. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus shorter than second tarsomere (bst:2^{nd} = 0.75–0.85).

Fore wing l:w 2.19–2.31. Submarginal vein with 5–7 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - as female except: body length 0.67–1.22 mm; occiput all yellow or with faint vertical stripes; prepectus yellow; hind tibial spur subequal in length to second tarsomere; postmarginal band present, with perpendicular extension less than or greater than that of stigmal apex.

Remarks: The majority of these specimens were identified in collections as *Z. americanum* as the color patterns on the body are similar between the species, but the setae density of *Z. villosum* makes identification straightforward.

Hosts: Recovered from lepidopteran leaf miners. See Table 2.3. **Lepidoptera**: Tischeriidae.

Distribution: Nearctic: USA (CA, TX). **Neotropical:** Mexico (OA) (Fig. 2.44).

Etymology: Villosum is Latin for hairy.

Type material: Holotype: USA: Texas: San Patricio Co., Welder Wildlife Ref. near Vena Mills, *28°06'42"N*, *97°24'24"W*, 4.v.1989, J. Heraty [1♀, UCRC: UCRCENT499453]. **Paratypes: MEXICO: Oaxaca:** 10.8 mi. W. Pinotepa Nacional, 99m, *16°21'4"N*, *98°12'32"W*, 9.vii.1987, J.B. Woolley & G. Zolnerowich, 87/026 [1♀, TAMU: UCRCENT473169 (**D5913**)]. **USA: Arizona: Pima Co.**, Kitt Peak Rd., Coyote Mtns. 5km SW jct Hwy 86 & 386, 31°58'52"N, 111°36'5"W, 2–12.v.2006, M.E. Irwin, damp wash, malaise [1M#, UCRC: UCRCENT499466 (**D5935**)].**Texas: Culberson Co.**, 3.6 mi. S. Pine Spgs, old Guadeloupe Pass Hwy., 1584m, *31°51'50"N*, *104°50'13"W*, 20–22.vii.1982, G. Gibson [2♂ 2♀, CNC: CNC508720, 508725, 508727, 508729]. **Hidalgo Co.**, S. of F.M. 2221 on Iowa Rd., 62m, 26°19'32"N, 98°24'34"W, 13.iv.2010, J. Mottern, acacia/mesquite scrub, sweep, M10-014 [1♂ 2♀, UCRC: UCRCENT357537 (**D3679**), 357538, 357539 (**D3681**)].

Additional material examined: MEXICO: Guerrero: Puerto Marques, *16°47'57"N*, *99°49'44"W*, 6.xii.1986, H. Miranda, host: Lepidoptera larva, host plant: *Mimosa pigra* [1♀, USNM: UCRCENT471437]. **Nuevo Leon: Mun. Allende**, Lazarillos de Abajo, 438m, *25°18'57"N*, *100°02'40"W*, 9.vii.1983, A. Gonzalez H. [1♀, UCRC: UCRCENT499449]. **Sinaloa:** N.W. Guamuchil, 45m, *25°28'51"N*, *108°05'8"W*, 23.x.1982, J.T. Huber, sweep [1♀, UCRC: UCRCENT499450]. **Tamaulipas:** S. Ciudad Victoria on Hwy 85, 318m, *23°42'13"N*, *99°07'5"W*, 1.xi.1982, J.T. Huber & A. Gonzalez, sweep [1♀, UCRC: UCRCENT499451]. **USA: Arizona: Cochise Co.**, 1.0 mi. W. Portal, 1419m, *31°54'50"N*, *109°07'26"W*, 31.vii.1982, G.A.P. Gibson [1♀, CNC: CNC508731]. **Yavapai Co.**, 10 mi. S. Camp Verde, 1248m, *34°24'38"N*, *111°49'20"W*, 10.vii.1969, G.W. Forister, host plant: *Acacia constricta* [2♀, UCDC: UCRCENT477917, USNM: UCRCENT471438]. **California: Modoc Co.**, Surprise Valley Rd. 2.8 mi. S. Oregon border, 1600mm, 41°57'33"N, 120°01'48"W, 8.vii.2007, R.L. Zuparko, host plant: *Juniperus occidentalis* [1♀, EMEC: EMEC84296]. **Texas: Culberson Co.**, 3.6 mi. S. Pine Spgs, old Guadeloupe Pass Hwy., 1584m, *31°51'50"N*, *104°50'13"W*, 20–22.vii.1982, G. Gibson [2♂ 6♀, CNC: CNC508719, 508721–508724, 508726, 508728, 508730]. **Presidio Co.**, Presidio, *29°33'39"N*, *104°22'19"W*, 1945, Lot no. 45-11727, host: *Tischeria* sp. [1♀, USNM: UCRCENT471648]. **San Patricio Co.**, Welder Wildlife Ref. nr Vena Mills, 15m, *28°07'18"N*, *97°26'33"W*, 1.vi.1988, J. Heraty [1♀, UCRC: UCRCENT499452]. **Travis Co.**, vic. Long Hollow Creek, 230m, 30°27'43"N, 97°52'19"W, 19.v.1994, M. Quinn, E. Riley, & R. Wharton [1?,

TAMU: UCRCENT426736]. vic. Cypress Creek, 230m, 30°25'58"N, 97°52'1"W, 19–20.v.1994, M. Quinn, E. Riley, & R. Wharton [1?, TAMU: UCRCENT426737]; 23–24.iv.1994, M. Quinn, E. Riley, & R. Wharton [1?, TAMU: UCRCENT426734]; 7–8.v.1994, M. Quinn, E. Riley, & R. Wharton [1?, TAMU: UCRCENT426735].

24. *Zagrammosoma yanegai* Perry n. sp.

Fig. 2.45.

Diagnosis: This species can be differentiated from all other *Zagrammosoma* by the asymmetrical funiculars (Fig. 2.45A, B), mesoscutum and mesoscutellum with linear-reticulate sculpturing (Fig. 2.45E), and propodeum posteriorly with a very faint median carina that may be difficult to see. The color patterns are most similar to *Z. latilineatum* (Fig. 2.25), also found in the Indo-Malay, and the two species can be differentiated by the number of dark lines laterally on the pronotum: two in *Z. latilineatum* and three in *Z. yanegai*.

Description: Female - body length 0.75–0.8 mm. Metallic luster on body absent. Scape all yellow. Lower face with median stripe absent. Vertex with one stripe above compound eye. Gena posteriorly with wide, dark band below compound eye; yellow spot on ventral margin of compound eye. Occiput yellow with 2 dark, vertical stripes. Pronotum with median band or stripe complete; laterally with 3 dark stripes. Prepectus yellow with dark stripe along dorsal margin. Mesoscutum with

median band or stripe complete. Mesoscutellum with one or three dark stripes. Propodeum yellow with dark markings laterally. Procoxa yellow with dark stripe or band basally. Mesocoxa yellow with faint, dark transverse band. Metacoxa yellow with black stripe or band basally and/or apically. Profemur and mesofemur yellow. Metafemur with interrupted stripe or dark band on outside of femur, tapering apically. Fore wing: basal and cubital bands absent; parastigmal band present, at junction of parastigmal and marginal veins only; stigmal band present, with perpendicular extension less than that of stigmal apex; postmarginal band absent; darkening of apical margin present; connection from parastigmal band to stigmal band absent. Hind wing hyaline. Metasoma yellow with median and transverse stripes present.

Upper ocular sulcus absent. Pedicel subequal in width: length. Funiculars asymmetrical and subequal in width: length (w:l = 1.0).

Pronotum, in dorsal view, more than twice as wide as long (w:l = 2.29–2.44); 3 pairs of setae along posterior margin. Mesoscutum linear reticulate; small, scattered setae absent; intermediate setae present. Mesoscutellum wider than long (w:l = 1.45–1.51); submedian grooves absent or present but faint and shallow. Propodeum with median carina present posteriorly only. Hind tibial spur distinctly shorter than basitarsus. Hind basitarsus subequal in length to 2nd tarsomere (bst:2nd =1.0).

Fore wing l:w = 1.91–2.03. Submarginal vein with 5 setae dorsally. Basal fold setose. Cubital fold setose. Admarginal setae present. Uncus originating on stigma by more than own length from stigmal apex.

Male - unknown.

Remarks: This species is described from two specimens collected in Thailand and is one of two species found in the Indo-Malayan region. Even with the variable color patterns on the mesoscutum observed within the species *Z. yanegai* is morphologically distinct and is easy to identify by the asymmetrical funiculars and linear-reticulate sculpturing, (Fig. 2.42B, D, F).

Hosts: Unknown.

Distribution: Indo-Malay: Thailand (Fig. 2.26).

Etymology: Named in honor of Dr. Doug Yanega, for his many years of taxonomic help and guidance.

Type Material: Holotype: THAILAND: Chiang Mai: Pa Huay Kho, Thambon Dunpao, Amphur Mae Wang, 511m, *18°40'12"N*, *98°38'24"E*, 1–10.iv.1997, S. Sonthichai [1♀, UCRCENT415797]. Deposited at UCDC.

Additional material examined: THAILAND: Songkhla: Nam Tok Ton Plui, 100m, *7°00'2"N*, *100°14'7"E*, 17.ii.2005, D. Yanega [1♀, UCRC: UCRCENT114200] (specimen lost after description but not before photographs were taken [Fig. 2.45B inset, F]).

Outgroup Material Examined:

***Burkseus flavoviridis,* (Crawford), 1913**

USA: California: San Diego Co. Pala, 37020 Magee Rd. Fluor Ranch, 395m, 33°23'17"N, 117°02'29"W, 8.viii.2006, T. Shea, #7, host: *Phyllocnistis citrella*, host plant: grapefruit [1♀, UCRC: UCRCENT491708 (**D4176**)].

***Burkseus robustus* Perry, 2019**

USA: Arizona: Graham Co., Coronado National Forest, Pinaleno Mts., Snow Flat, 2690m, 32°39'16"N, 109°51'49"W, 19.viii.2001, J.B. Woolley, 2001/083 [1♀, TAMU: UCRCENT426798 (**D4580**)].

***Burkseus sigillatus* Perry, 2019**

USA: CA: Contra Costa Co., Tilden Regional Park, off Nimitz trail, 323m, 37°54'49"N, 122°15'07"W, 5–6.vii.2002, A. Owen & T. Kim, Oak Scrub, YPT [1♀, UCRC: UCRCENT478935 (**D4738**)],

***Burkseus vittatus* (Walker), 1838**

Switzerland: Solothurn: Hinter Wiessenstein, 1225m, 47°15'10"N, 7°30'0"E, 17.vi.1999, Goulet & White, lush meadow, Photoeclector [1♀, CNC: CNC508649 (**D4699**)].

***Cirrospilus cinctithorax* (Girault), 1916**

USA: California: San Luis Obispo Co., Cal Poly SLO, lemon grove, 84m, 35°17'41"N, 120°40'15"W, 2.viii.2010, R.K. Perry, swp, RP10-008 [1♂, UCRC: UCRCENT414586 (**D3879**)].

***Cirrospilus* spp.**

ARGENTINA: Salta: 29 km NE Cafayate, 1525m, *25°58'49"S*, *65°45'2"W*, 2–4.x.2009, M.E. Erwin, in river basin, malaise [1♀, UCRC: UCRCENT395935 (**D3751**)].

AUSTRALIA: West Australia: D'Entrecasteaux N.P., Coastal Survivors Walk, 105m, 34°50'19"S, 116°00'17"E, 8.xii.2009, R. Waterworth, sweep, M09-100 [1♀, UCRC: UCRCENT414583 (**D3867**)]. **UK: England: Surrey**, Barnes Common, 9m, *51°27'58"N*, *0°14'43"W*, 28.vii.2015, N. Dale-Skey, swp [1♀, BMNH: NHMUK10734436 (**D5965**)].

***Diglyphus begini* (Ashmead), 1804**

USA: Utah: Grand Co., Green River along Hwy 70, 1223m, 38°59'42"N, 110°08'45"W, 10.v.2002, Buffington & Munro, disturbed riparian vegetation, sweeping [2♀, UCRC: UCRCENT414573 (**D3857**), 414574 (**D3858**)].

***Diglyphus isaea* (Walker), 1838**

USA: Texas: Hidalgo Co., S. of F.M. 2221 on Iowa Rd., 62m, 26°19'32"N, 98°24'34"W, 13.iv.2010, J. Mottern, acacia/mesquite scrub, sweep, M10-014 [1♀, UCRC: UCRCENT357540 (**D3682**)]

***Diglyphus* sp.**

USA: California: Los Angeles Co., Angeles National Forest, 1614m, 34°15'19"N, 117°38'28"W, 16.vi.2009, J. Mottern, sweep, M09-010 [1♀, UCRC: UCRCENT410527 (**D3789**)].

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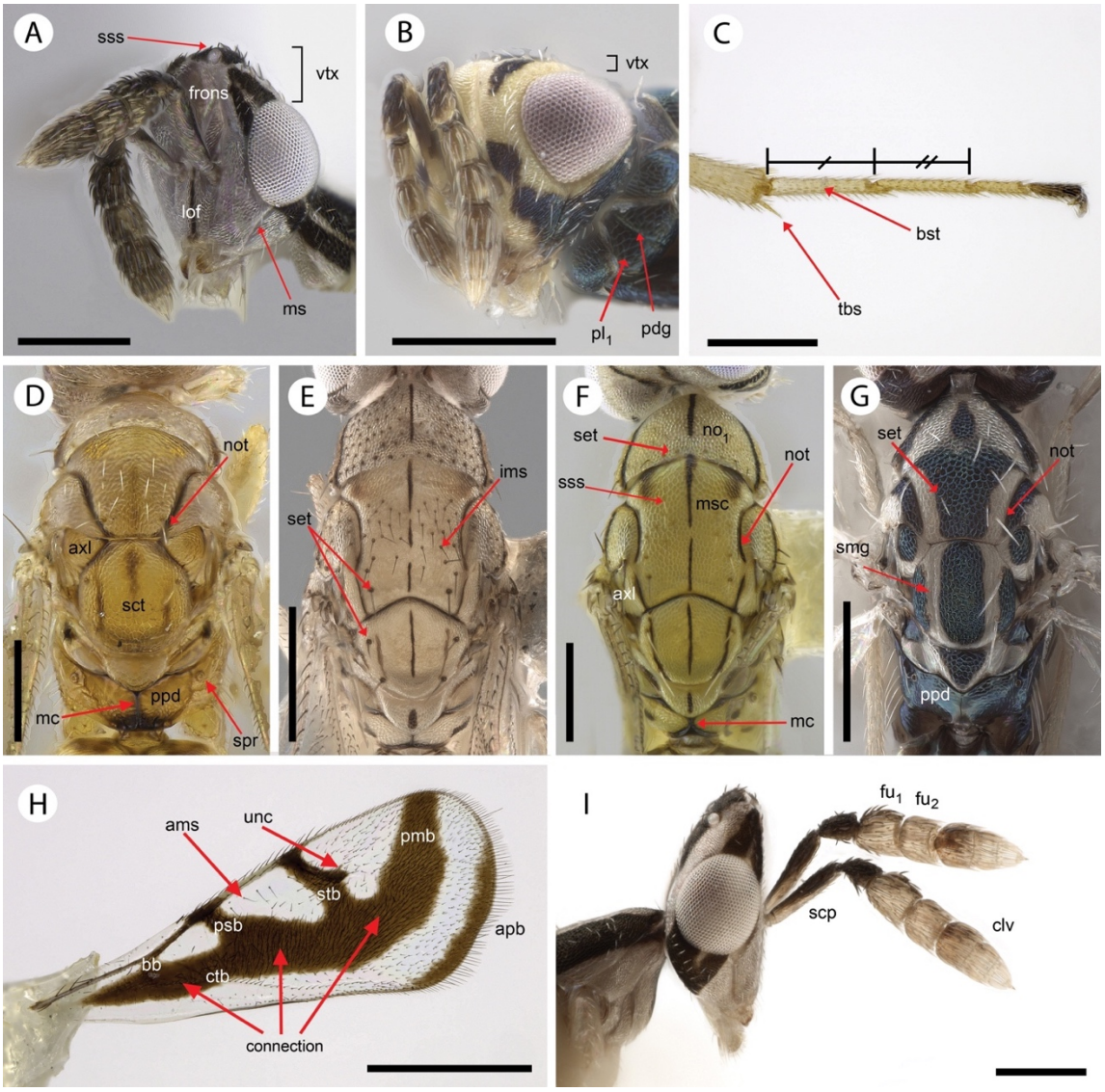

Fig. 2.1. Morphological characters. (A, B) head, frontolateral: (A) *Zagrammosoma flavolineatum*, (B) *Burkseus flavoviridis*. (C) hind leg: *Zagrammosoma trifurcatum* n. sp. (D–G) mesosoma, dorsal: (D) *Cirrospilus* sp., (E) *Zagrammosoma calvini* n. sp., (F) *Zagrammosoma americanum*, (G) *Burkseus flavoviridis.* (H) fore wing: *Zagrammosoma lineaticeps.* (I) head and antennae, lateral: *Zagrammosoma trifurcatum* n. sp. Scale bar = 0.2 mm (A–G, I), 0.5 mm (H). ams = admarginal setae, axl = axilla, bst = basitarsus, clv = clava, fu = funicular, ims = intermediary setae, lof = lower face, mc = median carina, ms = malar sulcus, msc = mesoscutum, no_1 = pronotum, not = notaulus, pdg = prodiscrimen groove, pl_1 = propleura, ppd = propodeum, scp = scape, sct = mesoscutellum, set = bristle-like setae, smg = submedian groove, sss = small scattered setae, tbs = tibial spur, vtx = vertex; apb, bb, ctb, pmb, psb, stb = bandings of fore wing.

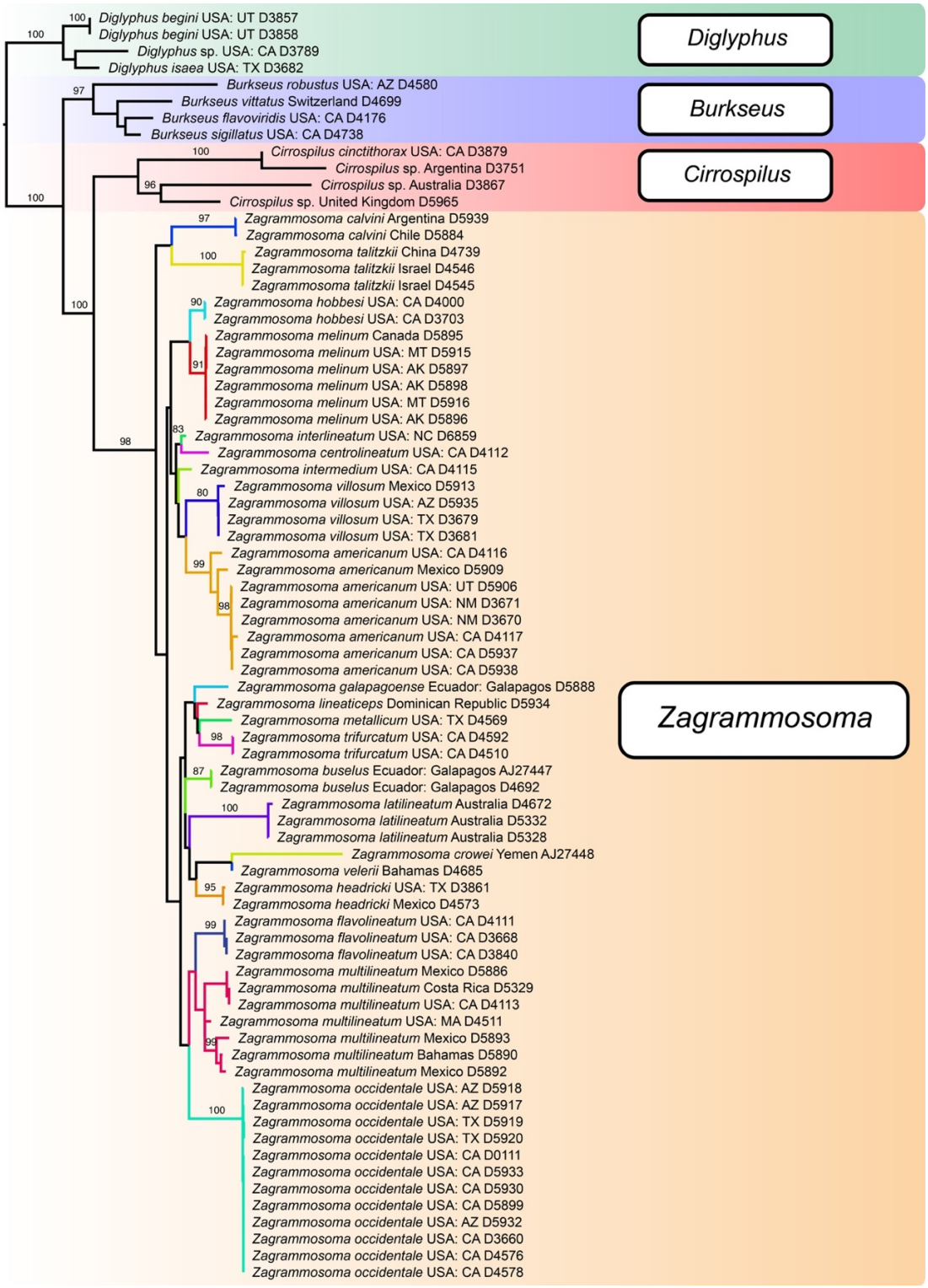

Fig. 2.2. Maximum likelihood tree using 28S D2 & D3–5, ITS2, and COI NJ. Bootstrap values shown. The varying colors within *Zagrammosoma* indicate different species.

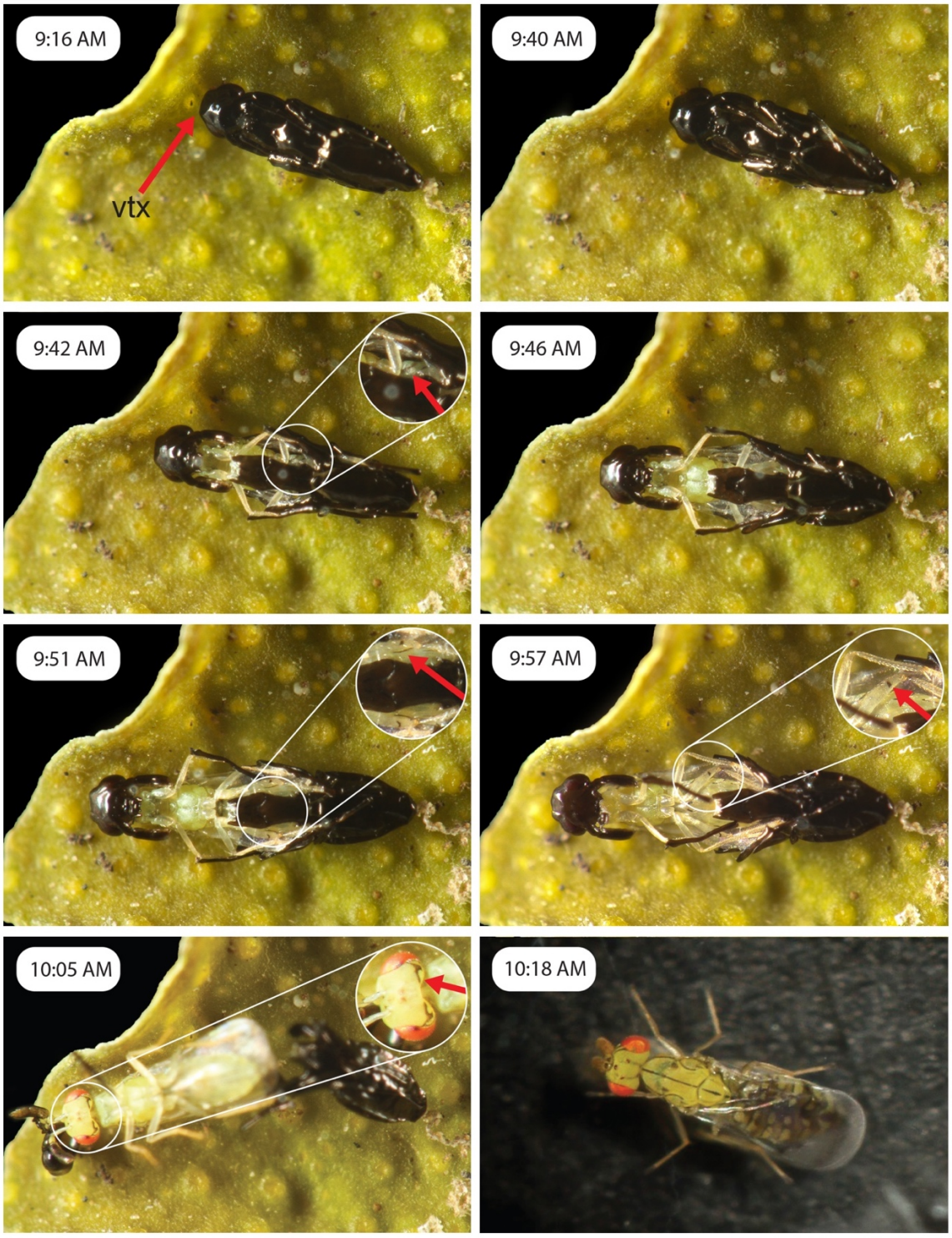

Fig. 2.3. Time lapse photographs of the emergence of *Zagrammosoma americanum.* The fully developed vertex (vtx) is visible before eclosion in the first image of the series. The inset images magnify areas where the dark color is visible during emergence.

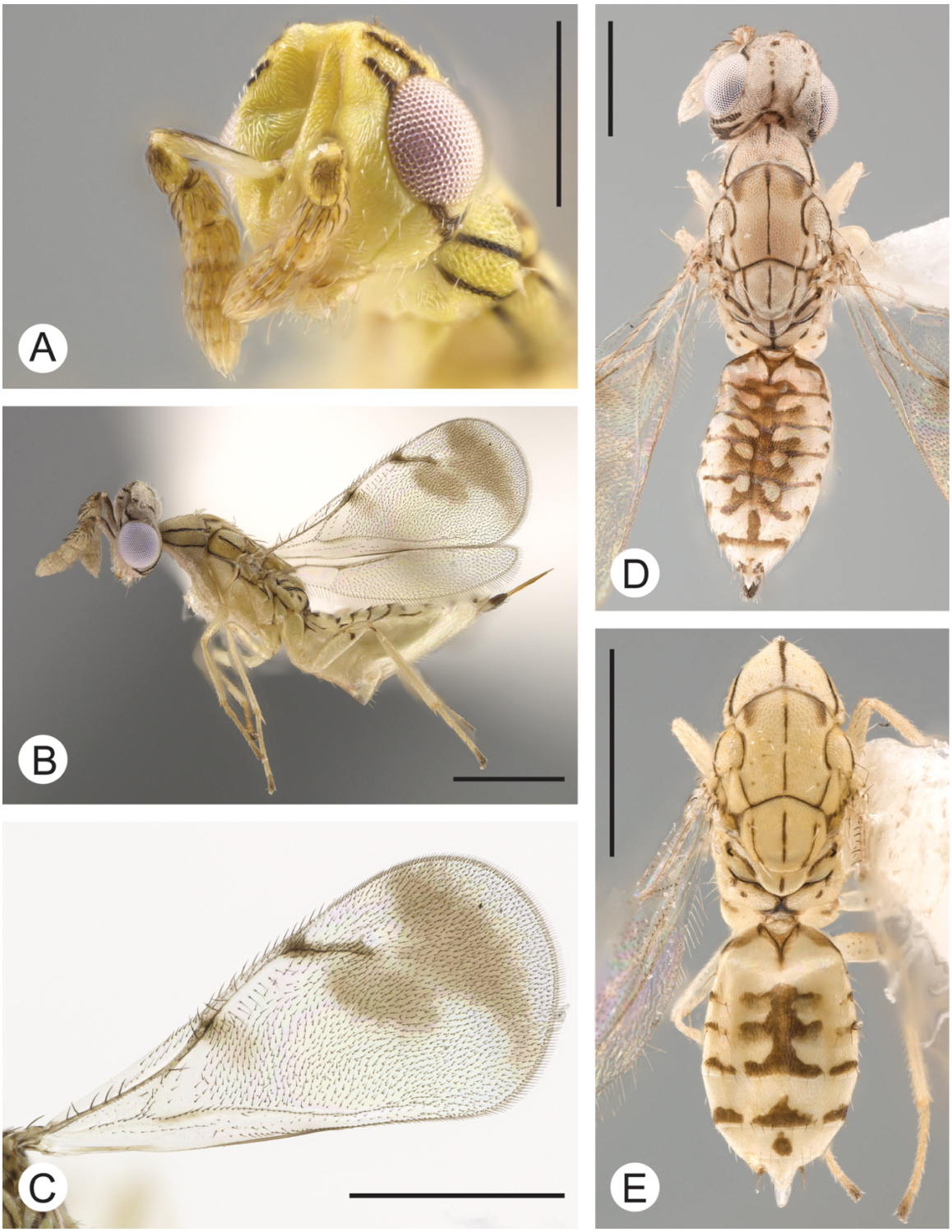

Fig. 2.2.4. *Zagrammosoma americanum*, ♀: (A) head, frontolateral, (B) lateral habitus-medial darkening on hind wing artifact from point mount, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5m (B–E).

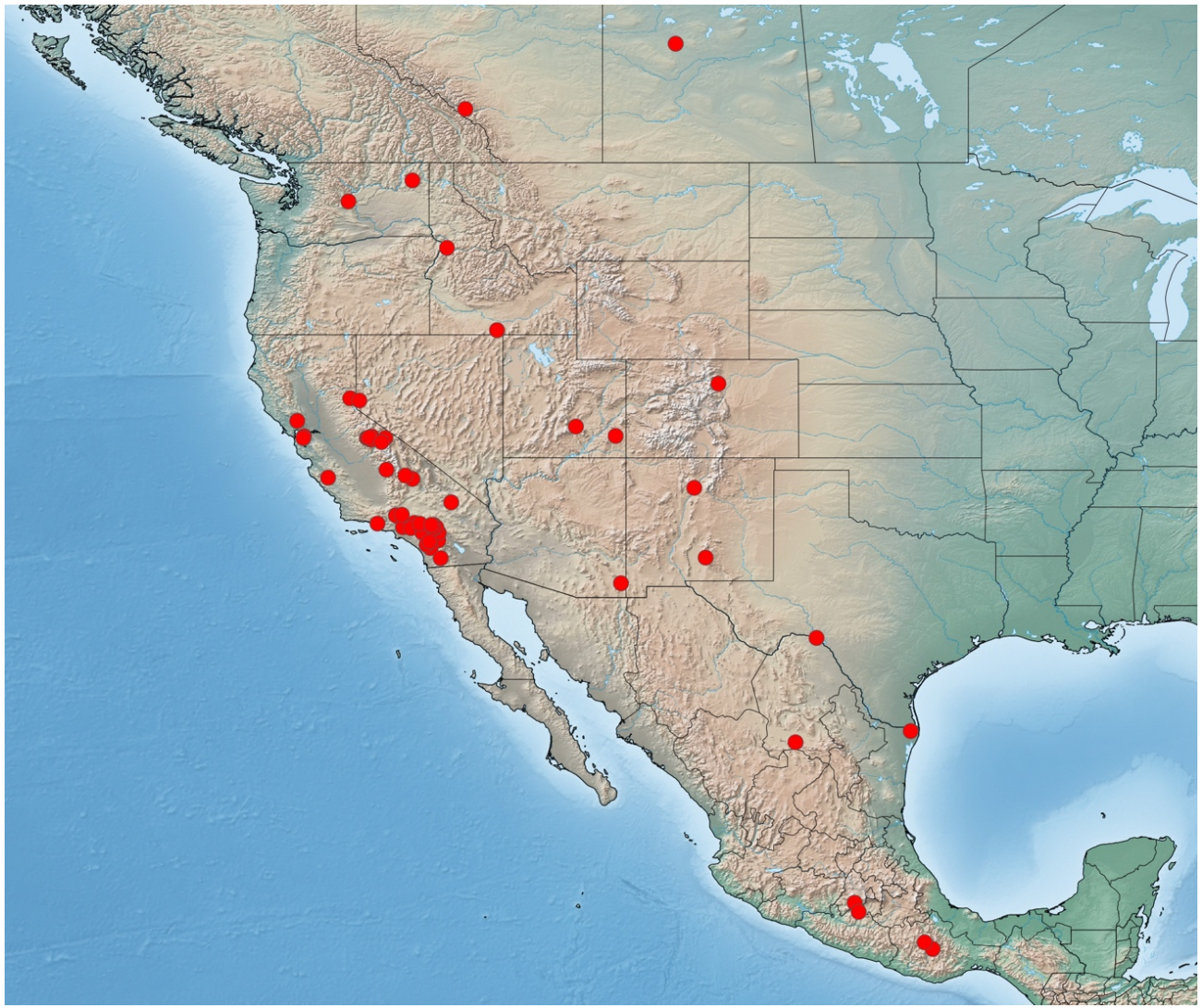

Fig. 2.5. Distribution of *Zagrammosoma americanum.*

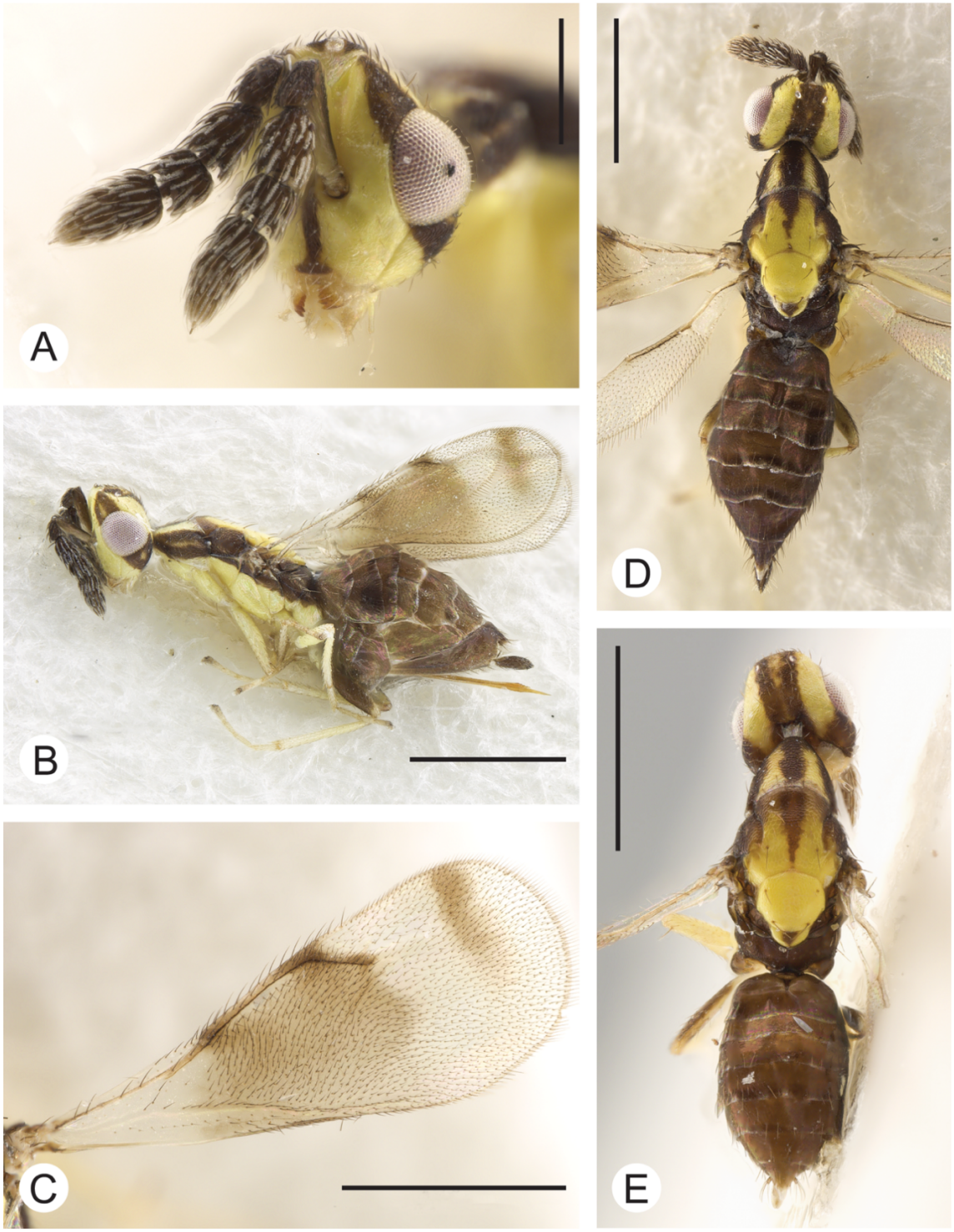

Fig. 2.6. *Zagrammosoma buselus*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

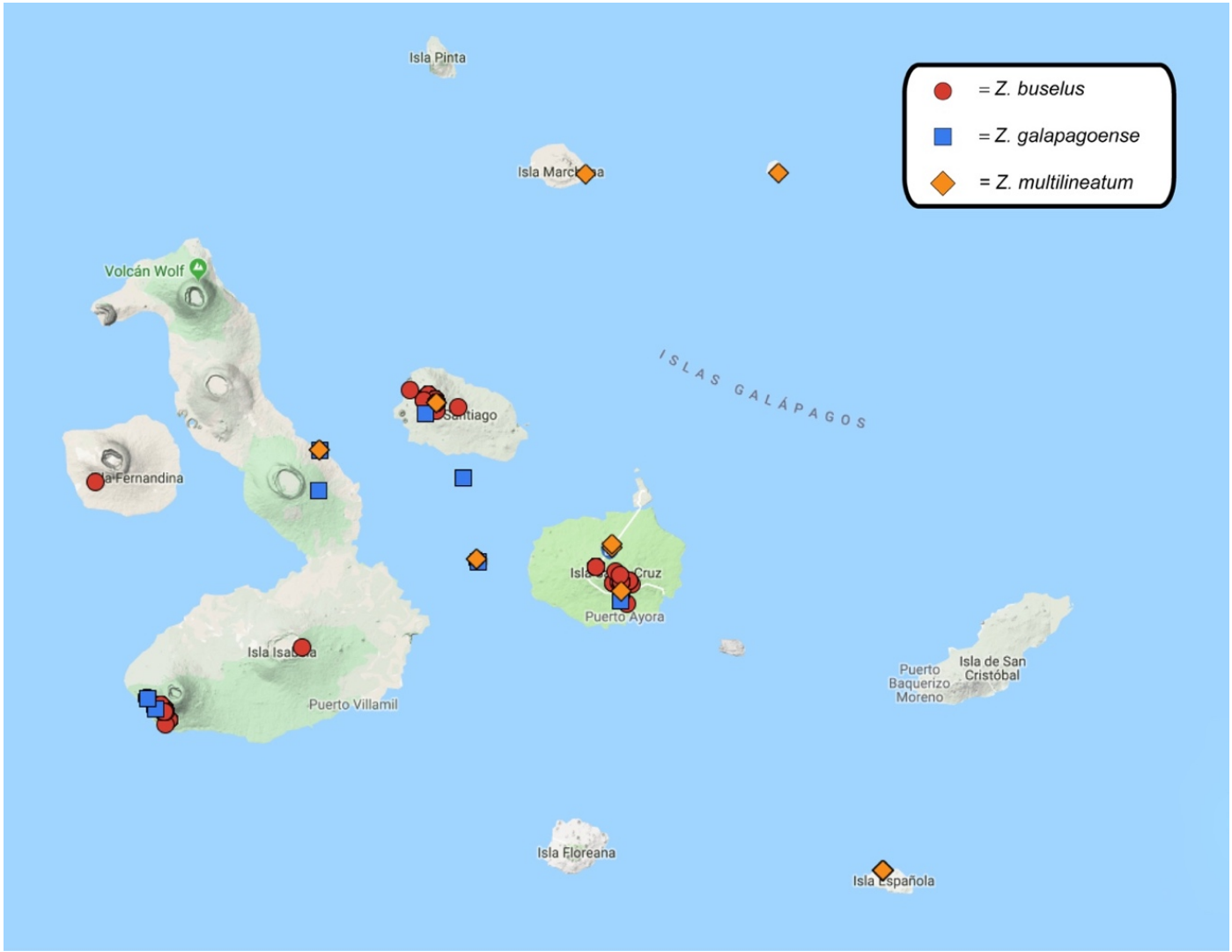

Fig. 2.7. Distribution of *Zagrammosoma* species in the Galapagos Island Archipelago.

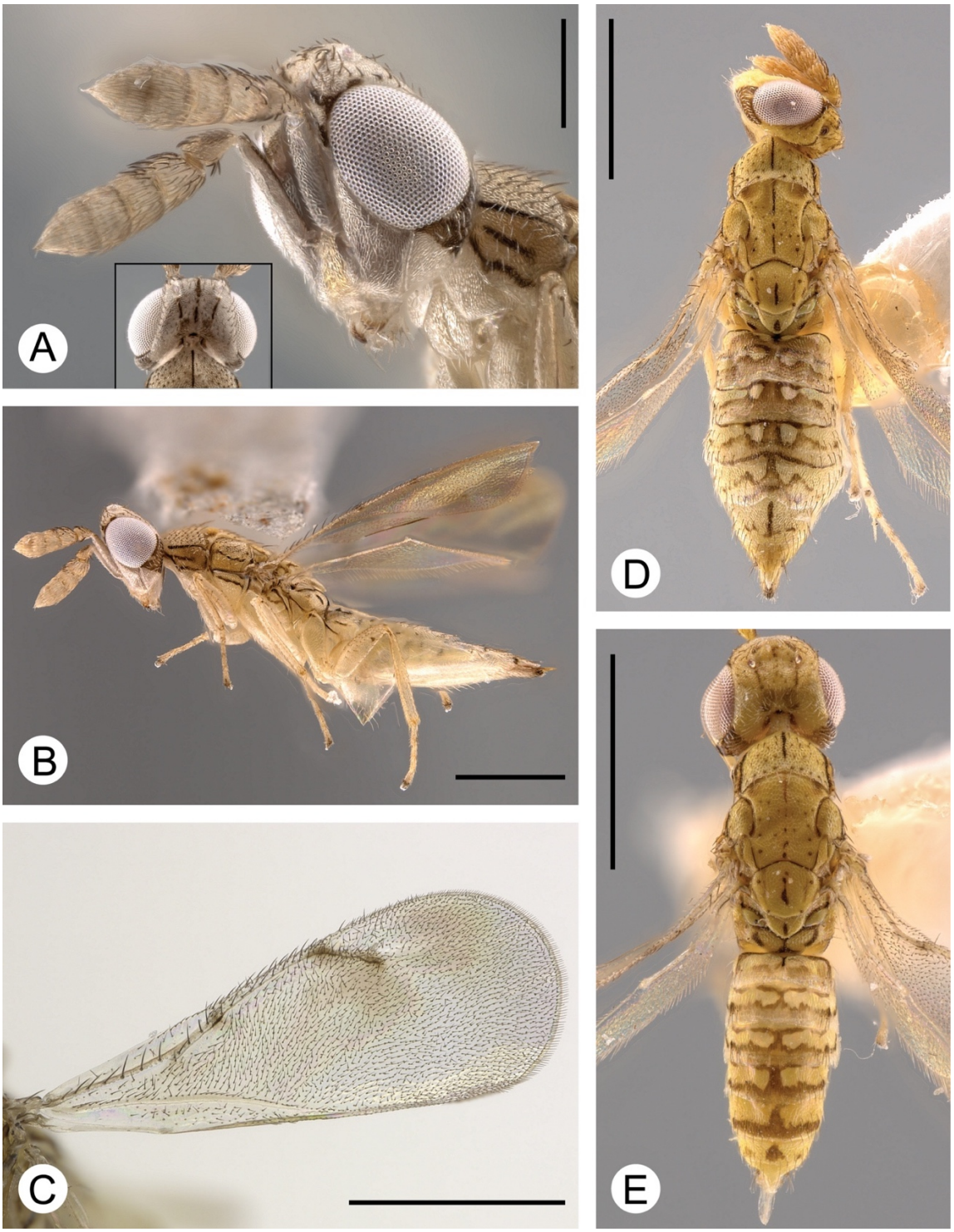

Fig. 2.8. *Zagrammosoma calvini* **n. sp.,** ♀: (A) head, frontolateral, inset rear (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

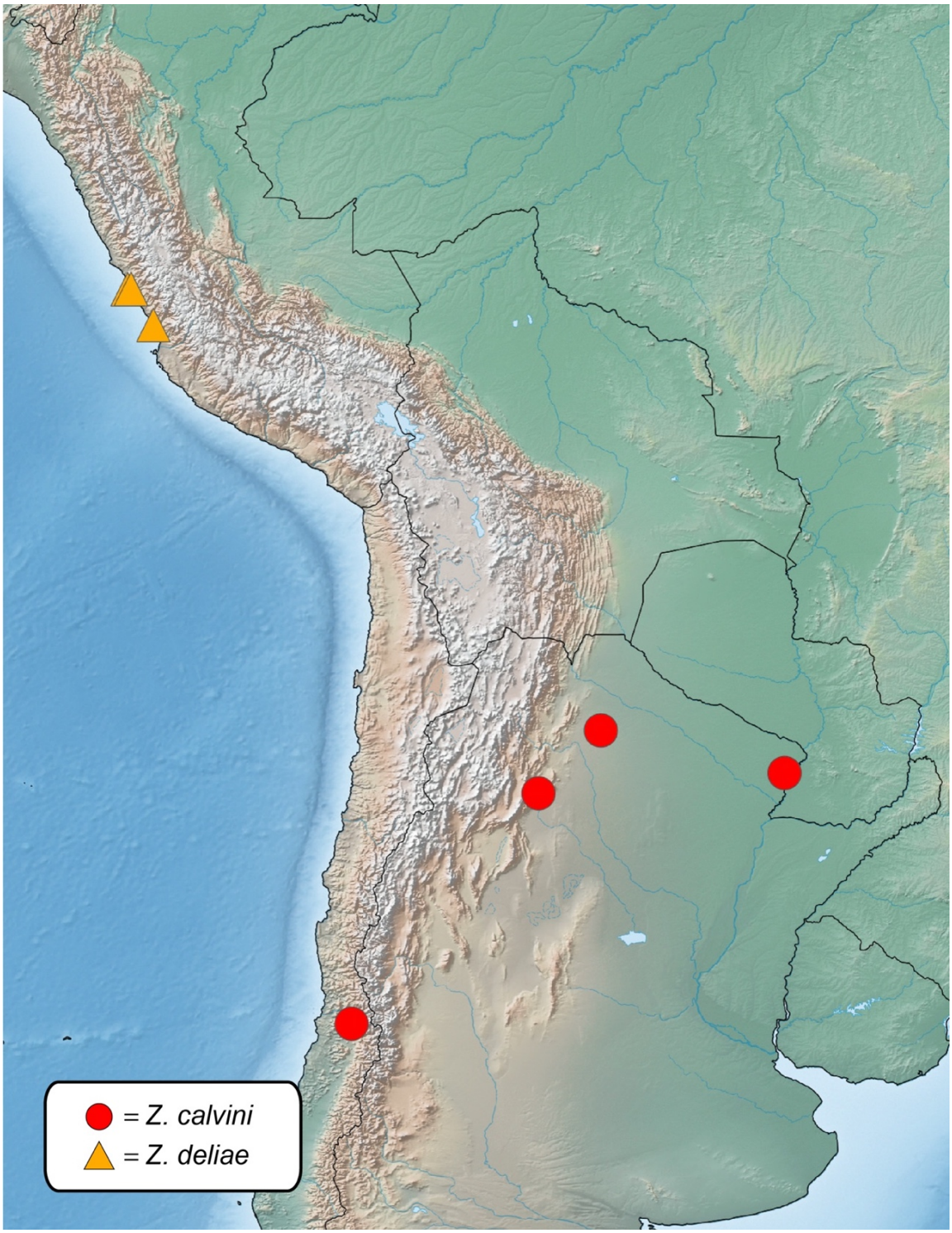

Fig. 2.9. Distributions of *Zagrammosoma calvini* **n. sp.** and *Z. deliae* **n. sp.**

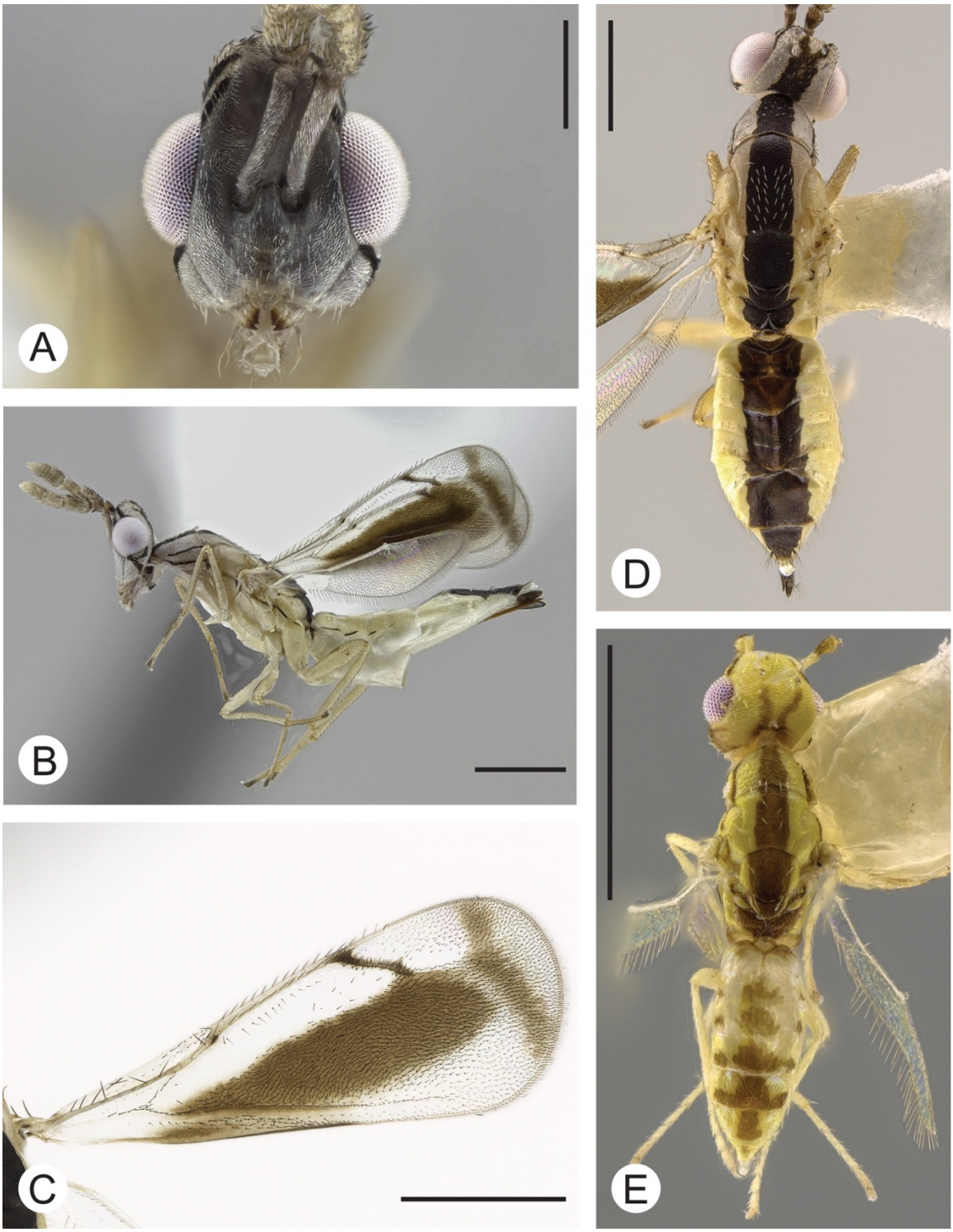

Fig. 2.10. *Zagrammosoma centrolineatum*, ♀: (A) head, frontal, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

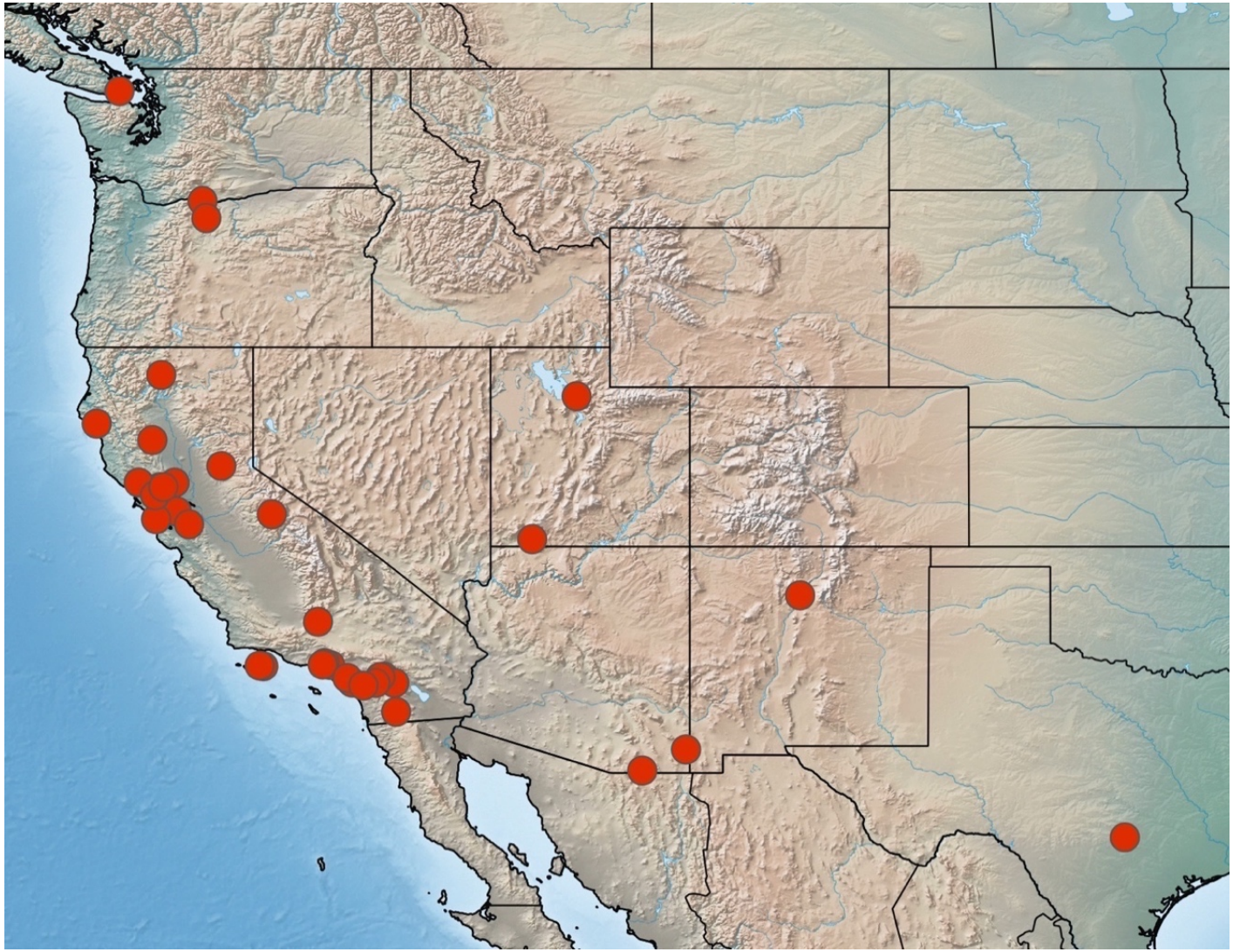

Fig. 2.11. Distribution of *Zagrammosoma centrolineatum.*

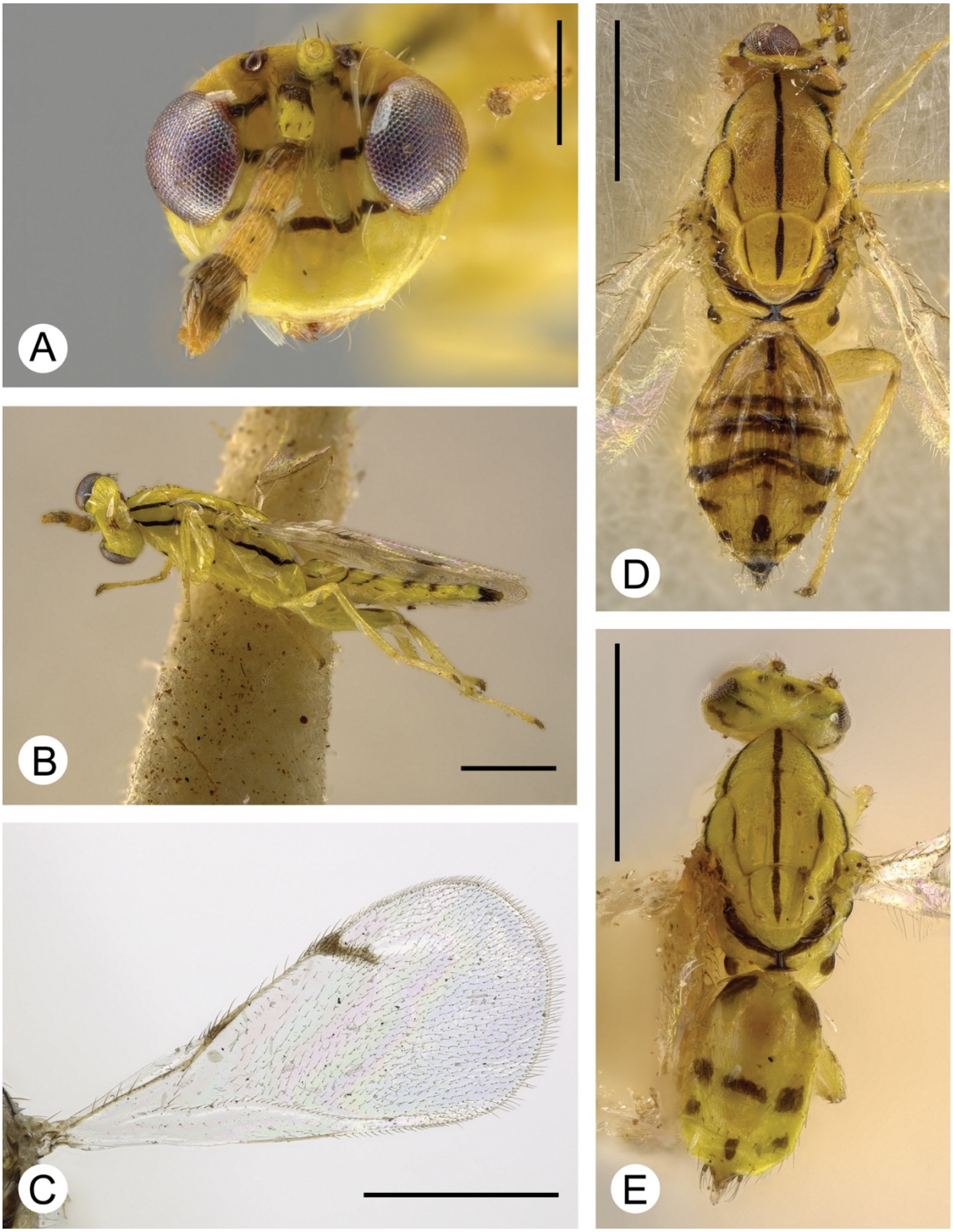

Fig. 2.12. *Zagrammosoma crowei*, ♀: (A) head, frontal, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

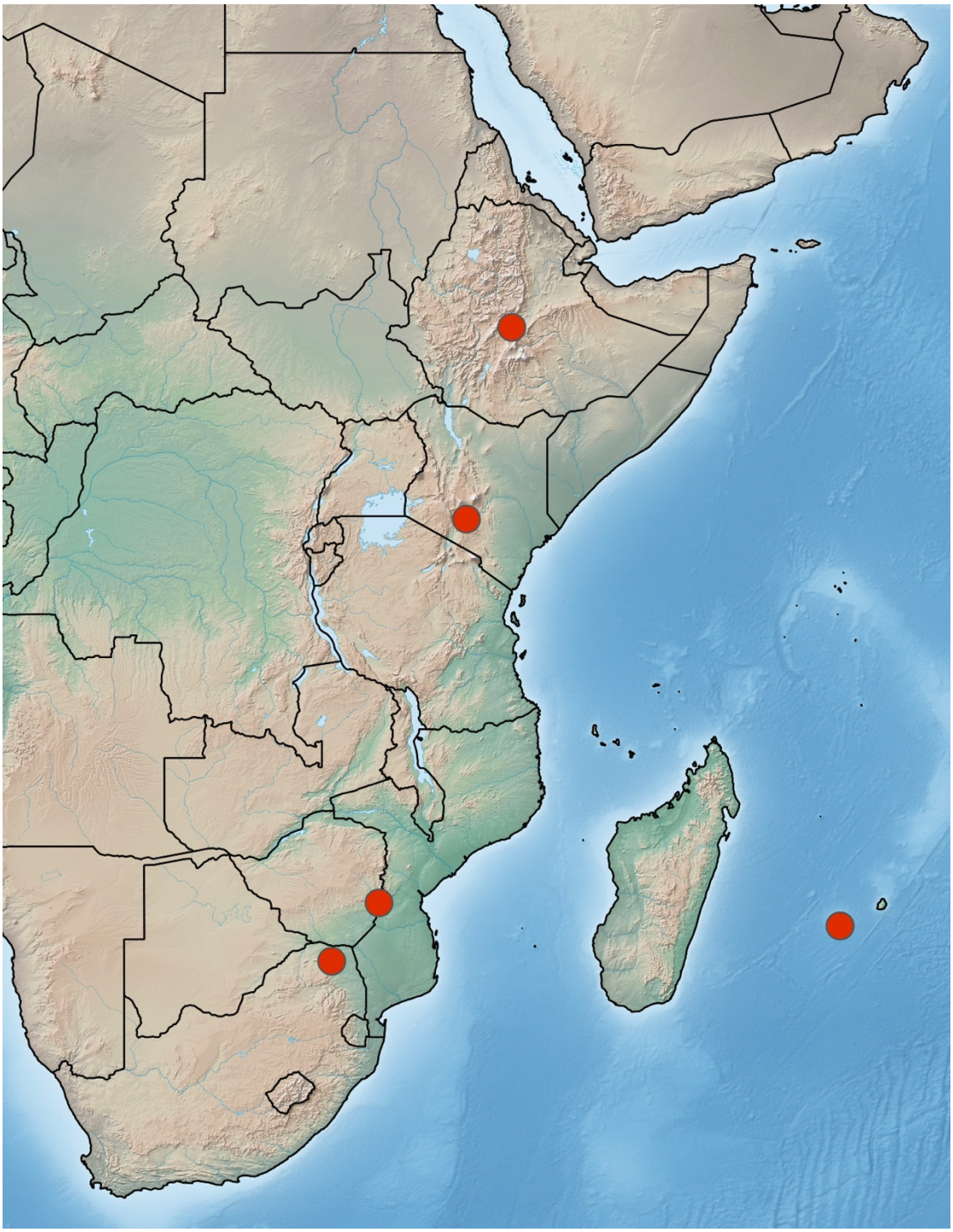

Fig. 2.13. Distribution of *Zagrammosoma crowei.*

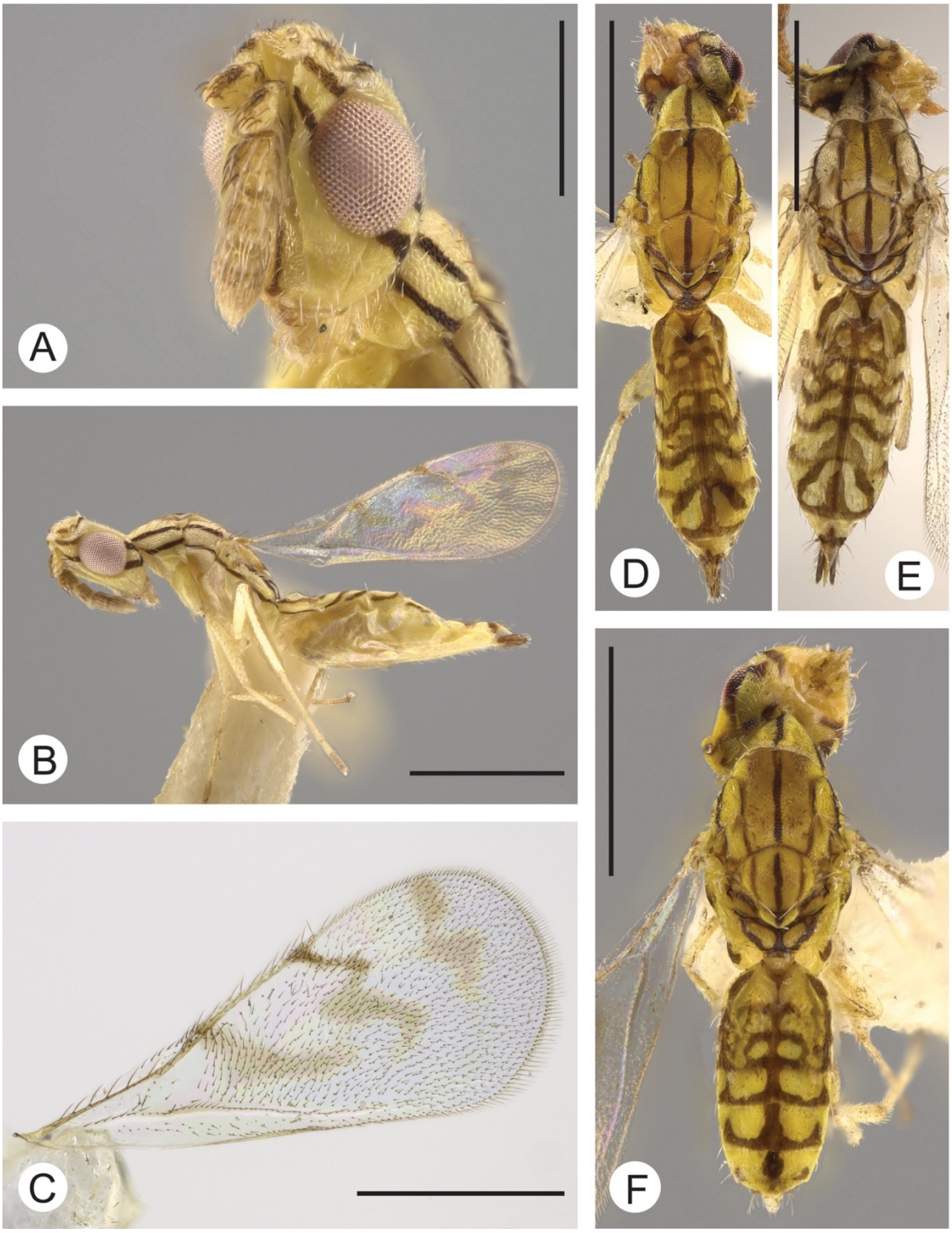

Fig. 2.14. *Zagrammosoma deliae* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D-E) dorsal habitus; (F) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–F).

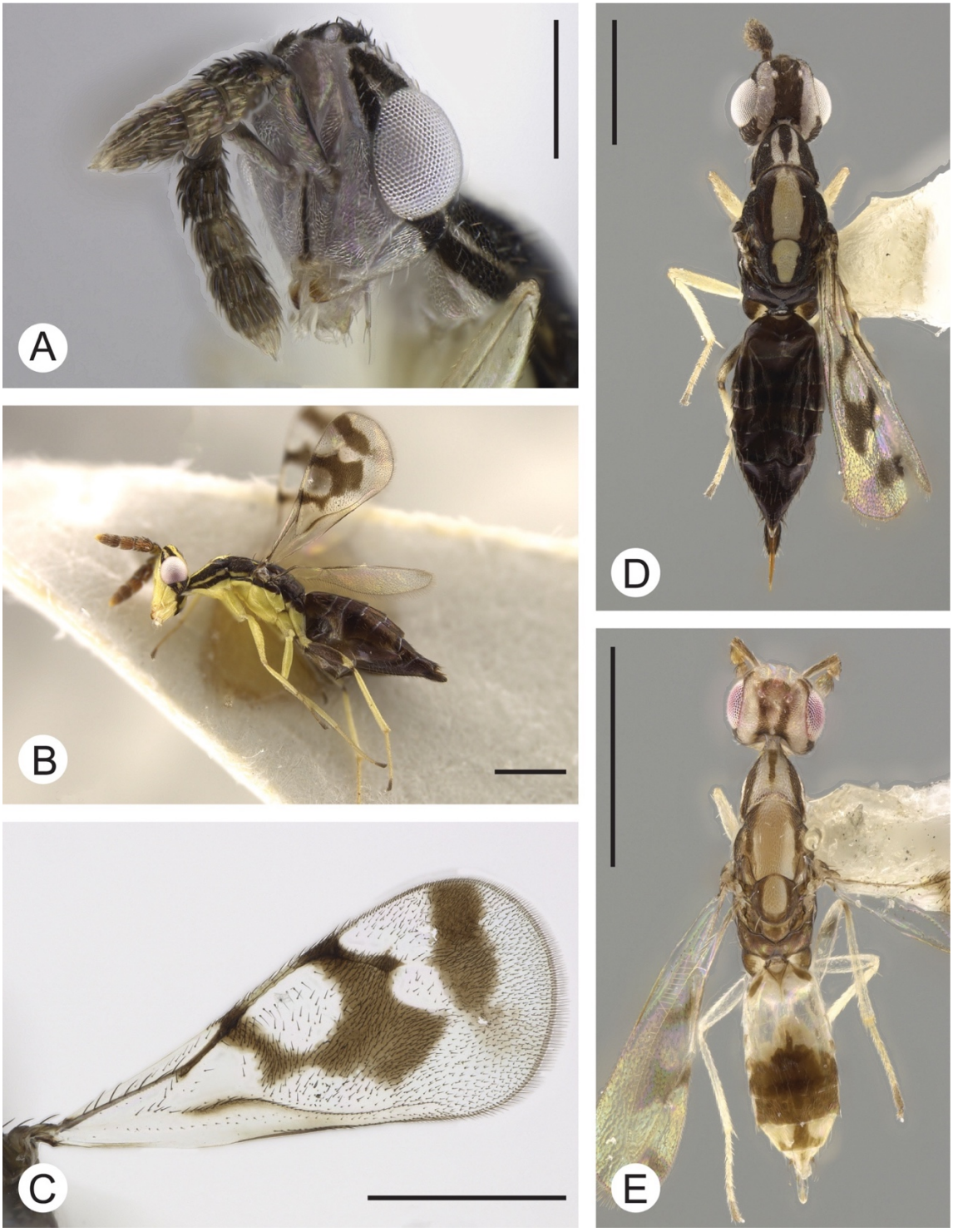

Fig. 2.15. *Zagrammosoma flavolineatum*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

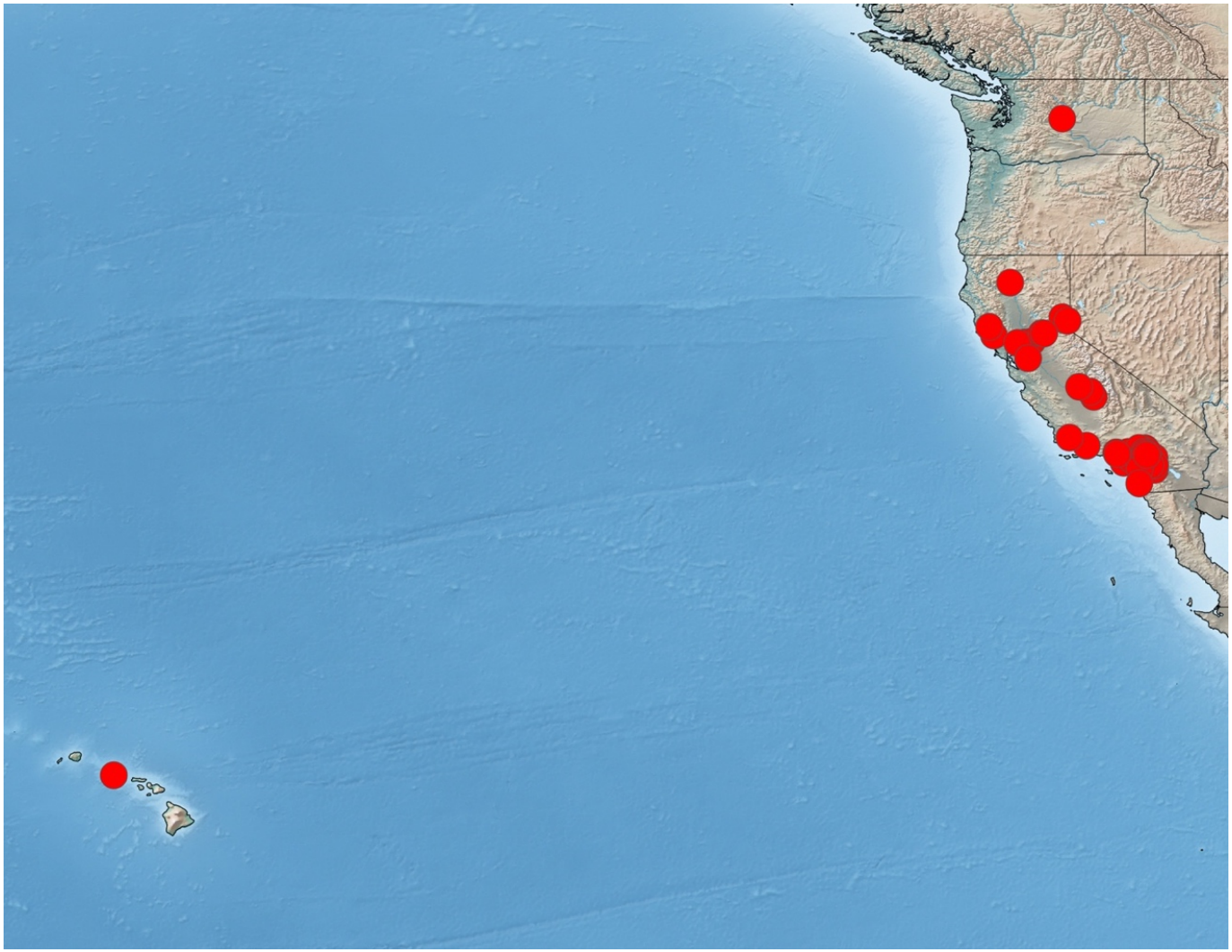

Fig. 2.16. Distribution of *Zagrammosoma flavolineatum.*

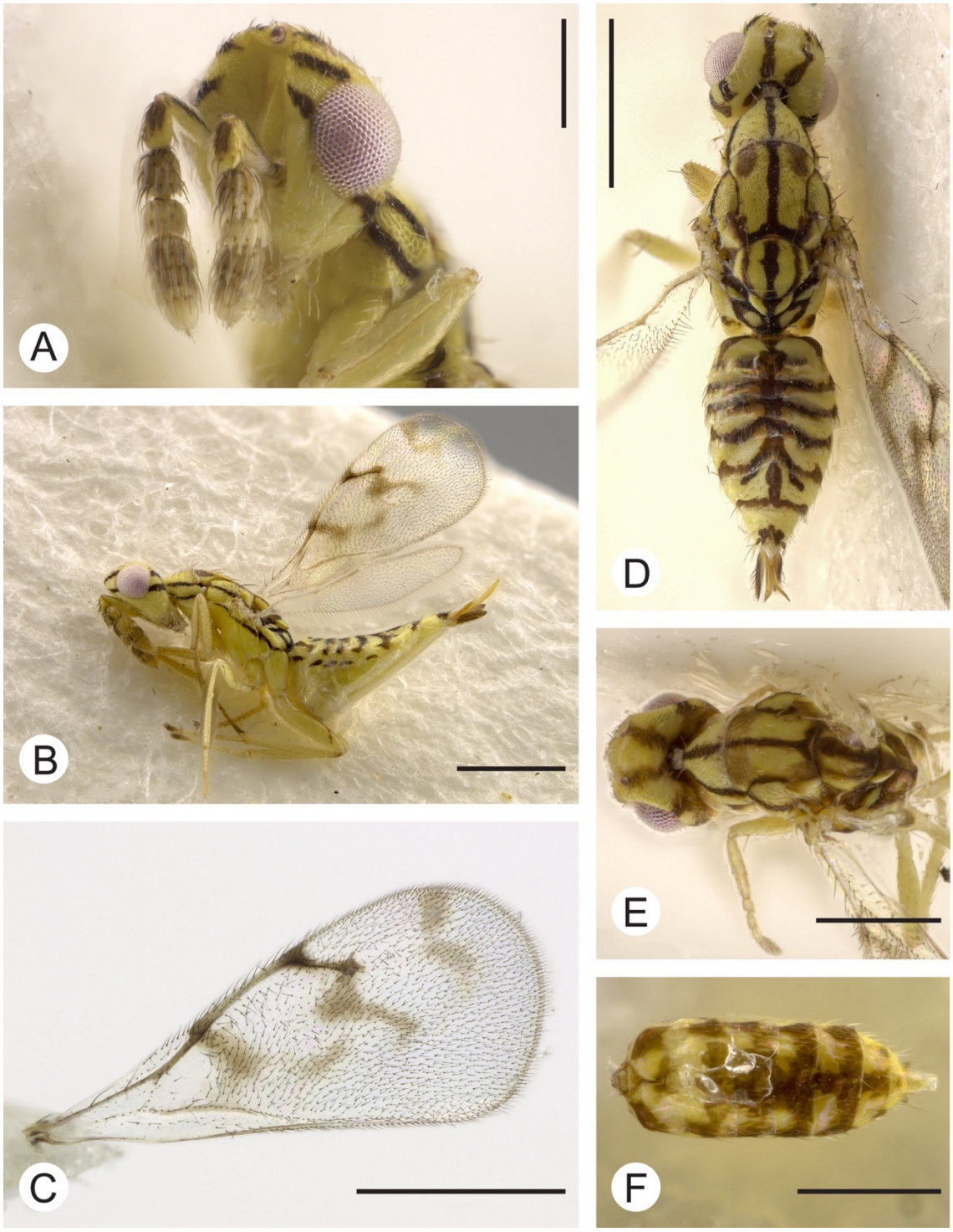

Fig. 2.17. *Zagrammosoma galapagoense* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E–F) ♂ dorsal habitus. Scale bar = 0.2 mm (A, E, F), 0.5 mm (B–D).

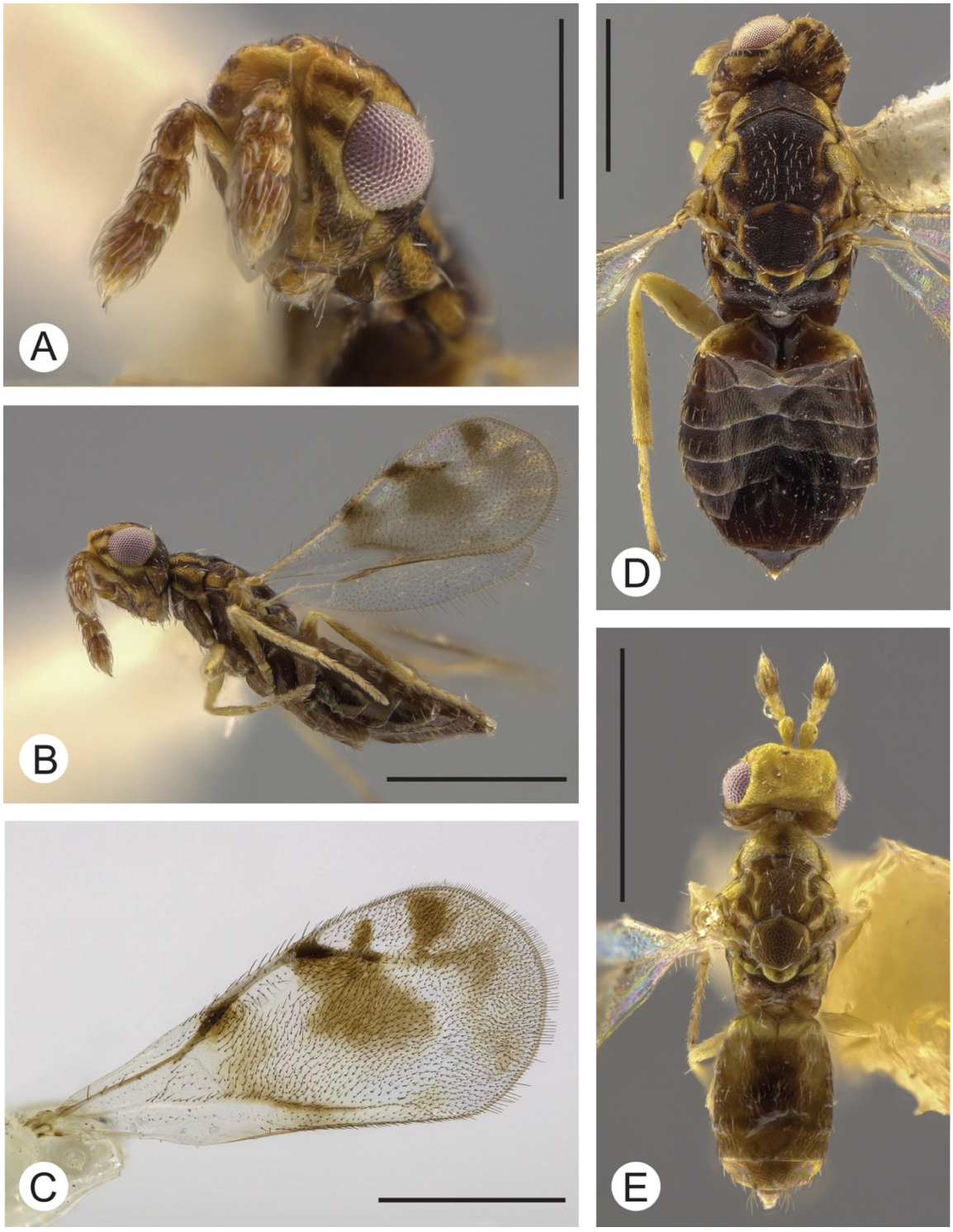

Fig. 2.18. *Zagrammosoma headricki* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

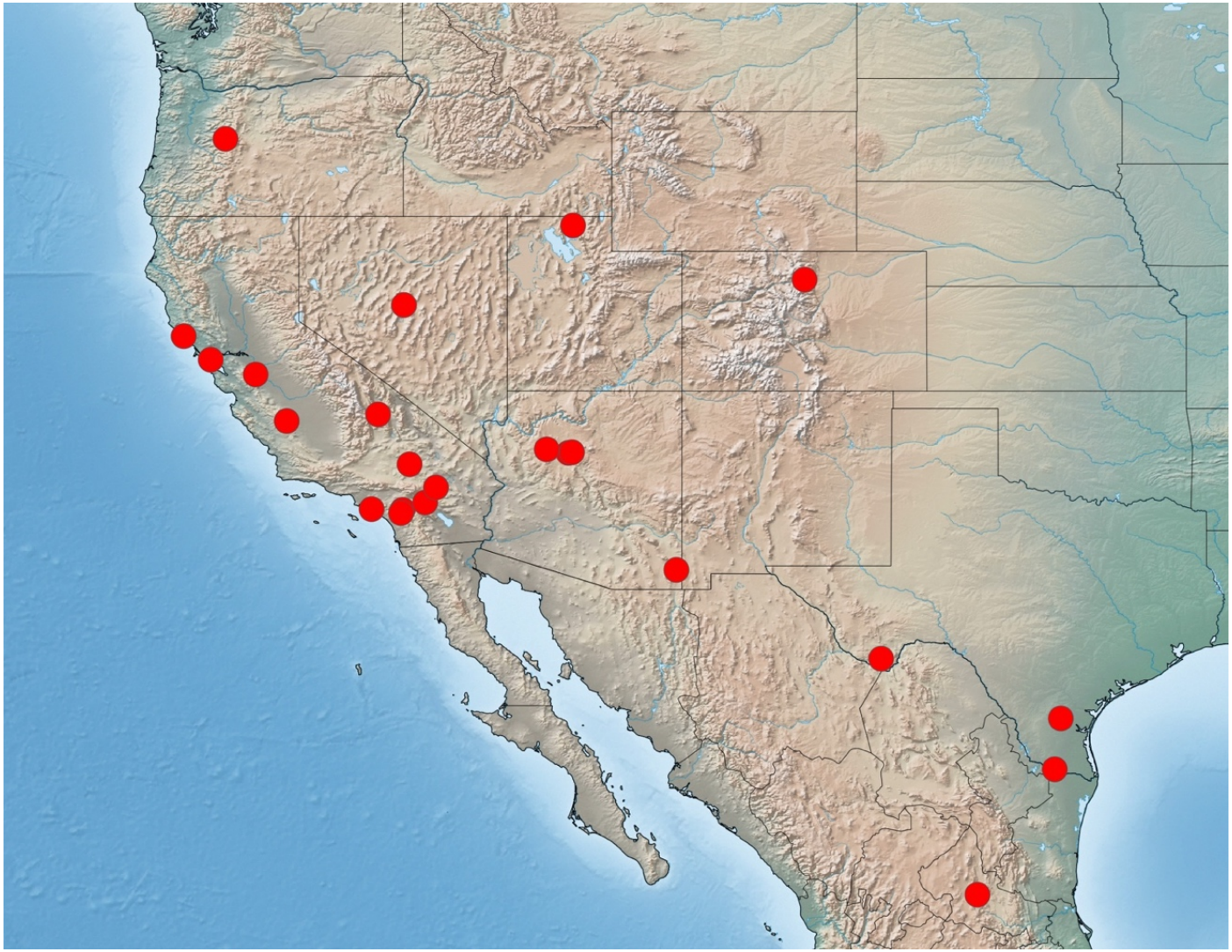

Fig. 2.19. Distribution of *Zagrammosoma headricki* **n. sp.**

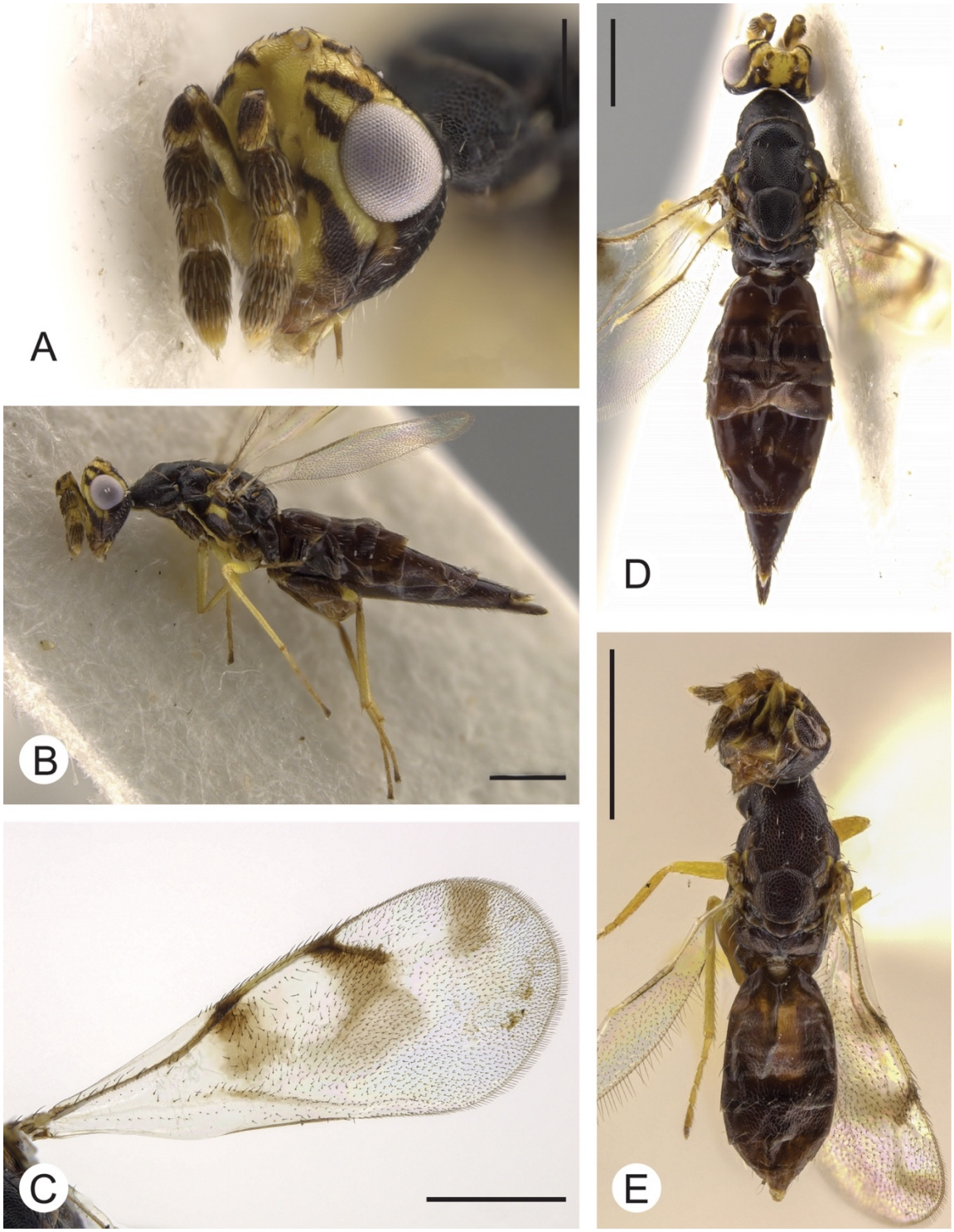

Fig. 2.20. *Zagrammosoma hobbesi*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

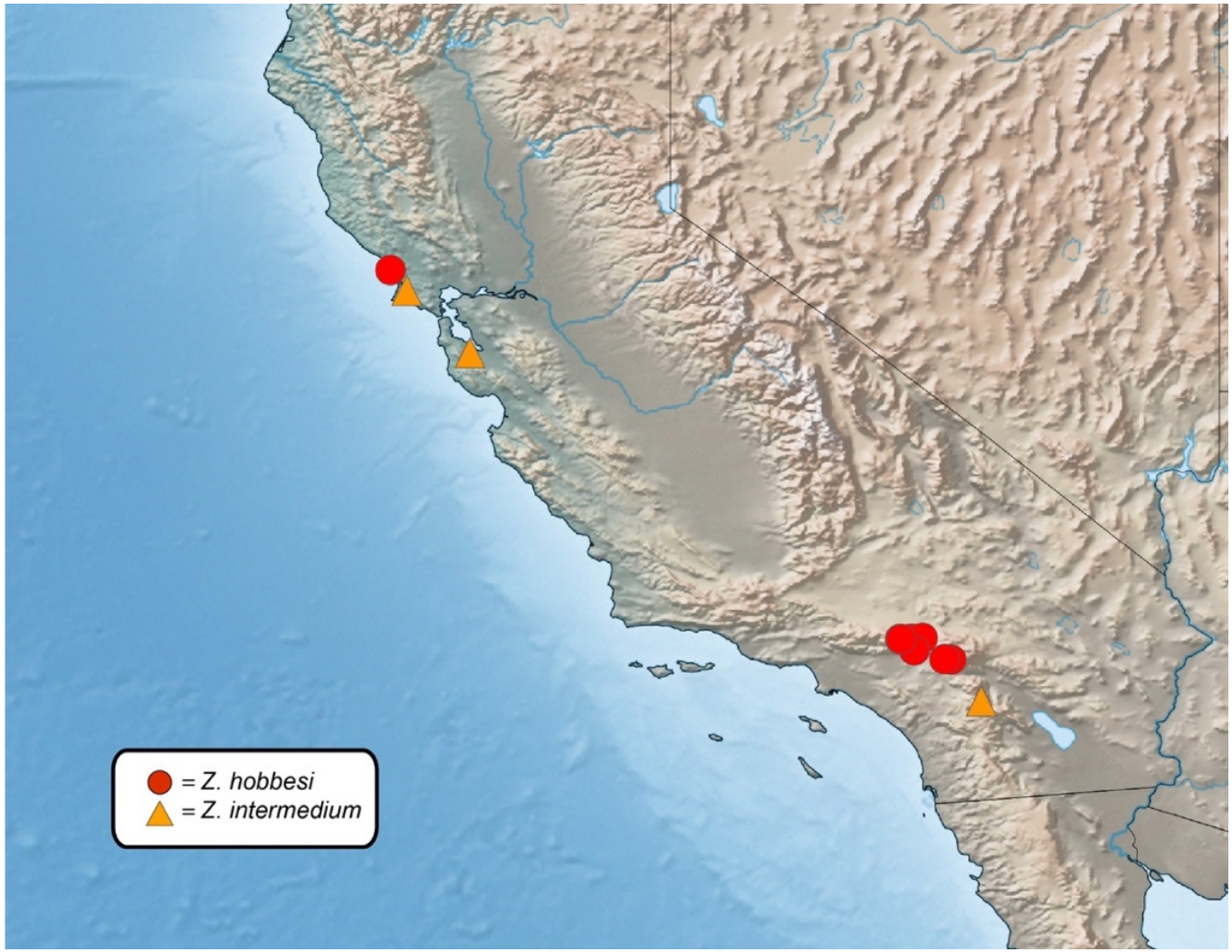

Fig. 2.21. Distributions of *Zagrammosoma hobbesi* and *Z. intermedium*.

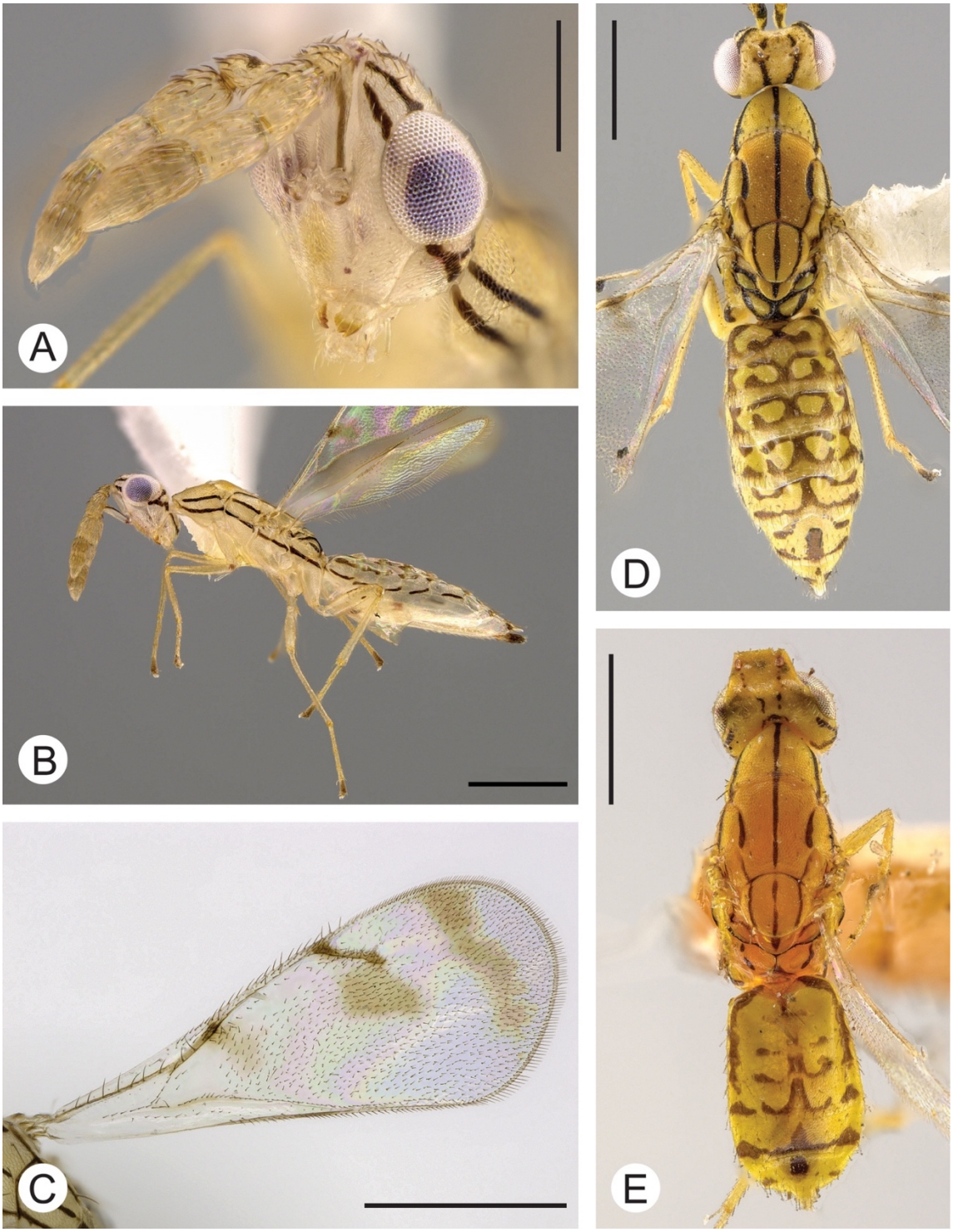

Fig. 2.22. *Zagrammosoma interlineatum* **stat. rev.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

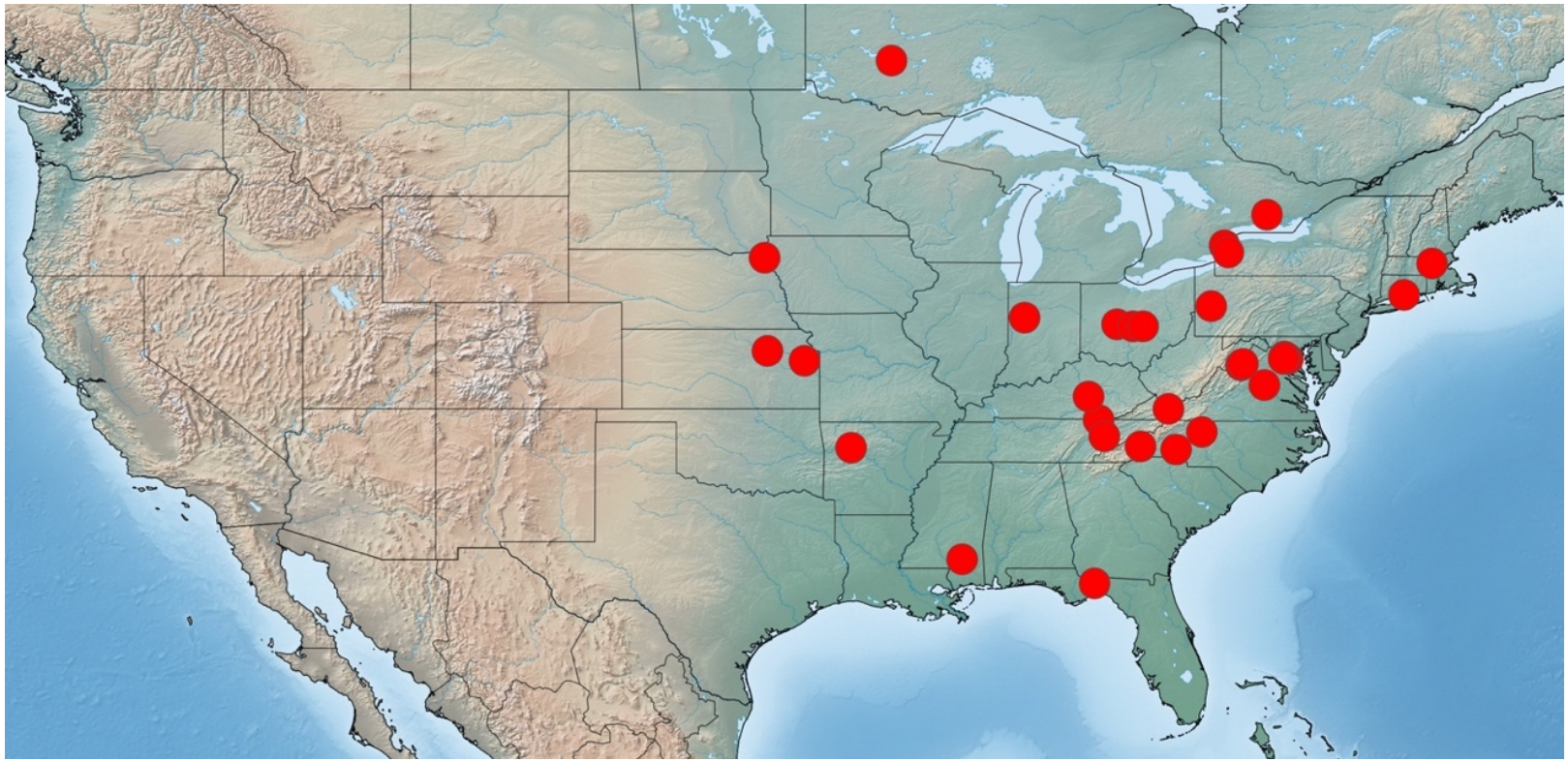

Fig. 2.23. Distribution of *Zagrammosoma interlineatum* **stat. rev.**

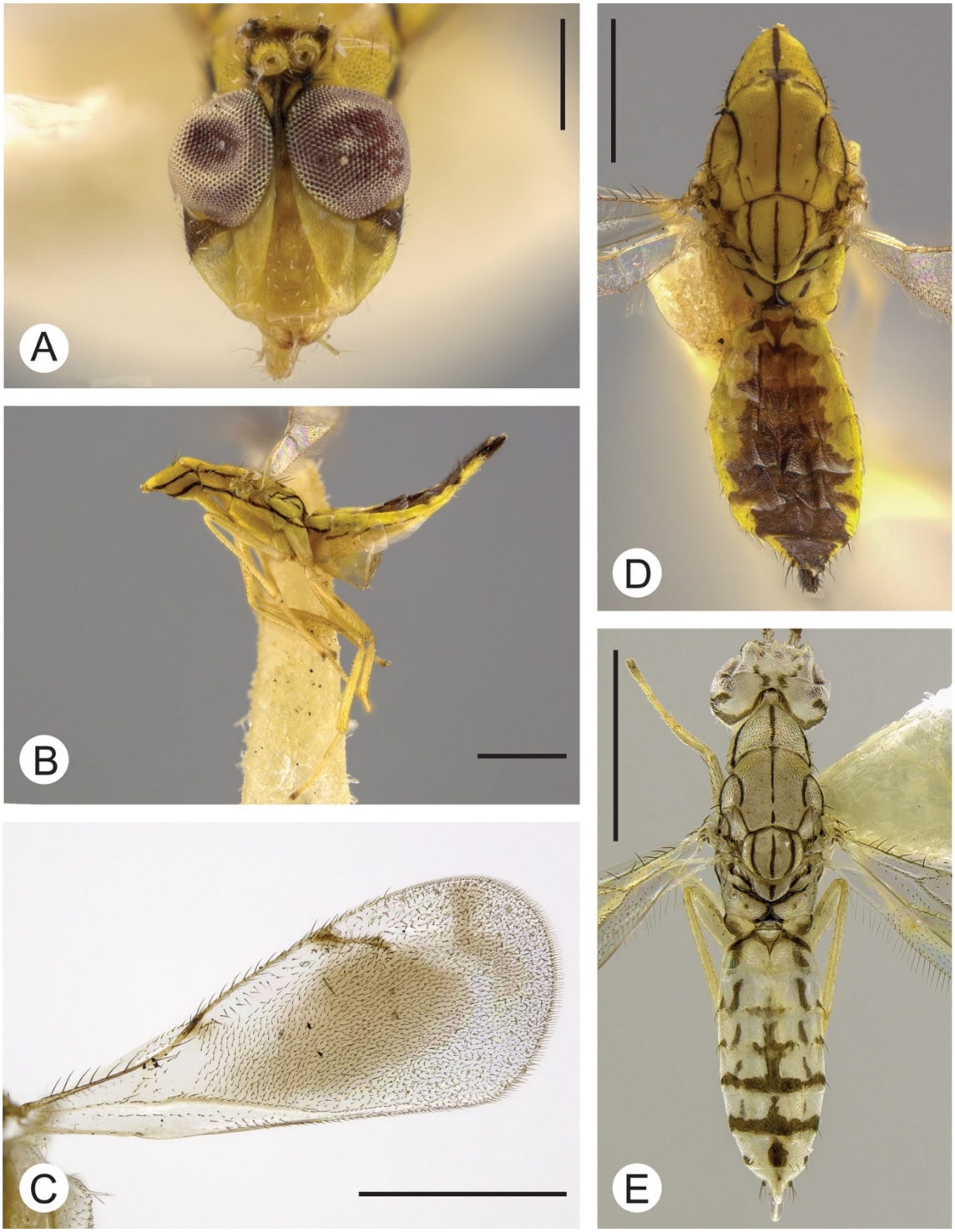

Fig. 2.24. *Zagrammosoma intermedium*, ♀: (A) head, frontolateral (collapsed, but best-preserved specimen), (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

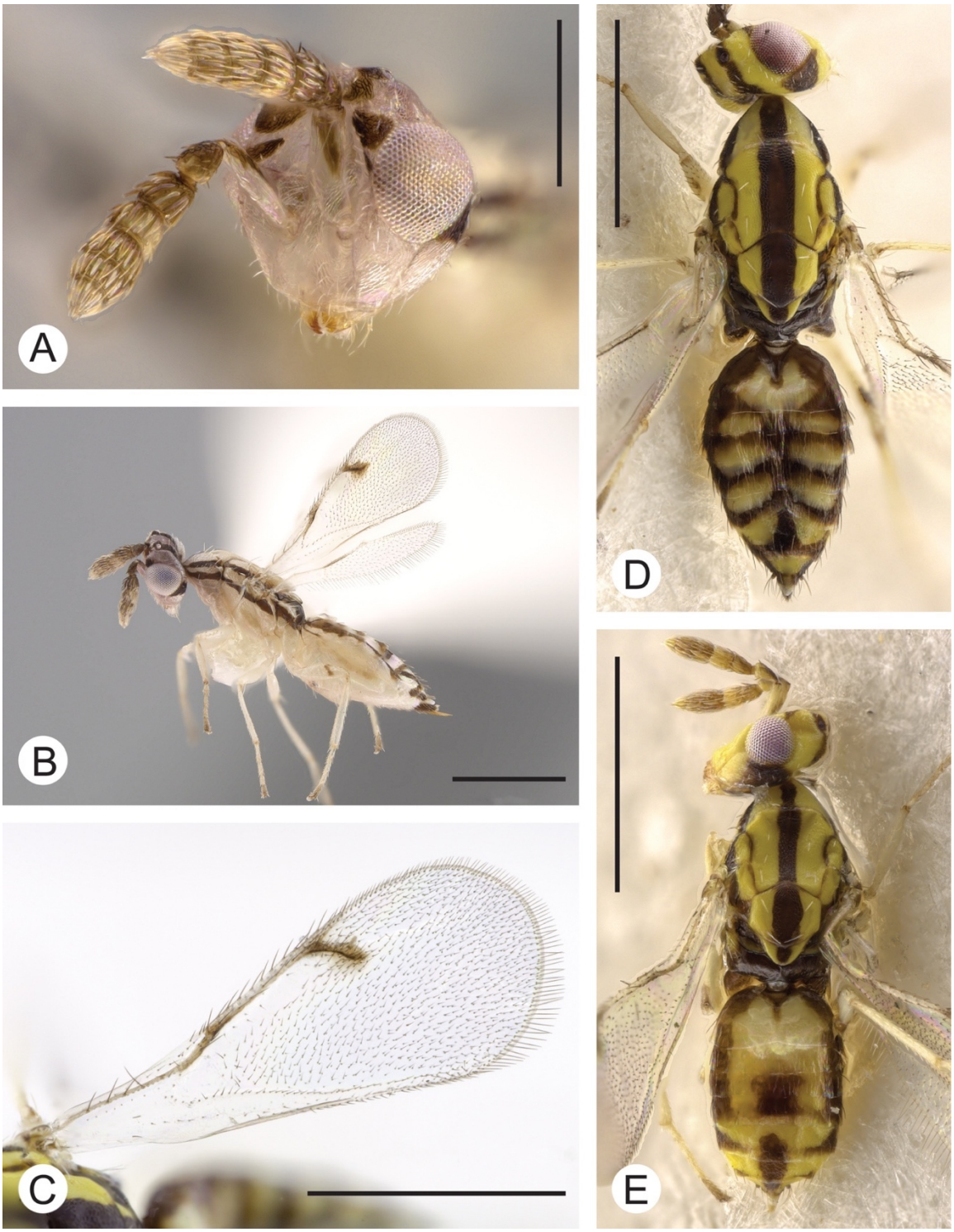

Fig. 2.25. *Zagrammosoma latilineatum*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

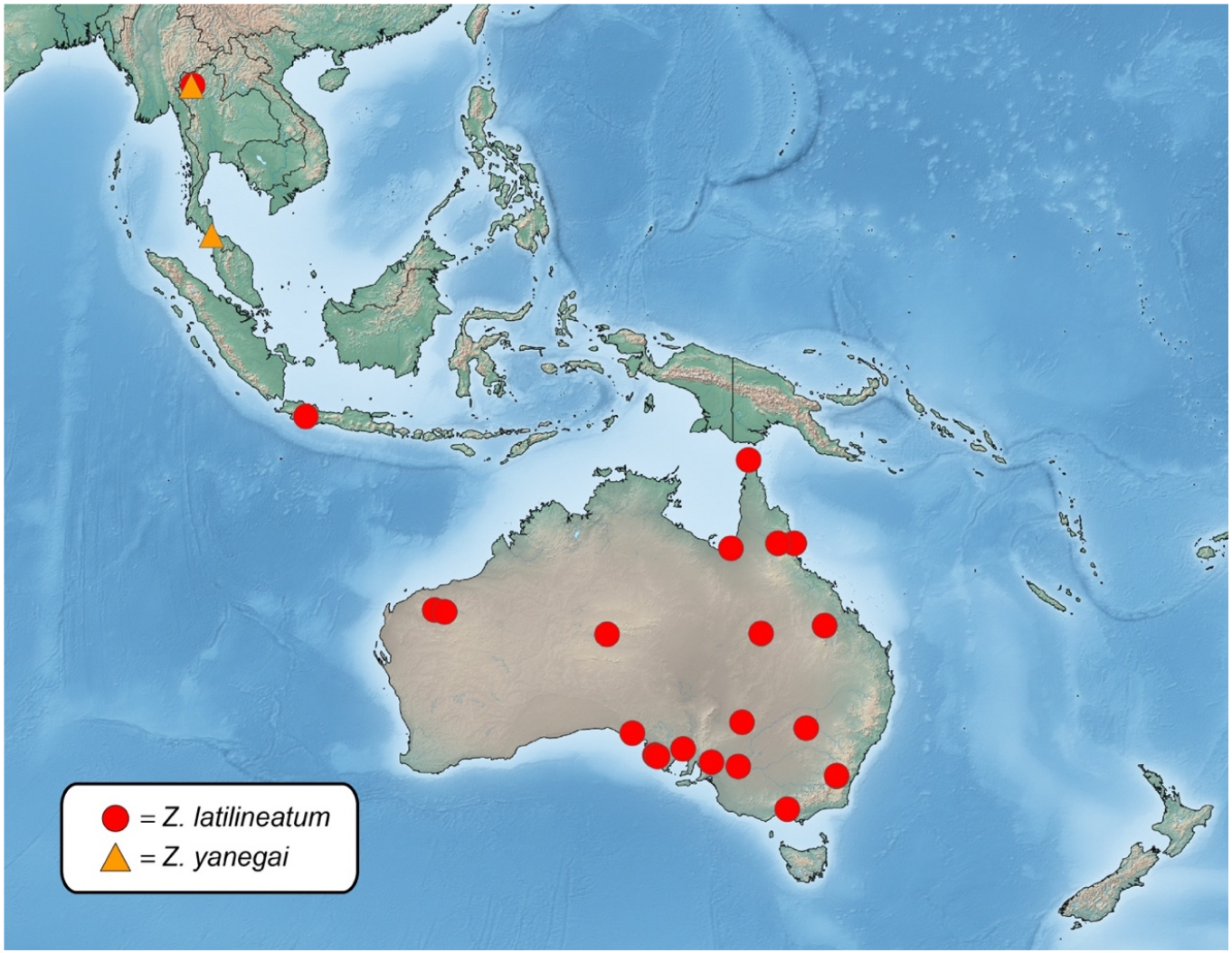

Fig. 2.26. Distributions of *Zagrammosoma latilineatum* and *Z. yanegai* **n. sp.**

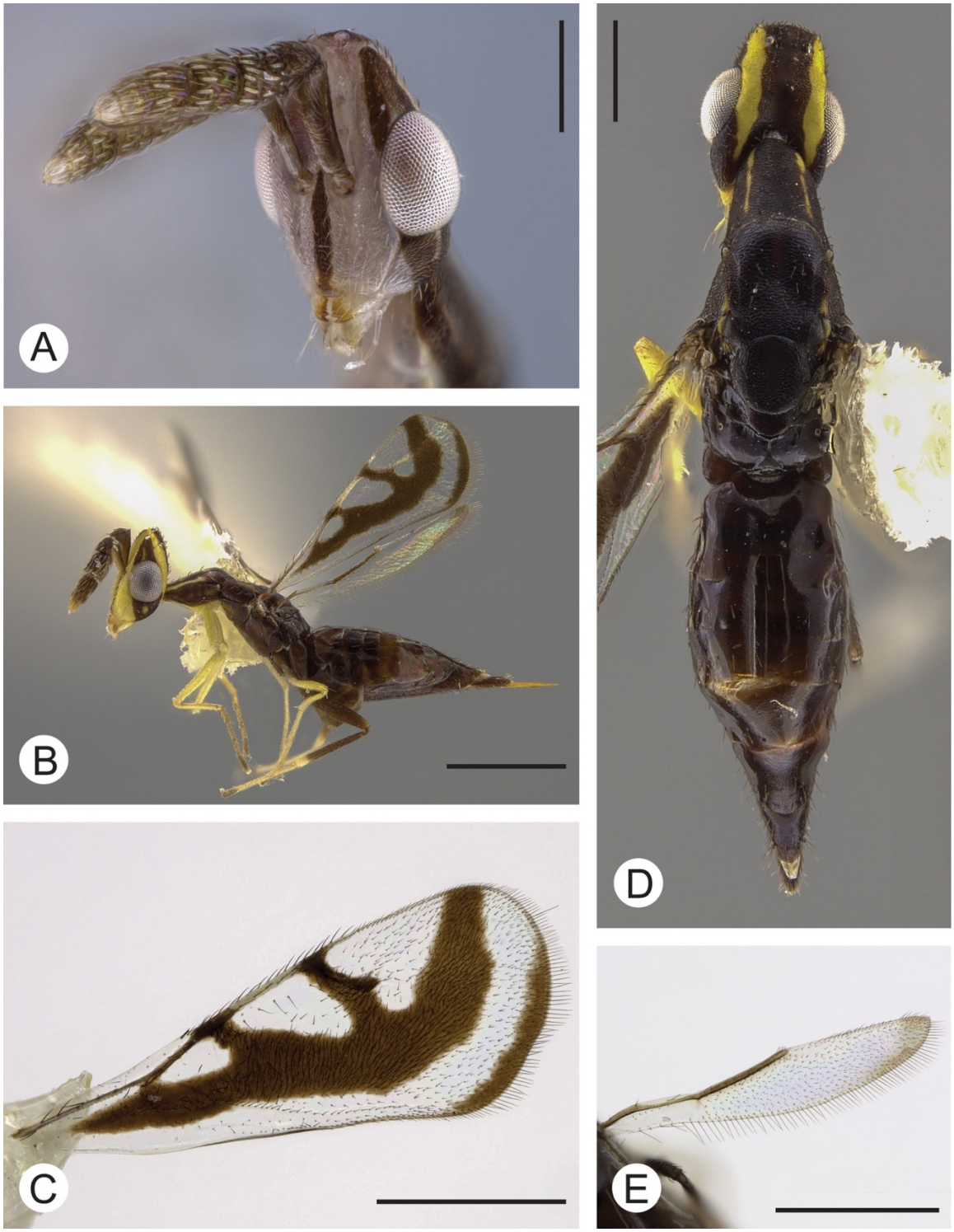

Fig. 2.27. *Zagrammosoma lineaticeps*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

Fig. 2.28. Distribution of *Zagrammosoma lineaticeps.*

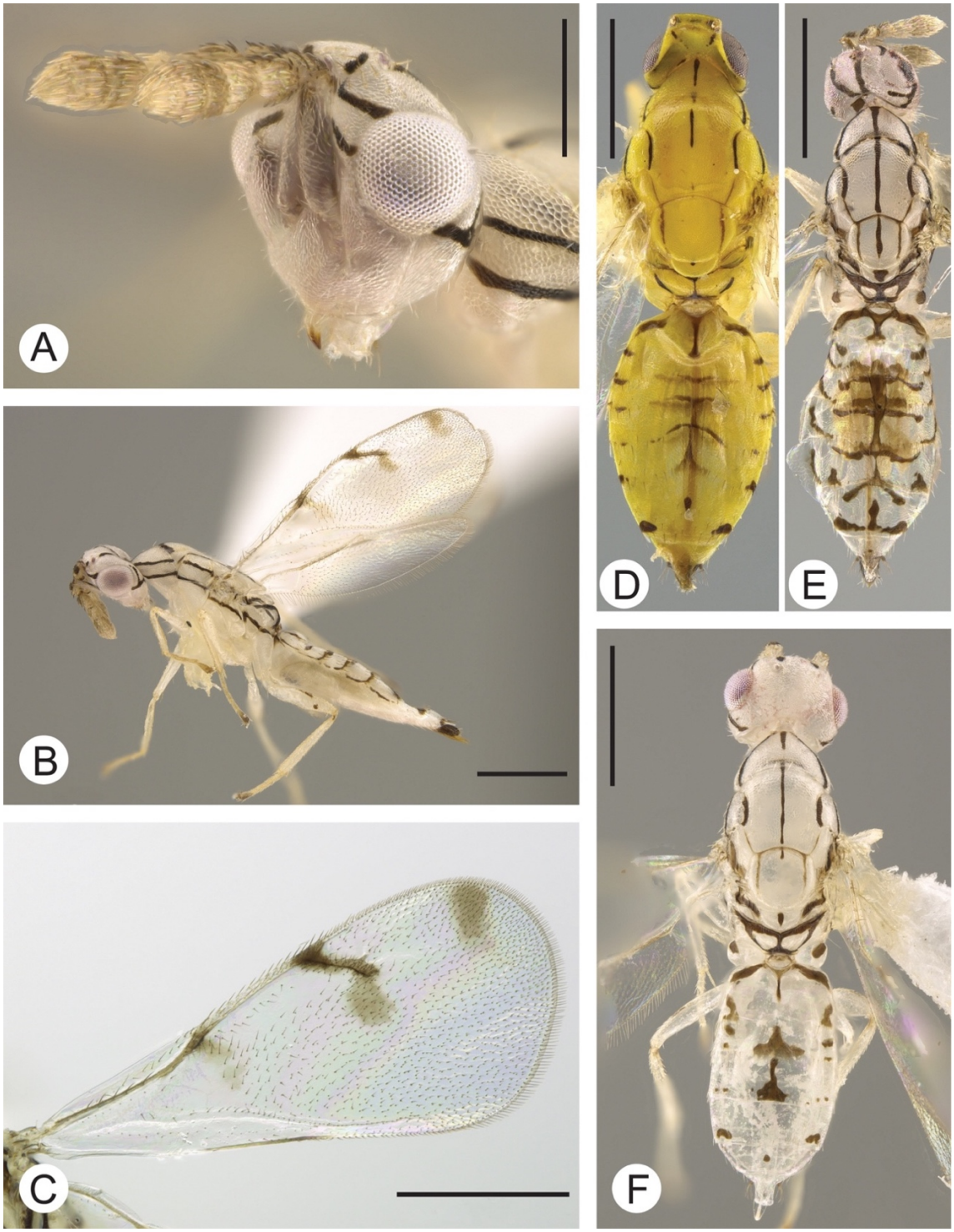

Fig. 2.29. *Zagrammosoma melinum*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D–E) dorsal habitus; (F) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–F).

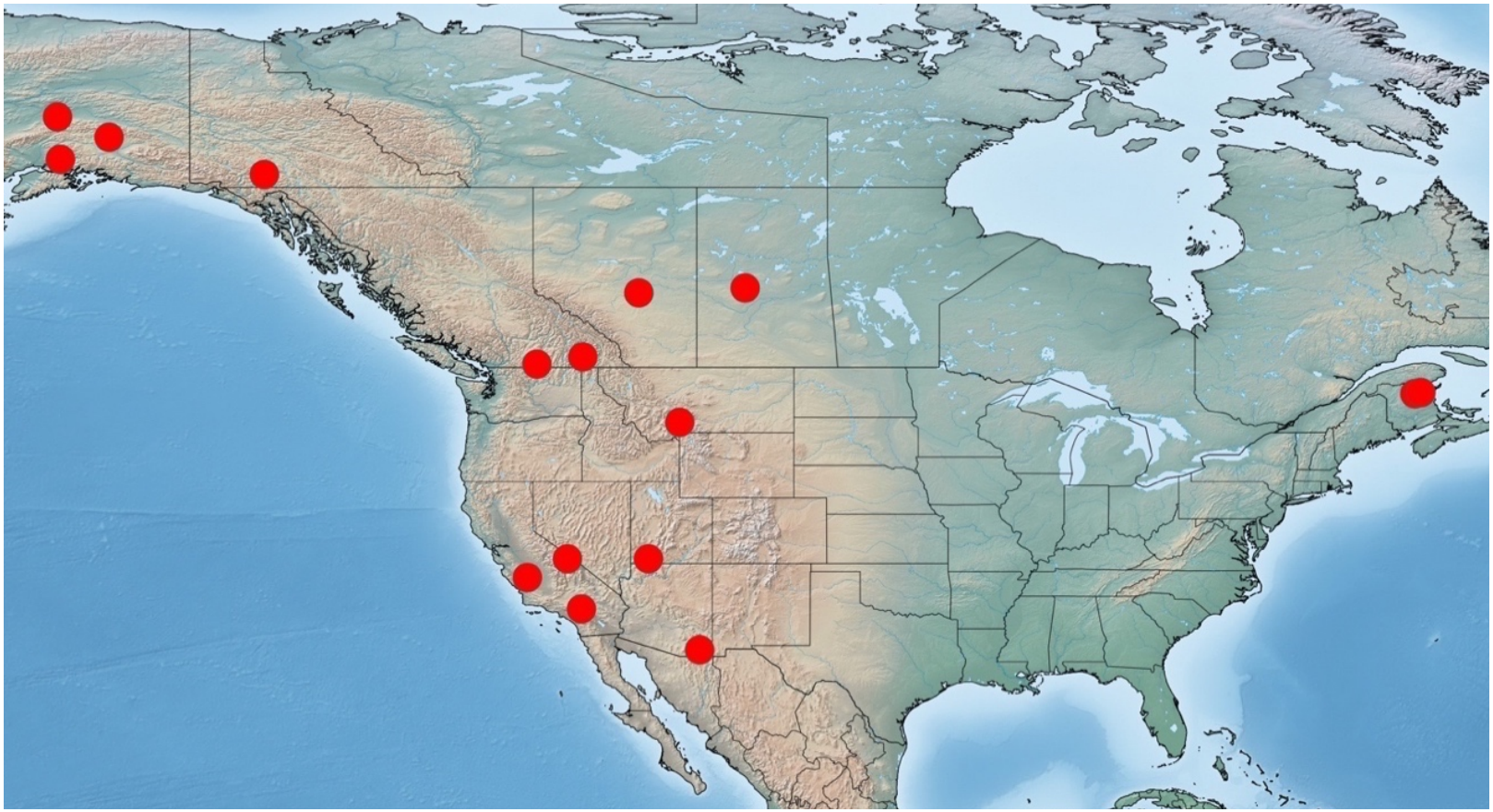

Fig. 2.30. Distribution of *Zagrammosoma melinum.*

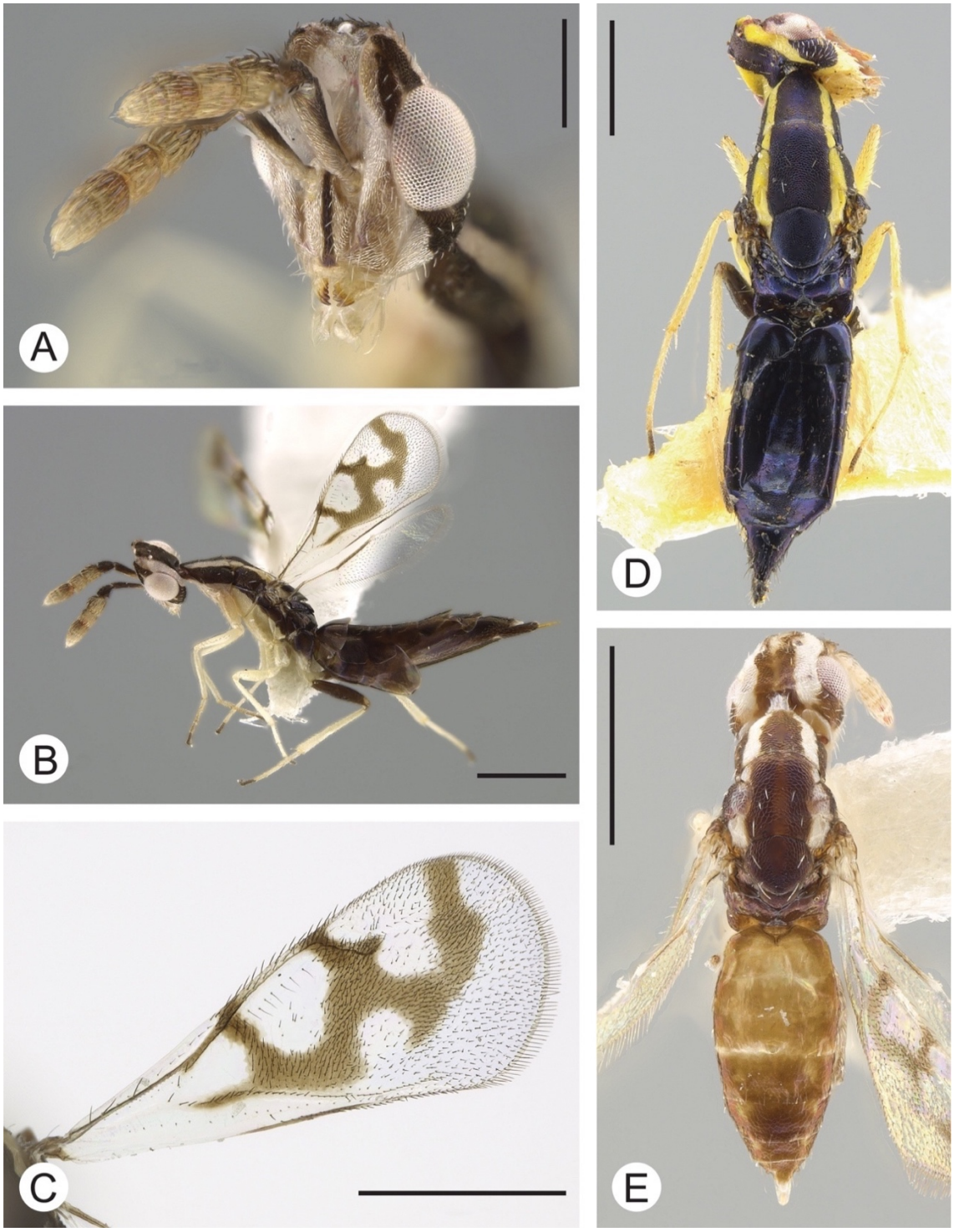

Fig. 2.2.31. *Zagrammosoma metallicum* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

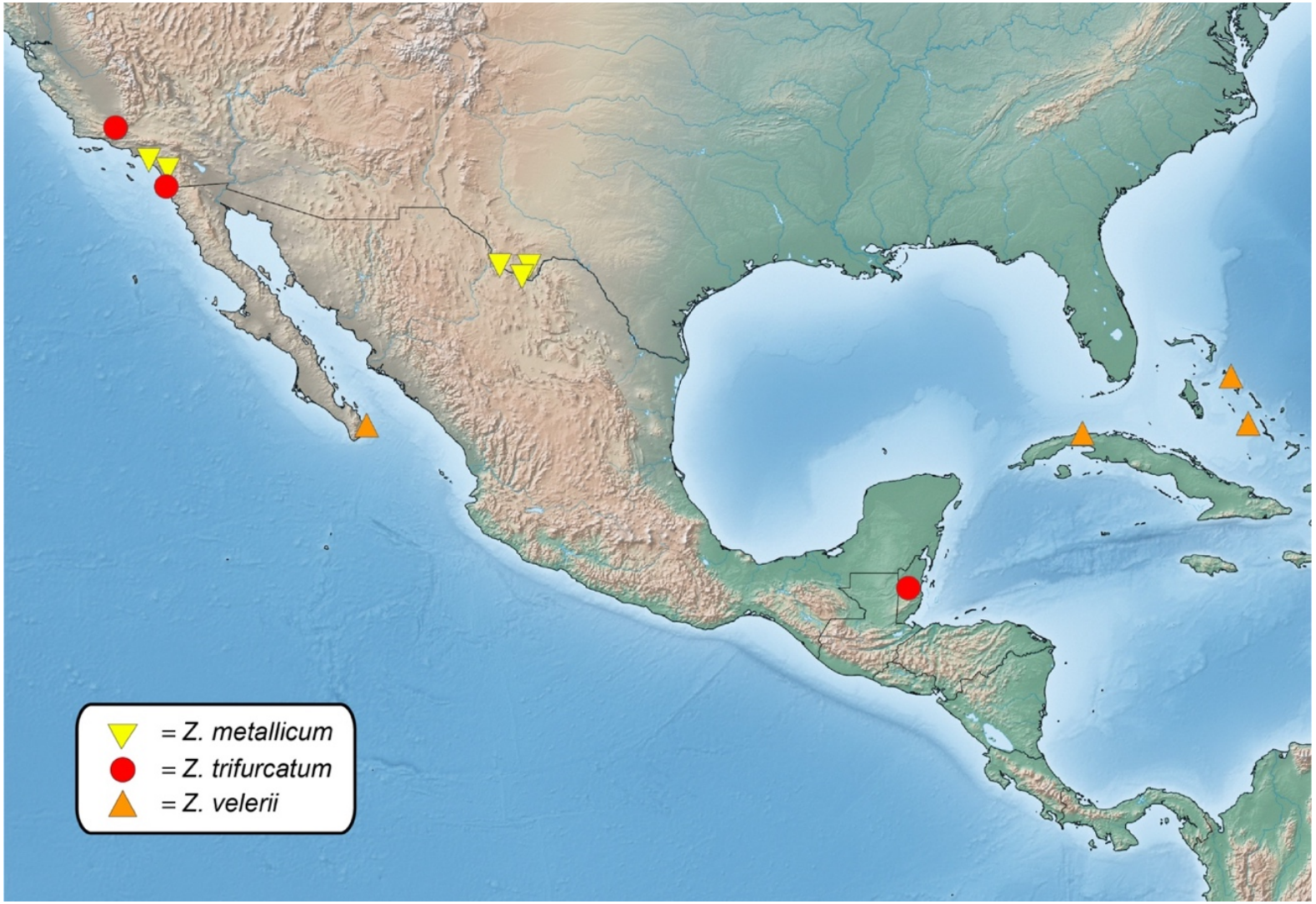

Fig. 2.32. Distributions of *Zagrammosoma metallicum* **n. sp.,** *Z. trifurcatum* **n. sp.,** and *Z. velerii*.

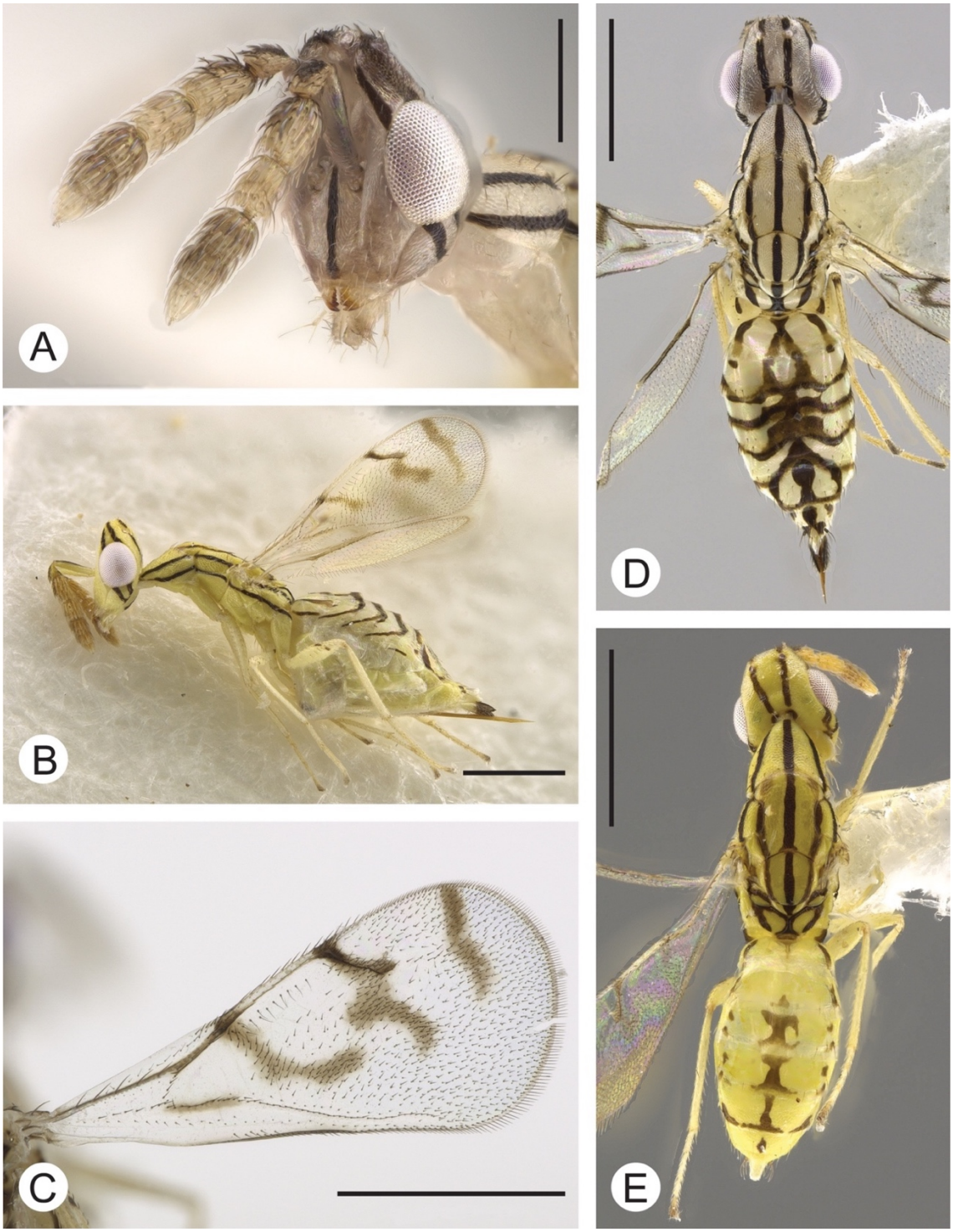

Fig. 2.33. *Zagrammosoma multilineatum*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

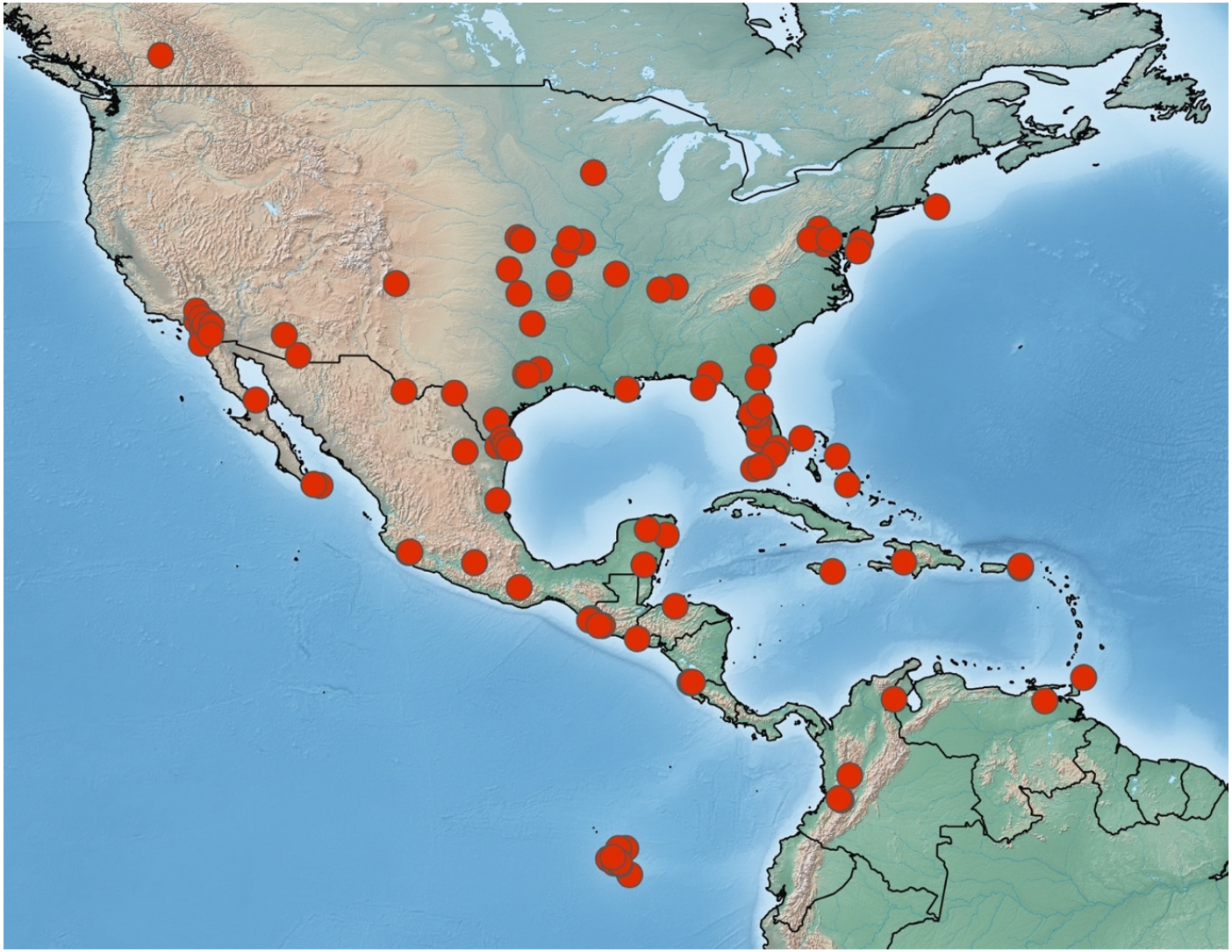

Fig. 2.34. Distribution of *Zagrammosoma multilineatum*.

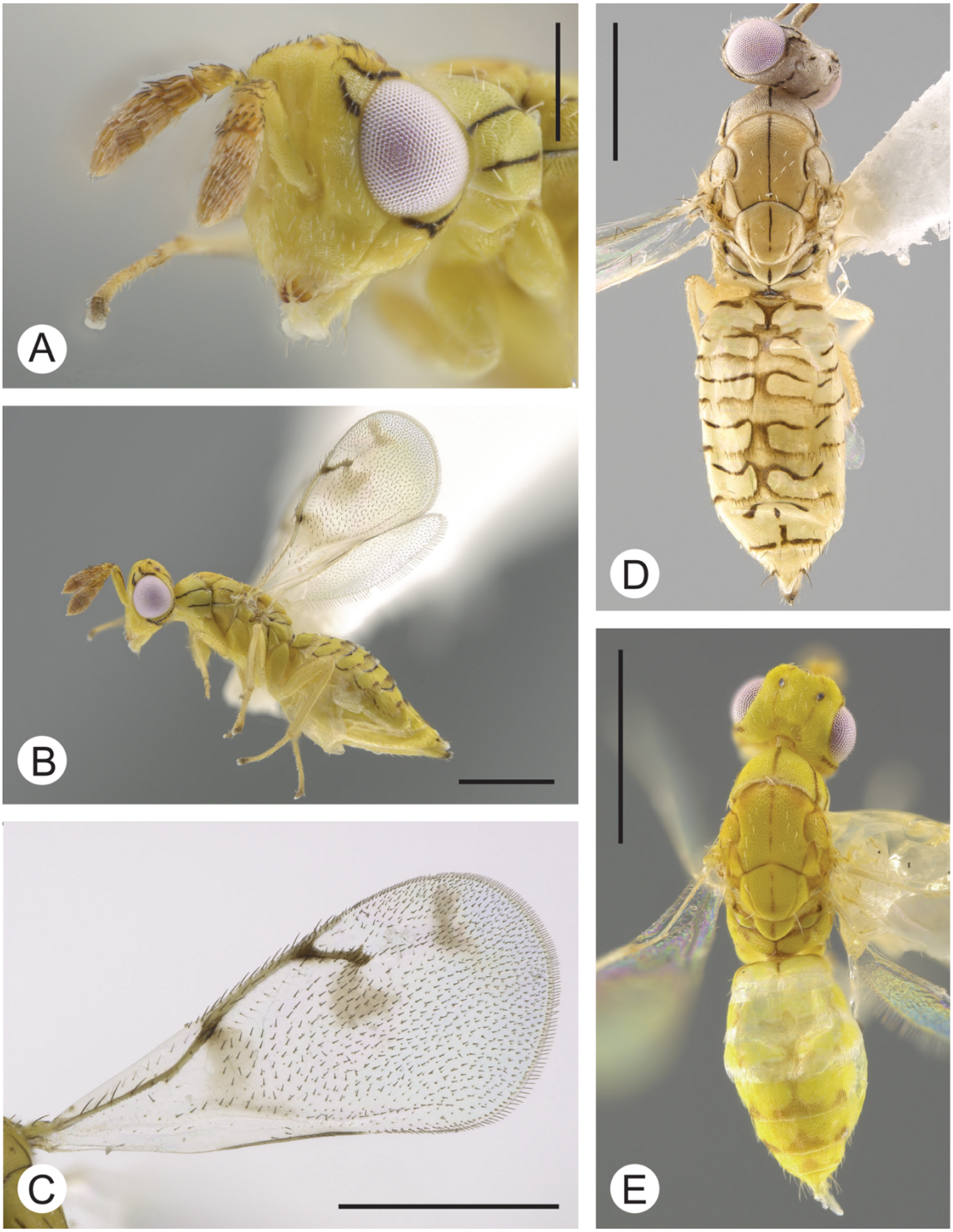

Fig. 2.35. *Zagrammosoma occidentale* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

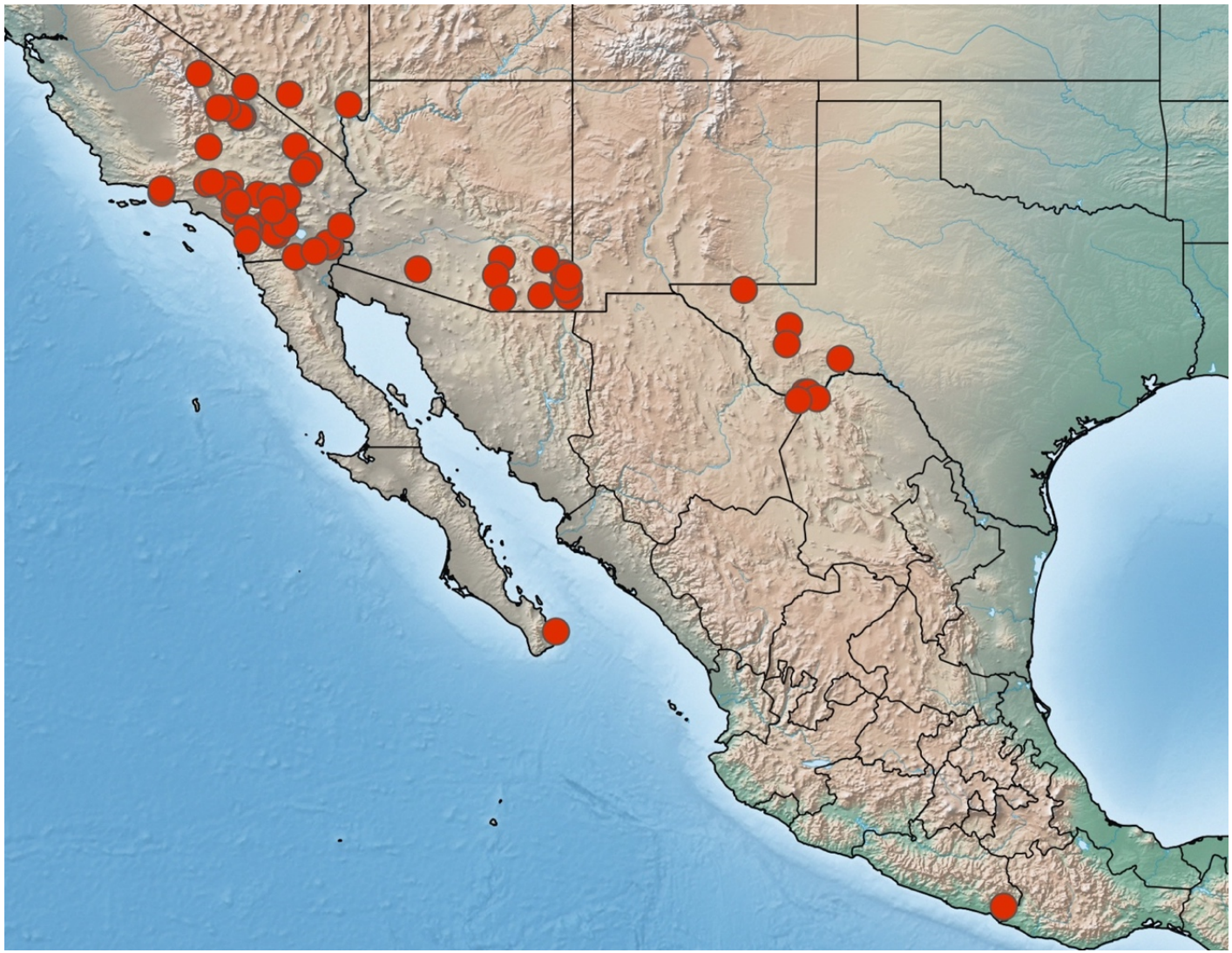

Fig. 2.36. Distribution of *Zagrammosoma occidentale* **n. sp.**

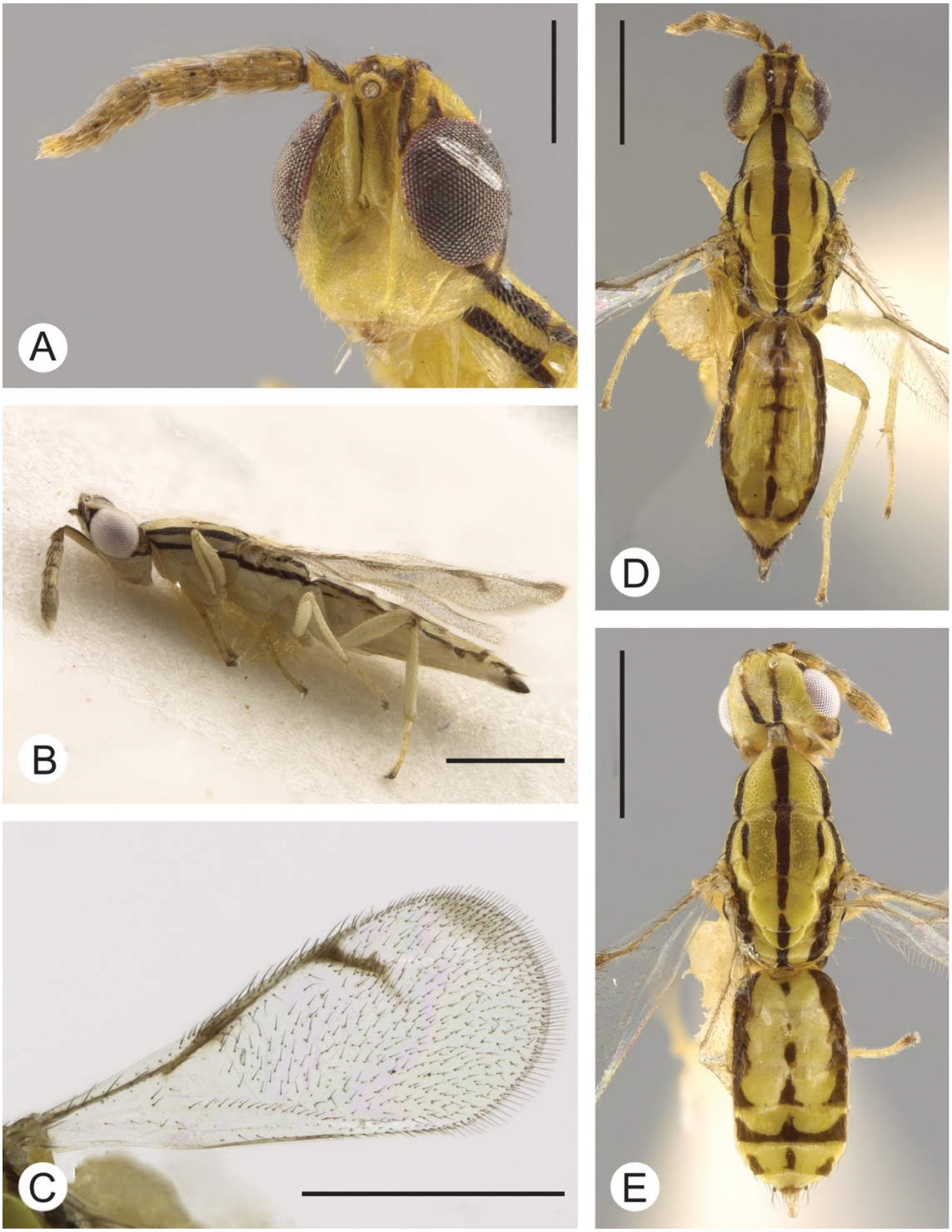

Fig. 2.37. *Zagrammosoma seini*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

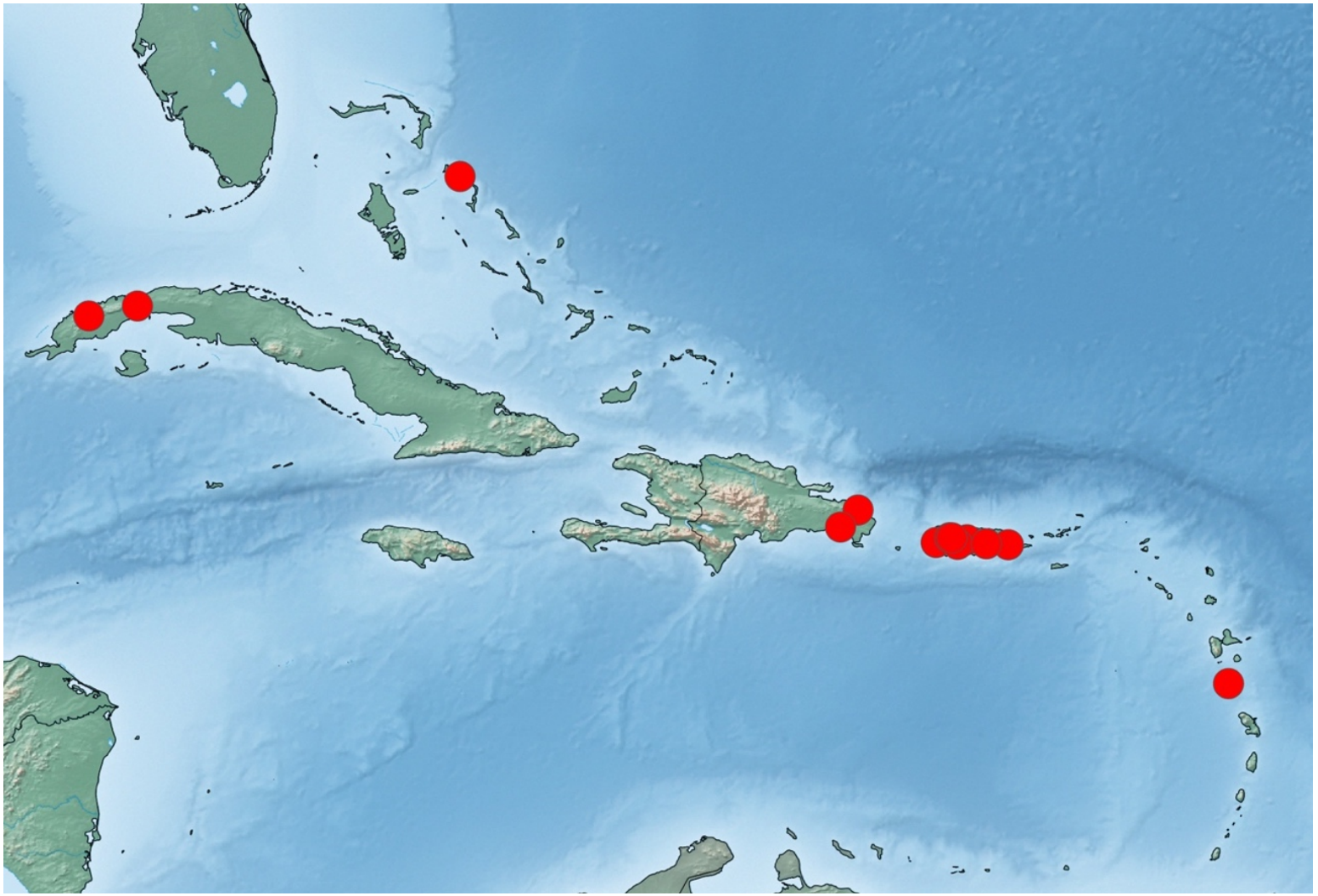

Fig. 2.38. Distribution of *Zagrammosoma seini.*

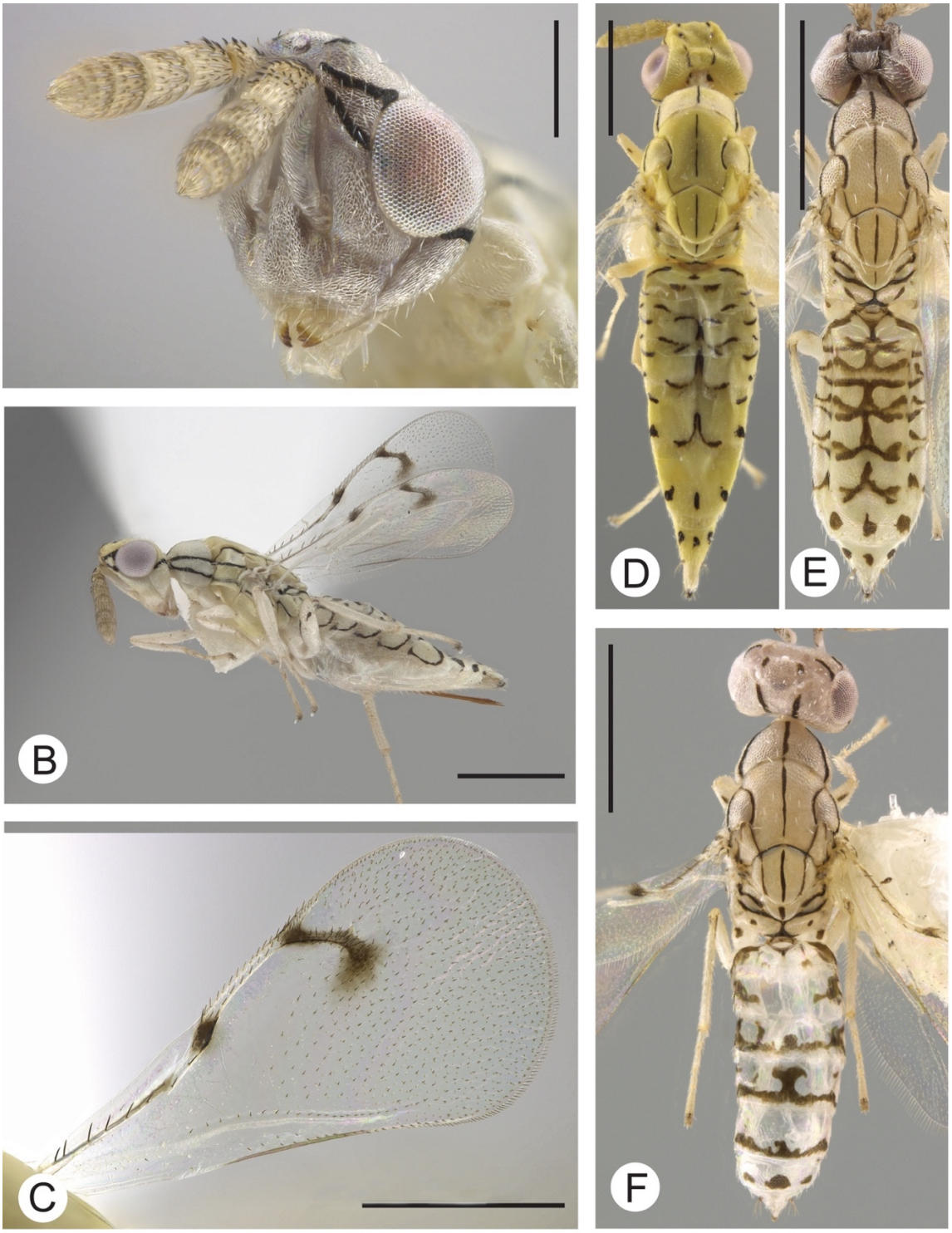

Fig. 2.39. *Zagrammosoma talitzkii*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D–E) dorsal habitus; (F) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–F).

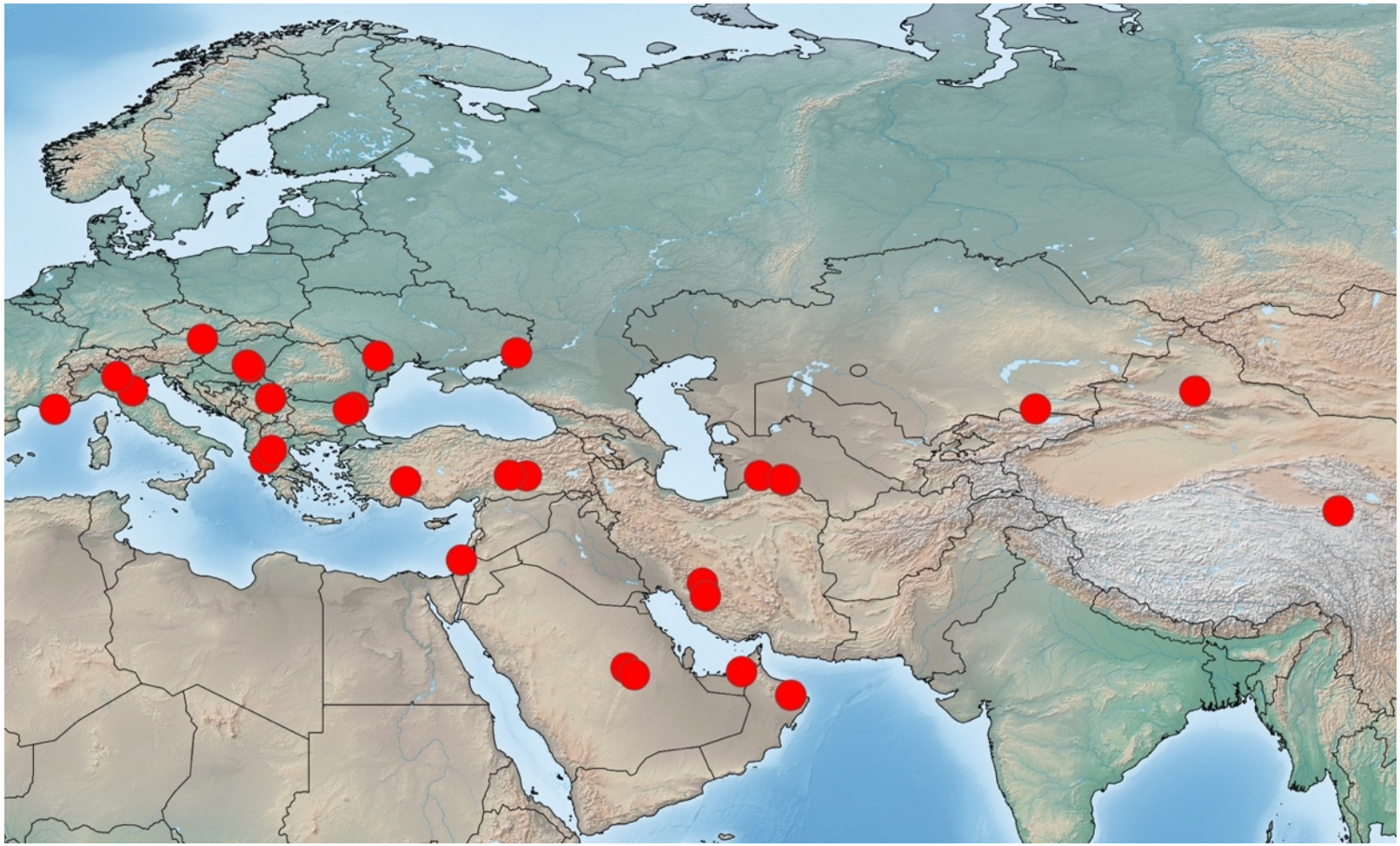

Fig. 2.40. Distribution of *Zagrammosoma talitzkii.*

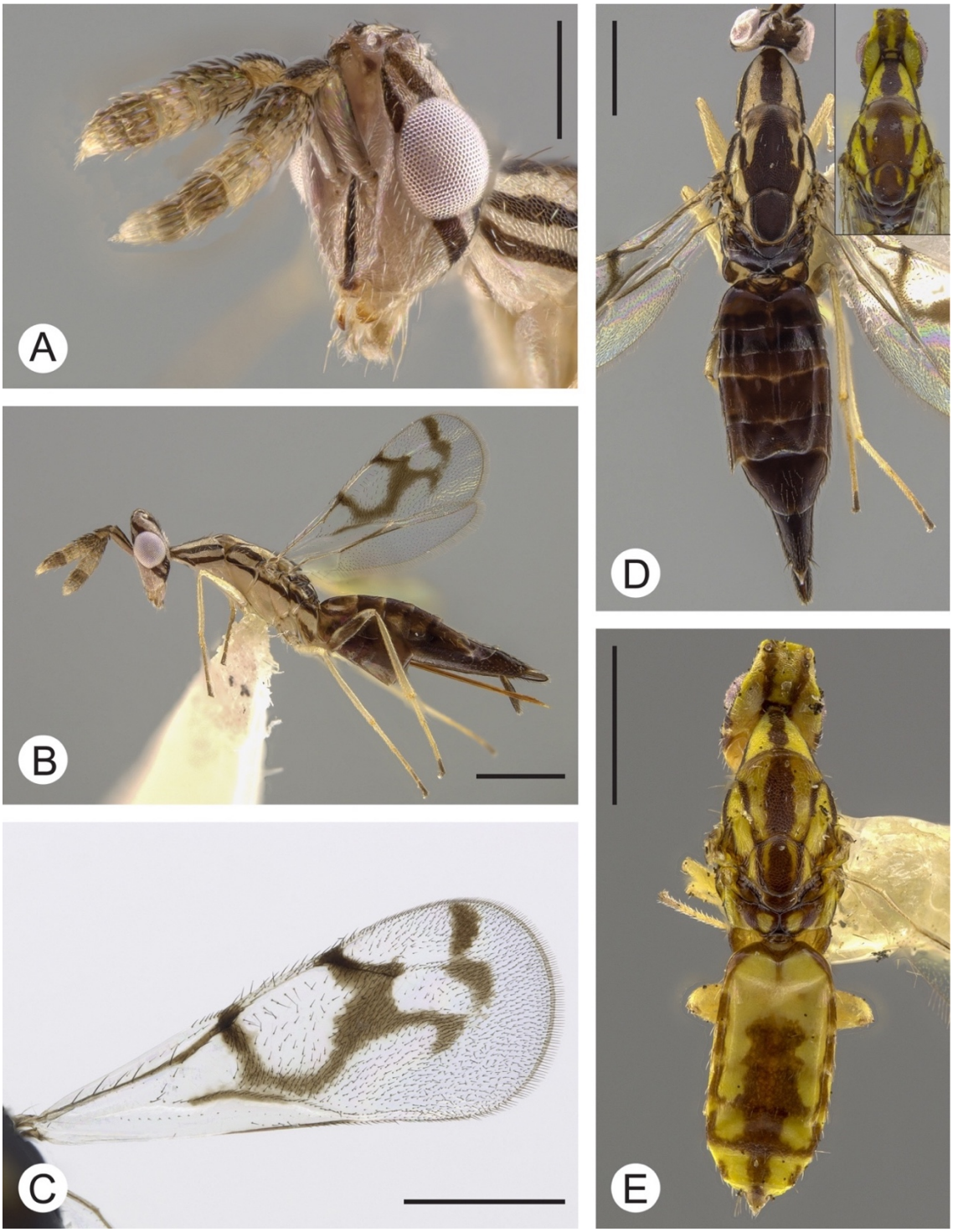

Fig. 2.41. *Zagrammosoma trifurcatum* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus, inset with color variant; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

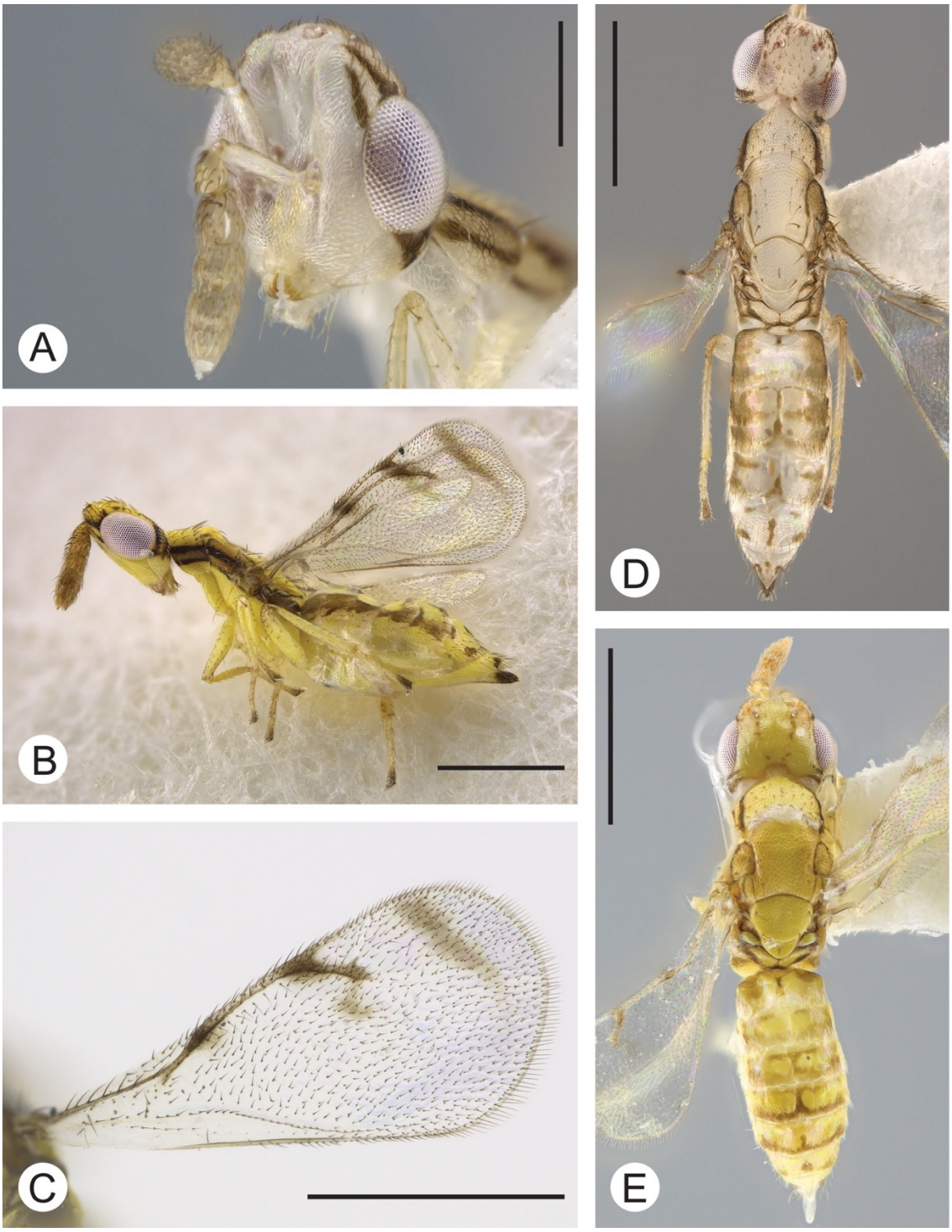

Fig. 2.42. *Zagrammosoma velerii*, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

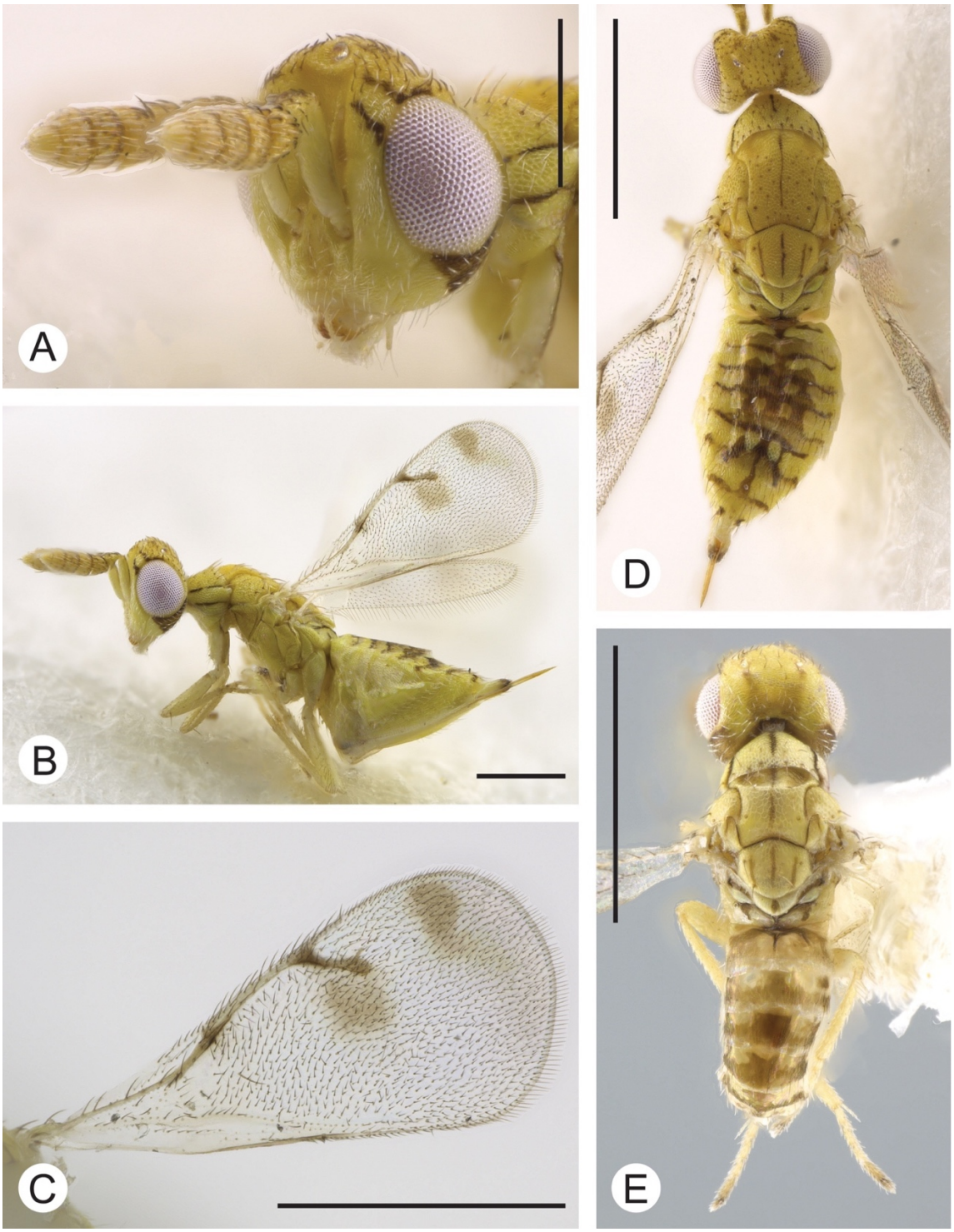

Fig. 2.43. *Zagrammosoma villosum* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, (C) fore wing, dorsal, (D) dorsal habitus; (E) ♂ dorsal habitus. Scale bar = 0.2 mm (A), 0.5 mm (B–E).

Fig. 2.44. Distribution of *Zagrammosoma villosum* **n. sp.**

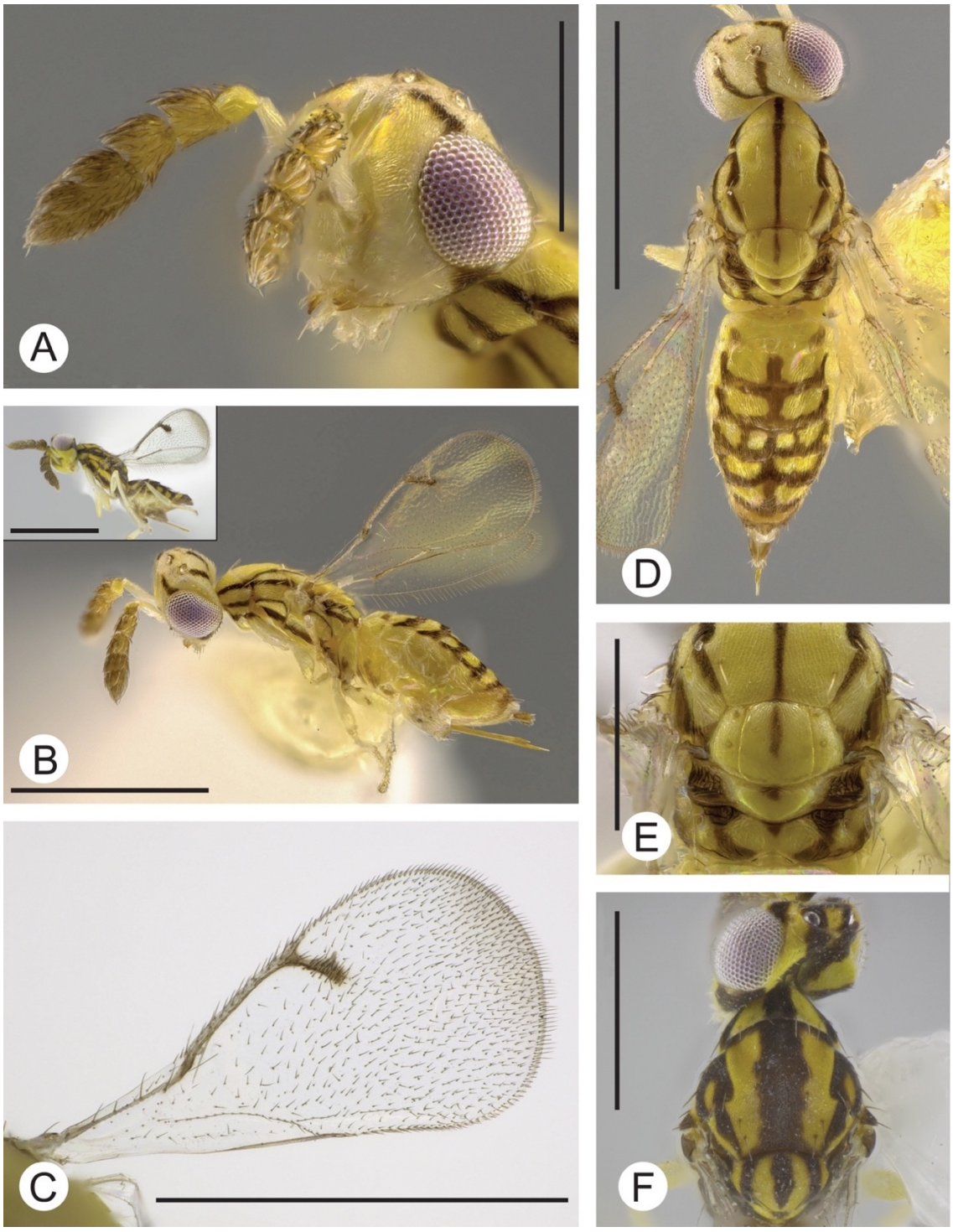

Fig. 2.45. *Zagrammosoma yanegai* **n. sp.**, ♀: (A) head, frontolateral, (B) lateral habitus, inset with color variant, (C) fore wing, dorsal, (D) dorsal habitus; (E) mesoscutellum and propodeum; (F) ♀ mesosoma color variation. Scale bar = 0.2 mm (A, E), 0.5 mm (B–D, F).

Table 2.1. List of taxa used in molecular analysis, with GenBank accession numbers and deposition location.

Taxon	Locality	Voucher number	D#	Deposition	D2	D3-5	ITS2	COI
Burkseus flavoviridis	USA: CA	UCRCENT 491708	D4176	UCRC	MH814412	MH814364	MH818336	MH825623
Burkseus robustus	USA: AZ	UCRCENT 312431	D4580	UCRC	MH814430	MH814382	MH818338	MH825625
Burkseus sigillatus	USA: CA	UCRCENT 478395	D4738	UCRC	MH814415	MH814367	MH818344	MH825628
Burkseus vittatus	Switzerland	CNC 508649	D4699	CNC	MH814426	MH814378	MH818353	MH825632
Cirrospilus cinctithorax	USA: CA	UCRCENT 414586	D3879	UCRC	MK388821	MK388835	-	MK388831
Cirrospilus sp	Argentina	UCRCENT 395935	D3751	UCRC	MK388823	MK388837	-	-
Cirrospilus sp	Australia	UCRCENT 414583	D3867	UCRC	MK388824	MK388838	-	-
Cirrospilus sp	United Kingdom	NHMUK 10734436	D5965	BMNH	MK388827	MK388841	MK388830	MK388834
Diglyphus begini	USA: UT	UCRCENT 414573	D3857	UCRC	MH814437	MH814389	MH818357	-
Diglyphus begini	USA: UT	UCRCENT 414574	D3858	UCRC	MH814438	MH814390	MH818358	-
Diglyphus isaea	USA: TX	UCRCENT 357540	D3682	UCRC	MH814439	MH814391	MH818359	MH825640
Diglyphus sp	USA: CA	UCRCENT 410527	D3789	UCRC	MH814440	MH814392	MH818360	MH825641
Zagrammosoma americanum	Mexico	UCRCENT 473167	D5909	TAMU	MK789143	-	MK789235	-
Zagrammosoma americanum	USA: CA	UCRCENT 312378	D4116	UCRC	MK789140	MK789210	MK789233	MK753229
Zagrammosoma americanum	USA: CA	UCRCENT 312379	D4117	UCRC	MH814443	MH814395	-	MH825633
Zagrammosoma americanum	USA: CA	UCRCENT 275094	D5937	UCRC	MK789141	-	MK789234	-
Zagrammosoma americanum	USA: CA	UCRCENT 275030	D5938	UCRC	MK789142	-		-
Zagrammosoma americanum	USA: NM	UCRCENT 357528	D3670	UCRC	MH814444	MH814396	MH818361	MH825634
Zagrammosoma americanum	USA: NM	UCRCENT 357529	D3671	UCRC	MH814445	MH814397	MH818362	MH825635
Zagrammosoma americanum	USA: UT	CNC 508678	D5906	CNC	-	-	MK789236	-
Zagrammosoma buselus	Ecuador: Galapagos	NCBI: txid 108813	-	-	AJ274447	-	-	-
Zagrammosoma buselus	Ecuador: Galapagos	CNC 508735	D4692	CNC	MK789144	MK789211	-	-
Zagrammosoma calvini	Argentina	UCRCENT 485707	D5939	UCRC	MK789145	-	MK789237	-
Zagrammosoma calvini	Chile	CNC 508654	D5884	CNC	MK789146	-	MK789238	-
Zagrammosoma centrolineatum	USA: CA	UCRCENT 312349	D4112	UCRC	MK789147	MK789212	MK789239	MK753230
Zagrammosoma crowei	Yemen	NCBI: txid 108814	-	-	AJ274448	-	-	-
Zagrammosoma flavolineatum	USA: CA	UCRCENT 357526	D3668	UCRC	MH814448	MH814400	MH818368	-
Zagrammosoma flavolineatum	USA: CA	UCRCENT 410536	D3840	UCRC	MH814449	MH814401	MH818369	MH825638
Zagrammosoma flavolineatum	USA: CA	UCRCENT 312350	D4111	UCRC	MK789148	MK789213	MK789240	MK753231
Zagrammosoma headricki	Mexico	UCRCENT 312424	D4573	UCRC	MK789149	MK789214	MK789241	-
Zagrammosoma headricki	USA: TX	UCRCENT 414577	D3861	UCRC	MK789150	MK789215	MK789242	MK753232
Zagrammosoma hobbesi	USA: CA	UCRCENT 395931	D3703	UCRC	MH814446	MH814398	MH818363	MH825636
Zagrammosoma hobbesi	USA: CA	UCRCENT 414594	D4000	UCRC	MH814447	MH814399	MH818364	MH825637
Zagrammosoma intermedium	USA: CA	UCRCENT 312377	D4115	UCRC	MK789151	MK789216	MK789243	-
Zagrammosoma latilineatum	Australia	CNC 508732	D4672	CNC	MK789152	MK789217	-	-
Zagrammosoma latilineatum	Australia	UCRCENT 238538	D5328	ANIC	MK789153	MK789218	-	MK753233
Zagrammosoma latilineatum	Australia	UCRCENT241931	D5332	QM	MK789154	MK789219	-	-

Table 2.1. cont.

Taxon	Locality	Voucher number	D#	Deposition	D2	D3-5	ITS2	COI
Zagrammosoma lineaticeps	Dominican Republic	UCRCENT 252450	D5934	UCRC	MK789155	-	MK789244	-
Zagrammosoma melinum	USA: AK	CNC 508666	D5896	CNC	MK789156	-	MK789245	-
Zagrammosoma melinum	USA: AK	CNC 508667	D5897	CNC	-	-	MK789246	
Zagrammosoma melinum	USA: AK	CNC 508670	D5898	CNC	-	-	MK789247	
Zagrammosoma melinum	USA: CAN	CNC 508665	D5895	CNC	MK789157	-	MK789248	-
Zagrammosoma melinum	USA: MT	UCRCENT 473171	D5915	TAMU	-	-	MK789249	
Zagrammosoma melinum	USA: MT	UCRCENT 473172	D5916	TAMU	MK789158	-	MK789250	-
Zagrammosoma metallicum	USA: TX	UCRCENT 312420	D4569	UCRC	MK789159	MK789220	MK789251	MK753234
Zagrammosoma multilineatum	Bahamas	CNC 508660	D5890	CNC	MK789162	-	MK789253	-
Zagrammosoma multilineatum	Costa Rica	NHMUK 10734425	D5329	BMNH	MK789161	MK789222	-	-
Zagrammosoma multilineatum	Mexico	CNC 508656	D5886	CNC	-	-	MK789254	-
Zagrammosoma multilineatum	Mexico	CNC 508662	D5892	CNC	-	-	MK789255	-
Zagrammosoma multilineatum	Mexico	CNC 508663	D5893	CNC	-	-	MK789257	-
Zagrammosoma multilineatum	USA: CA	UCRCENT 312348	D4113	UCRC	MK789160	MK789221	MK789252	MK753235
Zagrammosoma multilineatum	USA: MA	UCRCENT 416915	D4601	UCRC	MK789163	MK789223	MK789256	-
Zagrammosoma occidentalum	USA: AZ	UCRCENT 499454	D5917	UCRC	-	-	MK789258	-
Zagrammosoma occidentalum	USA: AZ	UCRCENT 499455	D5918	UCRC	-	-	MK789259	-
Zagrammosoma occidentalum	USA: AZ	UCRCENT 499461	D5932	UCRC	MK789164	-	MK789260	-
Zagrammosoma occidentalum	USA: CA	UCRCENT 175197	D0111	UCRC	MK789165	MK789224	-	-
Zagrammosoma occidentalum	USA: CA	UCRCENT 357518	D3660	UCRC	MH814450	MH814402	MH818365	-
Zagrammosoma occidentalum	USA: CA	UCRCENT 312427	D4576	UCRC	MH814451	MH814403	MH818366	-
Zagrammosoma occidentalum	USA: CA	UCRCENT 312429	D4578	UCRC	MH814452	MH814404	MH818367	-
Zagrammosoma occidentalum	USA: CA	CNC 508671	D5899	CNC	-	-	MK789261	-
Zagrammosoma occidentalum	USA: CA	UCRCENT 499459	D5930	UCRC	-	-	MK789262	-
Zagrammosoma occidentalum	USA: CA	UCRCENT 499462	D5933	UCRC	-	-	MK789263	-
Zagrammosoma occidentalum	USA: TX	UCRCENT 499456	D5919	UCRC	-	-	MK789264	-
Zagrammosoma occidentalum	USA: TX	UCRCENT 499457	D5920	UCRC	-	-	MK789265	-
Zagrammosoma talitzkii	China	UCRCENT 478936	D4739	UCRC	MK789166	MK789225	-	MK753236
Zagrammosoma talitzkii	Israel	UCRCENT 312395	D4545	UCRC	MK789167	MK789226	MK789266	-
Zagrammosoma talitzkii	Israel	UCRCENT 312396	D4546	UCRC	MK789168	MK789227	MK789267	-
Zagrammosoma trifurcatum	USA: CA	UCRCENT 416557	D4592	UCRC	MK789170	MK789229	MK789269	MK753238
Zagrammosoma trifurcatum	USA: CA	UCRCENT 416914	D4600	UCRC	MK789169	MK789228	MK789268	MK753237
Zagrammosoma velerii	Bahamas	CNC 508733	D4685	CNC	MK789171	MK789230	-	MK753239
Zagrammosoma villosa	Mexico	UCRCENT 473169	D5913	TAMU	-	-	MK789270	-
Zagrammosoma villosa	USA: TX	UCRCENT 357537	D3679	UCRC	MK789172	MK789231	MK789271	MK753240
Zagrammosoma villosa	USA: TX	UCRCENT 357539	D3681	UCRC	MK789173	MK789232	MK789272	MK753241

Table 2.2. List of modified primers used, with references

Gene	Primer	Sequence	References
28S D2	D2 F	5'-CGG GTT GCT TGA GAG TGC AGC-3'	Campbell *et al.*, 2000; Murray *et al.*, 2013
	D2Ra	5'-CTC CTT GGT TCC GTG TTT C-3'	Campbell *et al.*, 2000; Murray *et al.*, 2013
28S D3-5	D3Fa	5'-TTG AAA CAC GGA CCA AGG AG-3'	Nunn *et al.*, 1996; Murray *et al.*, 2013
	D5Ra	5'-CGC CAG TTC TGC TTA CCA-3'	Nunn *et al.*, 1996; Murray *et al.*, 2013
ITS2	ITS2F	5'-TGT GAA CTG CAG GAC ACA TG-3'	Campbell *et al.*, 2000; Ciociola et al., 2001
	ITS2R2	5'-TCT CGC CTG CTC TGA GGT-3'	Polihronakis, 2009; Hill & O'Malley, 2010
COI	NJ F	5'-TAT ATT TTA ATY TWC CWG GAT TTG G-3'	Simon *et al.,* 1994; Murray *et al.*, 2013
	MD R	5'-ATT GCA AAT ACT GCA CCT AT-3'	Dowton & Austin, 1997; Murray *et al.*, 2013

Table 2.3. List of host associations per species. Entries are alphabetized by *Zagrammosoma* species, host order, host species, and then host plant species. Each row contains the host and host plant record, if known, for a single *Zagrammosoma* specimen. Host records from literature are indicated by number: 1. Amiri *et al*., 2008; 2. Cao *et al*., 2014; 3. Çikman & La Salle, 2011; 4. Gates *et al*., 2002; 5. Girardoz *et al*., 2007; 6. Grabenweger *et al*., 2010; 7. Lupi, 2005; 8. Radeghieri *et al*., 2002; 9. Szőcs *et al*., 2015; 10. Varela & Welter, 1992.

Table 2.3. List of host associations per species.

	Host			Host Plant		
Species	**Host**	**Family**	**Order**	**Species**	**Family**	**Order**
Z. americanum	*Chaitophorus salicicola* Essig	Aphididae	Hemiptera	*Salix* sp.	Salicaceae	Malpighiales
	Cacopsylla pyricola (Foerster)	Psyllidae	Hemiptera			
	Coleophora laricella (Hübner)	Coleophoridae	Lepidoptera			
	coleophorid leaf miner	Coleophoridae	Lepidoptera	*Ceanothus integerrimus*	Rhamnaceae	Rosales
	Coelopoeta glutinosi Walsingham	Elachistidae	Lepidoptera			
	Coleotechnites milleri (Busck)	Gelechiidae	Lepidoptera	*Pinus contorta*	Pinaceae	Pinales
	Coleotechnites milleri (Busck)	Gelechiidae	Lepidoptera	*Pinus contorta* var. *murrayana*	Pinaceae	Pinales
	Coleotechnites sp.	Gelechiidae	Lepidoptera	*Pinus jeffreyi*	Pinaceae	Pinales
	Leucoptera coffeella (Guérin & Méneville)	Lyonetiidae	Lepidoptera			
	Phyllocnistis citrella Stainton	Gracillariidae	Lepidoptera	*Citrus* sp.	Rutaceae	Sapindales
	Phyllonorycter sp.	Gracillariidae	Lepidoptera	*Populus* sp. (Aspen)	Salicaceae	Malpighiales
	Phyllonorycter elmaella Doğanlar & Mutuura	Gracillariidae	Lepidoptera			
	Recurvaria sp.	Gelechiidae	Lepidoptera	*Pinus contorta* var. *murrayana*	Pinaceae	Pinales
	upper blotch mine			*Ceanothus integerrimus*	Rhamnaceae	Rosales
	upper surface leaf mine			*Salix lasiolepis*	Salicaceae	Malpighiales
	leaf miner			*Prunus ilicifolia*	Rosaceae	Rosales
	leaf roller			Sumac (*Rhus*) sp.	Anacardiaceae	Sapindales
	unk.			*Sarcobatus* sp.	Sarcobataceae	Caryophyllales
	unk.			*Pinus jeffreyi*	Pinaceae	Pinales
	unk.			*Populus tremuloides*	Salicaceae	Malpighiales
Z. centrolineatum	*Cameraria agrifoliella* (Braun)	Gracillariidae	Lepidoptera	*Quercus agrifolia*	Fagaceae	Fagales
	Cameraria macrocarpella (Frey & Boll)	Gracillariidae	Lepidoptera			
	Cameraria mediodorsella (Braun)	Gracillariidae	Lepidoptera			
	Cameraria sp.	Gracillariidae	Lepidoptera	*Quercus chrysolepis*	Fagaceae	Fagales
	Cameraria sp.	Gracillariidae	Lepidoptera	*Notholithocarpus densiflorus*	Fagaceae	Fagales
	Cameraria sp.	Gracillariidae	Lepidoptera	*Quercus lobata*	Fagaceae	Fagales
	Gracillaria elongella ("elongata") Linnaeus	Gracillariidae	Lepidoptera			
	Phyllonorycter platani Staudinger	Gracillariidae	Lepidoptera			
	Phyllonorycter nr. *elmaella* (10)	Gracillariidae	Lepidoptera	*Malus pumila*	Rosaceae	Rosales
	Phyllonorycter sp.	Gracillariidae	Lepidoptera	*Populus* sp. (Aspen)	Salicaceae	Malpighiales
	Phyllonorycter sp.	Gracillariidae	Lepidoptera	*Populus* sp.	Salicaceae	Mapighiales
	Phyllonorycter sp.	Gracillariidae	Lepidoptera	*Quercus keloggii*	Fagaceae	Fagales
	Coptodisca sp.	Heliozelidae	Lepidoptera	*Quercus lobata*	Fagaceae	Fagales
	leaf miner			*Quercus chrysolepis*	Fagaceae	Fagales
	miner			*Quercus keloggii*	Fagaceae	Fagales
	miner			*Rhamnus californica*	Rhamnaceae	Rosales
	upper surface blotch mine			*Quercus chrysolepis*	Fagaceae	Fagales
	upper surface blotch mine			*Quercus turbinella*	Fagaceae	Fagales
	unk.			*Quercus durata*	Fagaceae	Fagales
	unk.			*Quercus john-tuckeri*	Fagaceae	Fagales
	unk.			*Quercus* sp.	Fagaceae	Fagales
	unk.			*Pinus muricata*	Pinaceae	Pinales
	unk.			*Platanus* sp.	Platanaceae	Proteales
	unknown gall					
Z. crowei	*Leucoptera coffeella* (Guérin & Méneville)	Lyonetiidae	Lepidoptera	*Coffea* sp.	Rubiaceae	Gentianales
	Leucoptera meyricki Ghesquière	Lyonetiidae	Lepidoptera			
	Phyllocnistis citrella Stainton	Gracillariidae	Lepidoptera	*Citrus* sp.	Rutaceae	Sapindales
Z. deliae n.sp.	*Liriomyza* sp.	Agromyzidae	Diptera	*Medicago sativa*	Fabaceae	Fabales

Table 2.3. cont.

	Acrocercops sp.		Gracillariidae	Lepidoptera	*Cordia rotundifolia*	Boraginaceae	Boraginales
	Phytobia sp.		Agromyzidae	Diptera			
		unk.			*Gossypium* sp.	Malvaceae	Malvales
Z. flavolineatum	*Liriomyza sativae* Blanchard		Agromyzidae	Diptera			
	Keiferia lycopersicella (Walsingham)		Gelechiidae	Lepidoptera			
	Marmara gulosa Guillén & Davis		Gracillariidae	Lepidoptera	*Citrus* sp.	Rutaceae	Sapindales
	Nealyda sp.		Gelechiidae	Lepidoptera	*Abronia maritima*	Nyctaginaceae	Caryophyllales
	Phthorimaea operculella (Zeller)		Gelechiidae	Lepidoptera			
	Phyllonorycter crataegella (Clemens)		Gracillariidae	Lepidoptera			
	Phyllonorycter elmaella Doğanlar & Mutuura		Gracillariidae	Lepidoptera			
	Phyllonorycter nr. *elmaella* (10)		Gracillariidae	Lepidoptera	*Malus pumila*	Rosaceae	Rosales
	Tischeria sp.		Tischeriidae	Lepidoptera			
	Tischeria sp. (4)		Tischeriidae	Lepidoptera	*Ceanothus greggii*	Rhamnaceae	Rosales
	upper blotch mine				Mallow	Malvaceae	Malvales
		unk.			*Ceanothus greggii*	Rhamnaceae	Rosales
		unk.			*Solanum lycopersicum*	Solanaceae	Solanales
Z. headricki n.sp.	*Monoxi* sp.		Chrysomelidae	Coleoptera			
		unk.			*Atriplex* sp.	Chenopodiaceae	Caryophyllales
		unk.			*Beta vulgaris*	Amaranthaceae	Caryophyllales
		unk.			*Erodium cicutarium*	Geraniaceae	Geraniales
		unk.			*Lycium* sp.	Solanaceae	Solanales
Z. hobbesi	*Coelopoeta glutinosi* (Walsingham) - 1		Gelechiidae	Lepidoptera			
	Coelopoeta sp.		Gelechiidae	Lepidoptera	*Phacelia* sp.	Boraginaceae	Boraginales
		unk.			*Eriodictyon trichocalyx*	Boraginaceae	Boraginales
		unk.			*Eriodictyon* sp.	Boraginaceae	Boraginales
		unk.			*Haplopappus* sp.	Asteraceae	Asterales
Z. interlineatum stat. rev.	*Odontopus calceatus* (Say)		Curculionidae	Coleoptera			
	Orchestes pallicornis (Say)		Curculionidae	Coleoptera			
	Agromyza sp.		Agromyzidae	Diptera			
	Antispila nysaefoliella Clemens		Heliozelidae	Lepidoptera			
	Cameraria sp.		Gracillariidae	Lepidoptera	*Quercus* sp.	Fagaceae	Fagales
	Cameraria hamadryadella (Clemens)		Gracillariidae	Lepidoptera			
	Cameraria quercivorella (Chambers)		Gracillariidae	Lepidoptera			
	Coptotriche malifoliella (Clemens)		Tischeriidae	Lepidoptera			
	Parornix sp.		Gracillariidae	Lepidoptera			
	Phyllonorycter blancardella (Fabricius)		Gracillariidae	Lepidoptera			
	Phyllonorycter crataegella (Clemens)		Gracillariidae	Lepidoptera	*Malus* sp.	Rosaceae	Rosales
	Phyllonorycter sp.		Gracillariidae	Lepidoptera			
	Recurvaria nanella (Denis & Schiffermüller)		Gelechiidae	Lepidoptera	*Malus* sp.	Rosaceae	Rosales
	Stilbosis quadricustatella (Chambers)		Cosmopterigidae	Lepidoptera			
		unk.			*Pinus* sp.	Pinaceae	Pinales
		unk.			*Pinus echinata*	Pinaceae	Pinales
		unk.			*Quercus* sp.	Fagaceae	Fagales
Z. intermedium	*Cameraria nemoris* (Walsingham)		Gracillariidae	Lepidoptera	*Vaccinium ovatum*	Ericaceae	Ericales
	Cameraria nemoris		Gracillariidae	Lepidoptera			
Z. latilineatum	*Liriomyza chenopodii* (Watt)		Agromyzidae	Diptera	*Chenopodium album*	Amaranthaceae	Caryophyllales
	Liriomyza huidobrensis (Blanchard)		Agromyzidae	Diptera	*Solanum tuberosum*	Solanaceae	Solanales
	Phyllonorycter messaniella (Zeller)		Gracillariidae	Lepidoptera	*Quercus* sp.	Fagaceae	Fagales
Z. lineaticeps	*Calycomyza lantanae*		Agromyzidae	Diptera	*Lantana camara*	Verbenaceae	Lamiales

Table 2.3. cont.

	Liriomyza archboldi Frost		Agromyzidae	Diptera			
	Gelechia sp.		Gelechiidae	Lepidoptera	*Crotalaria* sp.	Fabaceae	Fabales
	Keiferia lycopersicella (Walsingham)		Gelechiidae	Lepidoptera	*Solanum lycospersicum*	Solanaceae	Solanales
	Leucoptera coffeella (Guérin & Méneville)		Lyonetiidae	Lepidoptera			
	Phyllocnistis citrella Stainton		Gracillariidae	Lepidoptera			
	Scrobipalpula sp.		Gelechiidae	Lepidoptera	*Solanum saponaceum*	Solanaceae	Solanales
	unknown gracillarid		Gracillariidae	Lepidoptera			
	leaf miner				*Sida acuta*	Malvaceae	Malvales
	serpentine leaf miner				*Tropaeolum majus*	Tropaeolaceae	Brassicales
		unk.			*Solanum lycospersicum*	Solanaceae	Solanales
Z. melinum	*Bucculatrix* sp.		Bucculatricidae	Lepidoptera	*Populus* sp. (Cottonwood)	Salicaceae	Malpighiales
	Coleotechnites sp.		Gelechiidae	Lepidoptera	*Pinus jeffreyi*	Pinaceae	Pinales
	Phyllonorycter nipigon (Freeman)		Gracillariidae	Lepidoptera			
	Phyllonorycter salicifoliella (Chambers)		Gracillariidae	Lepidoptera			
	Phyllonorycter sp.		Gracillariidae	Lepidoptera			
	leaf miner (Gracillariidae?)		Gracillariidae	Lepidoptera	*Populus trichocarpa*	Salicaceae	Malpighiales
	leaf miner				*Salix* sp.	Salicaceae	Malpighiales
		unk.			*Populus fremontii*	Salicaceae	Malpighiales
Z. multilineatum	*Pachyschelus laevigatus* (Say)		Buprestidae	Coleoptera	*Desmodium canadense*	Fabaceae	Fabales
	Agromyza parvicornis (Valenciennes)		Agromyzidae	Diptera			
	Liriomyza pusilla (Meigen)		Agromyzidae	Diptera			
	Liriomyza sativae Blanchard		Agromyzidae	Diptera			
	Bucculatrix sp.		Bucculatricidae	Lepidoptera	*Pluchea odorata*	Asteraceae	Asterales
	Callisto geminatella Packard		Gracillariidae	Lepidoptera			
	Caloptilia azaleella (Brants)		Gracillariidae	Lepidoptera			
	Canarsia sp.		Pyralidae	Lepidoptera			
	Keiferia lycopersicella (Walsingham)		Gelechiidae	Lepidoptera			
	Leucoptera coffeella (Guérin & Méneville)		Lyonetiidae	Lepidoptera	*Coffeea* sp.	Rubiaceae	Gentianales
	Leucoptera coffeella		Lyonetiidae	Lepidoptera			
	Ornix sp.		Gracillariidae	Lepidoptera			
	Phyllocnistis citrella Stainton		Gracillariidae	Lepidoptera	*Citrus* sp.	Rutaceae	Sapindales
	Phyllocnistis citrella		Gracillariidae	Lepidoptera	*Citrus paradisii*	Rutaceae	Sapindales
	Phyllocnistis citrella		Gracillariidae	Lepidoptera			
	Phyllocnistis sp.		Gracillariidae	Lepidoptera			
	Phyllonorycter blancardella (Fabricius)		Gracillariidae	Lepidoptera			
	Phyllonorycter blancardella		Gracillariidae	Lepidoptera	*Malus pumila*	Rosaceae	Rosales
	Phyllonorycter ornatella Chambers		Gracillariidae	Lepidoptera			
	Porphyrosela desmodiella (Clemens)		Gracillariidae	Lepidoptera	*Lespedeza* sp.	Fabaceae	Fabales
	Scrobipalpula sp.		Gelechiidae	Lepidoptera	*Solanum saponaceum*	Solanaceae	Solanales
	Tischeria sp.		Tischeriidae	Lepidoptera	*Melanthera* sp.	Asteraceae	Asterales
	unknown gracillarid		Gracillariidae	Lepidoptera	*Gliricidia sepium*	Fabaceae	Fabales
	leaf miner				*Populus alba*	Salicaceae	Malpighiales
	leaf miner				*Simmondsia chinensis*	Simmondsiaceae	Caryophyllales
	leaf miner				*Zea mays*	Poaceae	Poales
		unk.			*Ambrosia chenopodiifolia*	Asteraceae	Asterales
		unk.			*Ambrosia* sp.	Asteraceae	Asterales
		unk.			*Eleusine indica*	Poaceae	Poales
		unk.			*Periploca* sp.	Apocynaceae	Gentianales
		unk.			*Simmondsia chinensis*	Simmondsiaceae	Caryophyllales
		unk.			*Sphaeralcea lindheimeri*	Malvaceae	Malvales

Table 2.3. cont.

		unk.			*Trixis californica*	Asteraceae	Asterales
		unk.			*Vitis rotundifolia*	Vitaceae	Vitales
Z. occidentalum n.sp.	*Asphondylia* sp.		Cecidomyiidae	Diptera	*Larrea divaricata*	Zygophyllaceae	Zygophyllales
	Phyllocnistis citrella Stainton		Gracillariidae	Lepidoptera	Grapefruit	Rutaceae	Sapindales
	Phyllocnistis citrella		Gracillariidae	Lepidoptera	Lemon	Rutaceae	Sapindales
	Phyllocnistis citrella		Gracillariidae	Lepidoptera	Valencia	Rutaceae	Sapindales
		unk.			*Chilopsis linearis arcuata*	Bignoniaceae	Lamiales
		unk.			*Eriogonum inflatum*	Polygonaceae	Caryophyllales
		unk.			*Larrea* sp.	Zygophyllaceae	Zygophyllales
		unk.			*Wislizenia refracta*	Cleomaceae	Brassicales
Z. seini	*Dioryctria horneana* (Dyar)		Pyralidae	Lepidoptera			
	Leucoptera coffeella (Guérin & Méneville)		Lyonetiidae	Lepidoptera			
	Phyllocnistis sp.		Gracillariidae	Lepidoptera			
	Phyllocnistis citrella Stainton		Gracillariidae	Lepidoptera			
	Tischeria sp.		Tischeriidae	Lepidoptera	*Melanthera* sp.	Asteraceae	Asterales
	caterpillar				*Ananas comosus*	Bromeliaceae	Poales
	unknown gracillarid		Gracillariidae	Lepidoptera	*Gliricidia sepium*	Fabaceae	Fabales
Z. talitzkii	*Liriomyza congesta* (Becker) (3)		Agromyzidae	Diptera	*Medicago sativa*	Fabaceae	Fabales
	Liriomyza trifolii (Burgess) (3)		Agromyzidae	Diptera	*Solanum melongena*	Solanaceae	Solanales
	Liriomyza trifolii (3)		Agromyzidae	Diptera	*Lycopersicum esculentum*	Solanaceae	Solanales
	Cameraria ohridella Deschka & Dimić (5–8)		Gracillariidae	Lepidoptera	*Aesculus hippocastanum*	Sapindaceae	Sapindales
	Micrurapteryx sophorivora Kuznetzov & Tristan (2)		Gracillariidae	Lepidoptera	*Thurmopsis lanceolata*	Fabaceae	Fabales
	Parornix sp.		Gracillariidae	Lepidoptera	*Prunus persica*	Rosaceae	Rosales
	Parornix sp.		Gracillariidae	Lepidoptera			
	Phyllonorycter comparella (Duponchel) (9)		Gracillariidae	Lepidoptera	*Populus alba*	Salicaceae	Malpighiales
	Phyllonorycter corylifoliella (Hubner) (1)		Gracillariidae	Lepidoptera	*Malus pumila*	Rosaceae	Rosales
	Phyllonorycter corylifoliella		Gracillariidae	Lepidoptera			
	Phyllonorycter malella (Gerasimov)		Gracillariidae	Lepidoptera	*Malus domestica*	Rosaceae	Rosales
	Phyllonorycter robiniella (Clemens)		Gracillariidae	Lepidoptera	*Robinia pseudoacacia*		
		unk.			*Nitraria* sp.	Nitrariaceae	Sapindales
		unk.			*Salix* sp.	Salicaceae	Malpihiales
Z. trifurcatum n. sp.		unk.			*Heterotheca villosa*	Asteraceae	Asterales
Z. velerii		none				none	
Z. villosa n. sp.	*Tischeria* sp.		Tischeriidae	Lepidoptera			
	Lepidoptera larva			Lepidoptera	*Mimosa pigra*	Fabaceae	Fabales
		unk.			*Acacia constricta*	Fabaceae	Fabales
		unk.			*Juniperus occidentalis*	Cupressaceae	Pinales
Z. vanegai n. sp.		none				none	

1. Amiri *et al.*, 2008
2. Cao *et al.*, 2014
3. Çikman & La Salle, 2011
4. Gates *et al*., 2002
5. Girardoz *et al.*, 2007
6. Grabenweger *et al.*, 2010
7. Lupi, 2005
8. Radeghieri *et al.*, 2002
9. Szőcs *et al.*, 2015
10. Varela & Welter, 1992

Chapter 3

A Combined Molecular and Morphological Revision of Cirrospilini (Hymenoptera: Eulophidae)

Abstract

The tribe Cirrospilini LaSalle (Hymenoptera: Eulophidae: Eulophinae) contains parasitoids of leaf miners, leaf rollers, gall makers and sawfly eggs. It is revised for the first time in a combined morphological and molecular phylogenetic context, scoring specimens for 48 morphological characters and employing COI mitochondrial and 18S, 28S and ITS2 ribosomal DNA. Cirrospilini is recovered as monophyletic and sister to Eulophini Ashmead, with 20 recognized genera included in the analysis, of which 19 are molecularly verified. The genera *Colpoclypeus* Lucchese and *Trichospilus* Ferrière are included in Cirrospilini, while *Melittobiopsis* Timberlake and *Cirrospiloidelleus* Girault are removed from the tribe; Melittobiopsini Perry **n. tribe** is recovered as a monogeneric tribe, sister to and morphologically distinct from Eulophini. Species previously identified as *Cirrospilus* Westwood are recovered and redefined in 5 genera, with *Atoposoma* Masi **stat. rev.** and *Gyrolasella* Girault **stat. rev.** elevated from synonymy with *Cirrospilus*, and two new genera proposed, *Vagus* Perry **n. gen.** (Afrotropical, Australasian, Indomalaya) and *Pseuzagrammosoma* Perry **n. gen** (Nearctic)**.** The following **new synonymy** is proposed: *Semielacher* Bouček under *Cirrospilus*. New combinations for species previously belonging to *Cirrospilus* are detailed. New host and locality information is presented, and the first worldwide key to the tribes of Eulophinae and to the genera of Cirrospilini is provided.

Keywords: Chalcidoidea, Eulophidae, parasitoid, biocontrol, morphology

Introduction

Cirrospilini LaSalle (Chalcidoidea: Eulophidae: Eulophinae) is a tribe of parasitic wasps that is found worldwide, and previously represented by 265 species in 16 genera (Noyes, 2019). Cirrospilines generally attack concealed lepidopteran, dipteran, and to a lesser extent, coleopteran and hymenopteran larvae, such as leaf miners, leaf rollers, and gall makers (Ratzeburg, 1852; Dowden, 1941; Sundby, 1957; Bouček & Askew 1968; Gordh, 1978; Kamijo, 1987; Ubaidillah *et al*., 2003; Noyes, 2019; Perry & Heraty, 2019). Some species are known to attack sawfly eggs (Kirkland & Paramonov, 1962; Cingovski, 1965; Bouček & Askew 1968; Huber & Moreau, 2003; Perry & Heraty, 2019), spider eggs (Zhu *et al.*, 2002), or act as hyperparasites of hymenopteran parasitoids (Dowden, 1941; Bouček, 1959; Bouček & Askew, 1968; Perry & Heraty, 2019). Twelve of the genera contain fewer than 10 species, whereas *Cirrospilus* contains 155 described species (Ubaidillah *et al.*, 2003; Ubaidillah, 2006; Noyes, 2019).

Systematics

Bouček (1988) resurrected Ophelimini, incorporating genera previously assigned to Elachertini (*Aulogymnus, Cirrospilus, Cirrospiloidelleus* Girault*, Diaulinopsis* Crawford*, Zagrammosoma*), Eulophini (*Diglyphus, Meruacesca* Koçak & Kemal), Ophelimini (*Ophelimus* Haliday*, Australsecodes* Girault), and the newly described genus *Semielacher* Bouček. In a molecular analysis using 28S-D2, Gauthier *et al.* (2000) recovered a clade that included some of these genera (not all genera were available for sequencing) and created Cirrospilini. In their study, *Ophelimus*

emerged as distantly related to Cirrospilini, and was subsequently raised to subfamily status, Opheliminae, by Burks *et al.* (2011). Cirrospilini was diagnosed in Gauthier *et al.* (2000) by the following characters: upper ocular sulcus present; antenna with 2 or 3 funiculars; propleura separating posteriorly and exposing the prosternum; presence of a postmarginal vein on the fore wing; dorsal surface of submarginal vein with at least 3 setae; scutellum with 2 or more pairs of setae and usually submedian grooves; variable notauli: absent or incomplete, complete and extending to the axillae, or complete and extending to the scutellum. Of these features only the separation of the propleura was regarded as a potential synapomorphy. Two genera, *Colpoclypeus* Lucchese and *Trichospilus* Ferrière, were not available for their analysis, but they also possess the propleura separation and funicular count (2) that other cirrospilines share. *Dicladocerus* Westwood also possess a separated propleura, however, this was recovered within Eulophini in Gauthier *et al.* (2000). Fresh material for these 3 genera was available for sequencing in our analysis.

A morphological-only analysis (Ubaidillah *et al*., 2003) scored 53 cirrospiline species using 56 characters, and recovered a monophyletic tribe based on 7 character states: suture on frons present laterally, scrobal groove absent, male antenna with two anelli, mesoscutum with two pairs of large setae, hind tibia with one spur, maxillary palps with a single segment, and short hind basitarsus; these states were all homoplastic across Eulophidae. All genera in the study were found to be monophyletic, with the exception of *Cirrospilus*, however this analysis made

defining the group more complicated, as these character states are different from those used originally to describe the tribe (Gauthier *et al.,* 2000), and can be found in many non-cirrospiline eulophids.

Biological Control

The tribe contains some of the more important genera for both native and imported biological control of agricultural pests. For example, *Diglyphus* Walker are primarily parasitoids of dipteran leaf miners such as *Liriomyza* Mik (Bouček, 1988; Zhu *et al.,* 2000; Sha *et al*., 2007), *Cirrospilus* Westwood and *Zagrammosoma* Ashmead parasitize lepidopteran and dipteran larvae (Clausen, 1978; Smith & Hoy, 1995; Gates, 2000; Gates et al., 2002; Grafton-Cardwell *et al*., 2008) and *Aulogymnus* Förster, attack cynipid gall wasps (Askew, 1961; Bouček, 1988; Zhu *et al.,* 1999; Gates & Schauff, 2005). Species of *Cirrospilus* and *Zagrammosoma* have been evaluated unsuccessfully as candidates for classical biological control of leaf miners (Hoy & Ngyuen, 2003; Garcia-Marí et. al. 2004), however, some species of *Diglyphus, Cirrospilus,* and *Semielacher* Bouček have been used with success in projects targeting leaf miners (Parrella *et al*., 1989; Smith & Hoy, 1995; LaSalle *et al*., 1999; Braham *et al*., 2007; Argov & Rössler, 1996; Sha *et al*., 2007).

Correctly identifying cirrospiline species is critical for any successful biological control application. Potentially useful species may be identified as an undesirable species and vice-versa, a species might be described as parasitic when in fact it is hyperparasitic, or cultures of natural enemies may be contaminated with the introduction of a cryptic/similar species line (Rosen, 1978; Rosen 1986;

Stouthamer *et al.* 2000). This is especially important for conservation biological control programs, which presume that natural enemies already exist in localities with a potential to suppress invasive pest populations without the introduction of foreign biological control agents (De Bach, 1964; Van Driesche & Bellows, 1996). These programs are dependent on understanding relationships between wasp and host species in a particular environment, which can be difficult in areas where sibling or cryptic species occur (Bickford et al., 2007; Desneux et al., 2009).

The analysis in Chapter 1 (Perry & Heraty, 2019) demonstrates the utility of an integrative approach to species delimitation, and this current analysis of the tribe provides an opportunity to apply those findings on higher levels. There is currently no worldwide key to the genera in Cirrospilini, making it often difficult to correctly identify genera. Examination of thousands of cirrospiline specimens reveals that a large number of specimens are incorrectly identified as *Cirrospilus,* due to regional keys not accounting for all genera and because presently, there is no strong morphological definition for the genus. Correctly defining *Cirrospilus* is an important aspect of this study, as this is the largest, most widespread genus in the tribe, and it is morphologically similar to several related genera. Bouček (1988) had difficulty defining the genus morphologically, and divided the genus into 2 main species groups, based the on presence or absence of a median carina on the propodeum. Several other characters are also variable within the genus: vertex vaulted or not vaulted; notauli complete to axilla or transscutal articulation. These

characters are not variable in other genera in the tribe, generating evidence that *Cirrospilus* is comprised of more than a single genus.

The results of this study will define Cirrospilini morphologically, determine which genera are included in the tribe, and provide a worldwide key to all genera. In addition, we determine which characters are more important for tribe, generic, or species delimitation. Beyond the tribe, this study will be a basis on which other eulophid genera and species can be properly defined.

Materials and Methods

Specimen Examination

A total of 3808 specimens were examined and used for this study. A summary of localities is provided in each genus description; locality information not directly from material examined is indicated by a reference. Museum abbreviations used in this paper are defined below; institutions that loaned material for this study are denoted with the assisting curator(s) in parentheses:

ANIC The Australian National Insect Collection, Canberra, Australia (N. Fisher & J. Rodriguez)

BMNH The Natural History Museum, London, England (J. Noyes & N. Dale-Skey)

BPBM Bernice Pauahi Bishop Museum, Honolulu, Hawaii

CASC California Academy of Sciences, San Francisco, CA, USA (C. Grinter & N. Penny)

CNC Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, ON, Canada (G. Gibson, J. Huber, S. Cardinal)

EMEC Essig Museum Entomology Collection, University of California, Berkeley, CA, USA (R. Zuparko)

FSCA Florida State Collection of Arthropods, Gainesville, FL, USA (K. Williams)

HDOU Hope Department, Oxford University, Oxford, England (J. Hogan)

HNHM Hungarian Natural History Museum, Budapest, Hungary

MBBJ Museum Zoologicum Bogoriense, Bogor, Indonesia

MSNG Museo Civico di Storia Naturale di Genova, Giacomo Doria, Genova, Italy.

MLPA Museo de la Plata, Universidad Nacional de La Plata, La Plata, Argentina (D. Aquino & M. Cecilia)

MRAC Musée Royal d'Afrique Centrale, Tervuren, Belgium

MZH Finnish Museum of Natural History, Helsinski, Finland (J. Paukkunen)

NMPC National Museum Natural History, Prague, Czech Republic

NMV National Museum, Victoria. Melbourne, Victoria, Australia (K. Walker, S. Hinkley & P. Lillywhite)

QM Queensland Museum, Brisbane, Queensland, Australia (S. Wright)

SAMA South Australia Museum, Adelaide, South Australia, Australia

SANC South Africa National Collection of Insects, Pretoria, South Africa (W. Strumpher)

TAMU Texas A&M University, College Station, TX, USA (J. Woolley)

TMAG Tasmania Museum & Art Gallery, Hobart, Tasmania, Australia (S. Grove)

UCDC Bohart Museum of Entomology, University of California, Davis, CA, USA (S. Heydon)

UCRC Entomology Research Museum, University of California, Riverside, Riverside, CA, USA (S. Triapitsyn & D. Yanega)

USNM United States National Museum of Natural History, Washington, DC, USA (M. Gates)

Photographs of specimens were taken using a Leica Z16 APO automontage microscope and Leica DFC 450C 5-megapixel camera system, using Leica Application Suite v4.4, to create stacked images. All photos are of emale specimens, unless otherwise noted. Measurements were taken using a micrometer on a Leica M205C microscope with a Leica PLANAPO 0.63X lens attached.

Examined specimen localities were mapped using the online tool Simplemappr (Shorthouse, 2010). All locality and host information were recorded in a Filemaker Pro 17 database maintained in the Heraty lab at UC Riverside. All specimens received a plastic barcode and unique identification number; molecular

vouchers are assigned an additional DNA reference number (Dxxxx). For material examined, GPS coordinates in italics are estimates of the locality from specimen labels using Google Earth. Additionally, specimens loaned from **MZH** have localities with coordinates that use the Finnish Coordinate System Yhtenäiskoordinaatisto (YKJ), ex: 6771: 3391. Data within brackets indicate, in order: sex (a "?" indicates that sex determination was not possible), deposition location: specimen identification number, and a UCR molecular voucher D# (if applicable). When a single identification number indicates multiple specimens, more than one wasp was mounted on one pin.

A taxonomic summary is provided in each genus description, which highlights any taxonomic changes within the genus and gives a list of all described species.

Molecular Methods

A total of 209 specimens were used in the combined analysis, of which 176 specimens were Cirrospilini. Twenty eulophid sequences were from Gauthier *et al.* (2000) or Burks *et al.* (2011) downloaded from GenBank to incorporate as many representatives of Cirrospilini as possible and to have all five subfamilies of Eulophidae represented. Additionally, 9 sequences of Trichogrammatidae, Tetracampidae and Aphelinidae from Heraty et al. (2013) were used as outgroups. Primary voucher specimens (non-destructively sequenced) were given unique specimen identification numbers, imaged, and deposited in the Entomology Research Museum of the University of California, Riverside (UCRC), or in the

appropriate institution from which it was borrowed. All sequenced specimens are listed in Table 1.

The genes used in this study include three ribosomal gene regions (18S, 28S D2 & D3–5), an internal transcribed spacer (ITS2), and the mitochondrial cytochrome oxidase I (COI). All modified primers and references are listed in Table 2. Extraction, sequencing, amplification, and chromatogram verification methods follow those of Perry and Heraty (2019). Sequence alignment was completed using the MAFFT v7.3 online server (Katoh, 2013) with the G-INS-I alignment algorithm for 18S, 28S, and COI data, while the E-INS-i algorithm was used for ITS2, as it proves more accurate with alignments containing several gaps (Notredame, 2007; Morrison, 2009; Munro *et al.*, 2011; Klopfstein *et al.*, 2013). All settings were kept at default for the E-INS-I method, while the G-INS-I settings were modified with the "leave gappy region" alignment method, with the unalignlevel set to 0.4. After translation of COI sequences to amino acids, no stop codons were identified, and all sequences were considered as valid. Gene regions were concatenated using SEQUENCEMATRIX v1.7.8 (Vaidya *et al.*, 2011).

Maximum likelihood (ML) analyses were performed using RAXML v8.2.12 (Stamatakis, 2014) online via the CIPRES portal (Miller *et al.*, 2010), with a concatenated dataset of all 5 gene regions. Each gene region was treated as a separate partition, with COI partitioned as codon positions 1 and 2, and codon position 3. The non-eulophid families were set as the root. Molecular data were analyzed using a GTRCAT substitution model. In the combined molecular and

morphological analysis, the morphological data and five gene regions were treated as separate partitions, with the morphological data analyzed using the Mk substitution model (Lewis, 2001); all parameters as in Perry & Heraty (2019). The resulting phylogenetic trees were visualized using FIGTREE v1.4.3 (Rambaut, 2014).

Additional analyses were performed on 28S, COI, and ITS2 in an effort to determine which gene regions are more accurate for lower-level or higher-level phylogenetic studies of eulophids; 28S D2 and D3–5 were treated as one gene region (18S was not analyzed separately since only a small number of sequences were available). As no outgroup families were available for the COI and ITS2 analyses, Opheliminae, Entedoninae and Entiinae were set as the root for the COI analysis, and a non-cirrospiline eulophid set as the root for the ITS2 analysis.

Morphological Methods

A total of 194 eulophids used in the molecular analyses were scored for 49 morphological and color characters (Table 3.3). Several voucher specimens from Gauthier *et al.* (2001) and Burks *et al.* (2011) were either unavailable to examine or destroyed during their extraction process. *Dichatomus acerinus* Förster was scored using material identified by Bouček. Seven antennal characters were either male or female specific; if both male and female are known for a species, all antennal characters were scored appropriately, regardless of the sex of the voucher specimen. Several species were only represented by one specimen and therefore, sex, and scoring the antennal characters in this manner allows more

characters to be incorporated into the analysis. All characters are informative and unordered. The resulting matrix was combined with the sequencing data for the combined molecular and morphological analysis. Morphological characters were mapped on the combined tree using MESQUITE (Maddison & Maddison, 2018) for visual analysis and interpretation, and in MACCLADE v 4.08 (Maddison & Maddison, 2005) to trace unambiguous character state changes and help identify generic synapomorphies.

Morphological terminology and abbreviations follow Gibson *et al.* (1997), except for upper ocular sulcus (**uos**) from (Heraty *et al.*, 2013), prodiscriminal groove (**pdg**), lateral basal groove (**lbg**), basal fold (**bsf**), cubital fold **(cbf**), small, scattered setae on vertex (**ssv**), and carina (**car**).

Morphological Characters and States

Characters established and reviewed in Perry and Heraty (2019) are denoted by an asterix - with any changes to state assignments indicated. Characters important for outgroup relationships to Cirrospilini are followed by “(Outgroup)” after the character description.

Morphological Characters

1. Malar sulcus (ms): 0 = absent (Fig. 3.31A), **1** = present (Fig. 3.1B). Citations: modified from Graham (1987, char. 5), Schauff (1991, char. 10), Ubaidillah *et al.* (2003, char. 4).

2. **Anterior tentorial pits (atp): 0** = indistinct, not visible with with dissecting microscope (Fig. 3.1A–C), **1** = distinct and enlarged (Fig. 3.1D). Citation: modified from Ubaidillah *et al.* (2003, char. 12).
3. **Ventral margin of clypeus (cly): 0** = normal, linear (Fig. 3.1A), **1** = projecting ventrally, **2** = bilobed (Fig. 3.1D), **3** = concave ventrally (Fig. 3.1C). Citations: modified from Schauff (1991, char. 8), Ubaidillah *et al.* (2003, char. 2), Heraty *et al.* (2013, char. 27).
4. **Upper ocular sulcus (uos): 0** = absent (Fig. 3.1C), **1** = present (Fig. 3.1A, B), **2** = present but very faint. Citations: modified from Ubaidillah *et al.* (2003, char. 8), Heraty *et al.* (2013, char. 29). Ubaidillah *et al.* (2003) refer to this character as the transverse groove on frons.
5. **Frontal suture (fs): 0** = absent, **1** = present (Fig. 3.1A), **2** = present but very faint. Citation: modified from Ubaidillah *et al.* (2003, char. 5).
6. **Vertex* (vtx) height: 0** = normal, not vaulted (Fig. 3.1C), **1** = vaulted (Figs 3.2I, 3.50A–C).
7. **Paired large setae (set) on vertex*: 0** = absent (Fig. 3.2I), **1** = present (Fig. 3.2C). These setae have distinct, easily visible setal sockets, which makes separation from the small, scattered setae possible.
8. **Small, scattered setae (ssv) on vertex*: 0** = absent, **1** = present (Fig. 3.2I).
9. **Carina (car) posterior to vertex: 0** = absent, **1** = present (Fig. 3.2C). Citation: after Burks *et al.* (2011, char. 14). This is a short, medial transverse carina found in *Gallowayia.*

10. **Occipital carina (occ): 0** = absent, **1** = present (Fig. 3.1I). Citations: modified from Ubaidillah *et al*. (2003, char. 6), Heraty *et al.* (2013, char. 40).
11. **Dorsal margin of torulus (tor): 0** = at or below ventral margin of compound eye, but closer to ventral margin of eye than to clypeus (Fig. 3.31A), **1** = above ventral margin of compound eye (Fig. 3.1A, C), **2** = below ventral margin of compound eye, but closer to clypeus than to ventral margin of eye (Fig. 3.5A). Citation: modified from Heraty *et al.* (2013, char. 34).
12. **Scape (scp) length in regard to vertex*: 0** = not extending to vertex (Fig. 3.2I), **1** = extending to vertex, **2** = extending past vertex (Fig. 3.2F).
13. **Male scape: 0** = elongate, not swollen (Fig. 3.2F), **1** = bulbous, swollen (Fig. 3.23B, C). Citations: modified from Graham (1987, char. 14), Ubaidillah *et al.* (2003, char. 23).
14. **Female funicular (fu) number: 0** = two (Fig. 3.1B), **1** = three, **2** = four, **3** = five, **4** = one. Citations: modified from Schauff (1991, char. 1), Ubaidillah *et al.* (2003, char. 17), Burks *et al.* (2011, char. 1), Heraty *et al.* (2013, char. 8). Outgroup variation; all female Cirrospilini have 2–3 funiculars.
15. **Male funicular number: 0** = two, **1** = three (Fig. 3.2F), **2** = four (Fig. 3.2E), **3** = five, **4** = one. Citations: modified from Graham (1987, char. 5), Ubaidillah et al. (2003, char. 18). Outgroup variation; all male Cirrospilini have 2–3 funiculars.
16. **Male funicular shape: 0** = normal, cylindrical, **1** = with dorsal projection (Fig. 3.2E), **2** = branched (Fig. 3.2E). Citations: modified from Ubaidillah *et al.*

(2003, char. 21), Burks *et al*. (2011, char. 3). Outgroup variation; Cirrospilini do not have branched antennae.

17. Female clavomeres (clv): 0 = two (Fig. 3.2F), **1** = three (Fig. 3.2I). Citations: modified from Ubaidillah et al. (2003, char. 19), Burks et al. (2011, char. 2), Heraty et al. (2013, char. 9).

18. Male clavomeres: 0 = two, **1** = three. Citation: modified from Ubaidillah *et al.* (2003, char. 20),

19. Propleura (pl): 0 = meeting posteriorly and covering prosternum (Fig. 3.1F), **1** = separated posteriorly at 45° angle, exposing prosternum (Fig. 3.1E, G). Citations: modified from Ubaidillah *et al.* (2003, char. 40), Burks *et al.* (2011, char 20), Heraty *et al.* (2013, char. 75). Outgroup variation; all Cirrospilini have the propleura separated posteriorly.

20. Prodiscriminal groove (pdg): 0 = absent (Fig. 3.1E, F), **1** = present (Fig. 3.1G). Citation: modified from Heraty *et al.* (2013, char. 74). Outgroup variation; all Cirrospilini have the prodiscriminal groove present.

21. Mesoscutum sculpturing (msc): 0 = smooth (Fig. 3.1H), **1** = with thin sculpturing (Fig. 3.1J, K), **2** = with pronounced and distinct sculpturing (areolate) (Fig. 3.1I), **3** = with deep-reticulate sculpturing (Figs 3.10D, 3.16G. Modified from Perry and Heraty (2019, char. 9); from 2 states to 6 to accommodate the additional variation found across the tribe.

22. Condition of notaulus (not): 0 = absent (Fig. 3.1H), **1** = incomplete, curved and not reaching axilla or transscutal articulation (Fig. 3.1I), **2** = incomplete,

straight and not reaching axilla or transscutal articulation (Fig. 3.1J), **3** = complete, extending to anterior half of axilla (Fig. 3.1K), **4** = complete, extending to axilla but strongly curved medially (Fig. 3.2C), **5** = complete to posterior half of axilla (Fig. 3.2A), **6** = complete, extending to transscutal articulation with distinct separation of notaulus and axilla (Figs 3.2D, 3.3J). Modified from Schauff (1991, char. 14), Ubaidillah *et al.* (2003, char. 30), Burks *et al.* (2011, char. 14), Heraty *et al.* (2013, char. 89), Perry and Heraty (2019, char. 11).

23. Axilla (axl) advancement: 0 = advanced less than 10% of longitudinal length anterior to posterior margin of mesoscutum (Fig. 3.2C), **1** = advanced more than 10% but less than 75% of longitudinal length anterior to posterior margin of mesoscutum (Fig. 3.2A), **2** = advanced with more than 75% of longitudinal length anterior to posterior margin of mesoscutum (Figs 3.1J, K, 3.2D). Citations: modified from Perry and Heraty (2019, char. 10).

24. Submedian grooves (smg) on mesoscutellum (sct)*: 0 = absent (Fig. 3.2A), **1** = present and straight or slightly curved posteriorly, not meeting medially (Figs 3.1J, 3.3I), **2** = present, curved posteriorly, and meeting medially (Figs 3.2C, 3.3B). Modified from Perry and Heraty (2019, char. 15) to include the variation in groove shape. Occasionally, the submedian grooves will curve and appear to meet along the posterior margin of the scutellum, however, state 2 refers to a meeting of the submedian grooves that is separated from the posterior margin.

25. Sublateral grooves (slg) on mesoscutellum: 0 = absent (Figs 3.1H–K, 3.2A–C), **1** = present (Fig. 3.3I). Citation: modified from Ubaidillah *et al.* (2003, char. 40). Outgroup variation; all Cirrospilini have sublateral grooves absent.

26. Large, paired bristle-like setae (set) on mesoscutellum (msc): 0 = one pair, **1** = two pairs (Fig. 3.2A), **2** = numerous, unpaired setae. Citations: modified from Graham (1987, char. 33), Burks *et al.* (2011, char. 17). Outgroup variation; one pair of setae is a defining character of Entedoninae, and numerous, unpaired setae are found in *Dasyomphale* LaSalle & Schauff.

27. Paired mesoscutellar setae length comparison*: 0 = not applicable, only one pair of setae or numerous, unpaired setae, **1** = shorter than posterior pair of setae, **2** = equal in length to posterior pair, **3** = longer than posterior pair of setae. Citation: modified from Perry and Heraty (2019, char. 16).

28. Dorsellum (dor) extension: 0 = normal, not extending posteriorly (Fig. 3.2F), **1** = extending posteriorly over propodeum (Fig. 3.2B). Citation: modified from Heraty *et al.* (2013, char. 120).

29. Dorsellum setation: 0 = asetose (Figs 3.1J, 3.2D), **1** = setose (Fig. 3.3J).

30. Medial constriction of propodeum (ppd): 0 = not constricted medially (Figs 3.1H, I, 3.2C, 3.3A, B, D, E, J), **1** = constricted medially (Figs 3.2A, D, 3.3C, G, I). This refers to a constriction at the midline of the propodeum; the propodeum is considered constricted if the midline is shorter longitudinally than the lateral margin longitudinal length.

31. Median carina (mc) on propodeum (ppd): 0 = absent (Fig. 3.3A, I), **1** = present and complete (Fig. 3.3B, E, H), **2** = present posteriorly only (Fig. 3.3C), **3** = present anteriorly only (Fig. 3.3C), **4** = present and expanded posteriorly (Fig. 3.3G). Citations: modified from Perry and Heraty (2019, char. 17).

32. Plica (plc) on propodeum: 0 = absent (Fig. 3.3A, C, G), **1** = complete raised carinae present (Fig. 3.3B), **2** = present as sculptured groove (Fig. 3.2C), **3** = raised carinae present posteriorly only (Fig. 3.3F). Citations: modified from Graham (1987, char. 38), Schauff (1991, char. 25), Ubaidillah *et al.* (2003, char. 37).

33. Costula (cos) on propodeum: 0 = absent (Fig. 3.3A, C, F, G), **1** = present (Fig. 3.3B).

34. Lateral basal groove (lbg) on propodeum: 0 = absent, **1** = present (Figs 3.1I, 3.2C). Citation: after Ubaidillah *et al.* (2003, char 38).

35. Gaster: 0 = sessile (3.1I, K), **1** = petiolate (Figs 3.1J, 3.2C, 3.3D, E). Citation: modified from Heraty *et al.* (2013, char. 204).

36. Longitudinal carina or carinae dorsally on petiole (pet): 0 = absent, **1** = present (Figs 3.1J, 3.2C, 3.3E). Citation: modified from Graham (1987, char. 58), Schauff (1991, char. 21).

37. First gastral tergite (Gt_1) collar: 0 = dorsally smooth (Fig. 3.1K), **1** = dorsally with median suture or sulcus anteromedially (Fig. 3.3H).

38. Metacoxa (cx_3) sculpturing: 0 = smooth or with thin, shallow sculpturing (Fig. 3.2I), **1** = with areolate sculpturing (Fig. 3.2G), **2** = with deep-reticulate sculpturing (Fig. 3.2H).

39. Fore wing coloration*: 0 = hyaline (Fig. 3.2K), **1** = with dark patterns or infuscation present (Fig. 3.2M, O). Fore wing color pattern variation is pooled as absent or present, as there are few genera in this study, other than *Zagrammosoma* and *Aulogymnus*, which have most species exhibiting any patterns or infuscation on the fore wings; there is no need to further treat the exact placement of coloration on the wings.

40. Basal fold (bsf): 0 = asetose (Fig. 3.2K, M), **1** = setose (Fig. 3.2O). Citation: modified from Ubaidillah *et al.* (2003, char. 46), Heraty *et al.* (2013, char. 143).

41. Cubital fold (cbf): 0 = basally asetose (Fig. 3.2K, M), **1** = basally setose and straight or only slightly curved to meet basal fold (Fig. 3.2O), **2** = basally setose and curved sharply to meet basal fold (Fig. 3.16C, D). Citation: modified from Ubaidillah *et al.* (2003, chars 47&48), Heraty *et al.* (2013, char. 144).

42. Parastigma (pst): 0 = smoothly connecting with submarginal vein (**smv**) and not extending into basal fold (Fig. 3.2J), **1** = smoothly connecting with submarginal vein but extending slightly into basal fold (Fig. 3.2L), **2** = not smoothly connecting with submarginal vein, and extending distinctly into basal fold (Fig. 3.2N). Citations: modified from Ubaidillah *et al.* (2003, char. 43), Heraty *et al.* (2013, char. 146).

This character has traditionally been reported as being either a smooth or disjointed connection between the submarginal vein and parastigma (Graham, 1959; Graham, 1987; Bouček, 1988; Schauff, 1991; Ubaidillah *et a*l., 2003); however, a better way to characterize this connection is by the extension of the parastigma color into the basal fold. This character has been used to differentiate Eulophinae from other subfamilies, in particular Tetrastichinae, which have the parastigma distinctly extending into the basal fold, however, this character is also found in *Aulogymnus.*

43. Uncus (unc)*: 0 = originating on stigma by its own length or less from stigmal apex (Fig. 3.2K), **1** = originating on stigma by more than its own length but less than 2X length from stigmal apex, **2** = originating on stigma by 2x or more than its own length from stigmal apex (Fig. 3.2O). Citations: modified from Ubaidillah *et al.* (2003, char. 49); Heraty et al. (2013, char. 163).

44. Speculum (spc): 0 = present with few or no setae within (Fig. 3.2K, M, O), **1** = absent; fore wing setose posterior to parastigma (Fig. 3.21C, E).

45. Admarginal setae (ams)*: 0 = absent, **1** = present (Fig. 3.2K, M, O). Citations: modified from Ubaidillah *et al.* (2003, char. 45); Heraty *et al.* (2013, char. 157).

46. Postmarginal vein (pmv) length: 0 = less than 0.5X length of stigmal vein (**stv**) (Fig. 3.12B), **1** = between 0.5Xand 1.0X length of stigmal vein (Fig. 3.1K), **2** = between 1.0 and 1.5X length of stigmal vein (Figs 3.2D, 3.3O), **3** = more than 1.5X length of stigmal vein (Fig. 3.23G). Citations: modified from

Graham (1987, char. 56), Burks *et al.* (2011, char. 29), Heraty *et al.* (2013, char. 164).

47. Metallic color on mesosoma*: 0 = absent (Fig. 3.3I), **1** = present (Figs 3.1H–J, 3.2A, B, F, 3.3A–C, F, H, J.)

Metallic coloration is defined in this study as metallic blue, green, or copper/brown, present anywhere on the mesosoma.

48. Yellow color on mesosoma: 0 = absent, **1** = present (Figs 3.2A, D, I, 3.3D, E, G, I).

Absence or presence of yellow coloration refers to coloration on the mesosoma – this must be yellow coloration of the cuticle and not light yellow/brown color between sclerites. Legs are not included in this definition, as yellow is present on legs of all examined eulophid specimens.

Results

Higher-level Relationships

All outgroup families are recovered as monophyletic, and these relationships remain stable in both the molecular-only and combined analyses (Figs 3.4, S3.1 & S3.2). All subfamilies of Eulophidae are supported as monophyletic, with Tetrastichinae emerging sister to Eulophinae. There is also support for Eulophinae to be divided into three tribes in the analyses (bootstrap = 96 in both combined and molecular-only analyses): Cirrospilini is recovered as monophyletic, sister to a monophyletic Eulophini + *Melittobiopsis* Timberlake.

Cirrospilini

Specimens previously regarded as *Cirrospilus* emerge in what we recognize as 5 different genera: *Atoposoma* Masi **stat. rev**., *Cirrospilus* **s.s.**, *Gyrolasella* Girault **stat. rev.,** *Pseudozagramma* Perry **n. gen.,** and *Vagus* Perry **n. gen,** which are all morphologically definable (Fig. 3.5)**.** While most cirrospiline genera are recovered monophyletic in the molecular-only and combined analyses, there were several differences between the analyses, which are detailed below.

Combined analysis - Fig. 3.4B

The combined analysis is the most resolved and is the foundation for determining generic limits within Cirrospilini. *Gyrolasella* is recovered as a single, monophyletic clade. *Cirrospilus* and *Atoposoma* are recovered as separate groups, sister to one another. *Pseudozagramma* emerges distinct from *Gyrolasella*, and sister to *Zagrammosoma* + *Atoposoma* + *Cirrospilus*. *Oxycantha* emerges within Cirrospilini, recovered sister to *Trichospilus; Colpoclypeus* is recovered sister to this group*. Meruacesa* continues to render *Diglyphus* paraphyletic, and *Dichatomus* does the same to *Aulogymnus;* relationships within these groups are highlighted in Fig. 3.6.

Molecular-only analysis - Fig. 3.4A

Gyrolasella emerges polyphyletic in 3 groups, one of which includes *Pseudozagramma*. *Atoposoma* and *Cirrospilus* emerge together as a paraphyletic group, as do *Diglyphus* + *Meruacesa*, and *Aulogymnus* + *Dichatomus*. All other cirrospiline genera are recovered as monophyletic. *Colpoclypeus* and *Trichospilus* are recovered in Cirrospilini, as sister taxa.

Individual Molecular Analyses

Note: not all specimens used in this study were able to have all 5 gene regions sequenced, therefore, the individual analyses are not as complete as the combined analyses. 28S D2 + D3–5 (Fig. S3.3): All outgroup families and eulophid subfamilies emerge as monophyletic. *Trichospilus* is recovered as sister to Melittobiopsini + Eulophini; this is the only analysis where *Trichospilus* is not recovered within Cirrospilini. *Atoposoma* emerges within *Cirrospilus*, and *Pseuzagrammosoma* within a paraphyletic *Gyrolasella*. *Diglyphus* is recovered as paraphyletic, sister to *Vagus* + *Diaulinopsis*; *Meruacesa* is recovered sister to this clade. *Dichatomus* emerges within *Aulogymnus.* COI (Fig. S3.4): The COI analysis is the most unresolved of the analyses. *Burkseus* is the only genus recovered as monophyletic. Tetrastichinae and Eulophinae emerge together, while the remaining eulophid subfamilies are each monophyletic. ITS2 (Fig. S3.5): This analysis was the most focused on Cirrospilini, with all but one cirrospiline specimen used. While only 7 cirrospiline genera were incorporated into the analysis, all genera, except for *Cirrospilus,* emerge as monophyletic.

Morphology

To map character support across Cirrospilini (Fig. 3.5), we used the combined tree (Fig. 3.4B), but with species within a genus collapsed, and any variable characters within a genus treated as variable. Four genera (*Aulogymnus, Dichatomus, Diglyphus, Meruacesa*) treated as monophyletic to better characterize their morphological differences.

Melittobiopsini is supported by two unique character state changes: torulus placed close to the clypeal margin (char. 11, state 2) and presence of setae on the dorsellum (char. 29, state 1) (Fig. 3.5). This support, coupled with the molecular-only and combined analyses provides evidence for the separation of *Melittobiopsis* from Cirrospilni and Eulophini, therefore *Melittobiopsis* is hereby removed from Cirrospilini and elevated to the tribe Melittobiopsini Perry **n. tribe** (see Taxonomy for description).

Cirrospilini was not supported by any unique character states; one state change supported Cirrospilini (char. 32: 0→1), however this is homoplastic outside of and within the tribe (Fig. 3.5). The propleura is separated posteriorly (char. 19, state 1), a state found in all cirrospilines, but also in most eulophids (Fig. 3.7); certain genera of Eulophini have the propleura meeting posteriorly and covering the prosternum (char. 19, state 0). One purported and monospecific genus of Cirrospilini, *Cirrospiloidelleus* Girault, was unable to be sequenced or examined thoroughly due to it represented by a single specimen in subpar condition. The

holotype of *Cirrospiloidelleus bicolor* Girault, possesses propleura that meet posteriorly, covering the prosternum (C. J. Burwell & R. A. Burks, pers. comm.), a state not found in any member of Cirrospilini. This genus is therefore removed from Cirrospilini and placed in Eulophini. Several character state transformations offer clear support for separation of *Cirrospilus* into the 5 genera proposed (Fig. 3.5) and are discussed in the diagnostic treatments below.

Host Relationships

Table 4 provides a summary of host families for each cirrospiline genus. See each genus description for host species and host plants, if known.

Cirrospilini emerge from coleopteran, dipteran, hymenopteran, and lepidopteran leaf miners and rollers, with the majority of hosts in Diptera and Lepidoptera. Less common hosts include butterflies (*Trichospilus*), unconcealed caterpillars (*Colpoclypeus*, *Trichospilus*), borers (*Colpoclypeus*), and sawfly eggs (*Burkseus*). Two genera specialize on gall-forming Cynipidae (Hymenoptera) (*Aulogymnus, Dichatomus*). There are suspect host records from Orthoptera (*Trichospilus*) and Hemiptera (*Atoposoma, Colpoclypeus, Zagrammosoma*), which require more evidence before being determined to be accurate. It is highly probable that the plant material on which these specimens were collected contained unseen leaf miners or rollers.

Taxonomy

Melittobiopsini Perry n. tribe - Fig. 3.8

Type genus: *Melittobiopsis* Timberlake, 1925: 317.

Type species: *Melittobiopsis ereunetiphila* Timberlake; holotype ♀, by monotypy.

Locality: USA, Hawaii, Honolulu. Depository: BPBM.

Diagnosis: Melittobiopsini is distinguished from the other tribes by a combination of 3 characters: a torulus located close to the clypeal margin (char. 11 state 2, Fig. 3.5a), propleura separated posteriorly and the prodiscriminal groove absent (Fig. 3.1E), and setae present on the axilla and dorsellum (char. 29 state 1, Fig. 5C–E). No other eulophine genera examined possess this combination of characters. The few genera of Eulophini that possess the propleura separation as found in Melittobiopsini do not have setae on the axilla or dorsellum. The tribe is similar to Cirrospilini, sharing 2 funiculars and 3 clavomeres, but the prodiscriminal groove is present in Cirrospilini (Fig. 3.1G).

Description: ***Melittobiopsis ereunetiphila:***

Female: head and body metallic green or copper. Fore wing without infuscation or dark patterns. Legs yellow, with or without dark spots, patches, or banding. Head: malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus absent. Frontal suture present. Vertex normal, not vaulted; large, paired

setae and small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: torulus with dorsal margin below ventral margin of compound eye, and closer to clypeus than to ventral margin of eye. Scape not extending to vertex. 2 funiculars. 3 clavomeres; funiculars cylindrical and symmetrical.

Body: propleura separated posteriorly, exposing prosternum. Prodiscriminal groove absent. Mesoscutum with thin sculpturing. Notaulus complete, extending to transscutual articulation. Axilla advanced anteriorly more than 75% of longitudinal length past anterior margin of transscutal articulation; setose. Mesoscutellum with submedian and sublateral grooves absent; two pairs of setae - anterior pair of setae longer than posterior pair of setae. Dorsellum not extending posteriorly over propodeum.; setose. Propodeum normal, not constricted medially; median carina, plicae, and costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: hyaline. Basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum absent; fore wing is setose posterior to parastigma. Admarginal setae absent. Postmarginal vein less than 0.5X length of stigmal vein.

Male as female.

Remarks: Bouček (1988) mentions that his couplet 49 might also key to *Melittobiopsis,* presumably because this key was primarily for the Australasian region, and *Melittobiopsis* at this time, was only known from Southeast Asia and Hawaii; Bouček does mention that a specimen from Papua New Guinea may belong to *Melittobiopsis,* and 2 examined *Melittobiopsis* specimens are found in Papua New Guinea (see material examined). *Melittobiopsis* was included in Cirrospilini (Gauthier *et al*., 2000), likely on the morphological character combination of the propleura separated posteriorly and 2 funiculars; it is not stated explicitly in the text as to why *Melittobiopsis* is included in the tribe. Ubaidillah *et al.* (2003) consistently recovers *Melittobiopsis* within Cirrospilini, but these analyses are based on morphological characters only. Utilizing molecular data for the first time, Melittobiopsini is never recovered within or sister to Cirrospilini in the combined or molecular-only (ribosomal and COI) analyses (Figs 3.4, S3.1–3.3). Paired with the unique morphological character states, there is clear evidence for creation of this monospecific tribe, distinct from Eulophini and Cirrospilini. See Timberlake (1925) for a detailed description of the genus and species.

Hosts: COLEOPTERA: Dryophthoridae: *Rhabdocnemis obscura* (Boisduval) (Swezey, 1939) on *Saccharum* (Poales: Poaceae). **LEPIDOPTERA: Tineidae:** *Erechthias flavistriata* (Walsingham) on *Saccharum* and *Cocos nucifera* (Arecales: Arecaceae); *Pyloetis mimosa* (Stainton). **UNKNOWN:** on *Persea americana*

(Laurales: Lauraceae); on *Senna bicapsularis* (Fabales: Fabaceae) (Swezey, 1939).

Distribution (Fig. 3.9): **Australasian:** Papua New Guinea. **Indomalaya:** Australia (Christmas Island), Indonesia, Malaysia, Taiwan. **Oceania:** USA (Guam, Hawaii, Saipan – records for Guam and Saipan from Yoshimoto & Ishii (1965)).

Taxonomic Summary:

1. *Melittobiopsis ereunetiphila* Timberlake

Material examined: *Melittobiopsis ereunetiphila*

Paratypes: USA: Hawaii: Honolulu, *21°18'25"N*, *157°51'30"W*, 3–9.i.1924, O. H. Swezey, host: *Erechthias flavistriata*, host plant: sugar cane [1♂ 4♀, UCRC: UCRCENT416906–7, 498542–3, USNM: UCRCENT471372]. **Additional material examined: AUSTRALIA: Christmas Island:** Central Area Wkshp., 243m, *10°28'40"S*, *105°37'49"E*, 14–23.iv.1989, J. C. Cardale, Malaise Trap [1♂, ANIC: UCRCENT238662]. Grant's Well vic., 243m, *10°28'46"S*, *105°39'13"E*, 13–28.iv.1989, J.F. Lawrence, Berlesate leaf & log litter [1♂, ANIC: UCRCENT238663]. Hughs (No. 2) Dale, 56m, 10°28'41"S, 105°33'32"E, 12–25.iv.1989, J.F. Lawrence, Berlesate leaf & log litter [1♀, ANIC: UCRCENT238661]. **INDONESIA: Java:** Bogor (Buitenzorg), 230m, *6°35'0"S*, *106°47'0"E*, 23.vii.1936, Tjien Mo Tjoa, host: *Pylaetis mimosae* (Leipdoptera:

Tineidae) [1♀, BMNH: NHMUK10371731]. **MALAYSIA: Perak:** Teluk Intan (Telok Anson), *4°01'2"N*, *101°01'47"E*, 6.i.1981, Azhar, Mardi M4367 [2♀, BMNH: NHMUK10371730, 10371732]. **PAPUA NEW GUINEA:** Bulolo, Mt. Susu, 966m, *7°13'31"S*, *146°37'2"E*, 12.xii.1982, Z. Bouček [1♀, BMNH: NHMUK10371729]. **East New Britain:** Bainings Mountains, DPI base Camp, 4°26'22"S, 151°49'1"E, 30.vi–15.vii.1999, A. Mararuai & M. Kalamen [1♀, CNC: CNC509083 (**D4675**)]. **TAIWAN: Tainan: Danei**, Danei, 32m, 23°08'38"N, 120°24'24"E, 10–12.i.2017, R. Stouthamer & A. Eskalen, avocado, host plant: avocado [2♀, UCRC: UCRCENT485695 (**D5314**), 485696 (**D5315**)]. **USA: Hawaii:** Honolulu, *21°18'25"N*, *157°51'30"W*, 3–9.i.1924, O. H. Swezey, host: *Erechthias flavistriata*, host plant: sugar cane [3♂ 14♀ 3?, UCRC: UCRCENT498544–563]. **Kauai**, Opaeka'a Falls Lookout, *22°02'52"N*, *159°21'43"W*, 15.x.1983, D.M. LaSalle [1♀, ANIC: UCRCENT238574].

Cirrospilini LaSalle

Type genus: *Cirrospilus* Westwood, 1832: 128.

Type species: *Cirrospilus elegantissimus* Westwood [examined]; holotype ♀, by monotypy. Locality: England. Depository: HDOU, Type Hym. 610.

Diagnosis: No single morphological character defines Cirrospilini, therefore, a combination of characters is necessary to delimit the tribe: propleura separated posteriorly exposing the prosternum (Fig. 3.1E), prodiscriminal groove present

(Fig. 3.1G), and antenna with either 2 funiculars and 3 clavomeres, or 3 funiculars and 2 clavomeres. Most similar to Melittobiopsini, but Melittobiopsini possess setae on the axillae and dorsellum (Fig. 3.8C, D) and the torulus is closer to the clypeal margin than the ventral margin of the compound eye (Fig. 3.8A). Similar to Eulophini, however the propleura is separated posteriorly, exposing the prosternum (Fig. 3.1G), unlike the majority of genera in Eulophini, which possess propleura that meet posteriorly, covering the prosternum (Fig. 3.8F). Genera of Eulophini that do have the propleura separated have 3 funiculars and 3 clavomeres, whereas most genera of Cirrospilini have 2 funiculars, and any cirrospiline possessing 3 funiculars will only have 2 clavomeres. Similar to Tetrastichinae, however, sublateral grooves on the mesoscutellum are absent in Cirrospilini, whereas they are present in most Tetrastichinae (Fig. 3.3I), and the parastigma extension into the basal fold is usually greater in Tetrastichinae (char. 43, state 2).

Description: Color: head and body color highly variable: metallic or non-metallic, with or without stripes or patterns. Fore wing with or without infuscation or dark patterns. Legs yellow, with or without dark spots, patches, or banding.

Head: malar sulcus present (Fig. 3.1B), rarely absent (Fig. 3.31A); upper ocular sulcus and frontal suture present (Fig. 3.1A), sometimes absent (Fig. 3.1C); occipital carina absent, rarely present (Fig. 3.1I).

Antenna: 2 funiculars and 3 clavomeres, or rarely, 3 funiculars and 2 clavomeres; funiculars cylindrical and symmetrical, rarely asymmetrical.

Body: propleura separated posteriorly, exposing prosternum; prodiscriminal groove present; notaulus incomplete and curved (Fig. 3.1I) or straight (Fig. 3.1J), complete to axilla (Figs 3.1K, 3.2C), or complete to transscutal articulation (Figs 3.2D, 3.3J); two pairs, or very rarely, multiple pairs, of setae on mesoscutellum present; submedian grooves on mesoscutellum absent (Fig. 3.2A), or present and not meeting posteromedially (Figs 3.1J, 3.3I) or meeting posteromedially (Figs 3.2C, 3.3B).

Male: as female except: funiculars rarely with dorsal projection (Fig. 3.2E).

Distribution: Worldwide, all continents except Antarctica.

Key to tribes of Eulophinae and genera of Cirrospilini

1. Propleura meeting posteriorly, covering prosternum (Fig. 3.1F) .... Eulophini Ashmead, most
– Propleura separated posteriorly, exposing prosternum (Fig. 3.1E, G) 2
2. Dorsal margin of torulus below ventral margin of compound eye and close to clypeal margin (Fig. 3.5A); prodiscriminal groove absent (Fig. 3.1E); axilla and dorsellum setose (Fig. 3.5C, D) ..... Melittobiopsini Perry **n. tribe**

– Dorsal margin of torulus above ventral margin of compound eye, or if below, closer to compound eye than to clypeal margin (Fig. 3.1A, C); prodiscriminal groove present (Fig. 3.1G); axilla and dorsellum asetose (Fig. 3.1J) 3

3. 3 or 4 funiculars **and** 3 clavomeres; male funiculars branched dorsally (Fig. 3.2E)..... some Eulophini (*Dicladocerus* Westwood*, Elasmus* Westwood)

– 2 funiculars, or if 3 funiculars, then **only** 2 clavomeres; male funiculars always cylindrical and normal (Fig. 3.1B), or with small projection dorsally (Fig. 3.2F) ..... Cirrospilini LaSalle, 4

4. Posterolateral spines on pronotum present (Fig. 3.40B, C)*.....*

.....Oxycantha Surekha and Ubaidillah

– Posterolateral spines on pronotum absent (Figs 3.1H–K, 3.2A, C, D) 5

5. Notaulus complete and extending to axilla (Figs 3.1K, 3.2A, C) or transscutal articulation (Figs 3.2D, 3.3J) 6

– Notaulus absent (Fig. 3.1H) or incomplete and not extending to axilla or transscutal articulation (Fig. 3.1H, J) 20

6. Notaulus extending to anterior margin of axilla (Figs 3.1K, 3.42C, D) 7

– Notaulus extending to posterior margin of axilla (Figs 3.2A, C, 3.12E, 3.18E) or to transscutal articulation (Figs 3.1K, 3.2D, 3.3J) 11

7. Vertex vaulted (Fig. 3.50A–C); propodeum constricted medially (Figs 3.3G, 3.50H); frontal suture faint, indistinct; mesosoma yellow with dark longitudinal stripes or less commonly, black or metallic black with yellow stripes or coloration (Fig. 3.50) ..... *Zagrammosoma* Ashmead

– Vertex not vaulted (Fig. 3.1C); propodeum not constricted medially (Figs 3.1H, I, 3.3D, E); frontal suture distinct (Fig. 3.1B); mesosoma metallic green or blue, or drab brown, not as above 8

8. Propodeum without median carina (Figs 3.2A, 3.3A, J) 9

– Propodeum with median carina (Fig. 3.3B, C, G, H) 10

9. Mesoscutum with thin sculpturing (Fig. 3.27D, E); notaulus thin, shallow, and indistinct ..... some *Diglyphus* Walker

– Mesoscutum with deep-reticulate sculpturing (Fig. 3.48D–F); notaulus deep and distinct (Fig. 3.48D) ..... *Vagus* Perry **n. gen.**

10. Mesosoma metallic green; mesoscutellum with submedian grooves absent (Fig. 3.21C) ..... *Colpoclypeus* Lucchese

– Mesosoma light or dark brown; mesoscutellum with submedian grooves present (Figs 3.1K, 3.42C) ..... *Pseudiglyphus* Girault

11. Notaulus strongly extending medially, almost converging with opposite notaulus, with sharp turn towards axillae (Figs 3.2C, 3.29D, E); propodeum with lateral basal grooves present (Figs 3.2C, 3.29D, E); occipital carina absent; ♂ funiculars with dorsal projection (Figs 3.2F, 3.29G) ..... *Gallowayia* Bouček

– Notaulus not strongly extending medially (Fig. 3.2A, D); propodeum with lateral basal grooves absent, or if present, then occipital carina present (Fig. 3.1I); male funiculars cylindrical, normal (Fig. 3.1B) 12

12. Propodeum with median carina (Fig. 3.3B, C, G, H)..... 13

– Propodeum without median carina (Figs 3.2A, 3.3A, J) or present only anteriorly (Fig. 3.3C) 16

13. Mesoscutellum with submedian grooves present (Fig. 3.18E, F) .... *Cirrospilus* Westwood

– Mesoscutellum with submedian grooves absent (Figs 3.2A, 3.3A, J) 14

14. Vertex vaulted (Fig. 3.44A, B); notaulus extending to transscutal articulation (Figs 3.2D, 3.44C)..... *Pseudozagramma* Perry **n. gen.**

– Vertex not vaulted, normal (Fig. 3.1C); notaulus extending to posterior margin of axilla (Fig. 3.2A)..... 15

15. Dorsal margin of torulus below ventral margin of compound eye (Fig. 3.46A); 2 funiculars; gaster petiolate (Fig. 3.46D); body non-metallic .... *Trichospilus* Ferrière

– Dorsal margin of torulus above ventral margin of compound eye (Fig. 3.25A); 3 funiculars; gaster sessile (Fig. 3.25C); body metallic ..... *Dichatomus* Förster

16. Propodeum constricted (Figs 3.2A, D, 3.3G, I) 17

– Propodeum not constricted (Figs 3.1H, I, 3.3D, E) 19

17. Clypeus bilobed (Fig. 3.1D); submedian grooves on mesoscutellum absent (Fig. 3.14F, G, H) ..... *Aulogymnus* Förster

– Clypeus linear, normal (Fig. 3.1A); submedian grooves on mesoscutellum present (Figs 3.1I, J, 3.2C) 18

18. Axilla advanced anteriorly more than 75% of longitudinal length beyond anterior margin of transscutal articulation (Fig. 3.12E); admarginal setae absent

(Fig. 3.12B); postmarginal vein less than 0.5x length of stigmal vein (Fig. 3.12B); metallic coloration on body absent, rarely present (Fig. 3.12E, F) .... *Atoposoma* Masi **stat. rev.**

– Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length beyond anterior margin of transscutal articulation (Fig. 3.2A); admarginal setae present (Fig. 3.33G); postmarginal 0.5–1.5X length of stigmal vein; metallic coloration on body present ..... *Gyrolasella* Girault **stat. rev.**

19. Frontal suture distinct (Fig. 3.23D); anterior pair of setae on mesoscutellum shorter than posterior pair; cubital fold basally setose and straight or only slightly curved to meet basal fold (Fig. 3.23G) ..... *Diaulinopsis* Crawford

– Frontal suture indistinct, shallow; anterior pair of setae on mesoscutellum equal in length to posterior pair; cubital fold basally setose and curved sharply to meet basal fold (Fig. 3.16C, D) ..... *Burkseus* Perry

20. Propodeum without median carina (Figs 3.3A, 3.27E) ..... *Diglyphus* Walker

– Propodeum with median carina (Figs 3.2A, 3.3A, J) 21

21. Mesosoma without metallic coloration 22

– Mesosoma with metallic coloration 23

22. Malar sulcus absent (Fig. 3.31A); clypeus with dorsal projection (Fig. 3.31A); torulus with dorsal margin below ventral margin of compound eye (Fig. 3.31A); axilla advanced less than 10% of longitudinal length (Fig. 3.31C, D) .... *Gattonia* Bouček

– Malar sulcus present (Fig. 3.10A); clypeus linear; torulus with dorsal margin above ventral margin of compound eye (Fig. 3.10A); axilla advanced more than 75% of longitudinal length (Fig. 3.10B) ..... *Ascotolinx* Girault

23. Two funiculars; vertex with large, paired setae absent; occipital carina absent; mesoscutum with thin sculpturing (Figs 3.1J, 3.36C, D); propodeum without lateral basal grooves ..... *Meruacesa* Koçak and Kemal

– Three funiculars; vertex with large, paired setae present; occipital carina present (Figs 3.1I, 3.38B, D, E); mesoscutum with strong sculpturing (areolate) (Figs 3.1I); propodeum with lateral basal grooves (Figs 3.1I, 3.38B, D) .... *Naumanniola* Bouček

Descriptions of Genera

1. *Ascotolinx* Girault – Fig. 3.10

Ascotolinx Girault, 1913a: 106. Type species: *Ascotolinx funeralis* Girault [examined]; holotype ♀, by original designation and monotypy. Locality: Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 1875.

Diagnosis: The genus is characterized by a mesoscutum with deep-reticulate sculpturing (Fig. 3.10D), incomplete and curved notauli (Fig. 3.10B, C), and propodeum with a complete median carina and complete plicae (Fig. 3.10). It is similar to *Diglyphus*, however, *Diglyphus* lacks both the median carina and plicae on the propodeum (Fig. 3.27E), and the mesoscutum has thin sculpturing (Fig. 3.27D). *Ascotolinx* is also similar to *Pseudiglyphus,* but *Pseudiglyphus* has complete notauli, extending to the anterior margin of the axilla (Fig. 3.42C, D).

Description: Female: Shiny black or dark brown, with metallic luster absent. Fore wing disc with faint infuscation present.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture absent. Vertex normal, not vaulted; large, paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with deep-reticulate sculpturing. Notaulus incomplete, curved, and not reaching axilla or transscutal articulation. Axilla advanced anteriorly more than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present, curved posteriorly, and meeting medially; with two pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum; asetose. Propodeum normal, not constricted medially and with smooth/thin-reticulate sculpturing; median carina and plicae present; costula and lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa with deep, distinct sculpturing (areolate).

Fore wing: Basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae within. Admarginal setae present. Postmarginal vein between 0.5Xand 1.0X length of stigmal vein.

Male - as female except: 3 funiculars and 2 clavomeres.

Hosts (from examined material): Lepidoptera: Gracillariide: *Phyllocnistis citrella* Stainton. **Unknown**: leaf miner on *Teijsmanniodendron* sp. (Lamiales: Lamiaceae)

Distribution (Fig. 3.11)**: Australasia:** Australia (NSW, QLD), Papua New Guinea.

Taxonomic Summary:

1. *Ascotolinx funeralis* Girault
2. *Ascotolinx reticoxa* Bouček

Material Examined:

Ascotolinx funeralis

Paratype: AUSTRALIA: Queensland: nr. Wilson's Peak, *28°14'13"S*, *152°28'53"E* [1♀, BMNH: NHMUK10371661].

Additional material examined: AUSTRALIA: Queensland: 8km NW Bald Hill, Mcilwraith Range, 500m, 13°27'0"S, 143°13'12"E, 27.vi–12.vii.1989, I. D. Naumann, mango tree site, light [1♀, ANIC: UCRCENT238630]. Cape Hillsborough Natl. Park, Andrews Point, 20°55'41"S, 149°03'13"E, 1.vi.1996, C. J. Burwell [1♀, QM: UCRCENT491608]. Cape Hillsborough Natl. Park, Hidden Valley Track, *20°55'50"S*, *149°02'55"E*, 16.iv.1979, E. Dahms [1♂ 1♀, QM: UCRCENT491607, 491612]. Koah, *16°52'26"S*, *145°33'11"E*, 6.v.1976, K. Halfpapp, host: *Phyllocnistis citrella* [1♂ 1♀, BMNH: NHMUK10371664, QM: UCRCENT491606]. Rifle Creek, base of Black Mountain, 16°40'0"S, 145°30'0"E,

2.xii.1997, C. J. Burwell, rainforest [1♀, QM: UCRCENT491609]. South Johnstone Research Station, 11m, *17°36'2"S*, *145°59'56"E*, 27.iii.1973, B. Franzmann, host: *Phyllocnistis citrella* [1♀, QM: UCRCENT491605]. Stokes Range Quarry, 40m, *19°43'40"S*, *147°19'24"E*, 8.ix.1950, E.F. Riek [2♂, ANIC: UCRCENT238631, BMNH: NHMUK10371666]. **PAPUA NEW GUINEA: Admiralty Island:** Baluan Island, *2°33'23"S*, *147°17'7"E*, 11.iv.1985, T. Mala, host: *Phyllocnistis citrella* [1♀, BMNH: NHMUK10371660]. **East Sepik Prov.:** Ambunti, *4°12'50"S*, *142°49'2"E*, 15.vi.1985, E. Brough, host: *Phyllocnistis citrella* [2♀, ANIC: UCRCENT238629]. Ambunti, 83m, *4°12'50"S*, *142°49'2"E*, 15.vi.1985, T. Mala, host: *Phyllocnistis* [1♀, BMNH: UCRCENT10371665]. **Madang Prov.:** Ohu Village Laboratory, 124m, *5°18'7"S*, *145°42'53"E*, 9.iii.2005, B. Isua, S. Sau, E. Brus, K. Molem, R. Lilip, host: caterpillar in mine, host plant: *Teijsmanniodendron* sp. [1♀, USNM: USNMENT PNG 648385]. Wanang village, 118m, 5°15'0"S, 145°17'0"E, 27.ix.2006, Manumbor, Sau, Isua, Mogia, Sosanika, Idigel, Keltim, Kua, Bito [1♀, USNM: USNMENT PNG 681384]. Wanang village, 118m, 5°15'0"S, 145°17'0"E, 31.x.2006, Auga, Molem, Tamtiai, Lilip, Ibalim, Posmen, Rimandai, Brus, Novotny, Hrcek, host: leaf miner [1♀, USNM: USNMENT PNG 681116]. **Sanduan:** Vanimo, *2°41'39"S*, *141°18'7"E*, 18.iv.1985, T. Mala, host: *Phyllocnistis citrella* [1♂, BMNH: NHMUK10371667]. **Southern Highlands:** Catholic Mission, Erave, 1099m, *6°36'18"S*, *143°53'33"E*, 1985, E. J. Brough, host: *Phyllocnistis citrella* [1♀, BMNH: NHMUK10371663]. Catholic Mission, Erave, 1099m, *6°36'18"S*, *143°53'33"E*, 20.vii.1983, E. J. Brough, host: *Phyllocnistis citrella* [2♀, USNM:

UCRCENT471683, 471684]. **West New Britain:** Kimbe Dami Research Station, 5m, 5°31'53"S, 150°20'6"E, 1985, E. J. Brough, [1♀, BMNH: NHMUK10371662].

***Ascotolinx reticoxa* Bouček**

Paratypes: AUSTRALIA: Queensland: Conway Range, near Prosperine, *20°21'24"S*, *148°44'57"E* [1♀, BMNH: NHMUK10371669]. Cooloola Natl. Park, 29m, *26°01'47"S*, *153°01'23"E*, 18.x.1978, I. D. Naumann [1♀, BMNH: NHMUK10371668]. Kuranda, *16°49'17"S*, *145°38'3"E*, 29.iii.1991, J.D. Pinto, screen sweep [1♂, BMNH: NHMUK10371671]. Mt. Glorious, nr. Brisbane, *27°19'59"S*, *152°46'1"E*, 16.xii.1976, Z. Bouček [1♀, BMNH: NHMUK10371670].

Additional material examined: AUSTRALIA: New South Wales: Bungonia Gorge, *34°47'42"S*, *150°01'20"E*, 21.iii.1974, E.D. Edwards, host: Lepidoptera leafminer [1♀, ANIC: UCRCENT238628]. **Queensland:** 16km N. Boonah, 27°54'0"S, 152°41'0"E, 17.vi.1992, C. J. Burwell [1♂, UQIC: UCRCENT528595]. 20.6km N. Toowoomba, *27°24'30"S*, *151°59'45"E*, 14.vi.1990, J. Heraty [1♀, UCRC: UCRCENT124140]. 25km W. Ravenshoe, *17°38'56"S*, *145°16'54"E*, 5.v.1990, J. Heraty [1♀, UCRC: UCRCENT108047]. Blackbutt Range S.F., 12 km W of Moore, 370m, 25°52'28"S, 152°11'36"E, 22.i.1999, J. Heraty, Lantana/grass scrub, H99-033 [1♀, CNC: CNC509087]. Camp Milo, Cooloola State Forest, 91m, *26°01'28"S*, *153°04'42"E*, 5.ix.1979, G. Gordh & C. Dahms [1♂, CNC: CNC509085]. Cathu State Forest, Mt. Macartney, *20°49'21"S*, *148°32'11"E*, 21.iv.1979, E. Dahms, open forest [1♂, QM: UCRCENT491620]. Chelmer

(Chalamar on label), *27°31'0"S*, *152°58'33"E*, 5.ix.1979, G. Gordh & C. Dahms [1♀, CNC: CNC509086]. Cooloola Natl. Park, 29m, *26°01'47"S*, *153°01'23"E*, 7.iii.1984, L. Masner [1♂, CNC: CNC509127]. Cunninghams Gap via Aratula, 28°03'0"S, 152°23'0"E, 12.iv.1998, C. J. Burwell & C. Rodriguez [1♂, QM: UCRCENT491618]. Doomadgee, *17°56'12"S*, *138°49'46"E*, 18.iv.1983, J.F. Donaldson, D-vac [1♀, QM: UCRCENT491664]. Eungella Natl. Park, Broken River, 710m, *21°10'5"S*, *148°30'29"E*, 18.iv.1979, E. Dahms, rainforest edge [1♀, QM: UCRCENT491610]. Eungella Natl. Park, Mt. William, *21°01'29"S*, *148°35'51"E*, 18.iv.1979, E. Dahms, rainforest edge [1♂, QM: UCRCENT491611]. Goonburra Forest Park, Dalrymple Crk., 27°59'0"S, 152°20'0"E, 6.v.1998, C. J. Burwell [1♂, QM: UCRCENT491619]. Kingfisher Lodge, Julatten, 400m, 16°36'0"S, 145°20'0"E, 24.xi.1996, C. J. Burwell, sweep [1♀, QM: UCRCENT491662]. Kingfisher Park, 1km N. Julatten, 16°36'0"S, 145°20'0"E, 29.xi.1997, C. J. Burwell [1♀, QM: UCRCENT491617]. Mt. Abbott, rainforested gully, SE slopes, 650–700m, 20°06'0"S, 147°45'0"E, 10.iv.1997, C. J. Burwell [1♀, QM: UCRCENT491614]. Mt. Aberdeen, South Summit, 900m, *20°12'0"S*, *147°55'0"E*, 8.iv.1997, C. J. Burwell, rain forest [1♂, QM: UCRCENT491613]. Mt. Glorious, 650m, 27°21'0"S, 152°45'0"E, 11.iii.1998, C. J. Burwell, open forest [1♀, QM: UCRCENT491615]. Mt. Lewis Rd., 29km from hwy., 1210m, 16°31'0"S, 145°16'0"E, 23.xi.1998, C. J. Burwell, rain forest, sweep [1♀, QM: UCRCENT491665 (**D6719**)]. Mt. Rose Station via Taroom, 260m, 25°25'0"S, 149°58'0"E, 6.iii.1998, C. J. Burwell [1♀, QM: UCRCENT491616]. Mt. Superbus

summit, 1370m, 28°12'59"S, 152°27'59"E, 23–24.x.1998, C. J. Burwell, rainforest, sweep [2♀, QM: UCRCENT491663, 491666 (**D6720**)].

2. *Atoposoma* Masi stat. rev. - Fig. 3.12

Atoposoma Masi, 1907: 276. Type species: *Atoposoma variegatum* Masi; by monotypy. Locality: Italy, Umbria, Bevagna. Depository: MSNG.

Diagnosis: *Atoposoma* is characterized by a vaulted vertex (Fig. 3.12A, F), postmarginal vein that is less than 0.5X length of the stigmal vein (Fig. 3.12B), and by dark markings on the yellow head and body (Fig. 3.12). At first glance, it is similar to *Pseudozagramma* and *Zagrammosoma*, sharing a vaulted vertex (Figs 44A, B, 50A–C), and extensive dark markings on the yellow head and body. *Zagrammosoma* possess notauli that are complete but extend to the anterior margin of the axilla (Fig. 3.50J) and a propodeum with a median carina that expands posteriorly (Fig. 3.3G). *Pseudozagramma* have notauli that are complete but extend to the transscutal articulation (Fig. 3.44C) and a mesoscutellum with submedian grooves absent (Fig. 3.44C). *Atoposoma* is morphologically differentiated from *Cirrospilus* most easily by the vaulted vertex, more advanced axilla (Fig. 3.12E vs Fig. 3.18E, F), constricted propodeum (Fig. 3.12E), lack of admarginal setae of the fore wing (Fig. 3.12B), and postmarginal vein that is less than 0.5x the length of the stigmal vein (Fig. 3.12B). *Cirrospilus* also possess a medina carina on the propodeum (Fig. 3.18F).

Description: Female: Metallic color on head or body absent, rarely present. Yellow color on head and body present. Fore wing with dark patterns or infuscation present.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus linear. Upper ocular sulcus present. Frontal suture present but very faint. Vertex vaulted; large, paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with thin sculpturing. Notaulus complete to posterior half of axilla, close to transscutual articulation. Axilla advanced anteriorly more than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially; two pairs of setae present - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum; asetose. Propodeum constricted medially; with smooth or shallow-reticulate sculpturing; median carina, plica, costula, and lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: Basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by more than its own length from stigmal apex. Speculum present with few or no setae within. Admarginal setae absent. Postmarginal vein less than 0.5X length of stigmal vein.

Male as female.

Hosts (from material examined): DIPTERA: Agromyzidae: *Phytoliriomyza jacarandae* Steyskal & Spencer on *Jacaranda* sp. (Bignoniaceae). **LEPIDOPTERA: Lyonetiidae:** *Leucoptera coffeella* (Guérin-Méneville) on *Coffea arabica* (Rubiaceae). **Gracillariidae** *Phyllonorycter* sp. on *Tephrosia* sp. (Fabaceae). **HEMIPTERA: Aleyrodidae:** "with aleyrodid" on *Ficus abutilifolia* (Moraceae); **Coccidae:** *Ceroplastes* sp.; **Coccoidea:** "with scale" on *Rhus* sp. (Anacardiaceae); **Pseudococcidae:** "with mealybug in leaf axils" of *Senecio isatideus* (Asteraceae); **Psyllidae:** "with psyllid" on *Acacia karroo* (Fabaceae). These hemipteran host records are most likely due to contamination by leafminers or leafrollers in the plant material; further substantiation is necessary to corroborate these claims. **UNKNOWN**: leafminers on *Gossypium* sp. (Malvaceae), *Jacaranda mimosifolia* (Bignoniaceae), *Ochna pretoriensis* (Ochnaceae), *Schinus terebinthifolius* (Anacardiaceae), *Lippia* sp. (Verbeneaceae), *Vitis rotundifolia* (Vitaceae).

Distribution (Fig. 3.13)**: Afrotropic:** Madagascar, Namibia, South Africa, Tanzania, Zimbabwe. **Australasia:** Australia (QLD, SA, WA). **Indo-Malay:** Indonesia, Sri Lanka, Thailand. **Palearctic**: Germany. **Nearctic:** USA (CA, FL, NM, OK, TX). **Neotropic:** Brazil, Costa Rica, Ecuador, Mexico (BS, JA, NL, SI, SO, TM, VE), Peru.

Taxonomic Summary:

1. *Atoposoma afra* **stat. rev.**
2. *Atoposoma arnoldi* Girault **stat. rev.**
3. *Atoposoma atoposomoides* Girault **stat. rev.**
4. *Atoposoma channingi* Girault **stat. rev.**
5. *Atoposoma gregi* Girault **stat. rev.**
6. *Atoposoma grotiusi* Girault **stat. rev.**
7. *Atoposoma lanei* Girault **stat. rev.**
8. *Atoposoma mazzinini* Girault **stat. rev.**
9. *Atoposoma saintpierrei* Girault **stat. rev.**
10. *Atoposoma unguttatipes Girault* **stat. rev.**
11. *Atoposoma variegatum* Masi **stat. rev.**

    Named as *Cirrospilus variegatus* in Chapter 2 (Perry & Heraty, accepted), status hereby revised to *Atoposoma variegatum*
12. *Atoposoma zolai* Girault **stat. rev.**

Material Examined:

***Atoposoma afra* Silvestri**

TANZANIA: Amani, *5°05'55"S*, *38°37'55"E*, 1938–1939, T. W. Kirkpatrick, host: *Leucoptera coffeella* [1♂, BMNH: NHMUK10371813].

***Atoposoma variegatum* Masi**

USA: California: Riverside Co., Box Canyon Rd., 218m, 33°35'44"N, 115°55'29"W, 30.iv.2010, J. Mottern, desert scrub/wildflowers, sweep, M10-035 [1♀, UCRC: UCRCENT395937 (**D3753**)]. Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W, 31.viii–7.ix.2008, G. Pratt, malaise trap [2♀, UCRC: UCRCENT357522 (**D3663**), 357525 (**D3667**)]. **New Mexico: Otero Co.**, Sacramento Mtns, High Rolls, 2123m, 32°57'0"N, 105°49'0"W, 1–10.v.2004, M. E. Irwin, dry wash, malaise trap [1♀, UCRC: UCRCENT357527 (**D3669**)].

***Atoposoma* sp. AA**

AUSTRALIA: Queensland: Upper Hall Creek, 12km NW of Carmilla, 350m, 21°52'0"S, 147°18'0"E, 6.iv.1997, C.J. Burwell [1♀, QM: UCRCENT491646]. Upper Hall Creek, 12km NW of Carmilla, 350m, 21°52'0"S, 147°18'0"E, 7.iv.1997, C. J. Burwell [1♀, QM: UCRCENT491648].

***Atoposoma* sp. AB**

AUSTRALIA: Queensland: 3km N. Walkamin, Atherton Tableland, *17°06'14"S*, *145°26'6"E*, 21.iv.1987, E.C. Dahms, G. Sarnes [1♂, QM: UCRCENT491650]. 5km E. Leyburn, 28°00'0"S, 151°38'0"E [3♀, QM: UCRCENT491645, 491647, 491652]. Expedition Range NP 'Amphitheatre' camp, 440m, 24°54'0"S,

148°59'0"E, Burwell & Evans, open forest [1♀, QM: UCRENT00491653]. **Western Australia:** 41km W by S Caiguna, 32°10'48"S, 125°01'48"E, 18.ix.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238384].

***Atoposoma* sp. AC**

AUSTRALIA: Queensland: Kingfisher Park, 1km N. Julatten, 16°36'0"S, 145°20'0"E, 29.xi.1997, C.J. Burwell [1♀, QM: UCRCENT491651]. Mt. Aberdeen, E base, 900m, *20°12'0"S*, *147°56'0"E*, 8.iv.1997, C. J. Burwell [1♀, QM: UCRCENT491654].

***Atoposoma* sp. AD**

MADAGASCAR: Antananarivo: Ankokoy Forest, 3 km E of Ibity, 1700m, 20°04'3"S, 46°59'58"E, 2–12.iv.2009, M. Irwin, R.Harin'Hala, Uapaca forest, malaise trap, MG-56-16 [1♀, USNM: UCRCENT471430 (**D6711**)]

***Atoposoma* sp. AE**

NAMIBIA: Uis, *21°13'6"S*, *14°51'59"E*, 20.ii.1978, C. Kok, host: *Ceroplastes* sp. [1♀, SANC: SANC-HYM2470]. **SOUTH AFRICA: Gauteng:** Rietvlei Dam, Pretoria, 1479m, *25°52'33"S*, *28°15'51"E*, 7.iii.1995, R. Urban, host: with psylid, host plant: *Acacia karroo* [1♂, SANC: SANC-HYM2473]. Suikerbosrand N. Res., 1663m, *26°29'0"S*, *28°13'43"E*, 21.ii.1995, O. C. Neser, host: mealybug in leaf axils, host plant: *Senecio isatideus* (Asterales: Asteraceae) [1♂, SANC: SANC-HYM2472]. **North West:** Brits, 1132m, *25°36'38"S*, *27°47'51"E*, 8.v.1999, S. Neser, host: *Phytoliriomyza jacarandae*, host plant: *Jacaranda* sp. [1♂, SANC: SANC-HYM00000818]. Farm Mezeg, Enzelsberg, 20km NE Zeerust, 1175m,

25°22'21"S, *26°14'10"E*, 25.iii.1996, O. C. Neser, host: with aleyrodid, host plant: *Ficus abutilifolia* [1♀, SANC: SANC-HYM00002478]. **Northern Cape:** Tankwa National Park, Renoster River, 490m, 32°14'42"S, 20°05'49"E, 4.vi–10.vii.2014, S. van Noort, Acacia karoo thicket, Tanqua Wash Riviere, Succulent Karoo, malaise trap, TKW14-ACA1-M03 [1♂, SAMC: SAM-HYM86568 (**D6713**)]. **Western Cape:** Stellenbosch, *33°55'23"S*, *18°51'55"E*, 5.i.2002, S. Neser, host: leaf mine, host plant: *Jacaranda mimosifolia* [1♂, SANC: SANC-HYM1049].

***Atoposoma* spp.**

AUSTRALIA: Queensland: Heathlands, 61m, 11°27'0"S, 142°21'0"E, 15–26.i.1992, I. Naumann & T. Weir, malaise trap [2♀, ANIC: UCRCENT238385, 238386]. Kuranda, *16°49'17"S*, *145°38'3"E*, 7.xii.1982, Z. Bouček [1♀, BMNH: NHMUK10353941]. **South Australia:** 12km E. Penong, 31°33'36"S, 133°04'48"E, 16.ix.1981, I. D. Naumann & J. C. Cardale, ex. ethanol [1♀, ANIC: UCRCENT238387]. **BRAZIL: Paraná:** Curitiba, 907m, *25°25'34"S*, *49°16'1"W*, 22.i.2000, J. Gilmore, host: leaf miner, host plant: *Schinus terebinthifolius* [1♀, FSCA: UCRCENT424545]. **COSTA RICA: Guanacaste:** Santa Rosa NP, 300m, *10°53'33"N*, *85°45'59"W*, 7–28.xii.1985, D. H. Janzen, I. D. Gauld [1♀, USNM: UCRCENT471642]. **INDONESIA: Java:** Bogor, *6°35'0"S*, *106°47'0"E*, 2.vii–5.vi.1996, S.L. Heydon & S. Fung [1♀, UCDC: UCRCENT477998]. **PERU: Cañete Prov.:** 27m, *13°04'59"S*, *76°22'58"W*, v–vi.1941, P. Berry, 41-20639, host plant: caged cotton buds [2♂ 3♀, USNM: UCRCENT471650 – 471654]. **SOUTH AFRICA: Eastern Cape:** Langkloof, *33°47'3"S*, *24°00'57"E*, 5.viii.1978, R. L.

Kluge, host: with scales, host plant: *Rhus* sp. [1♀, SANC: SANC-HYM2480]. **Gauteng:** Pretoria, *25°44'46"S*, *28°11'17"E*, 15.x.1986, S. Neser, host: leaf mine, host plant: *Ochna pretoriensis* [1♀, SANC: SANC-HYM00002469]. **Limpopo: Vhembe**, Levubu, 680m, *23°05'4"S*, *30°16'57"E*, 16.ix.1986, H. Greyling, ACH-1443, host: *Leucoptera coffeella*, host plant: coffee [3♀, SANC: UCRCENT294731]. **SRI LANKA:** Alawakumbura, Madura Oya, 113m, *7°38'51"N*, *81°11'13"E*, 26.vi.1988, A. Wijesekara, on weeds [1♂, USNM: UCRCENT471649]. **TANZANIA:** Amani, *5°05'55"S*, *38°37'55"E*, 1938–1939, T. W. Kirkpatrick, host: *Leucoptera coffeella* [1♀, BMNH: NHMUK10371811]. **USA: Florida: Alachua Co.**, Gainesville, *29°39'6"N*, *82°19'29"W*, vii.1958, host: leaf miner, host plant: grape [1♀, USNM: UCRCENT471641]. **Miami-Dade Co.**, Hialeah, 2m, *25°51'18"N*, *80°16'42"W*, 11.ix.1962, C. E. Stegmaier, host plant: *Lippia* sp. [1♀, USNM: UCRCENT471640]. **Palm Beach Co.**, Jupiter, 2m, *26°55'58"N*, *80°05'42"W*, 1.iv.1987, K. Nicholson, host: Lyonetiid larva [1♀, FSCA: UCRCENT424546]. **Polk Co.**, Lk. Wales, 5 mi. E hwy. 60, Flaming arrow camp, 36m, *27°54'11"N*, *81°27'5"W*, 19.v.1995, H. W. Browning, host plant: *Vitis rotundifolia* [1♂, FSCA: UCRCENT042544]. **Puerto Rico: Mayagüez**, Mayagüez, 10m, *18°12'2"N*, *67°08'39"W*, 9.i.1939, H. K. Plank, P. R. 2108, host: *Phyllonorycter* sp., host plant: Tephrosia [2♂ 3♀, USNM: UCRCENT471643 – 471647]. **ZIMBABWE: Manicaland:** Chipinga, 1076m, *20°11'25"S*, *32°37'41"E*, 1971, A. Weaving, host: *Leucoptera meyricki* [1♀, BMNH: NHMUK10371812].

3. *Aulogymnus* Förster - Fig. 3.14

Aulogymnus Förster, 1851: 24. Type species: *Aulogymnus aceris* Förster; by monotypy. Locality: Liege, Belgium.

Olynx Förster, 1856: 72. Type species: *Ichneumon gallarum* Linnaeus; by original designation. Synonymy by Bouček, 1965: 551.

Cyniphoctonus Reinhard, 1858: 22. Type species: *Ichneumon gallarum* Linnaeus; by original designation. Synonymy by Bouček, 1968: 28.

Ophelinoideus Ashmead, 1904: 163. Type species: *Ophelinoideus japonicus* Ashmead; by original designation. Locality: Japan, Hakone. Depository: USNM, Type No. 7211. Synonymy by Kamijo, 1976: 482.

Scotolinx Ashmead, 1904: 354. Type species: *Scotolinx gallicola* Ashmead; by original designation and monotypy. Lectotype designated by Gordh, 1977: 207. Locality: Australia, New South Wales, Liverpool. Depository: USNM, Type No. 12793. Synonymy by Bouček, 1988: 609.

Pseudiglyphella Girault, 1913b: 255. Type species: *Pseudiglyphella caelestis* Girault; holotype ♀, by original designation. Description modified by Girault, 1915a: 264. Locality: Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 1874. Synonymy by Bouček 1988: 609.

Mirolynx Girault, 1916a: 131. Type species: *Mirolynx flavitibiae* Girault; by original designation. Locality: USA, California, Santa Cruz Mountains. Depository: USNM, Type No. 19648. Synonymy by Schauff and LaSalle, 1993: 491.

Pseudolynx Girault, 1916b: 152. Type species: *Pseudolynx io* Girault; holotype ♀, by original designation. Locality: USA, Massachusetts, North Saugus. Depository: USNM, Type No. 19630. Synonymy by Schauff and LaSalle, 1993: 491.

Scotolinx Ashmead, 1904: 354. Type species: *Scotolinx gallicola* Ashmead; by original designation. Locality: Depository: USNM, Type No. 12743 – USNMENT802291. Synonymy by Bouček, 1988: 609.

Scotolinx Girault, 1916c: 218. Type species: *Scotolinx gallicola* Girault; by original designation. Examined using same material as *Scotolinx gallicola* Ashmead. Synonymy by Bouček, 1988: 609.

Diagnosis: *Aulogymnus* is characterized by a bilobed clypeus (Fig. 3.1D), distinct tentorial pits (Figs 3.1D, 3.14B), the mesoscutellum with submedian grooves absent (Fig. 3.14F, H), a constricted propodeum (Fig. 3.14F, G), and the uncus separated from the apex of the stigmal vein by more than 2X length of uncus (Figs 2O, 14D, E). *Aulogymnus* is morphologically and biologically similar to *Dichatomus*, however, *Dichatomus* have a linear clypeus (Fig. 3.25A), the frontal suture is absent (Fig. 3.25A), the mesoscutum has deep-reticulate sculpturing vs. thin sculpturing (Fig. 3.25C vs 3.14H), the propodeum is not constricted (Fig. 3.25E), and the uncus originates on the stigma by its own length or less from stigmal apex (Fig. 3.25B). *Aulogymnus* has thin sculpturing on the metacoxa (Fig.

3.14I) whereas *Dichatomus* has deep, distinct sculpturing on the metacoxa (Fig. 3.25E).

Description: Female: Metallic color on head or mesosoma absent or present. Yellow color on mesosoma absent or present. Fore wing hyaline or with dark patterns or infuscation present.

Head: Malar sulcus present. Tentorial pits distinct and enlarged. Clypeus bilobed. Upper ocular sulcus absent or present. Frontal suture present, sometimes very faint. Vertex normal, not vaulted; with large, paired setae absent or present; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent. Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex or extending to vertex. 2 or 3 funiculars; funicular shape normal, cylindrical. Club with 2 or 3 clavomeres.

Body: Mesoscutum with thin or deep-reticulate sculpturing. Notaulus complete to posterior half of axilla, close to transscutual articulation. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves absent; with 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae or equal in length to posterior pair. Dorsellum not extending posteriorly over propodeum; asetose. Propodeum constricted medially; median carina absent or present anteriorly; plica and costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina present or absent. First gastral tergite collar smooth or

with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold asetose or setose. Cubital fold basally asetose or basally setose and straight or only slightly curved to meet basal fold. Parastigma not smoothly connecting with submarginal vein and extending distinctly into basal fold. Uncus originating on stigma by 2x or more than its own length from stigmal apex. Speculum present, with few or no setae within, or absent - fore wing is setose posterior to parastigma. Admarginal setae present. Postmarginal vein more than 1.0X but less than 1.5X length of stigmal vein.

Male as female.

Hosts (from material examined): HYMENOPTERA: Cynipidae: *Andricus quercusramuli* (Linnaeus) on *Quercus* sp. (Fagaceae); *Biorhiza pallida* Linnaeus on *Quercus pedunculate*; cynipids on *Quercus acutissima*, *Q. agrifolia*, *Q. petraea*. **UNKNOWN**: galls on *Aceris* sp. (Sapindaceae), *Barleria terminalis* (Acanthaceae), *Prunus persica* (Rosaceae), *Quercus alba*, *Q. ithaburensis*, *Q*. sp.

Distribution (Fig. 3.15)**: Australasian:** Australia (NSW, QLD). **Palearctic:** Austria, Bulgaria, Estonia, Finland, France, Germany, Hungary, Israel, Japan, Netherlands, Russia, South Korea, Sweden, UK (England). **Nearctic:** Canada (ONT), Mexico (TM), USA (CA, D.C., FL, GA, MN, MO, OH, SC, TX, UT, VA, WI). **Neotropical:** Chile, Costa Rica.

Taxonomic Summary:

1. *Aulogymnus aceris* Förster
2. *Aulogymnus albipes* (Askew)
3. *Aulogymnus arifaokhani* Özdikmen
4. *Aulogymnus arsames* (Walker)
5. *Aulogymnus balani* Pujade-Villar
6. *Aulogymnus bicolor* (Askew)
7. *Aulogymnus bivestigatus* (Ratzeburg)
8. *Aulogymnus boučeki* Schauff & Gates
9. *Aulogymnus caelestis* (Girault)
10. *Aulogymnus california* (Gordh)
11. *Aulogymnus chilonis* (Munakata)
12. *Aulogymnus defrizi* (Storozheva)
13. *Aulogymnus elevatus* Zhu LaSalle & Huang
14. *Aulogymnus euedoreschus* (Walker)
15. *Aulogymnus flavimaculata* (Girault)
16. *Aulogymnus fumatus* (Ratzeburg)
17. *Aulogymnus gallarum* (Linnaeus)
18. *Aulogymnus gallicola* (Ashmead)
19. *Aulogymnus gorditus* Schauff & Gates
20. *Aulogymnus hyalopterus* Zhu LaSalle & Huang
21. *Aulogymnus indicus* (Arifa & Khan)
22. *Aulogymnus insculptus* Zhu LaSalle & Huang
23. *Aulogymnus io* (Girault 1916)
24. *Aulogymnus japonicus* (Ashmead)
25. *Aulogymnus kelebiana* (Erdös)
26. *Aulogymnus longicalcar* Zhu LaSalle & Huang
27. *Aulogymnus minyas* (Walker)
28. *Aulogymnus obscuripes* (Mayr)

29. *Aulogymnus purpurascens* Schauff & Gates
30. *Aulogymnus pygmaeus* (Szelényi)
31. *Aulogymnus skianeuros* (Ratzeburg)
32. *Aulogymnus smithi* Schauff & Gates
33. *Aulogymnus testaceoviridis* (Erdös)
34. *Aulogymnus trilineatus* (Mayr)
35. *Aulogymnus virginiensis* Schauff & Gates

Material Examined:

***Aulogymnus aceris* Förster**

FRANCE: Vaucluse: Mt. Ventoux, *44°10'34"N*, *5°16'32"E*, 28.v.1985, Perrache [1♀, BMNH: NHMUK10371699, BMNH: NHMUK10371700]. **GERMANY:** Aachen, 210m, *50°46'30"N*, *6°02'17"E*, 1869, A. Förster [1♀, USNM: UCRCENT471661]. **Baden-Württemberg:** Urach, *48°29'22"N*, *9°23'29"E*, host: gall, host plant: Aceris sp. [1♀, USNM: UCRCENT471662].

***Aulogymnus albipes* (Askew)**

Paratype: ISRAEL: Kiryat Tivon: Tivon, 151m, *32°43'6"N*, *35°07'56"E*, iii.1956, host plant: Quercus ithaburensis [1♀, BMNH: NHMUK10371704].

Additional material examined: ISRAEL: Haifa: Pardes-Hanna, 62m, *32°28'24"N*, *34°58'20"E*, iii.1936, S. Duvdevani, 210-G, host plant: Quercus [1♂, BMNH: NHMUK10371703].

***Aulogymnus arsames* (Walker)**

SWEDEN: Skane: Åhus, 8m, *55°55'22"N*, *14°18'11"E*, 6.vi.1965, K. J. Hedqvist [1♀, BMNH: NHMUK10371715]. Dalby, 60m, *55°39'41"N*, *13°21'11"E*, 11.v.1938, D. M. S. P. & J. F. P. [1♂ 1♀, ANIC: UCRCENT238388, 238389].

***Aulogymnus bouceki* Schauff & Gates**

CANADA: Ontario: Hastings Co., 15km E Tweed, *44°27'43"N*, *77°08'54"W*, 19–30.v.2006, E. Fuller [1♀, UCRC: UCRCENT485233]. **MEXICO: Tamaulipas: Gomez Farias**, 2 km SW San Jose, 1350m, *23°41'52"N*, *99°11'31"W*, 17.iii.1988, mesophilic forest [1♀, TAMU: UCRCENT426801 (**D4571)**]. **USA: California: Riverside Co.**, Cactus Spring Trail, btwn. Hwy. 74 & Horsethief Cr.; Deep Canyon area, *33°34'44"N*, *116°26'55"W*, 11.iv.1971, S. Frommer & S. Frommer [1♀, UCRC: UCRCENT073383]. **District of Columbia:** NW Washington, Rock Creek Park, *38°56'15"N*, *77°02'53"W*, 19.ii.1984, W. E. Steiner, reared from dry grass in basal treehole, host plant: *Quercua alba* [1♀, USNM: UCRCENT471663]. **Georgia: Liberty Co.**, St. Catherine's Island, 31°40'0"N, 81°09'0"W, 6–10.iv.1995, A. Sharkov [1♂, UCRC: UCRCENT124250]. **Missouri: Washington Co.**, Delta Exper. Forest, Stoneville, 45m, 33°28'0"N, 90°54'0"W, 11–26.iii.1997, N. M. Schiff [1♀, UCDC: UCRCENT478000]. **Ohio: Clermont Co.**, 2.4km N Hwy. 32, Williamsburg, *39°05'24"N*, *84°03'15"W*, 19–26.iv.1997, D. E. Russell, malaise trap [1♂, UCDC: UCRCENT478002]. **Texas: Bandera Co.**, Lost Maples St. Pk., *29°49'33"N*, *99°35'15"W*, 22.iii.1985, Kovarik, Jones, & Haack [1♂, UCRC: UCRCENT485234]. **Wisconsin: Outagamie Co.**, 1000 Islands Environmental Ctr., Kaukana, *44°16'30"N*, *88°15'38"W* [1♂, UCDC: UCRCENT478001].

***Aulogymnus california* (Gordh)**

Paratypes: USA: California: Los Angeles Co., Whittier, *33°58'43"N*, *118°01'59"W*, 7.iv.1913, P. H. Timberlake, host: cynipid, host plant: *Quercus agrifolia* [2♀, UCRC: UCRCENT485230, 485231].

Additional material examined: USA: California: Los Angeles Co., Whittier, *33°58'43"N*, *118°01'59"W*, 7.iv.1913, P. H. Timberlake, host: cynipid, host plant: *Quercus agrifolia* [1♂, UCRC: UCRCENT485232]. **Los Angeles Co.**, San Gabriel Cyn, 3 mi. N. Fork Rd., 1150m, *34°15'33"N*, *117°51'19"W*, 6.iv.1996, M. Gates, G96-019 [1♀, UCRC: UCRCENT485228]. **Riverside Co.**, Harford Springs Park, 640m, 33°48'6"N, 117°20'41"W, 9.iv.2005, D. Yanega [1♀, UCRC: UCRCENT161048 (**D2129**)]. **San Diego Co.**, 11 mi. E Temecula, 477m, *33°27'55"N*, *116°58'20"W*, 3.iv.1981, S. Frommer [1♀, UCRC: UCRCENT485229]. **Texas: Hidalgo Co.**, Bentsen Rio Grande Valley State Park, 37m, *26°10'12"N*, *98°22'48"W*, 1–15.iv.1977, C. Porter, Malaise Trap [1♀, FSCA: UCRCENT424553].

***Aulogymnus euedoreschus* (Walker)**

ESTONIA: Haapsalu: Puhtu, 3m, *58°33'57"N*, *23°32'49"E*, 28.v.1990, M. Koponen [1♀, MZH: UCRCENT513292]. **Lääne-Viru:** Lehemaa, Sagadi, 7m, *59°33'47"N*, *25°47'7"E*, 26.v.1991, M. Koponen [1♀, MZH: UCRCENT513289]. **Lääne:** Vigala, *58°46'41"N*, *24°14'36"E*, 21.v.1991, M. Koponen [6♀, MZH: UCRCENT513287, 513288]. **Võru:** Murati, *57°35'21"N*, *27°05'6"E*, 27.v.1991, M. Koponen [3♀, MZH: UCRCENT513290]. **FINLAND:** Inkoo, 2m, 59°59'2"N,

23°54'20"E, 24.v.1989, M. Koponen [2♀, MZH: UCRCENT513281, 513282]. Nurmijärvi, 66m, 60°27'37"N, 24°48'25"E, 24.vii.1992, M. Koponen [1♀, MZH: UCRCENT513283]. Sipoo, 1m, 60°15'35"N, 25°11'58"E, 1.vi.1983, M. Koponen [1♀, MZH: UCRCENT513286], 24.v.1983, M. Koponen [2♀, MZH: UCRCENT513284, 513285]. **SWEDEN: Blekinge**, Listerby, 24m, *56°11'40"N*, *15°24'23"E*, 11.v.1964, K. J. Hedqvist [1♀, BMNH: NHMUK10371722]. **Stockholm**, Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 30.viii.1959, K. J. Hedqvist [1♀, BMNH: NHMUK10371720].

***Aulogymnus flavitibiae* (Girault)**

USA: California: San Diego Co., Cleveland NF, Fry Creek Cmpgrd., 1526m, *33°20'42"N*, *116°52'49"W*, 15.xi.1998, L. L. Fry, host: gall, host plant: Quercus sp. [1?, USNM: UCRCENT471664].

***Aulogymnus gallarum* (Linneaus)**

GERMANY: Gronau, 42m, *52°12'16"N*, *7°01'59"E*, 25.vii.1948, J. Ghesquière, host: *Biorhiza pallida*, host plant: *Quercus pedunculata* [1♂ 2♀, UCRC: UCRCENT485235 – 485237]. **NETHERLANDS: North Holland:** Hilversum, 20m, *52°13'39"N*, *5°09'55"E*, 20–28.iv.1897, Oudemans, host: galls, host plant: *Barleria terminalis* [1♂ 1♀, CNC: CNC509128]. **SWEDEN: Skane:** Dalby, 60m, *55°39'41"N*, *13°21'11"E*, 6.v.1938, D. M. S. P. & J. F. P. [1♀, BMNH: NHMUK10371717]. **UK: England:** Hemel Hempstead, 135m, *51°45'1"N*, *0°26'55"W*, 10.iv.1953, R. B. Benson, host: *Andricus quercusramulis* [1♂ 3♀,

ANIC: UCRCENT238390 – 238393]. **Surrey**, Barnes Common, 9m, *51°27'58"N*, *0°14'43"W*, 12.ix.2009, J.S. Noyes [1♀, BMNH: NHMUK10371716].

***Aulogymnus gorditus* Schauff & Gates**

USA: Texas: Brazos Co., College Station, Lick Creek Park, 66m, *30°33'39"N*, *96°12'49"W*, 18.ii–4.iii.2001, R. Wharton, malaise, Heraty lab loc. #13677 [1♀, TAMU: UCRCENT426800 (**D4570**)]. **Virginia: Essex Co.**, 1mi SE Dunnsville, 37°52'0"N, 76°48'0"W, 4–22.iv.1996, D. R. Smith, malaise trap [1♀, USNM: UCRCENT471667].

***Aulogymnus io* (Girault)**

USA: Missouri: Scott Co., *37°01'46"N*, *89°38'5"W*, 1.iv.1938, W. F. Turner, host plant: peach tree [1♀, USNM: UCRCENT471665]. **Ohio: Clermont Co.**, 2.4km N Hwy. 32, Williamsburg, 273m, *39°05'24"N*, *84°03'15"W*, 11–17.v.1997, D. E. Russell, malaise trap [1♂, UCDC: UCRCENT478003]. **Virginia: Essex Co.**, 1mi SE Dunnsville, 10m, 37°52'0"N, 76°48'0"W, 4–22.iii.1995, D. R. Smith [1♀, USNM: UCRCENT471666].

***Aulogymnus japonicus* (Ashmead)**

JAPAN: Honshu: Saitama, Urawa, 20m, *35°51'40"N*, *139°38'51"E*, 6.iv.1979, S. Usuba, host: Cynipid, host plant: *Quercus acutissima* [1♀, BMNH: NHMUK10371723].

***Aulogymnus minyas* (Walker)**

USA: Minnesota: Anoka Co., Helen Allison Savanna Nature Conservancy, *45°23'2"N*, *93°10'7"W*, 20.v.1978, B. Cutler [1♀, FSCA: UCRCENT424552].

***Aulogymnus purpurascens* Schauff & Gates**

USA: Florida: Alachua Co., Poe Springs, 9m, *29°49'30"N*, *82°38'54"W*, 15.iii.1977, E. E. Grissell, low vegetation, sweep [1♀, FSCA: UCRCENT424551]. San Felasco Hamock, *29°42'52"N*, *82°27'40"W*, 9–14.iii.1977, G. B. Fairchild & H. V. Weems, jr., insect flight trap [4♀, FSCA: UCRCENT424547 – 424550]. **Missouri: Boliver Co.**, Dahomey Ntl. Wildlf. Refuge, Hwy. 446, 19km W Boyle, 41m, 33°42'0"N, 90°56'0"W, 14–28.vi.1999, N. M. Schiff, malaise trap [1♀, UCDC: UCRCENT477999]. **Virginia: Essex Co.**, 1mi SE Dunnsville, 10m, 37°52'0"N, 76°48'0"W, 23.iii–11.iv.1995, D. R. Smith [1♂, USNM: UCRCENT471668].

***Aulogymnus skianeuros* (Ratzeburg)**

HUNGARY: Szolnok Co.: Tiszakürt, 82m, *46°53'1"N*, *20°07'39"E*, G. Stone, host: *Biorhiza pallida* [1♀, USNM: UCRCENT471669, 471670]. **SWEDEN: Stockholm**, Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 21.iii.1953, K. J. Hedqvist [1♀, BMNH: NHMUK10371709]. **Skane:** Kullaberg, 85m, *56°17'47"N*, *12°28'0"E*, 15.v.1973, K. J. Hedqvist [1♀, BMNH: NHMUK10371710]. **UK: England:** Worcester Park, 21m, *51°22'52"N*, *0°14'39"W*, 13.vii.1950, R. D. Eady, host: *Biorhiza pallida* [1♀, ANIC: UCRCENT238295].

***Aulogymnus smithi* Schauff & Gates**

USA: Georgia: Liberty Co., St. Catherine's Island, 31°40'0"N, 81°09'0"W, 6–10.iv.1995, A. Sharkov [2♀, UCRC: UCRCENT123446, 123480]. **Virginia: Essex Co.**, 1mi SE Dunnsville, 10m, 37°52'0"N, 76°48'0"W, 23.iii–11.iv.1995, D. R. Smith

[1♀, USNM: UCRCENT471672]. 1mi SE Dunnsville, 10m, 37°52'0"N, 76°48'0"W, 4–22.iii.1995, D. R. Smith [1♀, USNM: UCRCENT471671].

***Aulogymnus trilineatus* (Mayr)**

AUSTRIA: Vienna, *48°12'42"N*, *16°22'16"E*, G. Mayr [1♀, USNM: UCRCENT471675]. **BULGARIA:** Vežen, 2156m, *42°44'59"N*, *24°23'57"E*, 10.ix.1990, G. Stone, host: cynipid, host plant: *Quercus petraea* [2♀, USNM: UCRCENT471674].

Aulogymnus* nr *california

MEXICO: Tamaulipas: San Carlos, Cerro del Diente, 853m, *24°32'14"N*, *98°57'25"W*, 13.iii.1988, Jones, Kovanik, Mintzez, Quercus spp. [1♀, TAMU: UCRCENT426802 (**D4572**)].

***Aulogymnus* spp.**

COSTA RICA: Monte Verde T-B, *10°18'26"N*, *84°48'35"W*, 22–24.ii.1972, H. M. Oowell [1♂, UCDC: UCRCENT478004]. **HUNGARY:** ~1.0km NE Cák, 47°21'48"N, 16°31'35"E, 30.vi.2010, G.A.P. Gibson, sweep [1♀, CNC: CNC509130 (**D4983**)]. 4.5 km SW Koszeg, Meszes Völgy, 120m, 47°22'0"N, 16°31'0"E, 26.vi.2010, J.S. Noyes, BMNH(Ent) 2010-63 [1♀, BMNH: NHMUK10734444 (**D5973**)]. **RUSSIA: Far East:** Primorski krai Lazovski Zapovednik c. 170km E. Vladivostok, Korpad, 526m, 43°17'15"N, 134°07'10"E, 2–13.v.2001, M. Quest, Mountain top, malaise trap, BMNH (E) 2009-59 [1♀, BMNH: NHMUK10734432 (**D5961**)]. **SOUTH KOREA: Chungcheongbuk-do: Sangchon-myeon**, Dunjeon-ri, near Doma Pass, *36°05'35"N*, *127°50'53"E*, 2–26.v.2006, P. Tripotin, forest & small stream,

MT [1♀, CNC: CNC508736 (**D4690**)]. **Chungnam:** Daejon-si, Wadong, 131m, 36°24'1"N, 127°25'59"E, 16.iv–6.v.2006, P. Tripotin, forest edge, wild rose patch, MT [1♀, CNC: CNC508737 (**D4691**)]. **UK: England: Lincolnshire**, Woodhall Spa, 17m, *53°09'7"N*, *0°13'4"W*, 8.vi.1926, J. Wield, host: *Andricus quercusramuli*, host plant: Quercus [1♀, BMNH: NHMUK10371719]. **USA: Florida: Alachua Co.**, Gainesville (D. P. I.), *29°35'53"N*, *82°21'54"W*, 7–17.iv.1987, D.B. Wahl [1♂, CNC: CNC509131 (**D4992**)]. **South Carolina: Anderson Co.**, Pendleton; Tanglewood Spring, 225m, 34°38'42"N, 82°47'6"W, 21.iv–6.v.1987, J. Morse, disturbed site, malaise trap [1♀, CNC: CNC509132 (**D4992**)]. **Utah: Washington Co.**, Snow canyon St. Park ~1 mi. N Ivins, 986m, *37°11'37"N*, *113°38'47"W*, 29.iii.1989, J.D. Pinto, Rhus, Oak, Fraxinus [1♂, CNC: CNC508738 (**D4681**)].

4. *Burkseus* Perry - Fig. 3.16

Burkseus Perry, 2019: 12. Type species: *Cirrospilus vittatus* Walker, 1838: 308 [examined]; lectotype ♀, designated by Graham, 1991: 8. Locality: England. Depository: BMNH, Type No. 5.2666/NHMUK10353603.

Diagnosis: *Burkseus* is most similar morphologically and biologically to *Cirrospilus* and *Gyrolasella. Burkseus* is distinguished from *Cirrospilus* by the absence of a median carina on the propodeum (Fig. 3.16G, I), and a cubital fold that curves sharply to meet the basal fold (Fig. 3.16C, D). The scape extends to the vertex in *Burkseus*, while the scape does not extend to the vertex in *Gyrolasella*, and the

propodeum is constricted in *Gyrolasella* (Fig. 3.33H) and not constricted in *Burkseus* (Fig. 3.16G, I).

Remarks. The genus was established, the four species revised, and the host associations summarized by Perry & Heraty (2019).

Distribution (Fig. 3.17)**: Afrotropic:** South Africa. **Nearctic:** Canada (AB, BC, NB, NL, NS, ON, PE, QC, YT), Mexico (CH, MO, OAX), USA (AK, AZ, CA, CO, ID, ME, MT, NH, NM, NV, NY, OR, UT, VA, WA, WI, WY). **Neotropic:** Chile, Colombia, Costa Rica. **Oceania:** USA (HI). **Palearctic:** Austria, Croatia, Cyprus, Czech Republic, Finland, Germany, Hungary, India, Iraq, Japan, Kyrgyzstan, Morocco, Norway, Russia, Spain, Sweden, Switzerland, Turkey, UK (England, Ireland, Scotland, Wales).

Taxonomic Summary: *Cirrospilus staryi* Bouček lacks a median carina on the propodeum and agrees with *Burkseus*, therefore the species is hereby named *Burkseus staryi* (Bouček) **n. comb.**

1. *Burkseus elongatus* (Bouček)
2. *Burkseus flavoviridis* (Crawford)
3. *Burkseus pinicolus* (Askew)
4. *Burkseus robustus* Perry
5. *Burkseus sigillatus* Perry

6. *Burkseus singa* (Walker)
7. *Burkseus staryi* (Bouček) **n. comb.**
8. *Burkseus vittatus* (Walker)

5. *Cirrospilus* Westwood, 1832 - Figs 18 & 19

Cirrospilus Westwood, 1832: 128. Type species: *Cirrospilus elegantissimus* Westwood [examined]; holotype ♀, by monotypy. Locality: England. Depository: HDOU, Type Hym. 610.

Atoposomoidea Howard, 1910: 9. Type species: *Atoposomoidea ogimae* [examined]; holotype ♀, by original designation and monotypy. Locality: Japan. Depository: USNM, Type No. 12681/USNMENT 2545644. Synonymy by Bouček, 1959: 180.

Winnemana Crawford, 1911: 620. Type species: *Winnemana argei* Crawford [paratypes examined]; by monotypy. Locality: USA, Maryland, Plummer's Island. Depository: USNM, Type no. 13549. Synonymy by Graham, 1975: 281.

Achrysocharelloidea Girault, 1913b: 178. Type species: *Achrysocharelloidea pax* Girault; holotype ♀, by original designation and monotypy. Locality: Australia, New South Wales, Sydney. Depository: SAMA, Type No. I. 1349. Synonymy by Bouček, 1988: 612.

Cirrospilomella Girault, 1913b: 265. Type species: *Cirrospilomella fasciatus* Girault [examined]; holotype ♀, by original designation and monotypy. Locality:

Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 1896. Synonymy by Bouček, 1988: 612.

Pseudiglyphomyia Girault, 1913b: 267. Type species: *Pseudiglyphomyia biguttata* Girault [examined]; holotype ♀, by original designation. Locality: Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 1899. Synonymy by Girault, 1916: 222.

Cirrospilopsis Girault, 1915a: 263. Type species: *Cirrospilopsis nigrivariegatus* Girault [examined]; holotype ♀, by original designation. Locality: Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 2653. Synonymy by Bouček, 1988: 612.

Parzagrammosoma Girault, 1916c: 222. Type species: *Zagrammosoma pulchra* Girault; holotype ♀, by original designation. Locality: Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 1870. Synonymy by Bouček, 1988: 612.

Giraultia Gahan and Fagan, 1923: 66. Replacement name for *Cirrospilopsis* Girault, preoccupied by *Cirrospilopsis* Brèthes, 1913 (Eulophidae: Tetrastichinae).

Ootetrastichoides Ii, 1936: 221. Type species *Ootetrastichoides habachi* Ii; by monotypy. Locality: Japan, Tokyo. Synonymy by Graham, 1975: 281.

Plesiospilus Ferrière, 1953: 398. Type species: *Eulophus unistriatus* Förster, 1841; by original designation. Locality: Germany. Synonymy by Delucchi, 1958: 253. Synonymy by Delucchi, 1958: 253, and by Peck, 1963: 182.

Semielacher Bouček, 1988: 610. Type species: *Semielacher silvicola* Bouček, original designation. Locality: Australia, QLD, Eungella Natl. Park. Depository: ANIC. **syn. nov.**

Diagnosis: *Cirrospilus* is defined by a normal, non-vaulted vertex (Fig. 3.18A–C), a complete notaulus extending to posterior half of the axilla (Fig. 3.18E, F), propodeum with a complete median carina (Fig. 3.18F), and a postmarginal vein that is 0.5–1.5X length of stigmal vein (Fig. 3.18G). *Cirrospilus* is similar to many genera in the tribe, most notably *Atoposoma, Burkseus, Diaulinopsis, Gyrolasella, Pseudozagramma, Vagus, and Zagrammosoma*. The diagnoses for each of these genera details their morphological differences from *Cirrospilus s.s.*.

Description: Female: Metallic color on head or mesosoma absent or present. Yellow color on mesosoma absent or present. Fore wing hyaline or with dark patterns or infuscation present.

Head: Malar sulcus present. Tentorial pits indistinct or, rarely, distinct and enlarged. Clypeus normal, linear. Upper ocular sulcus absent or present, sometimes very faint. Frontal suture absent or present, sometimes very faint. Vertex normal, not vaulted; large, paired setae absent or present; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex, extending to vertex, or extending past vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with thin sculpturing. Notaulus complete to posterior half of axilla, close to transscutual articulation. Axilla advanced anteriorly less than 10% of longitudinal length past anterior margin of transscutal articulation, or more commonly, advanced anteriorly more than 10% but less than 75% of longitudinal length. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially; 2 pairs of setae, anterior pair of setae shorter than, equal in length to, or longer than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina present; plicae absent, present and complete, or present posteriorly only; costula absent; lateral basal groove absent. Gaster sessile or petiolate. Petiole with ventral carina or carinae absent or present. First gastral tergite collar smooth, or with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing, with deep, distinct sculpturing (areolate), or with distinct sculpturing (reticulate).

Fore wing: basal fold asetose or setose. Cubital fold basally asetose or basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein and not extending into basal fold, or smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less, by more than its own length from

stigmal apex, or by 2X or more than its own length from stigmal apex. Speculum present with few or no setae within, or absent. Admarginal setae present. Postmarginal vein between 0.5Xand 1.5X length of stigmal vein.

Hosts (from material examined): DIPTERA: Agromyzidae: *Liriomyza trifolii*. **HYMENOPTERA: Argidae:** *Arge* sp. **Ichneumonidae:** *Spilocryptus* sp. on *Cecropia* sp. (Urticaceae). **Tenthredinidae:** *Nematus oligospilus* Förster. **LEPIDOPTERA: Gracillariidae:** *Phyllocnistis citrella* Stainton on citrus; *Phyllocnistis* sp.; *Phyllonorycter crataegella* Clemens on apple; *Phyllonorycter* sp. on *Quercus* sp. (Fagaceae); **Lyonetiidae:** *Crobylophora daricella* Meyrick; *Leucoptera* sp. on *Coffee arabica* (Rubiaceae); *Leucoptera* pupa; lyonetiid on *Erythrina poeppigiana* (Fabaceae); **Tischeriidae:** *Tischeria bifurcata* Braun. **Saturniidae:** *Hylaphora cecropia* Linnaeus larva. **Unknown:** lepidopteran pupa on citrus. **UNKNOWN:** galls on *Quercus dilatate*; leaf miner on *Coffee arabica;* on *Quercus agrifolia.*

Distribution (Fig. 3.20)**: Afrotropic:** Ethiopia, Kenya, Madagascar, Republic of the Congo, Sao Tome, South Africa, Tanzania, Uganda**. Australasia:** Australia (ACT, NSW, QLD, WA), New Caledonia, New Zealand. **Indo-Malay:** Indonesia, Taiwan. **Nearctic:** Canada, USA (AZ, CA, FL, IL, MA, NM, VA). **Neotropic:** Argentina, Bahamas, Brazil, Colombia, Costa Rica, Guatemala, Honduras, Mexico (TP, VC), Nicaragua, Venezuela. **Palearctic:** China, Croatia, Cyprus, Finland,

France, Italy, Japan, Pakistan, Portugal, Russia, Spain, Sweden, Tunisia, Turkey, UK (England).

Taxonomic Summary: *Semielacher* was characterized by the distinct tentorial pits, however, this character was not strong enough to support *Semielacher* as a genus, and the molecular support overwhelmingly supports *Semielacher* emerging within *Cirrospilus. Semielacher* species agree with *Cirrospilus* morphologically, therefore the new synonymy is warranted, with the new combinations proposed: *Cirrospilus petiolatus* (Bouček) **n. comb.** and *Cirrospilus silvicolus* (Bouček) **n. comb.**

1. *Cirrospilus abalus* Narendran
2. *Cirrospilus acadius* Narendran
3. *Cirrospilus alternatus* Bouček
4. *Cirrospilus americanus* (Girault)
5. *Cirrospilus americus* Perry **nom. nov.**
   Replacement name for *Cirrospilus americanus* Özdikmen, preoccupied by *Cirrospilus americanus* (Girault)
6. *Cirrospilus argei* (Crawford)
7. *Cirrospilus atripropodeum* (Girault)
8. *Cirrospilus bifasciatus* Walker
9. *Cirrospilus biguttatus* (Girault)
10. *Cirrospilus brevicorpus* Shafee & Rizvi
11. *Cirrospilus brevis* Zhu, LaSalle & Huang
12. *Cirrospilus carinatus* (Girault)
13. *Cirrospilus caspicus* Bouček

14. *Cirrospilus centralis* Zhu, LaSalle & Huang
15. *Cirrospilus cinctithorax* (Girault)
16. *Cirrospilus cinctiventris* Ferrière
17. *Cirrospilus coachellae* Gates
18. *Cirrospilus coccivorus* Motschulsky
19. Cirrospilus columbia (Girault)
20. *Cirrospilus coptodiscae* (Girault)
21. *Cirrospilus coracipennellae* Förster
22. *Cirrospilus cosmopterygi* (Risbec)
23. *Cirrospilus curvineurus* Askew
24. *Cirrospilus cyanops* Goureau
25. *Cirrospilus denitus* Narendran
26. *Cirrospilus diallus* Walker
27. *Cirrospilus dispersus* Zhu, LaSalle & Huang
28. *Cirrospilus divergens* Zhu, LaSalle & Huang
29. *Cirrospilus dodoneae* (Risbec)
30. *Cirrospilus elegantissimus* Westwood
31. *Cirrospilus eunapius* Walker
32. *Cirrospilus flavicinctus* Riley
33. *Cirrospilus flavifacies* (Girault)
34. *Cirrospilus floridensis* Evans
35. *Cirrospilus fuscipennis* (Girault)
36. *Cirrospilus fuscus* (Girault)
37. *Cirrospilus giraulti* Peck
38. *Cirrospilus gracielae* De Santis
39. *Cirrospilus habachi* (Ii)
40. *Cirrospilus huangyanensis* Yang & Ren
41. *Cirrospilus immaculatus* Ashmead (**UNAVAILABLE NAME**)

    Nomen nudum

42. *Cirrospilus infuscatus* Gates & Schauff
43. *Cirrospilus ingenuus* Gahan
44. *Cirrospilus inimicus* Gahan,
45. *Cirrospilus insculptus* Zhu, LaSalle & Huang
46. *Cirrospilus iphigenia* (Girault)
47. *Cirrospilus isonoi* Kamijo
48. *Cirrospilus jiangxiensis* Sheng & Wang
49. *Cirrospilus kanpurensis* Shafee & Rizvi
50. *Cirrospilus kumatai* Kamijo
51. *Cirrospilus longifasciatus* Ferrière
52. *Cirrospilus longstigmae* Yang & Cao
53. *Cirrospilus lyncus* Walker
54. *Cirrospilus marilandi* Girault
55. *Cirrospilus marilandicus* (Girault)
56. *Cirrospilus metallicus* (Girault)
57. *Cirrospilus mimsalatis* Yang & Cao
58. *Cirrospilus neotropicus* Diez & Fidalgo
59. *Cirrospilus nephelodes* Graham
60. *Cirrospilus niger* Howard
61. *Cirrospilus nigrifemur* Zhu, LaSalle & Huang
62. *Cirrospilus nigriscutum* (Girault)
63. *Cirrospilus nigrivariegatus* (Girault)
64. *Cirrospilus nireus* Walker
65. *Cirrospilus occidentalis* (Girault)
66. *Cirrospilus ocellatus* Girault
67. *Cirrospilus ornatus* (Mukerjee)
68. *Cirrospilus ovisugosus* Crosby & Matheson
69. *Cirrospilus persicus* Lotfalizadeh & Delvare
70. *Cirrospilus perticus* Zhu, LaSalle & Huang

71. *Cirrospilus petiolatus* (Girault) **n. comb.**
72. *Cirrospilus phorbas* Walker
73. *Cirrospilus phyllocnistis* (Ishii)
74. *Cirrospilus polygoniae* Risbec
75. *Cirrospilus pondicheri* Narendran
76. *Cirrospilus pulchellus* Bouček
77. *Cirrospilus pulcheria* Girault
78. *Cirrospilus purpureus* Ashmead
79. *Cirrospilus quadrifasciatus* (Girault)
80. *Cirrospilus quinquefasciatus* (Girault)
81. *Cirrospilus rhadius* Walker
82. *Cirrospilus ringoniellae* Kamijo
83. *Cirrospilus rusticus* (Girault)
84. *Cirrospilus salatis* Walker
85. *Cirrospilus sapientia* (Girault)
86. *Cirrospilus scapus* Yefremova
87. *Cirrospilus setipes* Askew
88. *Cirrospilus silvae* (Girault)
89. *Cirrospilus silvicolus* (Bouček) **n. comb.**
90. *Cirrospilus striatus* Zhu, LaSalle & Huang
91. *Cirrospilus suaedaegallarum* Viggiani
92. Cirrospilus *submedialis* Zhu, LaSalle & Huang
93. *Cirrospilus tineivora* Risbec
94. *Cirrospilus tischeriae* Kamijo
95. *Cirrospilus transrugosus* Zhu, LaSalle & Huang
96. *Cirrospilus tricuspidatus* Sheng
97. *Cirrospilus unguttatipennis* (Girault)
98. *Cirrospilus varifasciata* (Girault)
99. *Cirrospilus virgatus* Yefremova

100. *Cirrospilus viridilineatus* (Froggatt)

101. *Cirrospilus viticola* (Rondani)

Material Examined:

***Cirrospilus alternatus* Bouček**

Paratypes: SAO TOME: *0°19'44"N*, *6°43'40"E*, 1.ix.1974, J. Derron, host: lyonetiid, host plant: *Erythrina poeppigiana* [2♂, BMNH: NHMUK10371765, 10371766].

***Cirrospilus argei* (Crawford)**

Paratypes: USA: Maryland: Montgomery Co., Plummer's Island, 22m, *38°58'11"N*, *77°10'36"W*, E.A. Schwarz, host: *Arge* [1♂ 1♀, USNM: UCRCENT471364, 471365]. **Additional material examined: USA: Florida: Alachua Co.**, Archer Road Lab, 31m, *29°37'57"N*, *82°22'3"W*, 15.vi.1978, K. Regas-Williams [1♀, USNM: UCRCENT471363].

***Cirrospilus atripropodeum* (Girault)**

AUSTRALIA: Australian Capital Territory: Canberra, 561m, *35°16'55"S*, *149°08'9"E*, 4.i.1980, host: *LIthocolletis* sp., host plant: *Quercus* sp. [1♀, BMNH: NHMUK10371792]. **Western Australia:** Stirling Range Natl. Park, Red Gum Spring, 323m, 34°18'38"S, 117°49'55"E, 14.i.1999, J.B. Woolley, 99/007 [1♀, TAMU: UCRCENT426767 (**D4663**)].

***Cirrospilus brevis* Zhu, LaSalle, & Huang**

Paratypes: SPAIN: lab culture, 1998, R. Vercher A., host: *Phyllocnistis citrella* [1♂ 1♀, BMNH: NHMUK10371827, 10371828].

Additional material examined: CYPRUS: Skarinou, *34°49'22"N*, *33°21'52"E*, x.1995, G. Orphanides, host: *P. citrella*, host plant: lemon [1♀, ANIC: UCRCENT238443]. **TAIWAN:** Ta-k'eng ("Taken" on label), *23°57'31"N*, *120°44'26"E*, 7.x.1992, C. C. Chien, host: *Liriomyza trifolii* [1♀, ANIC: UCRCENT238442]. **TURKEY:** Arsuz, 20m, *36°24'45"N*, *35°52'59"E*, 21.ix.1995, N. Uygun et al., host: *P. citrella* [1♂, ANIC: UCRCENT238440]. Dorytol, TIGEM, 52m, *36°50'24"N*, *36°13'0"E*, 15.viii.1995, N. Uygun et al., host: *P. citrella* [1♀, ANIC: UCRCENT238368]. Erzin, *36°57'15"N*, *36°12'24"E*, 6.vi.1995, N. Uygun et al., host: *P. citrella* [1♀, ANIC: UCRCENT238367]. Icel, Alata, 10m, *36°36'42"N*, *34°19'1"E*, 13.vii.1995, N. Uygun et al., host: *P. citrella* [1♀, ANIC: UCRCENT238439].

***Cirrospilus centralis* Zhu, LaSalle, & Huang**

China: Guangxi Region: Daxing, Xialei, 250m, *22°54'29"N*, *106°45'22"E*, 31.iii.1998, C. D. Zhu [1♀, BMNH: NHMUK10371794].

***Cirrospilus cinctithorax* (Girault)**

USA: California: San Luis Obispo Co., Cal Poly SLO, lemon grove, 84m, 35°17'41"N, 120°40'15"W, 2.viii.2010, R.K. Perry, reared, RP10-008 [1♀, UCRC: UCRCENT414586 (**D3879**)].

***Cirrospilus cinctiventris* Ferrière**

TANZANIA: Amani, *5°05'55"S*, *38°37'55"E*, 1938–1939, T. W. Kirkpatrick [1♀, BMNH: NHMUK10371764]. Nyakato, Bukoba, 1313m, *1°16'19"S*, *31°48'35"E*, 24.viii.1935, A. H. Ritchie, host: *Crobylophora daricella*, host plant: *Pavetta ternifolia* [1♀, BMNH: NHMUK10371763]. **UGANDA:** Kawanda, *0°50'0"N*, *31°54'59"E*, 25.ii.1963, D. J. Greathead, host: *Leucoptera* sp., host plant: *Coffee arabica* [1♀, BMNH: NHMUK10371761].

***Cirrospilus curvineurus* Askew**

FINLAND: Lapland: Sodankylä, 200m, *67°25'55"N*, *27°09'59"E*, 10.viii.1983, M. Koponen [2♀, MZH: UCRCENT513242, 513293].

***Cirrospilus diallus* Walker**

PAKISTAN: Jhika Gali, *33°54'52"N*, *73°24'51"E*, 15.i.1985, host: galls, host plant: *Quercus dilatata* [1♂, BMNH: NHMUK10371727]. **SWEDEN: Skane:** Krankesjön, Ekskogen, 28m, 55°41'10"N, 13°27'40"E, 27.ix.2015, C. Hansson [1♀, UCRC: UCRCENT509088]. Krankesjön, Fiskeplats, 26m, 55°41'54"N, 13°29'58"E, 3.ix.2015, C. Hansson [2♀, UCRC: UCRCENT499082, 499083]. Snogeholmssjön, 51m, *55°34'3"N*, *13°43'0"E*, viii.1976, T. H. & J. Q. [1♀, BMNH: NHMUK10371728]. Håckeberga W., kärr, 55m, 55°42'28"N, 13°27'10"E, 1.vii.2015, C. Hansson [1?, UCRC: UCRCENT499084]. **UK: England: Berkshire**, Silwood Park, 70m, *51°24'39"N*, *0°38'21"W*, vii.1972, F. Benton, malaise trap [1♀, BMNH: NHMUK10371726].

***Cirrospilus dispersus* Zhu, LaSalle, & Huang**

Paratypes: CHINA: Hainan: Hainan Island; Tien Fong Mtns., *19°09'28"N*, *109°40'34"E*, 17.v.1983, Bouček [1♂ 2♀, BMNH: NHMUK10371815 – 10371817].

***Cirrospilus elegantissimus* Westwood**

No information on label, det. label handwriting appears to be Westwood's [1♀, USNM: UCRCENT471733].

***Cirrospilus floridensis* Evans**

BAHAMAS: Abaco: *26°25'37"N*, *77°06'23"W*, 20.xi.1993, R. Nguyen, host: *Phyllocnistis citrella* [1♂, ANIC: UCRCENT238445]. **HONDURAS: Atlantida Dept.:** Buena Vista L13, 97m, *15°31'39"N*, *87°27'47"W*, 28.iii.1995, R. Chavez, host: *P. citrella* [2♀, ANIC: UCRCENT238449, 238450]. La Ceiba, 14m, *15°46'7"N*, *86°47'32"W*, 31.viii.1995, J. Ortega, host: *P. citrella*, host plant: grapefruit [2♀, ANIC: UCRCENT238451, 238452]. **MEXICO: Tamaulipas:** Hidalgo, La Diana, *24°14'51"N*, *99°26'16"W*, 18.ix.1995, C. Martinez, host: *P. citrella*, host plant: mandarin [1♀, ANIC: UCRCENT238447]. **Veracruz:** Cuitlahuac, *18°48'54"N*, *96°43'33"W*, 20.xi.1995, N. Bautista Mtz. [1♀, ANIC: UCRCENT238446]. **NICARAGUA:** Costa Azules, Masatepe, 501m, *11°52'10"N*, *86°09'37"W*, 14.viii.1995, A. de Lallama, host plant: Citrus [1?, ANIC: UCRCENT238444]. **VENEZUELA: Monagas:** Maturin, *9°43'58"N*, *63°11'27"W*, xi.1996, host: *Phyllocnistis* sp. [2♀, ANIC: UCRCENT238448].

***Cirrospilus fuscus* (Girault)**

AUSTRALIA: Queensland: Cairns District, Tinaroo Lake, *17°10'39"S*, *145°32'35"E*, 4.xii.1982, Bouček [1♀, BMNH: NHMUK10371793].

***Cirrospilus infuscatus* Gates & Schauff**

USA: Arizona: Cochise Co., Huachuca Mtns., Hunter Cyn., 1613m, *31°24'11"N*, *110°15'12"W*, 14.iv.1986, Wagner, host: *Tischeria bifurcata* [1♂ 1♀, USNM: UCRCENT471734, 471735].

***Cirrospilus ingenuus* Gahan**

Allotype: INDONESIA: Java: Bogor (Buitenzorg), 230m, *6°35'0"S*, *106°47'0"E*, 1930, A. Voute, host: *Phyllocnistis citrella* [1♂, USNM: UCRCENT471736]. **Paratypes: INDONESIA: Java:** Bogor (Buitenzorg), 230m, *6°35'0"S*, *106°47'0"E*, 1930, A. Voute, host: *P.* citrella [1♂, USNM: UCRCENT471737].

Additional material examined: USA: Florida: Miami-Dade Co., Homestead, 1m, *25°27'54"N*, *80°28'26"W*, 22.i.1998, R. E. Duncan [1♀, UCRC: UCRCENT471738]. Homestead, 1m, *25°27'54"N*, *80°28'26"W*, xi.1997, R. E. Duncan [1♀, UCRC: UCRCENT471739].

***Cirrospilus inimicus* Gahan**

Allotype: USA: Illinois: Dupage Co., Hinsdale, 212m, *41°48'0"N*, *87°56'13"W*, F. Marsh, Hym. lot 9991, host: *Spilocryptus* sp., host plant: *Cecropia* sp. [1♂, USNM: UCRCENT471740]. **Paratypes: USA: Illinois: Dupage Co.**, Hinsdale, 212m, *41°48'0"N*, *87°56'13"W*, 30.viii.1933, F. Marsh, host: *Cecropia* larva (*Hyalophora cecropia*) [1♀, BMNH: NHMUK10371783]. Hinsdale, 212m, *41°48'0"N*, *87°56'13"W*, F. Marsh, Hym. lot 9991, host: *Spilocryptus* sp., host plant: *Cecropia* sp. Urticaceae [1♀, USNM: UCRCENT471741].

Additional material examined: CANADA: Ontario: Ottawa, 80m, *45°23'26"N*, *75°42'16"W*, 9.vii.1951, O. Peck, host: *Nematus oligospilus* [1?, BMNH: NHMUK10371785].

***Cirrospilus longifasciatus* Ferrière**

ETHIOPIA: Sidama: Wondo, Anberber, *7°05'1"N*, *38°37'7"E*, 10.xi.1964, D. J. Greathead, host: serpentine leaf miner, host plant: *Coffee arabica* [1♂ 1♀, BMNH: NHMUK10371768, BMNH: NHMUK10371769]. **KENYA:** Taita, *3°23'54"S*, *38°21'55"E*, 10.i.1961, T. J. Crowe, host: leaf miner [1♀, BMNH: NHMUK10371767]. **TANZANIA:** Moshi, *3°22'31"S*, *37°20'7"E*, 14.vii.1937, E. B. Notley, host: pupa of *Leucoptera* [1♀, BMNH: NHMUK10371771].

***Cirrospilus lyncus* Walker**

SWEDEN: Skåne, Silvåkra, 25m, 55°41'0"N, 13°27'0"E, 25.x.1980, C. Hansson, host: *Phyllonorycter* sp., host plant: *Quercus robar* [1♂, USNM: UCRCENT471743]. **Skane:** Krankesjön S, 24m, 55°41'50"N, 13°28'12"E, 14.ix.2015, C. Hansson [1♀, UCRC: UCRCENT499075]. Krankesjön, Ekskogen, 28m, 55°41'10"N, 13°27'40"E, 27.ix.2015, C. Hansson [5♀, UCRC: UCRCENT499077–81]. Krankesjön, Fiskeplats, 26m, 55°41'54"N, 13°29'58"E, 29.viii.2015, C. Hansson [1♀, UCRC: UCRCENT499073]. Krankesjön, Lottågarden, 24m, 55°42'18"N, 13°29'19"E, 29.viii.2015, C. Hansson [1♂, UCRC: UCRCENT499074]. Håckeberga, 55m, 55°34'37"N, 13°24'31"E, 29.vii.1981, C. Hansson, host: *Phyllonorycter* sp., host plant: *Quercus robar* [1♀, USNM:

UCRCENT471742]. Håckeberga, kärr, 55m, 55°34'37"N, 13°24'31"E, 7.viii.2015, C. Hansson [1♀, UCRC: UCRCENT499076].

***Cirrospilus nephelodes* Graham**

PORTUGAL: Madeira: Balcões, *32°44'26"N*, *16°53'12"W*, 8.viii.1987, M. W. R. de V. Graham [1♀, BMNH: NHMUK10371795].

***Cirrospilus nigrivariegatus* Girault**

USA: Iowa: Story Co., Ames, *42°01'50"N*, *93°37'48"W*, host: *Tischeria malifoliella* [1♀, USNM: UCRCENT471699]. **Virginia: Frederick Co.**, Winchester, 249m, *39°11'5"N*, *78°10'37"W*, 16.ii.1947, C. M. Becham, host: *P. crataegella* [2♀, USNM: UCRCENT471696, 471697]. Winchester, 249m, *39°11'5"N*, *78°10'37"W*, 1946, C. M. Becham, host: *P. crataegella*, host plant: apple [1♀, USNM: UCRCENT471698].

***Cirrospilus pulcher* Masi**

FRANCE: Var Department: St. Tropez, 14m, *43°16'0"N*, *6°38'28"E*, 19.vi.1980, Bouček [1♀, BMNH: NHMUK10371838].

***Cirrospilus pulcheria* Girault**

USA: California: Inyo Co., Panamint Valley, Surprise Canyon, 1007m, *30°06'47"N*, *117°09'42"W*, 27.iv.1981, J.B. Woolley, 81/015 [1?, TAMU: UCRCENT426762].

***Cirrospilus varifasciata* (Girault)**

AUSTRALIA: Queensland: 25 km W. Inglewood, 262m, *28°32′27″S*, *150°53′7″E*, 31.x.1976, Z. Bouček [4♂ 2♀, BMNH: NHMUK10353920, 10353930, 10353934, 10353940, 10353943, 10353952].

***Cirrospilus viticola* (Rondani)**

SPAIN: Andalusia: Jaén, Santa Elena, 763m, *38°20′30″N*, *3°32′47″W*, 5.vii.1974, Z. Bouček [1♀, ANIC: UCRCENT238659].

***Cirrospilus* spp.**

ARGENTINA: Salta: 29 km NE Cafayate, 1525m, *25°58′49″S*, *65°45′2″W*, 2–4.x.2009, M. E. Erwin, in river basin, malaise [1♀, UCRC: UCRCENT395935 (**D3751**)]. **AUSTRALIA: New South Wales:** Styx River State Forest, Falls Rd. 22km SE Wollomombi, 870m, *30°36′6″S*, *152°09′23″E*, 16.ii–7.iii.1994, K. MacGregor, old dry sclerophyll, FIT [1♀, CNC: CNC508563 (**D5108**)]. **Queensland:** Brisbane Forest Park, 378m, 27°25'5"S, 152°50'13"E, 13–19.xii.1997, N. Power, across creek, malaise trap [1♀, CNC: CNC508566 (**D5111**)]. Mt. Cotton, 67m, 27°37'0"S, 153°12'0"E, 13.ix.1997, C.J. Burwell [1♂, QM: UCRCENT491656 (**D6722**)]. **Western Australia:** Badgingarra NP, Cadda Rd., 237m, 30°23'38"S, 115°25'6"E, 1.xii.2009, J. Mottern, sweep, M09-051 [1♂, UCRC: UCRCENT312383 (**D4151**)]. D'Entrecasteaux N.P., Coastal Survivors Walk, 105m, 34°50'19"S, 116°00'17"E, 8.xii.2009, R. Waterworth, sweep, M09-100 [1♀, UCRC: UCRCENT414583 (**D3867**)]. Keystone Rd #3, ~3km W. Walpole, power line cut North of Hwy. 1, 34°59'1"S, 116°41'16"E, 20–21.xi.2002, George,

Hawks, Munro & Owen, Eucalyptus forest, YPT, PEET02-019P [1♀, UCRC: UCRCENT414592 (**D3998**)]. **BRAZIL: Rondonia:** Rancho Grande, 62 km SE of Ariquemas, 10°17'49"S, 62°52'4"W, 6.viii.1997, Heraty, fallen log with globular fungi, swp, H97-065 [1♀, UCRC: UCRCENT496069 (**D0065**)]. **COLOMBIA: Valle del Cauca:** Palmira, Corpoica, C.I. Palmira, 1015m, 3°30'31"N, 76°19'11"W, 8.ix.2011, E. M. Quintero & T. Kondo, reared in lab, ex: lepidopteran pupa on citrus, TK011, host plant: citrus [1♀, UCRC: UCRCENT320142]. **COSTA RICA: Guanacaste:** Est. San Gerardo, 600m, 10°52'49"N, 85°23'20"W, 26.iv.2016, J. Heraty, H16-004 [1♀, UCRC: UCRCENT491712 (**D6709**)]. **CROATIA: Dalmatia:** 30km S. Šibenik, *43°37'25"N*, *16°14'37"E*, 1–15.ix.2010, J. Halada [1♀, CNC: CNC509101]. **GUATEMALA: Zacapa Dept.:** 5km NW San Lorenzo, *15°03'1"N*, *91°46'10"W*, iv.1987, M. Sharkey [1♀, CNC: CNC509098 (**D4989**)]. **INDONESIA: Krakatau:** Anak Krakatau, 36m, *6°06'9"S*, *105°25'50"E*, 2.ix.1984, beat [1♀, BMNH: NHMUK10734426 (**D5330**)]. Rakata, W. Ridge, 250m, *6°08'54"S*, *105°25'45"E*, 5.ix.1984, Schefflera, beat [1♀, BMNH: NHMUK10734440 (**D5969**)]. **ITALY: Lazio: Roma**, Castel Porziano Presidential Estate Coastal dunes in N. corner of estate, 41°24'9"N, 12°21'2"E, 11.vi.2003, Bologna, Munro, Owen & Pinto, S.S., PEET03-095C [1?, UCRC: UCRCENT512500 (**D2177**)]. **JAPAN: Hokkaido:** Lake Utonai, *42°42'12"N*, *141°42'20"E*, 6.vii.1989, M. J. Sharkey, sweep [1♀, CNC: CNC509100]. **Kyushu:** Fukoka, Mt. Hiko, *33°28'43"N*, *130°55'38"E*, 12–29.v.1989, Takeno & Sharkey [1♀, CNC: CNC509084 (**D4984**)]. **MADAGASCAR: Vatovavy-Fitovinany: Ifanadiana**, Ranomafana National Park, Vohiparara

bridge, 17km W Ranomafna, 1109m, 21°13'34"S, 47°22'11"E, 24.xii.2001–2.i.2002, M. Rin'ha, rainforest, high altitude, malaise trap [1♀, USNM: UCRCENT471431 (**D6712**)]. **NEW CALEDONIA: Nord:** 2.5 km WSW Nepoui, Presqu'ile de Pindai, 45m, *21°20'7"S*, *164°57'46"E*, 30.x–3.xi.2000, D.W. Webb, E.T. Schlinger, L.J. Boutin, MT [1♀, CNC: CNC508089 (**D4664**)]. **NEW ZEALAND:** Waitakere Ranges, Matuku Reserve, 25m, 36°52'1"S, 174°28'34"E, 5.iv.2010, L. Masner, sweep, #24 [1♀, CNC: CNC509102 (**D4987**)]. **REPUBLIC OF CONGO: Dept. Pool: Iboubikro**, Lesio-Loun Pk., 355m, 3°16'11"S, 15°28'16"E, 18.viii.2008, M. Sharkey, malaise trap [1♀, UCRC: UCRCENT264960]. **RUSSIA: Far East:** Primorski krai Lazovski, Zapovednik c. 170km E. Vladivostok, Korpad, 526m, 43°17'15"N, 134°07'10"E, 4–24.viii.2001, M. Quest, Mountain Top, Malaise Trap 487, BMNH (E) 2009-59 [1♀, BMNH: NHMUK10734430 (**D5959**)]. **Primorsky Krai: Ussuriysk District**, Gornotayozhnoye, 44°06'0"N, 132°25'0"E, 12–17.viii.1999, M.V. Michailovskaya, MT [1?, UCRC: UCRCENT512408 (**D2023**)]. **SOUTH AFRICA:** Mossel Bay, *34°11'0"S*, *22°08'0"E*, 18–30.xi.1921, R. E. Turner [1♀, BMNH: NHMUK10371770]. **TAIWAN: Nantou Hsien:** Sun Moon Lake Tehuache, 800–900m, *23°50'53"N*, *120°55'49"E*, 6.vi.1990, J. Heraty, Forest Edge [3♀, UCRC: UCRCENT307480 – 307482]. **TUNISIA:** Cap Ben, El Gabo, Orchard El Jahem, 36°37'46"N, 10°34'0"E, 14.xii.2015, M. Hoddle [1♀, UCRC: UCRCENT485194 (**D4995**)]. **UK: England: Norfolk Co.**, E Watton, 42m, *52°13'14"N*, *0°52'25"E*, 14–16.vii.2015, N. Dale-Skey, trees [1?, BMNH: NHMUK10734434 (**D5963**)]. **Surrey**, Barnes Common, 9m, *51°27'58"N*,

0°14'43"W, 28.vii.2015, N. Dale-Skey, swp [1♂ 2♀, BMNH: NHMUK10734435 (D5964), 10734436 (**D5965**), 10734437 (**D5966**)]. Richmond Park, 32m, *51°26'31"N*, *0°16'59"W*, 1.ix.2009, J. S. Noyes [1♀, BMNH: NHMUK10734441 (**D5970**)]. **USA: AZ: Cochise Co.**, Wilcox Dry Lake, 5 km E Hwy 186, 32°14'34"N, 109°45'12"W [1♀, UCRC: UCRCENT414590 (**D3996**)]. **California: Riverside Co.**, Berdoo Canyon, 321m, *33°48'43"N*, *116°10'24"W*, 26.iv.1979, G. Gordh [1♂, UCRC: UCRCENT416548]. **San Luis Obispo Co.**, Cal Poly, 84m, *35°18'0"N*, *120°40'2"W*, 4.x.2010, R. Perry, reared, host plant: *Quercus agrifolia* [1♀, UCRC: UCRCENT355650]. **Maryland: Montgomery Co.**, Riley's Lock, *39°04'8"N*, *77°20'31"W*, 18.v.1986, G. Gibson [1♀, CNC: CNC509103 (**D4994**)]. **New Mexico: Otero Co.**, Sacramento Mtns, High Rolls, 2123m, 32°57'0"N, 105°49'0"W, 1–10.v.2004, M. E. Irwin, dry wash, malaise trap [4♀, UCRC: UCRCENT357530 (**D3672**), UCRC: UCRCENT357531 (**D3673**), UCRC: UCRCENT357534 (**D3676**), UCRC: UCRCENT357535 (**D3677**)].

6. *Colpoclypeus* Lucchese - Fig. 3.21

Colpoclypeus Lucchese, E. 1941: 33. Type species: *Colpoclypeus florus* (Walker); by monotypy. Locality: UK, England, Isle of Wight. Depository: BMNH. Lucchese described *C. silvestrii* as the type species, but this was named a synonym of *C. florus* by Bouček (1959).

Diagnosis: *Colpoclypeus* is characterized by a bilobed clypeus (Fig. 3.21A), the dorsal margin of the torulus is below the ventral margin of the compound eye (Fig. 3.21A), notaulus that is complete and curves to the anterior margin of the axilla (Fig. 3.21C), propodeum with complete median carina and complete plica (Fig. 3.21C), and parastigma smoothly connecting the submarginal vein, not extending into the basal fold (Fig. 3.21C). Males possess 3 funiculars and 3 clavomeres. This genus is similar to *Pseudiglyphus*, however, the mesosoma of *Colpoclypeus* is metallic, and *Pseudiglyphus* is drab brown (Fig. 3.42). *Colpoclypeus* is also similar to *Vagus*, but in *Vagus* the median carina and plica are absent on the propodeum (Fig. 3.48D), and the clypeus is linear (Fig. 3.48A).

Description: Female: Metallic green head and mesosoma present; yellow absent. Fore wing hyaline.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus bilobed. Upper ocular sulcus absent. Frontal suture present. Vertex normal, not vaulted; large, paired setae and small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin at or below ventral margin of compound eye, but closer to ventral margin of eye than to clypeus. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with deep-reticulate sculpturing. Notaulus complete, extending to anterior half of axilla. Axilla advanced anteriorly more than 75% of longitudinal

length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves absent; 2 pairs of setae - anterior pair shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina present and complete; plicae present and complete; costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar with median depression or sulcus. Metacoxa with distinct sculpturing (reticulate).

Fore wing: basal fold setose. Cubital fold basally setose and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein and not extending into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum absent; fore wing is setose posterior to parastigma. Admarginal setae present. Postmarginal vein more than 1.0X but less than 1.5X length of stigmal vein.

Male as female, except: 3 funiculars. 2 clavomeres. Protibia in *Colpoclypeus michoacanensis* Sanchez and Figueroa greatly swollen (Fig. 3.21D).

Hosts: LEPIDOPTERA: Tortricidae: *Adoxophyes orana* Fischer von Röslerstamm; *Amorbia cuneanum* (Walsingham) on *Persea* sp. (Lauraceae); *Choristoneura rosaceana* (Harris); gregarious on *Tortrix* sp. on citrus; *Pandemis pyrusana* Meyrick. **UNKNOWN:** recovered from *Solidago* sp. (Asteraceae). **HEMIPTERA: Psyllidae:** *Psylla* sp. (These host records are most likely due to

contamination by leafrollers in the plant material; further substantiation is necessary to corroborate these claims).

Distribution (Fig. 3.22)**: Nearctic:** USA (CA, MI, WA), Mexico (MI) (Sanchez-Garcia *et al.*, 2011). **Palearctic:** Egypt, France, Moldova, Russia (Yefremova, 2002), Spain, Sweden, Switzerland.

Taxonomic Summary:

1. *Colpoclypeus florus* (Walker)
2. *Colpoclypeus michoacanensis* Sanchez & Figueroa

Material Examined:

***Colpoclypeus* florus (Walker, 1839)**

EGYPT: Minya Gov.: Mallawi, *27°44'2"N*, *30°51'2"E*, 22.ix.1991, A. El-Heneidy, cotton exp. plot [3♀, UCRC: UCRCENT485224 – 485226]. **FRANCE: Var Department:** Hyères, Daphne, 47m, *43°07'13"N*, *6°07'39"E*, v.1911, Chapman [3♀, USNM: UCRCENT471370]. **MOLDOVA:** Bachoy, *46°54'59"N*, *28°54'7"E*, 15.vii.1985, M. Babidorich, host: *Psylla* sp. [1?, USNM: UCRCENT471637]. **SPAIN:** (no location other than "Spain" on label), 5.iv.1973, host: gregarious on *Tortrix*, host plant: citrus [2♀, UCRC: UCRCENT485222, 485223]. **SWEDEN: VB:** Vindelns kommun Svartbergets försökspark, 64°09'16"N, 19°35'35"E, 18.viii–1.ix.2003, 15 yr. spruce plantation with blueberry, malaise trap [1♀, UCRC: UCRCENT161029 (**D2229**)]. **SWITZERLAND:** Geneva, Place des Nations, *46°13'23"N*, *6°08'21"E*, 7.vii.1992, J. Steffen, in glass bus shelter [1♀, CNC:

CNC509082 (**D4982**)]. **Valais**, Chateauneuf, *46°13'25"N*, *7°19'42"E*, 5.viii.1963, K. Carl, host: *Adoxophyes orana* (Tortricidae) Fischer von Röslerstamm [1♀, USNM: UCRCENT471369]. **USA: Michigan: Ionia Co.**, Klackle Farm, Greenville, 287m, *43°10'48"N*, *85°17'51"W*, 13.vii.1999, conv. row 10, #1, host: *Choristoneura rosaceana* (Harris) Tortricidae [1♀, USNM: UCRCENT471368]; 13.vii.1999, soft, row 6, #1, host: *Choristoneura rosaceana* (Harris) Tortricidae [1♀, USNM: UCRCENT471367]. **New York: Jefferson Co.**, E. of Alexandria Bay, 74m, 44°24'7"N, 75°48'7"W, 31.vii.2010, S. Triapitsyn, roadside of hwy., sweep [1♀, UCRC: UCRCENT485227]. **Washington: Chelan Co.**, Wenatchee, 211m, *47°15'36"N*, *120°12'0"W*, 17.viii.1992, J. F. Brunner, host: *Pandemis pyrusana* [1♂ 1♀, USNM: UCRCENT471638, 471639]. Wenatchee, 211m, *47°25'27"N*, *120°18'50"W*, 16.ix.1997, R. S. Pfannenstiel, T-202 [1♀, USNM: UCRCENT471366].

***Colpoclypeus michoacanensis* Sanchez & Figueroa**

USA: California: San Diego Co., *33°01'37"N*, *117°01'26"W*, 29.vi.2005, S. H. Dreistadt, host: *Amorbia cuneana*, host plant: *Persea* sp. [3♂ 16♀, UCDC: UCRCENT478175 – 478181]. San Diego POE, 158m, *32°33'7"N*, *116°56'18"W*, SELIS 0500495, host: cut flowers, host plant: *Solidago* sp. [1♀, USNM: UCRCENT471371].

7. *Diaulinopsis* Crawford - Fig. 3.23

Diaulinopsis Crawford, 1912: 182. Type species: *Diaulinopsis callichroma* Crawford [examined]; holotype ♀, by original designation and monotypy. Locality: USA, Arizona, Tempe. Depository: USNM, Type No. 14795.

Diagnosis: *Diaulinopsis* is most easily identified by a combination of 3 characters: a notaulus that is complete to the posterior half of the axilla (Fig. 3.23F), the median carina on the propodeum is absent (Fig. 3.23F), and the postmarginal vein length being more than 1.5X the length of the stigmal vein (Fig. 3.21G). Male *Diaulinopsis* are easy to recognize as the scape is always bulbous and swollen (Fig. 3.23B, C). This genus is often misidentified to *Diglyphus,* however, *Diglyphus* has notauli that are curved and incomplete (Fig. 3.27D, E) (rarely, the notaulus is complete to the anterior margin of the axilla), and the axilla is advanced anteriorly more than 75% of longitudinal length past anterior margin of the transccutal articulation (Fig. 3.27D); the axilla are only advanced anteriorly 10–75% of longitudinal length in *Diaulinopsis*. There are several species of *Cirrospilus* that have similar metallic green coloration as *Diaulinopsis*, but *Cirrospilus* has a complete median carina on the propodeum (Fig. 3.18F) and a postmarginal vein that is 0.5–1.5X length of stigmal vein (Fig. 3.18G).

Description: Female: Metallic green on head and mesosoma. Yellow color on mesosoma absent. Fore wing hyaline.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture present. Vertex normal, not vaulted; large, paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex or extending past vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with thin sculpturing. Notaulus complete to posterior half of axilla, close to transscutual articulation. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially; 2 pairs of setae - anterior pair shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina, plicae absent, and costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carinae absent. First gastral tergite collar with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by more than its own length from stigmal apex. Speculum present with few or no setae within or absent. Admarginal setae present. Postmarginal vein more than 1.5X length of stigmal vein.

Male as female, except: scape swollen.

Hosts (from material examined): DIPTERA: **Agromyzidae**: *Agromyza* sp.; *Liriomyza schmidti* (Aldrich) on *Bauhinia* leaves (Fabaceae); *Liriomyza* spp. on *Cicer arietinum* (Fabaceae), *Cucumis melo*, Cucurbita sp. (Cucurbitaceae), *Beta vulgaris* (Amaranthaceae); *Phytobia* (*Calycomyza*) *malvae* (Burgess) on *Sida acuta* (Malvaceae). **UNKNOWN:** leaf miner on *Brassica oleracea* (Brassicaceae), *Cucurbita foetidissima* (Cucurbitaceae), *Medicago sativa* (Fabaceae), nightshade (Solanaceae).

Distribution (Fig. 3.24)**: Indo-Malay:** India. **Nearctic:** Canada (ONT), USA (AZ, CA, CO, FL, GA, ID, IL, IA, MN, MO, MS, NE, NJ, OR, SD, TX). **Neotropic**: Colombia, Ecuador (Galapagos), Mexico (NL), St. Vincent, Trinidad. **Palearctic:** Austria, Bulgaria, Czech Republic, France, Italy, Mongolia, Morocco, Romania, Russia, Slovenia, Spain, Sweden, Switzerland, Syria.

Taxonomic Summary:

1. *Diaulinopsis albimaxilla* Hansson
2. *Diaulinopsis albiscapus* Girault
3. *Diaulinopsis arenaria* Erdös
4. *Diaulinopsis callichroma* Crawford
5. *Diaulinopsis subatricorpus* Girault,

Material Examined:

***Diaulinopsis albimaxilla* Hansson**

AUSTRIA: Lower Austria: Spitzerberg (S slope), 2.5km S of Hundsheim, 190–250m, 48°05'48"N, 16°56'29"E, 16.vi.2007, S. V. Triapitsyn & C. Thuróczy, sweep [1♀, UCRC: UCRCENT485239]. **ITALY: Roma:** Fosso di Trafusina, 30m, 41°46'40"N, 12°24'45"E, 11.vi.2003, Munro et al. [2♀, UCRC: UCRCENT108711, 108722]. Lazio, Bosco di Manziana, 400m, 42°07'24"N, 12°07'19"E, 9.vi.2003, Munro et al. [1♂, UCRC: UCRCENT104670]. **MONGOLIA:** Omnogov' Uhaa Tolgod, 1517m, 43°31'0"N, 101°32'0"E, 6–16.vii.1994, J. M. Carpenter *et. al.* [1♂, UCRC: UCRCENT485238].

***Diaulinopsis arenaria* (Erdös)**

AUSTRIA: Lower Austria: 1km. W. Hollern, 150m, 48°04'22"N, 16°52'37"E, 16.vi.2007, C. Thuroczy & S. Triapitsyn, sweep [1♀, UCRC: UCRCENT163605]. **Lower Austria:** 1km. W. Hollern, 150m, 48°04'22"N, 16°52'37"E, 16.vi.2007, S. Triapitsyn [5♂ 2♀, UCRC: UCRCENT124720, 219726, 219801, 219812, 219845, 219859, 219900]. **BULGARIA: Blagoevgrad:** Sandanski, 244m, *41°34'8"N*, *23°16'54"E*, vi.1969, Kocourek [1♀, BMNH: NHMUK01037145]. **COLOMBIA: Santander:** Virolín Costilla de Fara, 1800m, 6°06'0"N, 73°13'0"W, 29–31.iii.1999, E. Gonzalez, malaise trap, M.286 [1♀, UCRC: UCRCENT127546]. **CZECH REPUBLIC: Moravia:** Hosterádky, PR Špice, 290m, 49°06'47"N, 16°46'10"E, 18.viii.2009, P. Banar & I. Malenovsky, dry grassland, shrubs [1♂, CNC: CNC509137]. **FRANCE: Bouches du Rhones:** Foncolombe, *43°38'19"N*,

5°28'2"E, 24.vi.1986, M.W.R. de V. Graham [1♀, BMNH: NHMUK10371743]. **Gironde Dept.:** Sainte Colombe, (nr. Castillon-la-Bataille), 97m, 44°54'0"N, 0°02'0"W, 13.viii.1998, M. van Helden, MT [1♀, UCRC: UCRCENT509108]. **ITALY: Campania: Avellino Prov.**, Piana d. Dragone, 3km E. Volturara, 760m, 40°52'33"N, 14°58'23"E, 6.vi.2003, Munro et al. [4♀, UCRC: UCRCENT122627, 122630, 122632, 122656]. **Lazio: Roma Prov.**, Castel Porziano Estate, 30m, 41°42'9"N, 12°21'2"E, 11.vi.2003, Munro *et al.* [1♀, UCRC: UCRCENT124729]. **Roma:** Fosso di Trafusina, 30m, 41°46'40"N, 12°24'45"E, 11.vi.2003, Munro et al. [2♂ 1♀, UCRC: UCRCENT109507, 112449, 120272]. Lazio, Bosco di Manziana, 400m, 42°07'24"N, 12°07'19"E, 9.vi.2003, Munro et al. [3♀, UCRC: UCRCENT104603, 104614, 105604]. **MOROCCO: Souss-Massa:** Agadir, 58m, *30°25'41"N*, *9°35'54"W*, 4.v.1974, S. Erlandsson [1♀, BMNH: NMHMUK10371741]. **ROMANIA: Iasi**, Breazu, rzeski, 130m, 47°14'39"N, 27°28'58"E, 5.vii.2011, J.S. Noyes, steppe vegetaion, MT [3♂ 3♀, UCRC: UCRCENT485735 – 485740]. **RUSSIA: Stavropol Krai:** Achikulak, 44°33'43"N, 44°50'3"E, 5.vii.2003, V. Kostjukov, MT [3♂ 4♀, UCRC: UCRCENT263750, 270657, 270670, 270682, 270695, 270704, 270715]. hwy nr. Voznesenovskoye, 83m, 45°47'48"N, 43°24'42"E, 15.viii.2003, E. Khomchenko [1♂, UCRC: UCRCENT270868]. Prietokskiy, 43°59'4"N, 43°25'52"E, 13.vii.2003, V. Kostjukov [10♂ 25♀, UCRC: UCRCENT275753, 275755, 275773, 276524, 276555, 276570, 276591, 276594, 276595, 276603, 276662, 276664, 276700, 276740, 276749, 276752, 276754, 76770, 276778, 276783, 276785, 276791, 276816, 276818,

276828, 277249, 277252, 277256, 277296, 277304, 277312, 277332, 277352, 277360, 277363]. **SLOVENIA:** Kráľovský Chlmec, *48°25′23″N*, *21°58′39″E*, 27.vi.1948, Z. Bouček [1♀, BMNH: NHMUK10371742]. **SPAIN: Seville:** Carmona, 229m, *37°28′18″N*, *5°38′30″W*, v.1987, CIE A 19167, host: *Liriomyza* sp., host plant: chickpea [1♀, BMNH: NHMUK10371739]. **SWEDEN: Oland: Skogsby**, Kalkstad, 43m, 56°36'33"N, 16°30'33"E, 18.viii.1978, K. J. Hedqvist [1♀, BMNH: NHMUK10371740]. **SWITZERLAND: Basel-Landschaft:** Liesberg, 521m, *47°24′15″N*, *7°25′50″E*, 2.vii.1976, host: Diptera [1♀, BMNH: NHMUK01037144]. **SYRIA: Aleppo:** Tel-Hadya, 281m, *35°59′54″N*, *36°56′20″E*, 2.vi.1987, O. Tahhan, chickpeas, D-vac [1♀, BMNH: NHMUK10371738]. **UKRAINE:** Kiev, 5–6.vi.2004 [1?, UCRC: UCRCENT512320].

***Diaulinopsis callichroma* Crawford**

CANADA: Ontario: 3 mi. E Norwood, *44°24′16″N*, *77°57′2″W*, 3.viii.1981, J. T. Huber, roadside vegetation, sweep [1♀, UCRC: UCRCENT485216]. **ECUADOR: Galapagos: Fernandina Is.**, Cerro Verde 5km NE Cabo Hammond, 110–150m, *0°26′33″S*, *91°35′33″W*, 5.v.1991, J. Heraty, Palo Santo, H91-019 [1♀, UCRC: UCRCENT444206]. **Fernandina Island**, 10 km NE Cabo Hammond, 400m, *0°25′9″S*, *91°34′52″W*, 8.v.1991, J. Heraty, transition, H91-026 [4♀, UCRC: UCRCENT444202–205]. 10 km NE Cabo Hammond, 400m, *0°25′9″S*, *91°34′52″W*, 9.v.1991, J. Heraty, transition, H91-027 [3♀, UCRC: UCRCENT444188 – 444190]. 10 km NE Cabo Hammond, 400m, *0°25′9″S*, *91°34′52″W*, 9.v.1991, J. Heraty, transition, H91-028 [11♀, UCRC:

UCRCENT444191 – 444201]. **Isabela Island**, Alcedo 11kmSW NE Playa, 1100–1200m, *0°24'11"S*, *91°05'47"W*, 21.vi.1991, J. Heraty, shrub forest, H91-106 [1♂, UCRC: UCRCENT444212]. Cerro Azul, 7km E Caleta Iguana, 700m, *0°58'10"S*, *91°24'55"W*, 20.v.1991, J. Heraty, pampa, H91-046 [1♂ 1♀, UCRC: UCRCENT436428, 444187]. Cerro Azul, 8km E Caleta Iguana, 850m, *0°57'40"S*, *91°24'59"W*, 22.v.1991, J. Heraty, Crater/grass, H91-051 [2♀, UCRC: UCRCENT444207, 444208]. Cerro Azul, Caleta Iguana, 85m, *0°56'52"S*, *91°27'17"W*, 19.v.1991, J. Heraty, dry decid. for., H91-041 [1♂, UCRC: UCRCENT444211]. **Santa Cruz Island**, 3km S. Bellavista, 115m, 0°43'12"S, 90°19'35"W, 1–29.ii.1989, Peck & Sinclair, trans. z., malaise, 89-80 [1♀, UCRC: UCRCENT444210]. **Santiago Island**, 13kmE Playa Espumilla, 800m, *0°13'23"S*, *90°46'11"W*, 9.vi.1991, J. Heraty, grass pampa, H91-082 [1?, UCRC: UCRCENT444209]. **MEXICO: Nuevo Leon:** 20 km N. Salinas Victoria, Carr. 40, 550m, *26°08'47"N*, *100°20'21"W*, 13.vii.1983, A. Gonzalez H. [1♂ 1♀, UCRC: UCRCENT416588, 416589]. Ciénega de Flores, Hacienda La Amistad, 405m, *25°57'24"N*, *100°09'51"W*, 10.vii.1983, A. Gonzalez [2♂, UCRC: UCRCENT512264, 512265]. **Mun. Allende**, Lazarillos de Abajo, 438m, *25°18'57"N*, *100°02'40"W*, 9.vii.1983, A. Gonzalez [2♂, UCRC: UCRCENT416577, 416578]. **Santiago**, El Cercado, Hacienda Las 3 blanquitas, 531m, *25°22'53"N*, *100°08'51"W*, 9.vii.1983, A. Gonzalez [1♂ 1♀, UCRC: UCRCENT416584, 416585]. 8 km N Terán, *25°19'43"N*, *99°39'10"W*, 16.v.1984, Gordh, Sierra, Rodriguez [1♂, UCRC: UCRCENT416586]. Bustamante, Santo

Thomas, *26°32'4"N*, *100°30'20"W*, 18.v.1984, Gordh, Sierra, Rodriguez [2♂ 1♀, UCRC: UCRCENT416587, 512262, 512263]. Villa de Santiago, San Juan Bautista, 463m, *25°26'11"N*, *100°09'14"W*, 17.v.1984, Sierra & Rodriguez [2♀, UCRC: UCRCENT512260, 512261]. **SAINT VINCENT: St. George:** Kingstown, 46m, *13°09'38"N*, *61°13'31"W*, 4.vii.1976, wasteground [1♀, BMNH: NHMUK10371734]. **TRINIDAD:** *10°33'53"N*, *61°17'37"W*, vii.1972, No. 4 CIE A 3718, host: leaf miner, host plant: cabbage [1♀, BMNH: NHMUK10371733]. **USA: Arizona: Coconino Co.**, Hwy 180, 1851m, 35°36'54"N, 112°04'49"W, 23.vi.2014, A. Baker & S. Heacox, roadside veg., sweep [1♀, UCRC: UCRCENT485215]. **California: Glenn Co.**, Alder Springs, *39°39'2"N*, *122°43'33"W*, 7.vi.1984, J. D. Pinto [1♀, UCRC: UCRCENT416583]. **Imperial Co.**, 1 mi. E Brawley, -41m, *32°58'43"N*, *115°28'59"W*, 11.v.1996, M. Gates, G96/035 [3♀, UCRC: UCRCENT512251 – 512253]. 1 mi. E Brawley, *32°58'43"N*, *115°28'59"W*, 11.v.1996, M. Gates, LM96-274, host: serpentine leaf miner, host plant: *Medicago sativa* [2♀, UCRC: UCRCENT512249, 512250]. Hwy. 78, 1 mi. W of East Highline Canal, -2m, *32°58'29"N*, *115°19'2"W*, 16.viii.1996, M. Gates, LM96-1195, host: leaf mine, host plant: *Medicago sativa* [1♀, UCRC: UCRCENT512256]. Hwy. 78, 1 mi. W of East Highline Canal, -2m, *32°58'29"N*, *115°19'2"W*, 16.viii.1996, M. Gates, LM96-1179, host: leaf mine, host plant: *Medicago sativa* [2♀, UCRC: UCRCENT048417, 512255]. Hwy. 78, 1 mi. W of East Highline Canal, -2m, *32°58'29"N*, *115°19'2"W*, 16.viii.1996, M. Gates, LM96-1185, host: leaf mine, host plant: *Medicago sativa* [1♀, UCRC: UCRCENT48415]. Hwy. 78, 1 mi. W of East

Highline Canal, *32°58'29"N*, *115°19'2"W*, 16.viii.1996, M. Gates, LM96-1214, host: leaf mine, host plant: *Medicago sativa* [1♀, UCRC: UCRCENT512254]. **Orange Co.**, Garden Grove, 27m, *33°46'19"N*, *117°56'1"W*, 26.vi.1984, H. Andersen [2♂ 2♀, UCRC: UCRCENT485207 – 485210]. Laguna Canyon, 79m, *33°35'9"N*, *117°45'48"W*, 8.iv.1982, H. Andersen [1?, UCRC: UCRCENT512257]. **Riverside**, Lake Elsinore, 384m, *33°40'50"N*, *117°21'44"W*, 31.iii–1.iv.1989, H. Andersen, sweep [1♀, UCRC: UCRCENT485201]. **Riverside Co.**, Bautista Canyon, 855m, *33°39'0"N*, *116°48'42"W*, 7.iv.1981, G. Gordh [1♂, UCRC: UCRCENT485214]. Lake Skinner; NE end, 479m, 33°36'7"N, 117°02'5"W, 7–21.v.1996, J. D. Pinto, unburned, malaise trap, METU11 [1♀, UCRC: UCRCENT512259]. Menifee Vly. (hills on W. end), 549m, *33°39'0"N*, *117°13'0"W*, 28.vi.1983, J. D. Pinto [2♂, UCRC: UCRCENT485212, 485213]. Riverside, *33°57'12"N*, *117°23'46"W*, 2.vi.1978, J. C. Hall [2♀, UCRC: UCRCENT416597, 416598]. Thousand Palms Canyon, S. of Oasis, 149m, *33°49'58"N*, *116°18'40"W*, 17.xi.1995, M. Gates, G95/155 [1♀, UCRC: UCRCENT512266]. **San Bernardino Co.**, 3 km E 7 Oaks, 34°11'0"N, 116°53'27"W, 26.v.2001, D. Yanega [1♂, UCRC: UCRCENT052332]. Mitchell's Caverns, *34°56'27"N*, *115°30'52"W*, 25.ix.1984, D. Pinto [1♀, UCRC: UCRCENT416582]. San Bernardino Mtns., Baldwin Lake, 2045m, *34°16'34"N*, *116°48'36"W*, 27.vii.1996, M. Gates [1♀, UCRC: UCRCENT512258]. **San Diego Co.**, 4 km E Lake Henshaw off SH79, *33°13'59"N*, *116°41'38"W*, 26.vii.1996, M. Gates, LM96-1032, host: leaf mine, host plant: *Cucurbita foetidissima* [1♂, UCRC: UCRCENT509109]. Escondido, 219m, *33°07'7"N*, *117°04'24"W*, 24.vii.1963, E. R.

Oatman, host: *Liriomyza* sp., host plant: Crenshaw melon [1♀, UCRC: UCRCENT485204], 31.vii.1963, E. R. Oatman, host: *Liriomyza* sp., host plant: Table beet [1♂, UCRC: UCRCENT485203], 25.vi.1964, E. R. Oatman, host: *Liriomyza* sp., host plant: squash [1♀, UCRC: UCRCENT485202]. **Tulare Co.**, Johnsondale, Holey Meadows, 1920m, *35°57'15"N*, *118°36'55"W*, 21.vii.1981, H. Andersen [1♀, UCRC: UCRCENT485217]. **Colorado:** Sterling, Platle Riv., *40°37'4"N*, *103°11'17"W*, 13.viii.1986, J.D. Pinto [1♀, CNC: CNC509139]. **Florida: Gadsden Co.**, Chatahoochee, 71m, *30°42'17"N*, *84°50'39"W*, 30.iv.1952, O. Peck [1♀, CNC: CNC509141]. **Manatee Co.**, Bradenton, 27°29'55"N, 82°34'30"W, 25.v.1983, Baysinger, host: leaf miner, host plant: nightshade [1♂, CNC: CNC509124]. **Miami-Dade Co.**, Hialeah, 2m, *25°51'18"N*, *80°16'42"W*, 18.viii.1962, C. E. Stegmaier, host: *Phytobia* (*Calycomyza*) *malvae*, host plant: *Sida acuta* (Malvaceae) [1♀, FSCA: UCRCENT424542]. Hialeah, 2m, *25°51'18"N*, *80°16'42"W*, 19.viii.1962, C. E. Stegmaier, host: *Liriomyza schmidti* (Aldrich), host plant: *Bauhinia* leaves (Fabales: Fabaceae) [2♀, FSCA: UCRCENT476753, 476754]. Hialeah, 2m, *25°51'18"N*, *80°16'42"W*, 3.viii.1962, C. E. Stegmaier, host: Agromyzidae [2♂ 3♀, FSCA: UCRCENT424538 – 424541, 424543]. **Georgia: McIntosh Co.**, Sapelo Island, *31°28'38"N*, *81°14'31"W*, 28.iv–5.v.1987, BRD Team, shrub sand dunes, FIT [1♀, CNC: CNC509125]. **St. Clair Co.**, Chapel View Prarie, 246m, *38°13'10"N*, *93°51'11"W*, 29.vi.1999, M. Gates [1♂, UCRC: UCRCENT048466]. **Idaho: Cassia Co.**, Oakley, 1393m, *42°14'36"N*, *113°52'46"W*, 10.vi.1931, host plant: *Descurainia sophia* (Brassicales:

Brassicaseae) [1♂, BMNH: NHMUK10371735]. **Illinois: Champaign Co.**, Urbana, *40°06'25"N*, *88°12'28"W*, 3.ix.1983, J.T. & D.E. Huber [1♂, CNC: CNC509126]. **Cook Co.**, Schaumburg near Golf Road, 242m, *42°02'49"N*, *88°08'53"W*, 29.vii.1996, H. E. Andersen, sweep [2♂ 4♀, UCRC: UCRCENT416590 – 416595]. **Iowa: Cass Co.**, Lake Anita, 397m, *41°25'37"N*, *94°46'33"W*, 19.vii.1984, H. Goulet [1♀, CNC: CNC509122, 509123]. **Iowa Co.**, 2 mi. E Victor, on I-80, 244m, *41°41'41"N*, *92°13'50"W*, 21.vi.1991, H. E. Andersen, sweep [27♂ 5♀, UCRC: UCRCENT509091 – 509107, 509110 – 509120, 512241 – 512244]. **Minnesota: Clay Co.**, Bluestem prairie ca 4 mi SEE Glyndon, 302m, 46°51'19"N, 96°28'25"W, 31.v–1.vi.2004, R. Rakitov, moist tallgrass prairie, yellow pan trap [1♀, UCRC: UCRCENT485211]. **Mississippi: Forrest Co.**, Petal, *31°20'43"N*, *89°15'25"W*, 23.ix.1983, J.D. Pinto [1♂, UCRC: UCRCENT416581]. **Missouri: Bates Co.**, Ripgut Prairie, NE Rich Hill, 225m, *38°06'59"N*, *94°20'23"W*, 29.vi.1999, M. Gates [1♂ 1♀, UCRC: UCRCENT416599, 416600]. **Nebraska: Dawson Co.**, Gothenburg, 783m, *40°55'47"N*, *100°09'34"W*, 22.vi.1991, H. E. Andersen, sweep [1♂, UCRC: UCRCENT485206]. **New Jersey:** ix.1975, R-15-10, host: leaf miner [1♂, BMNH: NHMUK10371736]. **Oregon: Harney Co.**, Steen Mtn., Loop rd. at Blitzen Crossing, 1545m, 42°38'0"N, 118°46'0"W, 9.vii.1999, J. D. Pinto [2♀, UCRC: UCRCENT416579, 416580]. **South Dakota: Union Co.**, Elk Point, 345m, *42°41'2"N*, *96°40'55"W*, 1913, C.N. Ainslie, host: *Agromyza* sp. [1♂, CNC: CNC509140]. **Texas: Anderson Co.**, 5 mi SE Elkhart, Salmon, 153m, 31°34'25"N, 95°29'57"W, 27.iv.1985, J.B. Woolley, 85/007 [1♂, TAMU: UCRCENT473294

(**D5976**)]. **Burnet Co.**, Inks Lake State Park, *30°43'58"N*, *98°21'59"W*, 25.vii.1988, J. Heraty, sweep [1♂, UCRC: UCRCENT485205]. Inks Lake State Park, North Trail, *30°44'0"N*, *98°21'30"W*, 2.v.1987, J. Heraty, sweep [3♂ 1♀, UCRC: UCRCENT512245 – 512248].

***Diaulinopsis* sp.**

INDIA: Uttar Pradesh: New Delhi, IARI, 220m, 28°37'51"N, 77°09'50"E, 27.vi.2005, J. Heraty, field, sweep, H05-61 [1♀, UCRC: UCRCENT122427]. New Delhi, IARI, 220m, 28°37'51"N, 77°09'50"E, 8.xi.2003, J. Heraty, pan trap, H03-112 [1♀, UCRC: UCRCENT414578 (**D3862**)].

8. *Dichatomus* Förster - Fig. 3.25

Dichatomus Förster, 1878: 48. Type species: *Dichatomus acerinus* Förster; depository: unknown.

Diagnosis: *Dichatomus* is identified by the linear clypeus (Fig. 3.25A), notaulus that is complete to the posterior half of the axilla (Fig. 3.25C, D), median carina on the propodeum (Fig. 3.25C), and postmarginal vein that is more than 1.5X length of stigmal vein (Fig. 3.25B). This genus is very similar to *Aulogymnus,* however, *Aulogymnus* has a bilobed clypeus (Fig. 3.1D), lacks a median carina on the propodeum (Fig. 3.14F–H), and the frontal suture is present (Fig. 3.14B).

Description: Female: Metallic green head and mesosoma. Yellow color on mesosoma absent. Fore wing hyaline.

Head: Malar sulcus present. Tentorial pits distinct and enlarged. Clypeus linear. Upper ocular sulcus absent. Frontal suture absent. Vertex not vaulted; large, paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. 3 funiculars. 2 clavomeres.

Body: Mesoscutum with deep-reticulate sculpturing. Notaulus complete to posterior half of axilla, close to transscutual articulation. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves absent; with 2 pairs of setae present - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum; asetose. Propodeum not constricted medially; with smooth or shallow-reticulate sculpturing; median carina present; plica, costula, and lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa with deep, distinct sculpturing (areolate).

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae

within. Admarginal setae present. Postmarginal vein more than 1.5X length of stigmal vein.

Male as female.

Hosts: HYMENOPTERA: Cynipidae: *Pediaspis aceris* on *Acer pseudoplatanus* (Sapindaceae). **UNKNOWN**: galls on *Acer pseudoplatanus*, *Acer* sp.

Distribution (Fig. 3.26)**: Palearctic:** Austria, Croatia (Sláma, 2015), Czech Republic (Sláma, 2015), France, Iran (OILB, 1971) Italy, Netherlands (Gijswijt, 2003), Slovakia (Sláma, 2015), Spain (Pujade, 1994; Vårdal *et al*., 2016), Turkey (Sláma, 2015).

Taxonomic Summary:

1. *Dichatomus acerinus* Förster
2. *Dichatomus notatus* Suciu

Material Examined:

***Dichatomus acerinus* Förster**

AUSTRIA: Böhlerwerk a.d. Ybbs, 331m, *47°59'15"N*, *14°44'42"E*, 1950, Novitzky, host: *Pediaspis aceris*, host plant: *Acer pseudoplatanus* [3♂ 6♀, ANIC: UCRCENT238550, ANIC: UCRCENT238551, BMNH: NHMUK10371697]. Tenneck a/ Salzach, *47°29'26"N*, *13°10'39"E*, 1984, Z. Bouček, host: galls, host plant: *Acer pseudoplatanus* [7♂, CNC: CNC509054]. Tenneck a/ Salzach,

47°29'26"N, *13°10'39"E*, 1984, Z. Bouček, host: galls, host plant: *Acer* sp. [30♀, ANIC: UCRCENT238549, BMNH: NHMUK10371698, CNC: CNC509053]. Tenneck a/ Salzach, 523m, *47°29'26"N*, *13°10'39"E*, ix.1984–iv.1985, Z. Bouček, host: *Pediaspis aceris* [2♀, CNC: CNC509055]. **FRANCE:** La Rochelle, 1m, *46°09'39"N*, *1°09'24"W*, iv.1961, host: *Pediaspis aceris* [1♀, BMNH: NHMUK10371696]. **ITALY: Sardinia: Cagliara**, ca. 2km N. Santa Margherita, *38°56'49"N*, *8°56'27"E*, 22.v.2007, P. Banar, humid meadow [1♀, CNC: CNC509129].

9. *Diglyphus* Walker - Fig. 3.27

Diglyphus Walker, 1844: 409. Type species: *Cirrospilus chabrias* Walker, by monotypy.

Diaulus Ashmead, 1904: 356. Type species *Diaulus begini* Ashmead; by monotypy. Preoccupied by *Diaulus* Müller, 1879 (Trichoptera: Hydroptilidae).

Diaulinus Schulz, 1906: Replacement name for *Diaulus* Ashmead. Synonymy by Peck, 1963: 102.

Cycloscapus Erdös and Novicky, 1951: 323. Type species: *Cycloscapus pusztensis* Erdös & Novicky; by monotypy. Locality: Hungary. Synonymy by Bouček, 1959: 171.

Danuviella Erdös, 1958: 212. Type species: *Danuviella subplana* Erdös; holotype ♀, by original designation and monotypy. Locality: Hungary, Ásvány. Depository: HNHM, Hym. Typ. No. 4808. Synonymy by Burks, 2012: 28.

Diagnosis: *Diglyphus* is characterized by a completely metallic mesosoma, a curved and incomplete notaulus (Fig. 3.27D, E) (rarely extending to anterior margin of the axilla), and a propodeum that lacks a median carina (Fig. 3.3A). *Diglyphus* is most similar to *Meruacesa*, however *Meruacesa* has a notaulus that is incomplete but straight (Fig. 3.36C), a propodeum with a complete median carina (Fig. 3.36D), and gaster that is petiolate (Fig. 3.36D, E) as opposed to sessile in *Diglyphus* (Fig. 3.27E). Several species of *Cirrospilus* are similar in appearance, having a metallic green mesosoma, but *Cirrospilus* has a notaulus that is complete and extending to the posterior half of the axilla (Fig. 3.18E) and a median carina on the propodeum (Fig. 3.18F). *Diaulinopsis* is similar biologically and morphologically to *Diglyphus*, but the notaulus is complete, extending to posterior half of the axilla, (Fig. 3.23F), and the scape in males is swollen (Fig. 3.23B, C).

Description: Female: metallic green or dark blue on head and mesosoma. Yellow on mesosoma absent.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture present. Vertex normal, not vaulted; large,

paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with thin sculpturing. Notaulus incomplete, curved, and not reaching axilla or transscutal articulation – rarely, thin and complete to anterior margin of axilla. Axilla advanced anteriorly more than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially; 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina, plicae, and costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold setose. Cubital fold basally setose and straight or only slightly curved to meet basal fold, or basally setose, and curved sharply to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by more than its own length from stigmal apex. Speculum present with few or no setae within, or absent. Admarginal setae present. Postmarginal vein between 0.5X to more than 1.5X length of stigmal vein. Male as female.

Remarks: There are several species of *Diglyphus* that possess a notaulus that is complete, extending to the anterior margin of the axilla. As noted by Hansson (2017), when this occurs, the notaulus is thin and superficial. No representatives of these species were available for sequencing, which will be necessary to confirm the validity of their placement in *Diglyphus*.

Hosts: DIPTERA: Agromyzidae: *Agromyza albipennis* Meigen; Aulagromyza *hendeliana* (Hering) on *Lonicera xylosteum* (Caprifolicaeae) and *Salix alba* (Salicaceae); *Liriomyza pusilla* (Meigen) on *Pisum sativum* (Fabaceae); *Liriomyza sativae* (Blanchard) on *Apium graveolens* (Apiaceae); *Liriomyza* sp. on beans, garlic, pepper; *Phytomyza atricornis* Meigen on *Chrysanthemum* sp. (Asteraceae); *Phytomyza syngenesiae* (Hardy) on *Senecio* sp. (Asteracea); "dipterous leaf miner" on *Linum usitatissimum* (Linanceae). **UNKNOWN:** leaf miners on *Brassica juncea* (Brassicaceae), *Medicago sativa* (Fabaceae), *Pisum sativum, Sonchus* sp. (Asteraceae), *Vicia faba* (Fabaceae).

Distribution (Fig. 3.28)**: AUSTRALASIA:** Australia (QLD, TAS). **INDO-MALAY:** India**. NEARCTIC**: USA (CA, FL, OR, TX, UT). **NEOTROPIC:** Guatemala. **PALEARCTIC:** Egypt, France, Germany, Greece, Hungary, Israel, Italy, Japan, Kazakhstan, Portugal, Russia (Yefremova, 2002), Spain, Sweden, Turkey, UK (England, Scotland, Wales).

Taxonomic Summary:

1. *Diglyphus agrophlomicum* Kurashev
2. *Diglyphus albinervis* Zhu LaSalle & Huang
3. *Diglyphus albiscapus* Erdös
4. *Diglyphus albitibiae* Zhu LaSalle & Huang
5. *Diglyphus anadolucus* Doganlar
6. *Diglyphus begini* (Ashmead)
7. *Diglyphus bimaculatus* Zhu LaSalle & Huang
8. *Diglyphus bulbus* Ubaidillah & Yefremova
9. *Diglyphus carlylei* (Girault)
10. *Diglyphus chabrias* (Walker)
11. *Diglyphus clematidis* Navone & Hansson
12. *Diglyphus crassinervis* Erdös
13. *Diglyphus eleanorae* Graham
14. *Diglyphus frontolatus* Arifa & Khan
15. *Diglyphus funicularis* Khan
16. *Diglyphus gibbus* Zhu LaSalle & Huang
17. *Diglyphus guptai* (Subba Rao)
18. *Diglyphus horticola* Khan
19. *Diglyphus indicus* Arifa & Khan
20. *Diglyphus inflatus* Zhu LaSalle & Huang
21. *Diglyphus insularis* (Gahan)
22. *Diglyphus intermedius* (Girault)
23. *Diglyphus isaea* (Walker)
24. *Diglyphus kashmiricus* Ahmad, Khurseed & Azim
25. *Diglyphus mandibularis* Khan
26. *Diglyphus metallicus* Zhu LaSalle & Huang
27. *Diglyphus minoeus* (Walker)
28. *Diglyphus pachyneurus* Graham

29. *Diglyphus pedicellus* Gordh & Hendrickson
30. *Diglyphus phytomyzae* (Ruschka)
31. *Diglyphus poppoea* Walker
32. *Diglyphus propodealis* Szelényi
33. *Diglyphus pulchripes* (Ashmead) (**UNAVAILABLE NAME**)
    -Nomen nudem
34. *Diglyphus pulchripes* (Crawford)
35. *Diglyphus pusztensis* (Erdös & Novicky)
36. *Diglyphus sabulosus* Erdös
37. *Diglyphus sensillis* Yefremova
38. *Diglyphus scapus* Yefremova
39. *Diglyphus subplanus* (Erdös)
40. *Diglyphus turcomanica* Kurashev
41. *Diglyphus wani* Liu, Zhu & Yefremova (**UNAVAILABLE NAME**)
    Published in e-journal, and does not comply with ICZN Article 8.5
42. *Diglyphus websteri (*Crawford)

Material Examined:

***Diglyphus albiscapus* Erdös**

JAPAN: Hokkaido: Sapporo, 25m, *43°03'38"N*, *141°20'38"E*, 10.vii.1958, K. Homma, host: *Agromyza albipennis* [1♂ 1♀, BMNH: NHMUK10371841, 10371842].

***Diglyphus anadolucus* Doganlar**

Paratypes: TURKEY: Eastern Anatolia: Erzurum, *39°54'19"N*, *41°15'2"E*, 8.ix.1979, H. Ozbek [1♂ 1♀, BMNH: NHMUK10371843, 10371844].

***Diglyphus begini* (Ashmead)**

USA: California: Marin Co. US Hwy. 1; ~ 6mi. south of Valley Ford, 10m, 38°13'23"N, 122°55'8"W, 4.vi.2002, Buffington & Munro, Sweep [1♀, UCRC: UCRCENT414591 (**D3997**)]. **Utah: Grand Co.**, Green River along Hwy 70, 1223m, 38°59'42"N, 110°08'45"W, 10.v.2002, Buffington & Munro, disturbed riparian vegetation, sweeping [2♀, UCRC: UCRCENT414573 (**D3857**), 414574 (**D3858**)].

***Diglyphus bulbus* Ubaidillah & Yefremova**

KAZAKHSTAN: Mangystau Prov.: Fort-Shevchenko, 907m, *44°30'27"N*, *50°15'43"E*, 25.vi.1965, Skopina [1♂, BMNH: NHMUK10371845].

***Diglyphus chabrias* (Walker)**

Paralectotypes: UK: England: London, 22m, *51°30'21"N*, *0°10'37"W*, x.1837, Walker [1♀, BMNH: NHMUK10371870].

Additional material examined: INDIA: Punjab: Ludhiana, 252m, *30°54'4"N*, *75°51'25"E*, 16.iii.1974, G.S. Sandhu, host: dipterous leaf miner, host plant: ornamental *Alsi* (Flax) [1♂, BMNH: NHMUK10371871]. **SWEDEN: Oland:** Karums, 40m, 56°46'28"N, 16°37'30"E, 4.vii.2014, C. Hansson, Alvar [1♀, UCRC: UCRCENT485732]. **Skogsby**, Kalkstad, 43m, 56°36'33"N, 16°30'33"E, 24.vi.2014, C. Hansson [1♀, UCRC: UCRCENT485731]. **Örebro:** Örebro, Adolfberg, *59°15'1"N*, *15°10'1"E*, 27.viii.1954, A. Sundholm [1♀, BMNH: NHMUK10371872]. **Skane:** Krankesjön, Ekskogen, lönnalle, 55°41'10"N, 13°27'40"E, 14.vii.2014, C. Hansson [1♂, UCRC: UCRCENT485733]. Lk.

Krankesjon “West”, 55°42'0"N, 13°27'0"E, 8.viii.2006, C. Hansson, CH04980 [1♂, UCRC: UCRCENT485734].

***Diglyphus crassinervis* Erdös**

EGYPT: Minya, 40m, *28°04'44"N*, *30°45'9"E*, 1970, host: leaf miner, host plant: *Vicia faba* [, BMNH: NHMUK10371848]. **GREECE: Crete:** Topolia, 252m, *35°25'39"N*, *23°41'12"E*, 10.v.1984, K. J. Hedqvist [1♀, BMNH: NHMUK10371847]. **SPAIN:** Madrid, 678m, *40°26'33"N*, *3°41'32"W*, 1984, host: *Liriomyza* sp., host plant: Garlic [1♀, BMNH: NHMUK20371846].

***Diglyphus eleanorae* Graham**

PORTUGAL: Madeira: Machico, 221m, *32°43'53"N*, *16°47'27"W*, 1.i.1973, M.W.R. de V. Graham [2♀, BMNH: NHMUK10371849].

***Diglyphus guptai* (Subba Rao)**

INDIA: Jammu and Kashmir: Srinagar, 1589m, *34°04'54"N*, *74°47'42"E*, 1981, A.R. Ghar, host: leafminer, host plant: *Brassica juncea* [1♂ 1♀, BMNH: NHMUK10371868, 10371869].

***Diglyphus intermedius* (Girault)**

Material examined: USA: California: Santa Clara, Santa Clara, 23m, *37°21'11"N*, *121°57'14"W*, R.E. Campbell, host: *Liriomyza pusilla*, host plant: pea [2♀, BMNH: NHMUK10371862]. **Florida: Miami-Dade Co.**, Homestead, 1m, *25°27'54"N*, *80°28'26"W*, iii.1983, host: *Liriomyza* sp., host plant: beans [1♂, BMNH: NHMUK10371863]. **Orange Co.**, Zellwood, *28°43'49"N*, *81°36'2"W*, 11.iii.1976, C. Musgrave & D. Bennett, host: *Liriomyza sativae*, host plant: *Apium*

graveolens [3♀ 1?, FSCA: UCRCENT476761 – 476764]. **Palm Beach Co.**, Bella Glade, *26°41'11"N*, *80°39'53"W*, 6.iv.1976, D. Bennett & C. Musgrove, host: *Liriomyza sativae*, host plant: *Apium graveolens* [1♂ 5♀, FSCA: UCRCENT476755 – 476760]. **Oregon: Lane Co.**, Eugene, *44°02'57"N*, *123°04'32"W*, 22.vii.1976, K. J. Hedqvist [1♀, BMNH: NHMUK10371864]. **Texas: Hidalgo Co.**, S. of F.M. 2221 on Iowa Rd., 62m, 26°19'32"N, 98°24'34"W, 13.iv.2010, J. Mottern, acacia/mesquite scrub, sweep, M10-014 [1♀, UCRC: UCRCENT357541 (**D3683**)].

***Diglyphus isaea* (Walker)**

AUSTRALIA: Tasmania: Airstrip Rd. Site 3C, 327m, 42°50'32"S, 146°14'26"E, 22.iii.2002, M. Driessen, buttongrass moorland, sweep [1♀, TMAG: TMAGRegNo.31268 (**D5957**)]. **HUNGARY:** 4.5 km SW Koszeg, Meszes Völgy, 120m, 47°22'0"N, 16°31'0"E, 26.vi.2010, J.S. Noyes, BMNH(Ent) 2010-63 [1♀, BMNH: NHMUK10734445 (**D5974**)]. **ITALY: Campania:** Caserta Prov. SE end of Lago del Matese, 1050m, 41°24'25"N, 14°24'12"E, 7.vi.2003, Bologna, Munro, Owen, Pinto, *Salix* pasture, screen sweep, PEET03-027C [1?, UCRC: UCRCENT512475 (**D2176**)]. **SWEDEN: Oland: Skogsby**, Kalkstad, 43m, 56°36'33"N, 16°30'33"E, 29.vii.2015, C. Hansson [1♀, UCRC: UCRCENT499069]. Egby, 21m, 56°52'3"N, 16°46'28"E, 22.vii.2015, C. Hansson [1♂ 1♀, UCRC: UCRCENT499062, 499063]. Lenstadstendep, 32m, 56°36'40"N, 16°32'37"E, 29.vii.2015, C. Hansson [2♂ 3♀, UCRC: UCRCENT499057 – 499061]. Österskoh, alvar., 56°42'41"N, 16°36'57"E, 31.vii.2015, C. Hansson [2♂ 1♀, UCRC:

UCRCENT499070 – 499072]. **Skane:** Krankesjön, Ekskogen, 28m, 55°41'10"N, 13°27'40"E, 4.viii.2015, C. Hansson [1♀, UCRC: UCRCENT499068]. Krankesjön, Fiskeplats, 26m, 55°41'54"N, 13°29'58"E, 29.viii.2015, C. Hansson [1♂, UCRC: UCRCENT499067]. Håckeberga, vid bäck, 68m, 55°34'12"N, 13°25'59"E, 7.ix.2015, C. Hansson [2♂ 1♀, UCRC: UCRCENT499064 – 499066]. **UK: Scotland:** Edinburgh, at castle, *55°56'56"N*, *3°11'56"W*, 28.vi.2012, O. Lonsdale, host: *Phytomyza syngenesiae* (Hardy), host plant: *Senecio* sp. [1♀, CNC: CNC509104 (**D4678**)]. **ZAMBIA:** *15°22'7"S*, *28°13'27"E*, DEH [1♂, BMNH: NHMUK10734438 (**D5967**)].

***Diglyphus minoeus* (Walker)**

Lectotype: UK: England: "near London, Cornwall", 202m, *51°06'19"N*, *2°10'21"W*, ix.1837, Walker [1♀, BMNH: NHMUK10371850].

Additional material examined: ITALY: Piedmont: Mattie, 712m, *45°07'8"N*, *7°07'3"E*, 5.vi.1979, host: *Aulagromyza hendeliana*, host plant: *Lonicera xylosteum* [1♀, BMNH: NHMUK10371851]. **UK: England: Kent**, 73m, *51°16'53"N*, *0°35'39"E*, vii.1980, host: leaf miner, host plant: Sow thistle [1♂, BMNH: NHMUK03711852].

***Diglyphus pachyneurus* Graham**

FRANCE: Landes: Capbreton, 15m, *43°38'12"N*, *1°25'7"W*, 12.vii.1974, Z. Bouček [1♀, BMNH: NHMUK10371853]. **SWEDEN: Skane:** Svarte, 957m, *55°25'50"N*, *13°43'3"E*, 18.vii.1973, K. J. Hedqvist [1♂, BMNH: NHMUK10371854].

***Diglyphus poppoea* Walker**

ISRAEL: Panyas, 334m, 33°14'51"N, 35°41'39"E, 7–9.v.2012, J. Heraty, oak forest, swp, H12-021 [1♀, UCRC: UCRCENT416916 (**D4557**)]. **SWEDEN: Stockholm**, Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 23.ix.1961, K. J. Hedqvist [1♀, BMNH: NHMUK10371856]. **Uppsala:** Röskär, 15m, *59°25'11"N*, *18°09'52"E*, 3.vi.1972, K. J. Hedqvist [1♀, BMNH: NHMUK10371855]. **UK: England:** *52°20'29"N*, *1°09'10"W*, 1950, G.B. Thompson, host: *Phytomyza atricornis*, host plant: Chrysanthemum [1♂, BMNH: NHMUK10371857].

***Diglyphus pulchripes* (Crawford)**

USA: C.N. Ainslie, host: leaf miner, host plant: Alfalfa [1♂, BMNH: NHMUK10371865].

***Diglyphus pusztensis* Erdös & Novicky**

SWEDEN: Blekinge, Rödeby, 47m, *56°15'37"N*, *15°37'19"E*, 8.viii.1969, K. J. Hedqvist [1♀, BMNH: NHMUK10371861]. **UK: Wales: Glamorgan**, Swansea, 44m, *51°37'22"N*, *3°56'53"W*, 1.viii.1975, J.S. Noyes [1♀, BMNH: NHMUK10371860].

***Diglyphus subplanus* (Erdös)**

GERMANY: Hamburg: Wilhelmsburg, 2m, *53°29'51"N*, *9°59'47"E*, vii.1982, S. Vidal, host: *Aulagromyza tridentata*, host plant: *Salix alba* [1♂, BMNH: NHMUK10371859]. **SWEDEN: Stockholm**, Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 19.viii.1974, K. J. Hedqvist [1♀, BMNH: NHMUK10371858].

***Diglyphus websteri* (Crawford)**

GUATEMALA: Guatemala City, *14°37'22"N*, *90°31'15"W*, 8.ix.1977, R. Burkhart, RB-10-77, host plant: Sonchus [1♂, BMNH: NHMUK10371866]. **USA: California: Los Angeles Co.**, Angeles National Forest, 1614m, 34°15'19"N, 117°38'28"W, 16.vi.2009, J. Mottern, sweep, M09-010 [1♀, UCRC: UCRCENT410527 (**D3789**)]. **Texas: Hidaldo Co.**, Weslaco, 25m, *26°08'50"N*, *97°59'25"W*, 20.v.1982, host: *Liriomyza* sp., host plant: pepper [1♂, BMNH: NHMUK10371867]. S. of F.M. 2221 on Iowa Rd., 62m, 26°19'32"N, 98°24'34"W, 13.iv.2010, J. Mottern, acacia/mesquite scrub, sweep, M10-014 [1♀, UCRC: UCRCENT357540 (**D3682**)].

***Diglyphus* spp.**

AUSTRALIA: Queensland: ~9 km N Ellis Beach, 10m, 16°41'15"S, 145°34'51"E, 17.v.2015, Heraty & Hash, Mallee scrub, swp, H15-039 [1♀, UCRC: UCRCENT312397 (**D4547**)]. **ITALY: Campania:** Caserta, 2.2 km SW Passo di Miralago, 1025mm, 41°23'25"N, 14°24'47"E, 7.vi.2003, Bologna, Munro, Owen, Pinto, pasture & forest edge, screen sweep, PEET03-026C [1?, UCRC: UCRCENT512465 (**D2147**)]. **USA: CA: Los Angeles Co.**, Rancho Palos Verdes Forrestal Reserve coastal sage scrub, 33°44'0"N, 118°20'0"W, 20.iv–24.v.2003, J. George, malaise trap [1?, UCRC: UCRCENT512349 (**D1959**)].

10. *Gallowayia* Bouček - Fig. 3.29

Gallowayia Bouček, 1988: 656. Type species: *Gallowayia picta* Bouček [examined], holotype ♀, by original designation and monotypy. Locality:

Australia, Queensland, Mt. Tambourine. Depository: QM, UCRCENT 491637.

Diagnosis: *Gallowayia* is morphologically distinct from all other genera in Cirrospilini, identified by 3 synapomorphies: a carina posterior to the vertex (Fig. 3.2C), a complete notaulus that extends to the anterior margin of the axilla but strongly curved medially (Fig. 3.2C), and plica on the propodeum that is present as a sculptured groove (Fig. 3.2C). *Naumaniolla* is morphologically similar, having a lateral basal groove on the propodeum (Fig. 3.29D), and overall coloration that is similar to *Gallowyia,* but differs in several ways. In addition to the synapomorphies for *Gallowayia*, *Naumanniola* differs from *Gallowayia* by lacking the carina posterior to the vertex, possessing an incomplete notaulus (Fig. 3.1I), and costula that are absent or present, but never present as sculptured grooves as in *Gallowayia*. Female *Gallowayia* also have 2 funiculars, whereas female *Naumanniola* have 3 funiculars.

Description: Female: Metallic color on head or mesosoma present. Yellow color on mesosoma present. Fore wing with dark patterns or infuscation present.
Head: Malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture present. Vertex normal, not vaulted; large, paired setae and small, scattered setae present. Carina posterior to vertex present. Occipital carina absent.

Antenna: Torulus with dorsal margin above ventral margin of compound eye. Scape extending past vertex. 3 funiculars. 2 clavomeres.

Body: Mesoscutum with thin sculpturing. Notaulus complete, extending to axilla but strongly curved medially. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present, curved posteriorly, and meeting medially; anterior pair of setae longer than posterior pair of setae. Dorsellum not extending posteriorly over propodeum; asetose. Propodeum normal, not constricted medially and with smooth or shallow-reticulate sculpturing. Propodeum with median carina present; plicae present as sculptured groove; costula absent; lateral basal groove present. Gaster petiolate. Petiole with ventral carina or carinae present. First gastral tergite collar smooth. Metacoxa with deep, distinct sculpturing (areolate).

Fore wing: basal fold setose. Cubital fold basally setose and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae within. Admarginal setae present. Postmarginal vein between 0.5X and 1.0X length of stigmal vein.

Male as female except: funiculars with projection dorsally.

Hosts: unknown.

Distribution (Fig. 3.30)**: Australasian:** Australia (NSW, QLD, TAS).

Taxonomic Summary:

1. *Gallowayia picta* Bouček

Material examined

***Gallowayia picta* Bouček**

Holotype: AUSTRALIA: Queensland: Mt. Tamborine, 520m, *27°55'28"S*, *153°11'38"E*, x.1977, I. D. Galloway, Malaise Trap [1♀, QM: UCRCENT491637]. **Paratypes: AUSTRALIA: New South Wales:** Tooloom, *28°30'51"S*, *152°25'4"E*, 8.i.1977, Bouček, Scrub [1♀, BMNH: NHMUK10371683]. **Queensland:** Brisbane-Indooroopilly, 47m, *27°29'54"S*, *152°58'0"E*, 11.xii.1976, Z. Bouček [1♂, BMNH: NHMUK10371686]. Eungella Natl. Park, Broken River, *21°10'5"S*, *148°30'29"E*, 30.xi.1976, Bouček [1♂, BMNH: NHMUK10371685]. Mt Glorious, SEQ, *27°19'48"S*, *152°45'36"E*, 28.ii.1984, Galloway, Rainforest [1♂, CNC: CNC509113]. Mt Glorious, SEQ, *27°19'48"S*, *152°45'36"E*, 28.ii.1984, Masner [1♂, BMNH: NHMUK10371684]. Mt. Tamborine, 520m, *27°55'28"S*, *153°11'38"E*, xi.1977, MT [1♀, BMNH: NHMUK10371682]. Mt. Tambourine, 500m, *27°55'36"S*, *153°11'51"E*, Malaise Trap [1♀, ANIC: UCRCENT238575].

Additional material examined: AUSTRALIA: New South Wales: Gibraltar Range, 1008m, *29°32'58"S*, *152°15'17"E*, I. D. Naumann, rainforest margin [1♀, ANIC: UCRCENT238692]. W. Woodenbong, Bald Knob State Forest, *28°21'45"S*,

152°32'37"E [1♂, UCRC: UCRCENT416904]. **Queensland:** 13 km up Davies Creek Rd., 667m, *17°01'32"S*, *145°35'58"E*, 2.x–6.xi.1984, Storey, Halfpapp, Casuarina forest, MT [1♀, QM: UCRCENT491634]. Brisbane Forest Park, 390m, 27°25'4"S, 152°49'48"E, 3–9.x.1998, N. Power, dry sclerophyll, malaise trap 3 [1♀, CNC: CNC509099 (**D4670**)]. Carnarvon Stn., nr. Piebald Spring (CN1M1), 821m, 24°49'52"S, 147°44'31"E, 13.xii.2010–15.vi.2012, C. Zwick & C. Wilson, Malaise Trap, 19428 [1♀, QM: UCRCENT241933]. Fig Tree Pocket, Brisbane, 25m, 27°32'0"S, 152°58'0"E, 10.xi.1991, P. Fidalgo, 50173 [2♀, QM: UCRCENT491658, QM: UCRCENT491659]. Forest Station, Bulburin State For., via Many Peaks, 600m, *24°31'36"S*, *151°28'18"E*, 12–15.iv.1974, I. Naumann, rainforest margin, swp [1♂, UQIC: UCRCENT528606]. Main Range N.P., Cunningham Gap, 28°03'1"S, 152°23'35"E, 9.xii.2002, George, Munro, & Owen, rainforest, sweep, PEET02-045S [1♂, UCRC: UCRCENT491711]. NEQ: 2 km SSE Mt Spurgeon, 1100m, 16°27'0"S, 145°12'0"E, 19–22.xi.1997, C. J. Burwell, rainforest [1♂, QM: UCRCENT491635]. Wongabel State Forest, 6 km S Atherton, NQ, 805m, *17°19'11"S*, *145°26'26"E*, 9.i–10.ii.1984, Storey & Brown [1♂, QM: UCRCENT491636]. **Tasmania:** Mt. Field Natl. Park, Wombat Moor, *42°41'7"S*, *146°36'35"E*, 8.i.1984, L. Masner [1♂, CNC: CNC509112].

11. *Gattonia* Bouček - Fig. 3.31

Gattonia Bouček, 1988: 652. Type species: *Gattonia basifura* Bouček [examined]; holotype ♀, by original designation. Locality: Australia, Queensland, Gatton. Depository: ANIC: UCRCENT238541.

Diagnosis: *Gattonia* is an easily identifiable genus, as it is the only genus in Cirrospilini that lacks a malar sulcus (Fig. 3.31A) and has a clypeus that projects slightly forward (Fig. 3.31A). The dorsal margin of the torulus in *Gattonia* is below the ventral margin of the compound eye, but closer to the compound eye than to the clypeal margin (Fig. 3.31A, B). The head is triangular in shape (Fig. 3.31B), lacks both the upper ocular sulcus and frontal suture (Fig. 3.31A, B), and the mesosoma is completely black. The only other genus that might be confused with *Gattonia* is *Ascotolinx*, but *Ascotolinx* has a malar sulcus (Fig. 3.10A), linear clypeus, and torulus positioned above the ventral margin of the compound eye (Fig. 3.10A).

Description: Female: Metallic color on head or mesosoma absent. Yellow color on mesosoma absent. Fore wing hyaline.

Head: Malar sulcus absent. Tentorial pits indistinct. Clypeus projecting ventrally. Upper ocular sulcus absent. Frontal suture absent. Vertex not vaulted; large, paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin at or below ventral margin of compound eye, but closer to ventral margin of eye than to clypeus. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with pronounced and distinct sculpturing (areolate). Notaulus incomplete, straight, and not reaching axilla or transscutal articulation. Axilla advanced anteriorly less than 10% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially; two pairs of setae present - anterior pair of setae longer than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum not constricted medially; with rugose sculpturing; median carina and plica present; costula and lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa with deep, distinct sculpturing (areolate).

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae within. Admarginal setae present. Postmarginal vein between 0.5X and 1.0X length of stigmal vein.

Hosts: unknown.

Distribution (Fig. 3.32)**: AUSTRALASIA:** Australia (NSW, NT, QLD, WA).

Taxonomic Summary:

1. *Gattonia basifura* Bouček
2. *Gattonia nigra* Bouček

Material Examined:

***Gattonia basifura* Bouček**

Paratypes: AUSTRALIA: Queensland: Gatton, *27°34'33"S*, *152°16'23"E*, 13.v.1980, J.S. Noyes [1♂ 1♀, BMNH: NHMUK10371653, 10371656]. Gayndah, *25°37'29"S*, *151°36'17"E*, 27.iv.1964, A.R.B. [1♂, BMNH: NHMUK10371655]. Mt. Coot-tha, Brisbane, *27°28'14"S*, *152°56'52"E*, 17.v.1980, J.S. Noyes [1♀, BMNH: NHMUK10371654]. **Additional material examined: AUSTRALIA: New South Wales:** Culgoa NP, 8km WNW Cawwell HS, Diemunga Lagoon (CGN2M) Coolibah, 29°02'49"S, 146°59'46"E, 30.i–18.v.2010, C. Lambkin, R. Ohlsen, & B. Shiebaan, Malaise trap [1♀, QM: UCRCENT241934 (**D5335**)]. **Northern Territory:** Uluru Natl. Park, Kata Tjuta (Mt. Olga), 572m, 25°19'0"S, 130°47'0"E, 12.ix.1994, M. Schauff [1♀, USNM: UCRCENT471660]. W of Alice Spr., 3 km E Ellery's Hole, 650m, 23°48'35"S, 133°11'26"E, 14.iii.2002, J. Heraty, eucalyptus/creek bed, H02-041 [1♀, UCRC: UCRCENT446001 (**D6718**)]. **Queensland:** 12km SE Stanthorpe, *28°44'24"S*, *152°00'36"E*, 12–16.iv.1990, E. C. Dahms, malaise trap [1♂, UCRC: UCRCENT119998]. 9.7km N Ellis Beach, 10m, *16°41'15"S*, *145°34'55"E*, 23.iv.1988, E.C. Dahms, G. Sarnes [1♂, QM:

UCRCENT491598]. Charleville, 4.3km on Rd. to Adavale, *26°22′38″S*, *146°11′51″E*, 1.iii.1989, E. Dahms, G. Sarnes, Themeda sp. & Aristida sp., sweep [1♀, QM: UCRCENT491597]. E. of Chillagoe, *17°09′53″S*, *144°33′7″E*, 22.iv.1983, J.F. Donaldson, D-vac [1♀, QM: UCRCENT491661]. Fig Tree Pocket, *27°31′48″S*, *152°57′36″E*, 16–24.i.1992, P. Fidalgo [1♀, QM: UCRCENT491599]. Gatton, *27°34′23″S*, *152°16′28″E*, 4.xii.1979, E.C. Dahms [1♂, UCRC: UCRCENT416905]. Long Pocket, Brisbane, 27°31'0"S, 153°00'0"E, 9.vi.1991, C.J. Burwell [1♂, UQIC: UCRCENT528596]. nr. Wilson's Peak, via Teviot Gap, *28°15′0″S*, *152°28′21″E*, 12.v.1974, I. Naumann, rainforest edge, beat & sweep [1♀, UQIC: UCRCENT528597]. **Western Australia:** Yanchep NP, 50km N. Perth, *31°33′20″S*, *115°41′20″E*, xii.1986, J.S. Noyes, Malaise Trap [1♀, ANIC: UCRCENT238576].

***Gattonia nigra* Bouček**

Paratypes: AUSTRALIA: Western Australia: Melaleuca Natl. Park, 30km N. Perth, *31°41′35″S*, *115°55′15″E*, 18.xi.1982, Z. Bouček [1♀, BMNH: NHMUK10371657]. Perth, Darling Range, *31°24′53″S*, *116°00′0″E*, 16.xi.1982, Z. Bouček [2♀, BMNH: NHMUK10371658, 10371659]. **Additional material examined: AUSTRALIA: Northern Territory:** 32km SE of Alice Springs, 793m, 23°35'24"S, 133°33'36"E, 23.ix.1978, J.C. Cardale [1♀, ANIC: UCRCENT238660]. **Queensland:** 11km S. Charleville, Rd. to Cunnamulla, *26°29′13″S*, *146°13′10″E*, 14.v.1991, E.C. Dahms, G. Sarnes [1♀, QM: UCRCENT491600]. 9.7km N Ellis Beach, 10m, *16°41′15″S*, *145°34′55″E*, 17.iv.1988, E.C. Dahms & G. Sarnes [1♂, QM: UCRCENT491604]. Mungana Railway Station, 344m, 17°06'25"S,

144°23'32"E, 8.iv.1992, E. Dahms & G. Sarnes [1♀, QM: UCRCENT491603]. Rd to Gundare, 63km N. of Charleville, *25°57'21"S*, *146°28'40"E*, 10.iii.1989, E. Dahms & G. Sarnes, Brigalow, Acacia, sweep [1♀, QM: UCRCENT491601]. Townsville, nr. J. Cook Uni., *19°19'41"S*, *146°46'0"E*, 15.iv.1988, E. Dahms & G. Sarnes [1♀, QM: UCRCENT491602]. **Western Australia:** 60 km N Tom Price on Hamersley Iron Rd., 600m, 22°18'48"S, 117°40'30"E, 20.iv.2003, F.D. Parker & M. E. Erwin, Flowering *Eucalyptus* [1♀, CNC: CNC509135 (**D4674**)].

12. *Gyrolasella* Girault stat. rev. - Figs 3.33 & 3.34

Gyrolasella Girault, 1913b: 166. Type species: *Gyrolasella fasciatus* Girault [examined]; holotype ♀, by original designation. Locality: Australia, Queensland, Brisbane. Depository: QM, Type No. Hy. 1684.

Achrysocharelloidea Girault, 1913b: 178. Type species: *Achrysocharelloidea pax* Girault; holotype ♀, by original designation and monotypy. Locality: Australia, New South Wales, Sydney. Depository: SAMA, Type No. I. 1349. Synonymy by Bouček, 1988: 612. **syn. nov.**

Gyrolasella Girault, 1913c: 105. Type species: *Gyrolasella consobrinus* Girault [examined]; holotype ♀, by original designation. Locality: Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 1685. Redescription of genus using different species.

Austrolynx Girault, 1929: 325. Type species: *Austrolynx flavitibia* Girault [paratypes examined]; by monotypy. Locality: Australia, South Australia, Blackiston. Depository: SAMA. **syn. nov.**

Diagnosis: *Gyrolasella* is defined by a complete notaulus that extends to the posterior half of the axilla (Fig. 3.33C, E), and propodeum constricted and lacking a median carina (Fig. 3.33H). Bouček synonymized *Gyrolasella* under *Cirrospilus,* however, *Cirrospilus* has a normal, non-constricted propodeum (Fig. 3.18F), and possesses a complete median carina on the propodeum (Fig. 3.18F). Similar to *Zagrammosoma,* several species of *Gyrolasella* have yellow bodies and dark color patterns on the body (Fig. 3.34), however, these color patterns are always metallic in *Gyrolasella*, and dark brown or black in *Zagrammosoma* (Fig. 3.50). Additionally, in *Zagrammosoma*, the notauli extend to the anterior margin of the axilla (Fig. 3.50J) and the median carina on the propodeum is complete and expanding posteriorly (Fig. 3.3G).

Description: Female: metallic color on head or mesosoma present, rarely absent. Yellow color on mesosoma present. Fore wing hyaline or with dark patterns or infuscation present.

Head: malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present, sometimes faint. Frontal suture present, sometimes faint.

Vertex normal, not vaulted, or vaulted; large, paired setae absent or present; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent. Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. Male scape normal, not swollen. 2 funiculars. 3 clavomeres.

Body: mesoscutum with thin sculpturing or with deep-reticulate sculpturing. Notaulus complete to posterior half of axilla, close to transscutual articulation. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves absent, or present and straight or slightly curved posteriorly; 2 pairs of setae, rarely with 3 or more pairs - anterior pair of setae shorter than posterior pair of setae or equal in length to posterior pair. Dorsellum extending or not extending posteriorly over propodeum. Propodeum constricted medially; median carina, plicae, and costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carinae absent. First gastral tergite collar smooth or with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold asetose or setose. Cubital fold basally asetose, or basally setose and straight or only slightly curved to meet basal fold, or basally setose, and curved sharply to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex, by more than its own length from stigmal apex, or by 2x or more than its own length from stigmal apex. Speculum

present with few or no setae within. Admarginal setae present. Postmarginal vein length variable, between 0.5Xand 1.5X length of stigmal vein.

Remarks: This genus is only recovered as monophyletic in the combined (Figs 3.4, S3.1) and ITS2-only analysis (Fig. S3.5). Justification for the separation of *Gyrolasella* from *Cirrospilus* is based on the combined analysis and morphological differences.

Austrolynx Girault was synonymized by Bouček (1988) under *Cirrospilus,* however the propodeum in *Austrolynx* is constricted and lacks a median carina on the propodeum. The type species, *Austrolynx flavitibia* Girault*,* agrees with *Gyrolasella* and not *Cirrospilus,* and is hereby named *Gyrolasella flavitibia* (Girault) **n. comb.** *Aulogymnus purpureus* (Girault), from Australia, does not share all the characters of *Aulogymnus*; it lacks a bilobed clypeus and distinct tentorial pits, and the uncus is not shifted basally on the stigmal vein as far as other *Aulogymnus* species. This species agrees more with *Gyrolasella* and is hereby named *Gyrolasella purpureum* **n. comb.** *Aulogymnus gallicola* (Ashmead), also from Australia and agreeing with *Gyrolasella*, possess a dorsellum that extends slightly posteriorly over the propodeum, a character found in *Gyrolasella*, therefore, the species is hereby named *Gyrolasella gallicolum* **n. comb.**

Hosts: COLEOPTERA: Chrysomelidae: *Notosacantha dorsalis* (Waterhouse); Chrysomelidae egg mass. **HYMENTOPERA: Pergidae:** *Phylacteophaga*

eucalypti Froggatt; *Phylacteophaga froggatti* Riek on *Eucalyptus globulus* and *E. marginata* (Myrtaceae); *Phylacteopha* sp. **LEPIDOPTERA: Elachistidae:** *Elachista gerasmia* Meyrick**;** *Elachista nodosae* Kaila; *Elachista* sp. **Gracillariidae:** *Phyllonorycter messaniella* (Zeller) on *Quercus* sp. (Fagaceae); *Phyllonorycter* sp. on *Quercus* sp. **UNKNOWN:** galls on *Eucalyptus camaldulensis;* galls on leaves of *E. obliqua;* leaf miner on *Eucayptus* sp; unknown host on *Brachychiton populneus* Malvaceae, and on *Callitris glauca* (Cupressaceae).

Distribution (Fig. 3.35)**: Australasia:** Australia (ACT, NSW, NT, QLD. SA, VIC, TAS, WA), Papua New Guinea.

Taxonomic Summary:

1. Gyrolasella aeneipropodeum Girault **stat. rev.**
2. *Gyrolasella aenea* Girault **stat. rev.**
3. *Gyrolasella aereiguttata* Girault **stat. rev.**
4. *Gyrolasella bifasciatifrons* Girault **stat. rev.**
5. *Gyrolasella bioculativentris* Girault **stat. rev.**
6. *Gyrolasella bracteata* Girault **stat. rev.**
7. *Gyrolasella channingi* Girault **stat. rev.**
8. *Gyrolasella consobrinus* Girault **stat. rev.**
9. *Gyrolasella duplolineata* Girault **stat. rev.**
10. *Gyrolasella elegantissimus* Girault **stat. rev.**

    Designated as *Cirrospilus electus* by Bouček (1988); preoccupied by *C. elegantissimus* Westwood

11. *Gyrolasella fasciatus* Girault **stat. rev.**
12. *Gyrolasella festiva* Girault **stat. rev.**
13. *Gyrolasella flavitibia* (Girault) **n. comb**

    Originally designated *Austrolynx flavitibia* Girault
14. *Gyrolasella gemma* Girault **stat. rev.**
15. *Gyrolasella gracilis* Girault **stat. rev.**
16. *Gyrolasella hopkinsi* Girault **stat. rev.**
17. *Gyrolasella immaculativentris* Girault **stat. rev.**
18. *Gyrolasella lateroguttata* Girault **stat. rev.**
19. *Gyrolasella margiscutellum* Girault **stat. rev**.
20. *Gyrolasella miriguttata* Girault **stat. rev.**
21. *Gyrolasella mirilineata* Girault **stat. rev.**
22. *Gyrolasella multipunctum* Girault **stat. rev.**
23. *Gyrolasella occipitis* Girault **stat. rev.**
24. *Gyrolasella particolor* Girault **stat. rev.**
25. *Gyrolasella pax* Girault **stat. rev.**
26. *Gyrolasella pulchra* Girault **stat. rev**.
27. *Gyrolasella purpurea* (Girault) **n. comb**

    Originally designated *Aulogymnus purpureus* Girault
28. *Gyrolasella rarifasciatus* Girault **stat. rev.**
29. *Gyrolasella ruskini* Girault **stat. rev.**
30. *Gyrolasella speciosissima* Girault **stat. rev.**
31. *Gyrolasella speciosa* Girault **stat. rev.**
32. *Gyrolasella tau* Girault **stat. rev.**
33. *Gyrolasella trilongilineata* Girault **stat. rev.**
34. *Gyrolasella viridipronotum* Girault **stat. rev.**
35. *Gyrolasella worcesteri* Girault **stat. rev.**

Material Examined:

***Gyrolasella festivus* Girault**

AUSTRALIA: Queensland: Acacia Ridge near Brisbane, 37m, *27°35'23"S*, *153°01'41"E*, 15.i.1977, Bouček [1♂, BMNH: NHMUK10353980]. Brookfield, nr. Brisbane, 49m, *27°30'36"S*, *152°54'59"E*, 7.i.1983, Z. Bouček [2♂ 1♀, BMNH: NHMUK10371802 – 10371804]. Kuranda, *16°49'17"S*, *145°38'3"E*, 7.xii.1982, Z. Bouček [1♀, BMNH: NHMUK10371805].

***Gyrolasella flavitibia* Girault**

Paratypes: AUSTRALIA: South Australia: Blakiston, 356m, *35°02'50"S*, *138°52'36"E*, 1888, T. D. Smeaton, host: galls on leaves, host plant: *Eucalyptus obliqua* [2♀, BMNH: NHMUK10371789, 10371790]; host: galls, host plant: *Eucalyptus camaldulensis* [2♀, BMNH: NHMUK10371789, 10371790], v.1888, T. D. Smeaton, host: galls on leaves, host plant: *Eucalyptus obliqua* [1♂, BMNH: NHMUK01037191].

***Gyrolasella margiscutellum* Girault** - Fig. 3.34C

AUSTRALIA: Australian Capital Territory: 17km SbyW Picadilly Circus, Brindabella Range, 898m, 35°16'12"S, 148°28'48"E, 24.xi.1981, I. D. Naumann [7♀, ANIC: UCRCENT238453 – 238459]. Canberra, 561m, *35°16'55"S*, *149°08'9"E*, 19.i.1980, host: *Phyllonorycter sp*, host plant: *Quercus* sp. [1♀, BMNH: NHMUK10371796]. Canberra, 561m, *35°16'55"S*, *149°08'9"E*, 22.ii.1973, C. Z. Zimmerman, host plant: *Brachychiton populneus* [1♀, ANIC: UCRCENT238478]. Canberra, 561m, *35°16'55"S*, *149°08'9"E*, 9.ii.1980, host:

Phyllonorycter messaniella [1♂, BMNH: NHMUK10371797]. Mt. Ginini, Brindabella Range, 1723m, *35°31'41"S*, *148°46'31"E*, 24.xi.1981, I. D. Naumann [1♀, ANIC: UCRCENT238466]. Tuggeranong, Isabella Drive, 586m, *35°25'27"S*, *149°05'25"E*, 19.xi.1991, R. Farrow, host: *Phylacteophaga eucalypti* [1♂, ANIC: UCRCENT238635]. Yarralumla, 568m, *35°18'19"S*, *149°05'55"E*, 10–15.ii.1976, H. Cameron, host: *Phyllonorycter messaniella*, host plant: Quercus [1♀, ANIC: UCRCENT238640]. **Australian Capital Territory:** Blundells Ck 3km E. of Piccadilly Circus, 850m, 35°13'12"S, 148°30'0"E, iii.1984, Lawrence, Weir, Johnson, flight intercept/ window trough trap [1♀, ANIC: UCRCENT238475]. **New South Wales:** Pigeon House Range, via Nerriga, *35°06'30"S*, *150°05'37"E*, 25.x.1979, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238477]. Sunny Corner S. F. 25km EbyS Bathurst, 1111m, *33°22'51"S*, *149°51'26"E*, 19.iv.1981, J. C. Cardale [5♂ 1♀, ANIC: UCRCENT238469 – 238474]. **South Australia:** 4km SW Normanville, Fleurieu Peninsula, 11m, *35°28'23"S*, *138°17'27"E*, 10.viii.1999, L. Kaila, host: *Elachista nodosae* [1♀, ANIC: UCRCENT238460]; 28.viii.1999, L. Kaila, host: *Elachista nodosae* [1♀, ANIC: UCRCENT238461]. Lake Tungketta, *33°45'45"S*, *135°06'9"E*, 30.xi.1992, I. D. Naumann & J.C. Cardale [2♀, ANIC: UCRCENT238467, 238468]. Sir Richard Peninsula, 2km SSW Goolwa, 11m, *35°30'24"S*, *138°45'28"E*, 13.viii.1999, L. Kaila, host: *Elachista* sp. [1♀, ANIC: UCRCENT238462]. Sir Richard Peninsula, 2km SSW Goolwa, *35°30'24"S*, *138°45'28"E*, 1999, L. Kaila, host: *Elachista* sp. [1♂ 1♀, ANIC: UCRCENT238464, 238465]. Sir Richard Peninsula, 2km SSW Goolwa, 9m, *35°30'24"S*, *138°45'28"E*,

22.viii.1999, L. Kaila, host: *Elachista gerasmia* [1♀, ANIC: UCRCENT238463]. **Tasmania:** 14km ESE Cranbrook, 42°02'24"S, 148°07'48"E, 28.i.1983, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238482]. **Victoria:** Melbourne, 17m, *37°49'46"S*, *144°58'47"E*, 19.xii.1989, R. Wharton, ex: *Eucalyptus* blotch mine [1♀, TAMU: UCRCENT426766 (**D4662**)]. **Western Australia:** ca 45km ENE Albany, 'dixon', 168m, 34°31'48"S, 118°10'48"E, v.2001, A. Loch, host: *Phylacteophaga froggatti*, host plant: *Eucalyptus globulus* [1♂, ANIC: UCRCENT238634]. ca 45km ENE Albany, 'dixon', 183m, 34°29'24"S, 118°09'36"E, v.2001, A. Loch, host: *Phylacteophaga froggatti*, host plant: *Eucalyptus globulus* [1?, ANIC: UCRCENT238633]. ca 45km ENE Albany, 'mountview', 34°29'24"S, 118°09'36"E, v.2001, A. Loch, host: *Phylacteophaga froggatti*, host plant: *Eucalyptus globulus* [1♀, ANIC: UCRCENT238632]. Perry Lakes, Perth, *31°36'28"S*, *115°46'42"E*, 14.ii.1982, Z. Mazanec, host: *Phylacteophaga froggatti*, host plant: *Eucalyptus marginata* [1♀, BMNH: NHMUK10371798]. Porongurup 'sixpenny', 34°25'48"S, 117°33'0"E, v.2001, A. Loch, host: *Phylacteophaga froggatti*, host plant: *Eucalyptus globulus* [3♂, ANIC: UCRCENT238636 – 238638]. Wanneroo, *31°44'57"S*, *115°48'26"E*, 5.vi.1982, S. J. Curry, host: *Phylacteophaga* sp. [2♀, ANIC: UCRCENT238479, 238480]. Wanneroo, *31°44'57"S*, *115°48'26"E*, 7–8.ix.1982, S. J. Curry, host: *Phylacteophaga* sp. [1♀, ANIC: UCRCENT238481]. Wembley, Perth, 17m, *31°36'1"S*, *115°49'16"E*, xi.1967, host: leaf miner, host plant: Eucalyptus [1♂, BMNH: NHMUK10371799].

***Gyrolasella occipitus* Girault** - Fig. 3.34A

AUSTRALIA: Queensland: 25 km W. Inglewood, 262m, *28°32'27"S*, *150°53'7"E*, 31.x.1976, Z. Bouček [3♂ 4♀, ANIC: UCRCENT238641 – 238643, BMNH: NHMUK10371788]. 25 km W. Inglewood, 262m, *28°32'27"S*, *150°53'7"E*, xi.1976, Z. Bouček [, BMNH: NHMUK10371786, 10371787].

***Gyrolasella rarifasciata* Girault**

AUSTRALIA: Tasmania: Barrow Ck. 8km NE Nunamara, 456m, *41°21'5"S*, *147°22'38"E*, 11.i.1983, I. D. Naumann & J. C. Cardale, malaise trap/ethanol [2♀, ANIC: UCRCENT238490, 238491]. **Western Australia:** 49km NE Wubin, *29°42'18"S*, *116°24'48"E*, 28.ix.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238492].

***Gyrolasella tau* Girault**

AUSTRALIA: New South Wales: Sawpit Creek, Mt. Kosciuszko Nat. Park, *36°20'48"S*, *148°33'3"E*, 12.ii.1977, Z. Bouček [1♀, BMNH: NHMUK10371800]. **Queensland:** Brookfield, nr. Brisbane, 49m, *27°30'36"S*, *152°54'59"E*, 24.xii.1982, Z. Bouček [1♂, BMNH: NHMUK10371801]. **Western Australia:** Perth, Darling Range, *31°24'53"S*, *116°00'0"E*, 16.xi.1982, Z. Bouček [1♀, BMNH: NHMUK01035932].

***Gyrolasella trilongilineata* Girault**

AUSTRALIA: Australian Capital Territory: Canberra, 561m, *35°16'55"S*, *149°08'9"E*, 24.ii.1978, E. C. Zimmerman, host plant: *Brachychiton populneus* [1♀, ANIC: UCRCENT238516]. **New South Wales:** Fowler's Gap Res. Stn., 179m,

31°05'16"S, *141°42'24"E*, 8–9.xii.1982, I. D. Naumann & J. C. Cardale, malaise trap/ethanol [1♀, ANIC: UCRCENT238518]. **Northern Territory:** 15km W by N Ross R. Tourist Camp, 540m, *23°32'3"S*, *134°22'52"E*, 22.v.1978, J. C. Cardale [1♀, ANIC: UCRCENT238509]. 32km SE of Alice Springs, 793m, 23°35'24"S, 133°33'36"E, 23.ix.1978, J.C. Cardale [1♀, ANIC: UCRCENT238515]. 35km N by W Alice Springs, 654m, 23°13'12"S, 133°28'48"E, 2.vi.1978, J. C. Cardale [1♀, ANIC: UCRCENT238512]. 35km N by W Alice Springs, 654m, 23°13'12"S, 133°28'48"E, 27.v.1978, J. C. Cardale [4♀, ANIC: UCRCENT238510, 238511, 238513, 238514]. 41km S by E Alice Springs, 654m, *24°01'47"S*, *133°58'10"E*, 4.x.1978, J. C. Cardale [1♂, ANIC: UCRCENT238517]. **Queensland:** Braemar S.F. via Kogan, *27°12'12"S*, *150°47'36"E*, 15–19.x.1979, G. B. Monteith, Acacia, Pyrethrum [1♀, BMNH: NHMUK10353923]. **South Australia:** 12km E. Penong, 31°33'36"S, 133°04'48"E, 16.ix.1981, I. D. Naumann & J. C. Cardale, ex. ethanol [3♂, ANIC: UCRCENT238380 – 238382]. 2km SSE Wilmington, 388m, 32°23'42"S, 138°03'36"E, 11.xi.1987, I. Naumann & J. Cardale [2♀, ANIC: UCRCENT238374, 238379]. Brachina Creek, 31°12'0"S, 138°19'48"E, 9.xi.1987, I. D. Naumann & J. C. Cardale [2♀, ANIC: UCRCENT238377, 238378]. Orroroo, 429m, 32°26'24"S, 138°22'12"E, 11.xi.1987, I. D. Naumann & J. C. Cardale [1♂, ANIC: UCRCENT238383]. Parachilna Creek, 31°04'48"S, 138°19'48"E, 8.xi.1987, I. D. Naumann & J. C. Cardale, ex. ethanol [1♂ 1♀, ANIC: UCRCENT238375, 238376].

***Gyrolasella* sp.**

AUSTRALIA: Queensland: Cooloola, *26°01'47"S*, *153°01'23"E*, vi.1980, J.S. Noyes [1♂, BMNH: NHMUK01035957]. Mt. Tibrogargan, 26°55'39"S, 152°56'48"E, 5.vi.1980, J.S. Noyes [1♂, BMNH: NHMUK10353861]. **Western Australia:** D'Entrecasteaux N.P., Tookulup, Clifftop Walk, 71m, 34°49'55"S, 115°59'57"E, 8.xii.2009, J. Mottern, sweep, M09-101 [2♀, UCRC: UCRCENT414581 (**D3865**), 414582 (**D3866**)]. Stirling Range N.P., scenic lookout, 434m, 34°23'35"S, 117°48'37"E, 4.xii.2009, J. Mottern, sweep, M09-062 [1♀, UCRC: UCRCENT312384 (**D4152**)].

Gyrolasella* nr. *margiscutellum

AUSTRALIA: New South Wales: 23km E by S Cobar, 222m, *31°41'28"S*, *145°54'21"E*, 3.xii.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238484]. Mt. Boppy, *31°32'23"S*, *146°16'53"E*, 25.xi.1949, E. F. Riek, host plant: *Callitris glauca* [1♀, ANIC: UCRCENT238483]. **Queensland:** Kuranda, *16°49'17"S*, *145°38'3"E*, 7.xii.1982, Z. Bouček [1♂, BMNH: NHMUK10353936]. **South Australia:** 46 km N of Bordertown, 113m, *35°57'35"S*, *140°44'56"E*, 20.x.1983, I. D. Naumann & J. C. Cardale, host: 1 [1♀, ANIC: UCRCENT238486]. Moana Sands Cons. Pk., *35°12'6"S*, *138°28'27"E*, 4.viii.1999, L. Kaila, host: Elachista nodosae [1♂, ANIC: UCRCENT238488]. **Victoria:** 8km SSW Kiata, *36°21'50"S*, *141°47'57"E*, 23.x.1983, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238485]. **Western Australia:** 1km W of Jimberlana Hill, Norseman, 310m, *32°09'13"S*, *121°48'17"E*, 11.i.1993, E. D. Edwards 7 e. S. Nielsen [1♀,

ANIC: UCRCENT238487]. Stirling Range N.P., scenic lookout, 379m, 34°25'20"S, 117°55'59"E, 4.xii.2009, J. Mottern, sweep, M09-066 [1♀, UCRC: UCRCENT312385 (**D4153**)].

***Gyrolasella* sp. AA** – Fig. 3.34D

AUSTRALIA: Queensland: Dalby, 25km WNW, 328m, 27°07'0"S, 151°02'0"E, C. J. Burwell, Brigalow, sweeping [1♀, QM: UCRCENT491673]. Mt. Rose Station via Taroom, 260m, 25°25'0"S, 149°58'0"E, 6.iii.1998, C.J. Burwell [1♀, QM: UCRCENT491672].

***Gyrolasella* sp. AB**

AUSTRALIA: New South Wales: 41km E by S Wilcannia, *31°35'57"S*, *142°56'24"E*, 10.xii.1982, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238496]. **Northern Territory:** 32km WNW Alice Springs, 647m, 23°21'36"S, 133°21'0"E, 8.x.1978, J. C. Cardale [1♀, ANIC: UCRCENT238507]. 33km WNW Alice Springs, 23°21'36"S, 133°20'24"E, 30.ix.1978, J. C. Cardale [1♀, ANIC: UCRCENT238506]. James Ranges, 582m, *24°09'0"S*, *133°15'36"E*, 22.ix.1978, J. C. Cardale [1♀, ANIC: UCRCENT238505]. Palm Valley, 558m, *24°00'52"S*, *132°46'3"E*, 14.v.1978, J. C. Cardale [4♂, ANIC: UCRCENT238501 – 238504]. Todd River, 9km N by E Alice Springs, 556m, *23°45'19"S*, *133°53'56"E*, 1.x.1978, J. C. Cardale [1♀, ANIC: UCRCENT238500]. **Queensland:** 6km N. Taroom, 199m, 25°36'0"S, 149°46'0"E, 3.iii.1998, C. J. Burwell [1♀, QM: UCRCENT491670]. Braemar S.F. via Kogan, 391m, *27°12'12"S*, *150°47'36"E*, 15.iii.1980, G. B. Monteith, host: *Notosacantha dorsalis*, host plant: *Acacia crassa*

[1♀, QM: UCRCENT491671]. Charleville, 11.7km on Rd. to Cunnamulla, *26°29'37"S*, *146°13'7"E*, 8.iii.1989, E.C. Dahms & G. Sarnes, Acacia murrayana, Triodia marginata & broom brush, sweep [1♀, QM: UCRCENT491667]. Gracemere nr. Rockhamstead (Rockhampton?), *23°24'37"S*, *150°28'43"E*, 12.iv.1988, J. D. Pinto & G. Gordh [1♀, ANIC: UCRCENT238497]. Heathlands, 61m, 11°27'0"S, 142°21'0"E, 22.xi–8.xii.1992, P. Zborowski & W. Dressler, malaise trap [1♀, ANIC: UCRCENT238508]. Isla Gorge National Park, NE corner, 240m, 25°10'0"S, 150°01'0"E, 3.iii.1998, C.J. Burwell [1♀, QM: UCRCENT491669]. Musselbrook Camp, 18°21'36"S, 138°04'48"E, 8–21.v.1995, I. D. Naumann, malaise trap [1♀, ANIC: UCRCENT238494]. Rd to Gundare, 62km N. of Charleville, 357m, *25°57'59"S*, *146°28'31"E*, 9.iii.1989, E. C. Dahms, G. Sarnes, Brigalow, Acacia, sweep [1♀, QM: UCRCENT491668]. Yatala, *27°44'59"S*, *153°13'0"E*, 24.xi–23.xii.1981, L. N. Robertson, among sugarcane [1♀, ANIC: UCRCENT238498]. **South Australia:** 32km NW by W Ceduna, *31°59'55"S*, *133°30'22"E*, 14.x.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238493]. **Western Australia:** 60km NE Wubin, *29°39'5"S*, *116°22'0"E*, 27.ix.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238499]. 9km E by S Carrabin, *31°26'47"S*, *118°44'7"E*, 9.x.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238489]. Alanooka Rd., *29°03'38"S*, *115°03'42"E*, 21.x.1987, N. Gough, swept off Geraldton Wax, *Chamelaucium uncinatum* [1♀, ANIC: UCRCENT238495].

***Gyrolasella* spp.**

AUSTRALIA: Australian Capital Territory: Namadgi N. Pk., Brindabella Mtns., Blundells Cr. Rd., 810m, 35°21'26"S, 148°50'1"E, 28.ii.1999, G. Gibson [1♀, CNC: CNC508561 (**D5106**)]; 13.ii.1999, G. Gibson [1♀, CNC: CNC509134 (**D4977**)]. **Australian Capital Territory:** Canberra, Black Mountain, 35°16'0"S, 149°06'0"E, 2.ii.1999, G. Gibson, malaise trap, host: Chrysomelidae egg mass [1♀, CNC: CNC509108 (**D4697**)], 7–13.xii.1998, G. Gibson, yellow pan trap [1♀, CNC: CNC508556 (**D5100**)]. **Northern Territory:** 30km NW by W Alice Springs, 571m, *23°19'12"S*, *133°22'48"E*, 7.x.1978, J. C. Cardale [1♀, ANIC: UCRCENT238371]. **Queensland:** ~9 km N Ellis Beach, 10m, 16°41'15"S, 145°34'51"E, 17.v.2015, Heraty & Hash, Mallee scrub, swp, H15-039 [1♀, UCRC: UCRCENT312398 (**D4548**)]. Brisbane Forest Park, 378m, 27°25'5"S, 152°50'13"E, 13–19.xii.1997, N. Power, across creek, malaise trap [1♀, CNC: CNC509106 (**D4676**)]. Brisbane Forest Park, 389m, 27°25'4"S, 152°49'48"E, 16–23.x.1998, N. Power, malaise trap [1♀, CNC: CNC508565 (**D5110**)]; 2 –9.i.1997, N. Power, malaise trap [1♀, CNC: CNC509109 (**D4697**)]; 26.ix–2.x.1998, N. Power, malaise trap [1♂, CNC: CNC509110 (**D4976**)]. Brisbane, 38m, *27°27'56"S*, *153°01'19"E*, unknown date or collector [1♀, BMNH: NHMUK10353953]. Brookfield, nr. Brisbane, 49m, *27°30'36"S*, *152°54'59"E*, 24.xii.1982, Z. Bouček [1♀, BMNH: NHMUK10353929]. Carr Ck., 18km NNW Mareeba, *16°50'2"S*, *145°22'13"E*, 21.v.1980, I. D. Naumann & JC. Cardale [1♀, ANIC: UCRCENT238370]. **South Australia:** 49km SW Pinnaroo, 35°25'12"S, 140°29'24"E, 20–24.x.1983, I. D. Naumann & J. C. Cardale, ex ethanol [1♂, ANIC: UCRCENT238373]. Inneston Heritage Site, Yorke

Peninsula above Engineers cottage, 17m, *35°16'22"S*, *136°53'35"E*, 4.ix.1999, G. Gibson [1♀, CNC: CNC508558 (**D5103**)]. The Coorong, Salt Creek, 4m, 36°07'33"S, 139°38'48"E, 24–25.ii.1990, R. Wharton [1♀, TAMU: UCRCENT426808 (**D4575**)]. **Tasmania:** 3km E National Park, *42°40'39"S*, *146°45'38"E*, 12.xii.1981, I. D. Naumann [1♀, ANIC: UCRCENT238519]. **Victoria:** 7km S by E Hattah, 59m, *34°49'13"S*, *142°17'34"E*, 19.x.1983, I. D. Naumann & J. C. Cardale [1♂, ANIC: UCRCENT238520]. 8km SSW Kista, 157m, 36°15'36"S, 141°27'36"E, 23.x.1983, I. D. Naumann & J. C. Cardale [2♀, ANIC: URCRENT00238523, ANIC: URCRENT00238524]. **Western Australia:** 10km W by S Ravensthorpe, *33°35'16"S*, *119°56'58"E*, 22.ix.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238372]. 29km SE of Coolgardie, 31°04'12"S, 121°14'24"E, 11.x.1981, I. D. Naumann & J. C. Cardale [2♀, ANIC: UCRCENT238521, ANIC: UCRCENT238522]. 60 km N Tom Price on Hamersley Iron Rd., 600m, 22°18'48"S, 117°40'30"E, 20.iv.2003, F.D. Parker & M. E. Erwin, Flowering eucalyptus [1♀, CNC: CNC509105 (**D4673**)]. D'Entrecasteaux N.P., Tookulup, Clifftop Walk, 71m, 34°49'55"S, 115°59'57"E, 8.xii.2009, J. Mottern, sweep, M09-101 [1♂, UCRC: UCRCENT414580 (**D3864**)]. Mt. Augustus Nat. Park, 9km S. Tourist Camp, 24°22'48"S, 116°54'12"E, 9–22.v.2003, M. E. Irwin & F. D. Parker, across small dry wash, malaise trap [1♂, CNC: CNC509107 (**D4677**)]. Stirling Range N.P., scenic lookout, 379m, 34°25'20"S, 117°55'59"E, 4.xii.2009, J. Mottern, sweep, M09-066 [2♀, UCRC: UCRCENT312386 (**D4154**), 416911 (**D4224**)]. Stirling Range N.P., Talyuberlup Car Park, 347m, 34°24'50"S,

117°57'26"E, 4.xii.2009, J. Mottern, dense *Eucalyptus* forest, sweep, M09-068 [1♀, UCRC: UCRCENT312430 (**D4579**)].

13. *Meruacesa* Koçak and Kemal - Fig. 3.36

Meruana Delucchi, 1962: 267. Type species: *Meruana elegans* Delucchi; holotype ♀, by original designation. Locality: Tanzania. Depository: MRAC.

Meruacesa Koçak and Kemal, 2009: 28. Replacement name for *Meruana* Delucchi, preoccupied by *Meruana* Sjoestedt, 1909 (Orthoptera: Acrididae).

Diagnosis: *Meruacesa* is defined by an absence of the upper ocular sulcus (Fig. 3.36A), incomplete and straight notauli (Fig. 3.1J), presence of a median carina and plica on the propodeum (Fig. 3.36D, E), and a petiolate gaster (Fig. 36D, E). This genus is most often confused with *Diglyphus*, however, *Diglyphus* possess the upper ocular sulcus, the notauli are incomplete but curved (Fig. 3.27D), lack a median carina and plica on the propodeum, and the gaster is sessile (Fig. 3.27E). *Diaulinopsis* is also similar, but the postmarginal vein is 1.5X or more in length than the stigmal vein, whereas it is less than 1.5X in *Meruacesa*, and the gaster is sessile in *Diaulinopsis* (Fig. 3.23G). Additionally, the male scape is swollen in *Diaulinopsis* (Fig. 3.23B, C) and normal in *Meruacesa*.

Description: Female: Metallic color on head or mesosoma present. Yellow color on mesosoma absent. Fore wing hyaline.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus absent. Frontal suture present. Vertex normal, not vaulted; large, paired setae absent small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape extending to vertex. 2 funiculars two. 3 clavomeres.

Body: mesoscutum with thin sculpturing. Notaulus incomplete, straight, and not reaching axilla or transscutal articulation. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially. 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina and plicae present and complete; costula absent; lateral basal groove absent. Gaster petiolate. Petiole with ventral carina or carinae present. First gastral tergite collar smooth. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum absent; fore wing is setose posterior to parastigma. Admarginal setae present. Postmarginal vein between 0.5X and 1.0X length of stigmal vein.

Male as female.

Hosts: DIPTERA: Agromyzidae: *Liriomyza brassicae* Riley; *Ophiomyia phaseoli* (Tryon); *Phytomyza horticola* Goureau on *Brassica oleracea* - cabbage (Brassicaceae); agromyzid on *Sonchus* sp. (Asteraceae). **UNKNOWN:** leaf miner on *Phaseolus vulgaris* (Fabaceae).

Distribution (Fig. 3.37)**: AFROTROPIC:** Cape Verde, Eritrea, Ethiopia, Kenya, Mauritius, South Africa, Tanzania, Zimbabwe. **AUSTRALASIA:** Australia (QLD).

Taxonomic Summary:

1. *Meruacesa arabica* Narendran & Subair Ahmad
2. *Meruacesa camerounensis* Risbec
3. *Meruacesa cuprata* Ferrière
4. *Meruacesa elegans* Delucchi
5. *Meruacesa liriomyzae* Bouček

Material Examined:

***Meruacesa camerounensis* (Risbec)**

ETHIOPIA: Oromia: Holetta, *9°03'34"N*, *38°29'49"E*, 26.xii.1983, T. Abate, CIE A 15634, host: *Phytomyza horticola*, host plant: cabbage [1♂ 1♀, BMNH: NHMUK10370181, 10370195].

***Meruacesa cuprata* (Ferrière)**

AUSTRALIA: Queensland: Indooroopilly, *27°29'52"S*, *152°58'21"E*, 14.xi.1979, G. Gordh [1♂, UCRC: UCRCENT498540]. Indooroopilly, *27°29'52"S*, *152°58'21"E*, 15.xi.1979, G. Gordh [1♂, UCRC: UCRCENT416903]. Indooroopilly, *27°29'52"S*, *152°58'21"E*, 20.xi.1979, G. Gordh [1♂, UCRC: UCRCENT498539]. **CAPE VERDE:** "bosbouwstation", 1500m, 10.xi.1980, H. van Hoof [1♂, BMNH: NHMUK10370201]. **Santiago:** São Jorge, 294m, *15°03'14"N*, *23°36'6"W*, ii.1985, A. van Harten, suction trap [2♂ 1♀, BMNH: NHMUK10370205, 10370210, 10370228]. **ZIMBABWE: Harare:** Harare, *17°50'14"S*, *31°03'1"E*, ii.1987, Watsham [1♀, BMNH: NHMUK10734427].

***Meruacesa elegans* (Delucchi)**

KENYA: Mt. Kenya, Teleki Valley, *0°10'17"S*, *37°12'52"E*, iv.1980, D. Levin, bamboo forest along stream [1♂ 2♀, CNC: CNC509114 – 509116].

***Meruacesa liriomyzae* (Bouček)**

Paratypes: MAURITIUS: Réduit, *20°13'54"S*, *57°29'20"E*, 1979, CIE A 11772, host: *Liriomyza brassicae* [1♀, BMNH: NHMUK10371746]. **TANZANIA:** Lyamungu, *11°05'54"S*, *34°51'59"E*, ix–xi.1979, J.M. Katunov, C.I.E. A 11076, host plant: *Phaseolus vulgaris* [1♀, BMNH: NHMUK10371747]. **Additional material examined: AUSTRALIA: Queensland:** Brisbane, *27°27'56"S*, *153°01'19"E*, 1.xi.1976, Z. Bouček [2♂, ANIC: UCRCENT238580, 238581, NMV: UCRCENT533450]. Brisbane, 38m, *27°27'56"S*, *153°01'19"E*, 20.xi.1976, Z. Bouček [1♀, BMNH: NHMUK10371752]. Brisbane, 38m, *27°27'56"S*, *153°01'19"E*, 24.xi.1976, Z. Bouček [1♀, BMNH: NHMUK10371749]. **ERITREA:**

Maekel: Asmara, 2329m, *15°19'8"N*, *38°55'21"E*, 18–20.i.1962, S.M. Clark [1♂, CNC: CNC508121]. **ETHIOPIA:** Melkasa, 1531m, *8°23'46"N*, *39°20'3"E*, 15.i.1987, T. Abate, CIE A 19607, host: *Ophiomyia phaseoli* [3♀, ANIC: UCRCENT238577, BMNH: NHMUK01037151]. **Addis Ababa:** Gafarsa (Welenso), 2605m, *8°44'0"N*, *38°04'0"E*, 26.i.1962, S.M. Clark [3♂ 1♀, CNC: CNC509117 – 509120]. **Oromia:** Holetta, *9°03'34"N*, *38°29'49"E*, 26.xii.1983, T. Abate, CIE A 15634, host: *Phytomyza horticola*, host plant: cabbage [2♀, ANIC: UCRCENT238578, BMNH: NHMUK10371748]. **MAURITIUS:** Réduit, *20°13'54"S*, *57°29'20"E*, 1979, CIE A 11772, host: *Liriomyza brassicae* [2♀, ANIC: UCRCENT238579]. **SOUTH AFRICA:** Port Elizabeth, *33°57'27"S*, *25°36'12"E*, 18.iii.1949 [3♀, BMNH: NHMUK10371750].

14. *Naumanniola* Bouček - Fig. 3.38

Naumanniola Bouček, 1988: 654. Type species: *Naumanniola varians* Bouček [examined]; holotype ♀, by original designation. Locality: Australia, New South Wales, Warrumbungles National Park. Depository: ANIC: UCRCENT238539.

Diagnosis: *Naumanniola* is characterized by the presence of an occipital carina (Fig. 3.1I), 3 funiculars and 2 clavomeres, presence of a lateral basal groove on the propodeum (Fig. 3.1I), and incomplete notaulus (Fig. 3.38D). *Gallowayia* is the only genus that may be confused with *Naumanniola*, however, it differs

morphologically by the lack of an occipital carina (Fig. 3.29D, E), possession of 2 funiculars and 3 clavomeres (Fig. 3.29A), and the notaulus is complete and strongly curved medially (Fig. 3.2C).

Description: Female: metallic blue or green on head or mesosoma. Yellow color on mesosoma absent or present. Fore wing hyaline or with dark patterns or infuscation present.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture present. Vertex normal, not vaulted; large, paired setae present; small, scattered setae present. Carina posterior to vertex absent. Occipital carina present.

Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape extending to vertex. 3 funiculars. 2 clavomeres.

Body: mesoscutum with pronounced and distinct sculpturing (areolate). Notaulus incomplete, curved, and not reaching axilla or transscutal articulation. Axilla advanced anteriorly more than 10% but less than 75%, or more than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially or present, curved posteriorly, and meeting medially; 2 pairs of setae - anterior pair of setae longer than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina present and complete; plicae absent, or present and

complete; costula absent. Propodeum with lateral basal groove present. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa with deep, distinct sculpturing (areolate).

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae within. Admarginal setae present. Postmarginal vein between 0.5X and 1.5X length of stigmal vein.

Male as female, except: funiculars with projection dorsally.

Hosts: Lepidoptera: Elachistidae: *Elachista asperae* Kaila*, E. eriodes* Kaila*, E.* nr. *paragauda, E. paragauda* Kaila, *E. physalodes* Kaila, and *E.* sp.

Distribution (Fig. 3.38)**: Australasia:** Australia (ACT, NSW, QLD, SA, TAS, VIC, WA).

Taxonomic Summary: Bouček (1988) described an additional species, *Naumanniola ramosa,* based only on males, which does not fit with the description of the genus. *Naumanniola ramosa* specimens have branched funiculars (Fig. 3.1E), a state not found in any other cirrospiline species, but found within Eulophini. Examination of all type specimens of *N. ramosa* reveals propleura that meet

posteriorly, covering the prosternum, a character also only found within Eulophini. This species keys to *Naumanniola* (Bouček, 1988) only because the propleura separation is not addressed in the key, and the couplet that keys to *Naumanniola* (54) allows for the male antenna to have either “dorsal protuberances or branches.” If these 2 characters (propleura connected, branched antenna) are taken into account, *N. ramosa* does not key to any genus in Bouček (1988) and is most likely an undescribed Australian genus, morphologically similar to *Necremnus* Thomson and *Pnigalio* Schrank, but does not agree completely with either of these genera (Burks, pers. comm). This species is hereby removed from *Naumanniola* and named as *incertae* sedis.

1. *Naumanniola varians* Bouček

Material Examined:

***Naumanniola varians* Bouček**

Holotype: AUSTRALIA: New South Wales: Warrumbungles Natl. Park, via Connabarabran, 764m, *31°17'26"S*, *149°03'4"E*, 17.xii.1974, I. Naumann, grass by dry creek; dry sclerophyll forest, sweep [1♀, ANIC: UCRCENT238539]. **Paratypes: AUSTRALIA: Queensland:** 2km S Horseshoe Lookout Blackdown Tab., 23°27'36"S, 149°03'36"E, 23–24.iv.1981, I. D. Naumann [1♀, ANIC: UCRCENT238587]. Cootharaba Lake nr. Gympie, 8m, *26°15'59"S*, *152°59'9"E*, 13.xi.1976, Bouček [1♀, BMNH: NHMUK10371678]. **Western Australia:** 32 mls.

N. of Perth, 36m, *31°32'44"S*, *115°38'18"E*, 20–31.xii.1935, R. E. Turner [1♀, BMNH: NHMUK10371676]; 29.i–8.ii.1936, R. E. Turner [1♀, BMNH: NHMUK10371677]. Millstream, 177m, *21°20'1"S*, *117°14'23"E*, 25.x.1970, D. H. Colless [1♀, BMNH: NHMUK10371675]. **Additional material examined: AUSTRALIA: Australian Capital Territory:** Honeysuckle Creek, 585m, 35°21'0"S, 149°00'0"E, 21–31.iii.1985, I. Naumann & J. Cardale, malaise trap [1♀, ANIC: UCRCENT238695]. **New South Wales:** Batemans Bay, 35°25'48"S, 150°06'0"E, 6.viii.1999, L. Kaila, host: *Elachista physalodes* [1♀, ANIC: UCRCENT238693]; 14.viii.1999, L. Kaila, host: *E. physalodes* [1♀, ANIC: UCRCENT238694]. Monga St. Forest, nr. Monga, 35°34'31"S, 149°50'1"E, 14.ii.1999, G. Gibson [1♂, CNC: CNC509133 (**D4671**)]. Warrumbungles Natl. Park, via Connabarabran, 764m, *31°17'26"S*, *149°03'4"E*, 17.xii.1974, I. Naumann, grass by dry creek; dry sclerophyll forest, sweep [3♀, UQIC: UCRCENT528608 – 528610]. **Queensland:** 3 km S Mt. Spurgeon, 1100m, 16°27'0"S, 145°11'0"E, 20–22.xi.1997, C.J. Burwell, open forest [1♀, QM: UCRCENT491633]. Camp Milo, Cooloola State Forest, 91m, *26°01'28"S*, *153°04'42"E*, 5.ix.1979, G. Gordh & C. Dahms [1♂, UCRC: UCRCENT485221]. Chelmer (Chalamar on label), *27°31'0"S*, *152°58'33"E*, 5.ix.1979, G. Gordh & C. Dahms [1♂, UCRC: UCRCENT485220]. **South Australia:** Parachilna Gorge, 31°04'48"S, 138°19'12"E, 8.xi.1987, I. Naumann & J. Cardale [1♀, ANIC: UCRCENT238592]. **Victoria:** The Grampians, Fyan's Creek, 212m, *37°05'18"S*, *142°33'37"E*, 10.xii.1975, I. Naumann, grass by river; wet sclerophyll forest, sweep

[1♀, UQIC: UCRCENT528607]. **Western Australia:** Kalamunda, 233m, 31°58'0"S, 116°03'0"E, 18.vii.2001, L. Kaila, host: *Elachista paragauda* [2♀, ANIC: UCRCENT238369].

***Naumanniola* sp.**

AUSTRALIA: New South Wales: Long Beach nr. Batemans Bay, 467m, 35°25'12"S, 150°08'24"E, 18.viii.1999, L. Kaila, host: *Elachista asperae* [2♂, ANIC: UCRCENT238701, 238706]. **Queensland:** 2km S Horseshoe Lookout Blackdown Tab., 23°27'36"S, 149°03'36"E, 23–24.iv.1981, I. D. Naumann [1♂, ANIC: UCRCENT238590]. 40km W. of Warwick, *28°10'7"S*, *151°39'43"E*, 31.x.1976, Bouček [1♂, BMNH: NHMUK10371679]. Eurimbula Ck. via Round HIll Head, *24°10'7"S*, *151°53'9"E*, 3–5.v.1975, I. Naumann, low vegetation, open forest/sub-tropical rainforest boundary, sweep [1♂, ANIC: UCRCENT238591]. Mt. Tibrogargan, 230m, 26°55'39"S, 152°56'48"E, 26.xii.1976, Z. Bouček [1♂, BMNH: NHMUK10371680]. nr. Wilson's Peak, via Teviot Gap, *28°15'0"S*, *152°28'21"E*, 12.v.1974, I. Naumann, rainforest edge, beat & sweep [1♀, UQIC: UCRCENT528611]. **South Australia:** Aldinga Scrub Conservation Park, 20m, *35°17'40"S*, *138°27'17"E*, L. Kaila, host: *Elachista paragauda* complex [1♀, ANIC: UCRCENT238437], 27.vii.1999, L. Kaila, host: *Elachista paragauda* complex [1♀, ANIC: UCRCENT238436]. Cox Scrub Conservation Park, 210m, 35°20'4"S, 138°43'58"E, 1.viii.2001, L. Kaila, host: *Elachista eriodes* [1♀, ANIC: UCRCENT238434]; 13.viii.1999, L. Kaila, host: *Elachista* nr. *paragauda* [1♀, ANIC: UCRCENT238705]; 26.viii.1999, L. Kaila, host: *Elachista* nr. *paragauda*

[2♂, ANIC: UCRCENT238703, 238704]; L. Kaila, host: *Elachista eriodes* [1♂, ANIC: UCRCENT238435]. Strathalbyn, 72m, *35°15'28"S*, *138°53'28"E*, 23.ii.1984, E. R. Oatman [1♂ 1♀, UCRC: UCRCENT485218, 485219]. The Coorong, Salt Creek, 4m, 36°07'33"S, 139°38'48"E, 24–25.ii.1990, R. Wharton [1♀, TAMU: UCRCENT426803 (**D4574**)]. **Tasmania:** Airstrip Rd. Site 2A, 327m, 42°50'32"S, 146°14'26"E, 19.iii.1999, M. Driessen, buttongrass moorland, sweep [1♂, TMAG: TMAG Reg. No.31264]. Airstrip Rd. Site 6C, 327m, 42°50'32"S, 146°14'26"E, 14.iii.2001, M. Driessen, buttongrass moorland, sweep [1♂, TMAG: TMAG Reg. No.31269]. LPE SFT McPartlan Research B, 318m, 42°51'10"S, 146°11'20"E, 25.ii.2004, M. Driessen, buttongrass moorland [1♂, TMAG: TMAG Reg. No.31254]. McPartlan Pass Site 4A, 318m, 42°51'10"S, 146°11'20"E, 8.iii.2000, M. Driessen, buttongrass moorland, sweep [1♂, TMAG: TMAG Reg. No.31259]. McPartlan Pass Site 8A, 318m, 42°51'10"S, 146°11'20"E, 8.iii.2000, M. Driessen, buttongrass moorland, sweep [2♂, TMAG: TMAG Reg. No.31262, 31263]. McPartlan Pass Site, 42°51'10"S, 146°11'20"E, 14.iii.2001, M. Driessen, buttongrass moorland, sweep [1♂ 1♀, TMAG: TMAG Reg. No.31272 (**D5956**), 31273]. Melaleuca, Bathurst Harbour, 318m, 43°15'0"S, 146°06'0"E, 12–17.ii.1990, I. D. Naumann, heathy sedgeland [1♂, ANIC: UCRCENT238700]; 11–16.iv.1991, J. A. Berry [2♂ 1♀, ANIC: UCRCENT238697 – 238699]. **Western Australia:** 26km WNW Northampton, 28°16'52"S, 114°23'56"E, 30.ix.1981, I. D. Naumann & J. C. Cardale [1♂, ANIC: UCRCENT238588]. 32 mls. N. of Perth, 36m, *31°32'44"S*, *115°38'18"E*, 1–7.i.1936, R. E. Turner [1♂, BMNH:

NHMUK10371681]. Napler Ck. 21km NNE Albany, 34°30'0"S, 117°34'48"E, 7.x.1981, I. D. Naumann & J. C. Cardale [2♂, ANIC: UCRCENT238593, 238702]. Northcliffe Forest Park, Bardi Creek Trail, 278m, 34°38'9"S, 116°07'51"E, 5.xii.2009, J. Mottern, sweep, M09-072 [1♀, UCRC: UCRCENT312388 (**D4174**)]. Shannon N.P., Rocks Walk trail nr. Shannon Dam, 161m, 34°34'54"S, 116°24'46"E, 6.xii.2009, R. Waterworth, sweep, M09-079 [1♂, UCRC: UCRCENT414588 (**D3994**)]. Stirling Range Drive, Stirling Range Natl. Pk., 296m, *34°24'20"S*, *117°55'7"E*, 23.ix.1981, I. D. Naumman & J. C. Cardale [1♂, ANIC: UCRCENT238589]. Torndirrup, Frenchman's Bay, 13m, *35°05'33"S*, *117°56'57"E*, 31.vii–1.viii.2001, L. Kaila, host: *Elachista* sp. [1♀, ANIC: UCRCENT238438].

"Naumanniola ramosa" – incertae sedis

Holotype: AUSTRALIA: Western Australia: Beaufort R., 33km SW Wagin, 33°18'0"S, 117°02'24"E, 24.ix.1981, I. D. Naumann & J. C. Cardale [1♂, ANIC: UCRCENT238540].

Paratypes: AUSTRALIA: Queensland: Capalaba, *27°31'21"S*, *153°11'29"E*, 8.vi.1980, J. S. Noyes [1♂, ANIC: UCRCENT238594]. Cooloola, *26°01'47"S*, *153°01'23"E*, vi.1980, J. S. Noyes [1♂, BMNH: NHMUK10371674]. Gatton, 121m, *27°34'23"S*, *152°16'28"E*, 3.i.1977, Bouček [1♂, BMNH: NHMUK10371672]. Mt. Tibrogargan, 26°55'39"S, 152°56'48"E, 5.vi.1980, J. S. Noyes [1♂, BMNH: NHMUK10371673].

15. *Oxycantha* Surekha and Ubaidillah - Fig. 3.40

Oxycantha Surekha and Ubaidillah, 1996: 132. Type species**:** *Oxycantha darwini* Surekha and Ubaidillah, holotype ♂, by original designation and monotypy. Locality: Brunei, Bukit Sulang. Depository: BMNH, BM type 5.3957, NHMUK13458805.

Diagnosis: A rarely collected genus, *Oxycantha* is easily recognized by the enlarged spines projecting posterolaterally from either side of the pronotum (Fig. 3.40B, C); no other genera in Cirrospilini have this character. In addition, the head and body are completely yellow, lacking any metallic coloration, and the notaulus is incomplete. All other cirrospiline genera that possess incomplete notauli are either dark brown/black (*Ascotolinx, Gattonia*) or metallic (*Diglyphus, Meruacesa, Naumanniola*).

Description: Female: unknown. Male: head and body entirely yellow. Metallic color on body absent. Fore wing hyaline.

Head: malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture present. Vertex normal, not vaulted; large, paired setae present; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape extending past vertex. 2 funiculars. 3 clavomeres.

Body: mesoscutum with thin sculpturing. Notaulus incomplete, curved, and not reaching axilla or transscutal articulation. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves absent; 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina and plicae present and complete; costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold setose. Cubital fold basally setose and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae within. Admarginal setae absent. Postmarginal vein less than 0.5X length of stigmal vein.

Hosts: unknown.

Distribution (Fig. 3.41)**: Indo-Malay:** Brunei.

Taxonomic Summary:

1. *Oxycantha darwini* Surekha & Ubaidillah

Material Examined:

Oxycantha darwini

Paratype: BRUNEI: Tutong: Bukit Sulang nr. Lamunin, *4°39'0"N*, *114°44'0"E*, 20.vii–10.ix.1982, N. E. Stork, canopy fog, B.M. 1982-388 [1♂, BMNH: NHMUK10371687].

16. *Pseudiglyphus* Girault - Fig. 3.42

Pseudiglyphus Girault, 1913d: 458. *Nomen nudem*, identified by Bouček (1988) as *Pseudiglyphus* Girault.

Pseudiglyphus Girault, 1915a: 276. Type species: *Pseudiglyphus grotiusi* Girault [examined]; holotype ♀, by original designation. Locality: Australia, Queensland, Cairns. Depository: QM, Type No. Hy. 2678.

Diagnosis: *Pseudiglyphus* are drab brown, and possess a complete notaulus that extends to the anterior margin of the axilla (Fig. 3.42C, D), complete median carina on the propodeum (Fig. 3.42D), asetose basal fold (Fig. 3.2K), and a parastigma that smoothly connects with the submarginal vein and does not extend into the basal fold (Fig. 3.2K). *Colpoclypeus*, *Vagus*, and *Zagrammosoma* also share the same notaulus state as *Pseudiglyphus*, however both *Colpoclypeus* and *Vagus* are metallic, and *Zagrammosoma* has a vaulted vertex and is yellow or black in coloration (Fig. 3.50). While this genus is named *Pseudiglyphus*, there are very few characters shared between *Pseudiglyphus* and *Diglyphus*, with the differences

being: *Diglyphus* is metallic green or blue, has incomplete notauli, lacks a median carina on the propodeum, and the basal fold is setose (Fig. 3.27).

Description: Female: head and body drab brown. Metallic color absent. Yellow on mesosoma absent. Fore wing hyaline.

Head: Malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture present. Vertex normal, not vaulted; large, paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with thin sculpturing. Notaulus complete, extending to anterior half of axilla. Axilla advanced anteriorly more than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially; 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina and plicae present and complete; costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold asetose. Cubital fold basally asetose. Parastigma smoothly connecting with submarginal vein and not extending into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae within. Admarginal setae present. Postmarginal vein between 0.5X and 1.0X length of stigmal vein.

Hosts: UNKNOWN: red blotch mine at branch tips on *Eucalyptus gomphocephala* (Myrtales: Myrtaceae).

Distribution (Fig. 3.43)**: Australasian:** Australia: (ACT, NSW, QLD, SA, VIC, WA).

Taxonomic Summary:

1. *Pseudiglyphus grotiusi* Girault, 1915
2. *Pseudiglyphus orientalis* Khan, Agnihotri & Sushil, 2005

Material examined:

Pseudiglyphus grotiusi

AUSTRALIA: Australian Capital Territory: Blundells Ck. 3km E. of Piccadilly Circus, 857m, *35°21'15"S*, *148°50'7"E*, iii.1984, Lawrence, Weir, Johnson, Flight intercept window/trough trap [1♂ 1♀, ANIC: UCRCENT238672, 238677]. Canberra, *35°16'55"S*, *149°08'9"E*, 10.vi.1948, E.F. Riek [1♀, ANIC: UCRCENT238616]. **New South Wales:** 10 mi. S. Bateman's Bay, 23m,

35°51'14"S, *150°07'55"E*, 3.ix.1948, E.F. Riek [1♀, ANIC: UCRCENT238615]. 17km S. West Wyalong, 272m, 34°05'0"S, 147°08'0"E, 10.ii.1992, C. J. Burwell [1♀, UQIC: UCRCENT528604]. 30km S. of Wellington, *32°47'50"S*, *148°54'48"E*, 30.x.1976, Z. Bouček [1♂, BMNH: NHMUK10371651]. 51km N. Coonabarabran, 378m, 30°50'0"S, 149°36'0"E, 13.ii.1992, C. J. Burwell [1♀, UQIC: UCRCENT528605]. Cabramatta, 7m, *33°54'11"S*, *150°56'18"E*, 30.i.1962, M. Nikitin, BM 1962-638 [1♀, BMNH: NHMUK10371647]. Casula, Sydney, *33°57'5"S*, *150°54'23"E*, 17.xii.1961, M. Nikitin, BM 1962-206 [1♀, BMNH: NHMUK10371650]. Fowler's Gap Res. Stn., 179m, *31°05'16"S*, *141°42'24"E*, 29.xi–2.xii.1981, I. D. Naumann [3♂, ANIC: UCRCENT238607, 238674, 238675]. Fowler's Gap Res. Stn., *31°05'16"S*, *141°42'24"E*, 29.xi–2.xii.1981, J. C. Cardale, ex ethanol [1♂, ANIC: UCRCENT238610]. Sawpit Creek, Mt. Kosciuszko Nat. Park, *36°20'48"S*, *148°33'3"E*, 12.ii.1977, Z. Bouček [3♀, ANIC: UCRCENT238606, BMNH: NHMUK10371645, 10371649]. **Queensland:** 16km N. Boonah, 164m, 27°54'0"S, 152°41'0"E, 19.vii.1991, C. J. Burwell [1♀, UQIC: UCRCENT528600]. 30 km N Mareeba, Oaky Ck, 395m, *16°43'46"S*, *145°21'10"E*, 26.iv.1990, J. Heraty, open forest, H90-035 [1♂ 2♀, UCRC: UCRCENT119919, 119926, 119936]. 7–14m. W. of Herberton, via Watsonville, *17°22'55"S*, *145°15'30"E*, 1.v.1967, D.H. Colless [1♀, ANIC: UCRCENT238613]. 7.5km on Rd. to Granite Grge nr. Mt Aunt, Atherton Tble1, *17°05'39"S*, *145°23'2"E*, 19.iv.1988, E. Dahms & G. Sarnes [1♀, QM: UCRCENT491629]. Acacia Ridge near Brisbane, 37m, *27°35'23"S*, *153°01'41"E*, 27.ix.1980, G. Gordh & C. Dahms [1♀, UCRC:

UCRCENT499039]. Acacia Ridge near Brisbane, 37m, *27°35'23"S*, *153°01'41"E*, 31.viii.1980, G. Gordh & C. Dahms [1♀, UCRC: UCRCENT416901]. Acacia Ridge near Brisbane, 37m, *27°35'23"S*, *153°01'41"E*, 6.ix.1980, G. Gordh & C. Dahms [1♀, UCRC: UCRCENT499040]. Acacia Ridge, Calamvale Rd. nr. Brisbane, 84m, *27°36'51"S*, *153°03'13"E*, 1.ix.1980, G. Gordh [1♂ 2♀, UCRC: UCRCENT499041 – 499043]. Bribie Island, 7m, *26°59'11"S*, *153°07'57"E*, 22.xii.1976, Z. Bouček [2♀, ANIC: UCRCENT238609, QM: UCRCENT491624]. Brisbane-Indooroopilly, 47m, *27°29'54"S*, *152°58'0"E*, 22.xii.1976, Z. Bouček [2♀, BMNH: NHMUK10371644, 10371648]. Brisbane, Browns Plains, *27°39'46"S*, *153°03'8"E*, 11.ii.1981, Brothers, Dahms, & Sarnes, grass, sweep [1♂, QM: UCRCENT491622]. Brookfield, nr. Brisbane, 49m, *27°30'36"S*, *152°54'59"E*, i.1982, Z. Bouček [1♂, BMNH: NHMUK10371652]. C. Qld, Mahogany Forest, Mt. Moffat Nat. Park, 1200m, 24°56'0"S, 148°04'0"E, 24–26.ii.1996, C. J. Burwell, m.v. light [1♀, QM: UCRCENT491630]. Cathu State Forest, Mt. Macartney, *20°49'21"S*, *148°32'11"E*, 21.iv.1979, E. Dahms, open forest [1♀, QM: UCRCENT491623]. Charleville, 11.7km on Rd. to Cunnamulla, *26°29'37"S*, *146°13'7"E*, 8.iii.1989, E.C. Dahms & G. Sarnes, *Acacia murrayana*, *Triodia marginata* & broom brush, sweep [1♀, QM: UCRCENT491631]. Clayton Gully, 13km SW Aratula, 28°03'0"S, 152°26'0"E, 14.ii.1991, C. J. Burwell [1♂, UQIC: UCRCENT528598]. D.P.I. Brisbane, 17m, *27°30'35"S*, *152°59'46"E*, 3.ix.1980, G. Gordh [1?, UCRC: UCRCENT499056]. Desailly Creek, 10km W. by N. Mt. Carbine, 16°18'0"S, 144°33'0"E, 19–21.v.1981, I. D. Naumann [1♀, ANIC: UCRCENT238617]. Eungella Natl. Park, Mt. William,

21°01'29"S, *148°35'51"E*, 18.iv.1979, E. Dahms, rainforest edge [1♀, QM: UCRCENT491621]. Gatton, 115m, *27°34'33"S*, *152°16'23"E*, 11.ix.1980, G. Gordh & E.C. Dahms [2♂ 5♀, UCRC: UCRCENT499049 – 499055]. Gatton, 115m, *27°34'33"S*, *152°16'23"E*, 3.vi.1980, J. S. Noyes [1♀, BMNH: NHMUK10371646]. Millstream Falls Natl. Park, *17°38'8"S*, *145°27'36"E*, 24–25.v.1980, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238678]. Mt. Coot-tha, Brisbane, *27°28'14"S*, *152°56'52"E*, 2.ix.1979, Colls, G. Gordh, C. Dahms [1♀, UCRC: UCRCENT499048]. Mungana Railway Station, 344m, 17°06'25"S, 144°23'32"E, 6.iv.1992, E. Dahms & G. Sarnes [1♀, QM: UCRCENT491632]. NEQ, 6.3km N Ellis Beach, *16°41'49"S*, *145°36'34"E*, 26.iv.1988, E.C. Dahms, G. Sarnes [1♀, QM: UCRCENT491625]. Porter Creek, 22km SE Cardwell, 18°27'0"S, 146°08'0"E, 28.iv.1997, C. J. Burwell [1♀, QM: UCRCENT04901626]. S.E. Queensland, Stanley River, *27°08'55"S*, *152°33'35"E*, 25.viii.1979, G.Gordh. D.Dahms [1♀, UCRC: UCRCENT499047]. Samford, nr. Brisbane, 55m, *27°22'22"S*, *152°52'52"E*, 16.i.1977, Z. Bouček [1♀, USNM: UCRCENT471681]. Samsonvale Cemetary, 8.5km SSE Dayboro, 27°16'8"S, 152°51'49"E, 1995, C. J. Burwell [1♀, QM: UCRCENT491628]. Samsonvale Cemetary, 8.5km SSE Dayboro, 36m, 27°16'8"S, 152°51'49"E, 8.ix.1991, C. J. Burwell [1♀, UQIC: UCRCENT528599]. Sunday Ck. Environmental Study Centre, Jimpa State Frst., 650m, 26°42'46"S, 152°32'13"E, 15–17.iii.1996, C. J. Burwell [1♀, QM: UCRCENT491627]. Tinaroo Falls Dam (open savannah), *17°10'7"S*, *145°32'33"E*, 27.iv.1967, D.H. Colless [1♀, ANIC: UCRCENT238611]. Town Talk Mine, 1km NW Irvinebank, 17°26'0"S,

145°12'0"E, 12.xii.1991, C. J. Burwell [1♀, UQIC: UCRCENT528603]. **South Australia:** Aldinga Scrub, 22m, *35°17'51"S*, *138°27'22"E*, 3.xii.1989, R. Wharton [2?, TAMU: UCRCENT426759, 426760]. Kangaroo Island, Flinders Chase N.P., West Bay, 42m, *36°02'46"S*, *136°45'20"E*, 31.xii.1989–5.i.1990, R. Wharton [1?, TAMU: UCRCENT426761]. nr. Moonabbie Range, 192m, 33°10'12"S, 137°06'0"E, 28.xi.1992, I. D. Naumann, J. C. Cardale [1♀, ANIC: UCRCENT238676]. Trezona Camp, Brachina Ck., 31°12'0"S, 138°22'12"E, 4–10.xi.1987, I. D. Naumann, J. C. Cardale, malaise/ethanol [1♀, ANIC: UCRCENT238612]. **Victoria:** 30km W. Hershaw, *37°28'16"S*, *144°47'6"E*, 1.iii.1984, E. R. Oatman [1♂ 2♀, UCRC: UCRCENT499044 – 499046]. Shepparton, *36°22'51"S*, *145°23'44"E*, 15.xii.1974, I. Naumann, grass by creek, dry sclerophyll forest, sweep [1♀, UQIC: UCRCENT528601]. **Western Australia:** 9km SSW Bindoon, 31°16'12"S, 116°04'48"E, 25.ix.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238614]. Amelup, *34°18'30"S*, *118°10'12"E*, 23.ix.1981, I. D. Naumann & J. C. Cardale [1♀, ANIC: UCRCENT238673]. John Forrest Natl. Park, 305m, 31°53'4"S, 116°05'27"E, 18.i.1999, J. B. Woolley, 99/016 [1♀, TAMU: UCRCENT426765, (**D4661)**]. Perth, 31°57'0"S, 115°52'0"E, vi.1987, G. Tribe, host: red blotch at branch tips, host plant: *Eucalyptus gomphocephala* [1♀, SANC: HMYC5072]. Stirling Range N.P., scenic lookout, 379m, 34°25'20"S, 117°55'59"E, 4.xii.2009, J. Mottern, sweep, M09-066 [1♂, UCRC: UCRCENT416910, (**D4223)**]. Stirling Range N.P., Talyuberlup Car Park, 347m, 34°24'50"S, 117°57'26"E,

4.xii.2009, R. Waterworth, dense eucalyptus forest, sweep, M09-069 [1♀, UCRC: UCRCENT416912, (**D4225)**].

17. *Pseudozagramma* Perry n. gen. - Fig. 3.44

Type species: *Pseudozagramma coachellae* (Gates) [examined], 2000: 59; holotype ♀, by original designation. Locality: USA, California, Coachella Valley. Depository: USNM**.**

Diagnosis: This genus is characterized by a vaulted vertex (Fig. 3.44A, B), a complete notaulus that extends to the transscutal articulation (Fig. 3.44C), and a yellow body with extensive dark brown patterns and markings (Fig. 3.44). *Pseudozagramma* is most similar to *Atoposoma* and *Zagrammosoma*, however the notaulus is complete to the posterior half of the axilla in *Atoposoma* (Fig. 3.12E), and complete to the axilla in *Zagrammosoma* (Fig. 3.50J).

Description: Female: body yellow, with dark markings. Metallic color on head or mesosoma absent. Fore wing with dark patterns or infuscation present.

Head: malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present but very faint. Frontal suture present. Vertex vaulted; large, paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: Torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: Mesoscutum with thin sculpturing. Notaulus complete, extending to transscutual articulation. Axilla advanced anteriorly more than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves absent; 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum constricted medially; median carina, plicae, and costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by more than its own length from stigmal apex. Speculum present with few or no setae within. Admarginal setae absent. Postmarginal vein less than 0.5X length of stigmal vein.

Hosts (from material examined): LEPIDOPTERA: Gracillariidae: *Phyllonistis citrella* on citrus. *Marmara* sp. peelmines on grapefruit.

Distribution (Fig. 3.45)**: Nearctic:** Mexico (BC), USA (AZ, CA, TX). **Neotropic:** Costa Rica.

Etymology: Named for the close resemblance to and often misidentification as *Zagrammosoma.*

Taxonomic Summary:

1. *Pseudozagramma coachellae* (Gates) **n. comb.**

Material Examined:

***Pseudozagramma coachellae* (Gates)**

COSTA RICA: Guanacaste: Santa Rosa N.P., 300m, 10°50'7"N, 85°37'2"W, 19.viii.2010, J. Heraty, green dry forest / grass, sweep, H10-137 [1♀, UCRC: UCRCENT416913 (**D4226**)]. **USA: California: Riverside Co.**, Coachella Valley, *33°44'13"N*, *116°08'57"W*, 20.xii.2004, N. Smart, ex *Marmara gulosa* on grapefruit, reared [2♂ 2♀, UCRC: UCRCENT235905, 292872 – 292874]. Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W, 31.viii–7.ix.2008, G. Pratt, malaise trap [1♀, UCRC: UCRCENT357521 (**D3663**)]. **San Diego Co.**, Pauma, Rutz grove, 374m, *33°20'14"N*, *116°58'57"W*, 11.ix.2008, T.Shea, #36, host: *Phyllocnistis citrella*, host plant: citrus [1♀, UCRC: UCRCENT292477]. Pauma, Rutz grove, 374m, *33°20'14"N*, *116°58'57"W*, 21.x.2008, T. Shea, #44, host: *Phyllocnistis citrella*, host plant: citrus [1♀, UCRC: UCRCENT292451]. **Texas:**

Hidalgo Co., Bentsen-Rio Grande Park; Acacia Loop, 31m, 26°10'38"N, 98°23'3"W, 17.iv.2010, J. Mottern, hackberry forest, sweep, M10-028 [1♀, UCRC: UCRCENT414575 (**D3859**)].

18. *Trichospilus* Ferrière - Fig. 3.46

Trichospilus Ferrière, 1930: 358**.** Type species: *Trichospilus pupivora* Ferrière; by monotypy. Lectotype designated by Bouček (1976). Locality: Kochi, India. Depository: BMNH, BM type 5.1211, NHMUK013458806

Diagnosis: *Trichospilus* is easily identified by the absence of the upper ocular sulcus and frontal suture (Fig. 3.46A), torulus with the dorsal margin below the compound eye, but closer to the ventral margin of compound eye than to clypeal margin (Fig. 3.46A), and petiolate gaster (Fig. 3.46D). Many of the species also have distinct, tufts of setae, posterior to the parastigmal or marginal veins (Fig. 3.46B, E, F). *Trichospilus* is similar to *Cirrospilus*, but *Cirrospilus* have the dorsal margin of the torulus above the ventral margin of the compound eye (Fig. 3.18A), and there are never distinct tufts of setae on the fore wing (Fig. 3.46G, I).

Description: Female: Body yellow or light brown. Metallic color on head or mesosoma absent. Yellow color on mesosoma present. Fore wing with dark patterns or infuscation present.

Head: malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus absent. Frontal suture absent. Vertex normal, not vaulted; large, paired setae and small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: torulus with dorsal margin at or below ventral margin of compound eye, but closer to ventral margin of eye than to clypeus. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: mesoscutum with thin sculpturing. Notaulus complete to posterior half of axilla, close to transscutual articulation. Axilla advanced anteriorly more than 10% but less than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves absent; 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina and plicae present and complete; costula absent; lateral basal groove absent. Gaster petiolate. Petiole with ventral carina or carinae absent. First gastral tergite collar smooth. Metacoxa with deep, distinct sculpturing (areolate).

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by its own length or less from stigmal apex. Speculum present with few or no setae within. Admarginal setae present. Postmarginal vein between 0.5X and 1.0X length of stigmal vein.

Male as female.

Hosts: DIPTERA: Tachinidae: *Exorista sorbillans* (Wiedemann) puparium; **HYMENOPTERA: Tenthredinidae:** *Nematus epimeris* (Lindqvist) **LEPIDOPTERA: Noctuidae:** *Sesamia grisescens* Warren on *Saccharum* sp. (Poaceae). **Nymphalidae:** *Callicore* sp.; **Pyralidae:** *Eldana saccharina* Walker on *Saccharum* sp.; *Tirathaba* sp. **Xylorictidae:** *Pansepta teleturga* Meyrick. **ORTHOPTERA: Tettigoniidae:** *Sexava* sp. – As this is the only record of any cirrospiline parasitizing Orthoptera, this host relationship requires further substantiation.

Distribution (Fig. 3.47)**: AFROTROPIC:** Democratic Republic of the Congo, Gabon, Kenya, Republic of the Congo. **AUSTRALASIA:** Australia (QLD), Papua New Guinea. **INDO-MALAY:** India, Indonesia, Malaysia. **NEOTROPIC:** Brazil, British Virgin Islands, Mexico (TL), St. Vincent, USA (FL). **PALEARCTIC:** China, Pakistan, Russia.

Taxonomic Summary:

1. *Trichospilus albiflagellatus* Yang & Wang
2. *Trichospilus boops* Bouček
3. *Trichospilus diatraeae* Cherian & Margabandhu
4. *Trichospilus ferrierei* Bouček
5. *Trichospilus hayati* Narendran

6. *Trichospilus lutelineatus* (Liao)
7. *Trichospilus politus* Ubaidillah
8. *Trichospilus pupivorus* Ferrière
9. *Trichospilus striatus* Ubaidillah
10. *Trichospilus vorax* Bouček

Material Examined:

***Trichospilus diatraeae* Cherian & Margabandhu**

AUSTRALIA: Queensland: Prospering, Lilypool site XY18, 20°30'25"S, 148°33'32"E, 10.xi.2007, C. Burwell [1♀, QM: UCRCENT241932 (**D5333**)]. **BRAZIL: Minas Gerais:** Belo Horizonte, UFMG, *19°52'29"S*, *43°58'19"W*, 4.vi.1998, D. Yanega, host: *Callicore* sp. [2♂ 4♀, UCRC: UCRCENT061085 – 061087, 127685 – 127687]. **São Paulo:** Piracicaba, ESALQ, 494969m, 22°42'40"S, 47°37'57"W, 5.iv.1996, J. D. Pinto [1♀, UCRC: UCRCENT494969]. **BRIT. VIRGIN ISLANDS: W.I.:** Tortola, Sage Mtn. N. Pk, 87m, *18°24'13"N*, *64°39'38"W*, 28–29.viii.1986, J. LaSalle, screen sweep [1♀, ANIC: UCRCENT238622]. **CHINA: Guangdong:** Guangzhou, *23°07'44"N*, *113°15'32"E*, 3.v.1983, Z. Bouček [1♀, NMV: UCRCENT533451]. **INDIA: Karnataka:** 547m, *15°01'35"N*, *75°58'37"E*, 10.xii.1990, P. Kumar, IIE 21549, host: *Exorista sorbillans* puparium [2♂ 2♀, ANIC: UCRCENT238618, 238619]. **MEXICO: Tamaulipas:** Gómez Farías, Estación Los Cedros, 340m, 23°03'0"N, 99°09'3"W, 27.iv.2002, A. Córdoba-Torres, malaise trap [1♀, UCRC: UCRCENT113577]. Gómez Farías, Estación Los Cedros, 340m, 23°03'0"N, 99°09'3"W, 31.iii.2002, A. Córdoba-

Torres, malaise trap [1♀, UCRC: UCRCENT112150]. **PAKISTAN: Khyber Pakhtunkhwa: Swat**, Gul Jabba, 901m, *34°48'0"N*, *72°17'56"E*, 18.viii.1994, S. No. 5302 [1♀, ANIC: UCRCENT238621]. **PAPUA NEW GUINEA: Mandang Prov.:** Gusap, Ramu Sugar Est., 443m, *5°58'2"S*, *145°53'4"E*, 24.v.2006, K. Korowi, host: *Sesamia grisescens*, host plant: sugar cane [3♂ 3♀, SANC: SANC-HYM3781, UCRCENT294726 – 294730]. **New Hanover:** *2°36'17"S*, *150°16'7"E*, iv.1950, G. Dun, host: *Sexava* (Orthoptera: Tettigoniidae) [1♀, ANIC: UCRCENT238623]. **SAINT VINCENT: W.I.:** Parish St. Andrews, Kingstown Botan. Gard., *13°09'47"N*, *61°13'41"W*, 5–9.x.1991, R.R. Woodruff [1♀, ANIC: UCRCENT238620]. **USA: Florida: Miami-Dade Co.**, Homestead, 1m, *25°27'54"N*, *80°28'26"W*, v.1985, H. Glenn, host: *Epimeris* sp. [16♀, UCRC: UCRCENT498568, 498569].

***Trichospilus politus* Ubaidillah**

CHINA: Guandong: Guangzhou, Forest Park, 24m, 23°09'9"N, 113°21'23"E, 3–5.x.2009, L. Masner, YPT [1♀, CNC: CNC509136 (**D4978**)].

Trichospilus pupivorus

DEMOCRATIC REPUBLIC OF THE CONGO: Pool Abio, Lesio-Loun Park, 3°06'1"S, 15°31'26"E, 26.viii.2008, Braet, MT [1♀, UCRC: UCRCENT229302]. **KENYA: Laikipia District:** Mpala research Centre Isecheno, 1650m, 0°17'24"N, 36°54'0"E, 1–9.x.1999, R. Snelling, savannah, malaise trap [2♀, UCRC: UCRCENT498566, UCRC: UCRCENT498567]. **PAPUA NEW GUINEA: East New Britain:** Tavilo (Keravat), *4°21'2"S*, *152°02'33"E*, 9.ix.1971, Bailey, host:

Pansepta teleturga [1♂, ANIC: UCRCENT238625]. **Morobe Province:** “Marulumie Est.”, 24.vi.1976, G. Young, 27287, host: *Tirathaba* sp. [1?, ANIC: UCRCENT238624]. **REPUBLIC OF CONGO: Dept. Pool: Iboubikro**, Lesio-Loun Pk., 355m, 3°16'11"S, 15°28'16"E, 7–21.vii.2008, M. Sharkey, Malaise trap [2♀, UCRC: UCRCENT325506, 325507].

***Trichospilus striatus* Ubaidillah**

AUSTRALIA: Queensland: Tam O’Shanter State Forest; Mission Beach S. Road, 50m, *17°52'50"S*, *146°05'53"E*, 6.v.1990, J. Heraty, H051 [1♀, UCRC: UCRCENT498564]. **INDONESIA: Sumatra:** Bandar, Jalan Indrapura, 3°10'34"N, 99°20'13"E, 16–23.ii.2012, M. & C. Hoddle, MT [1♀, UCRC: UCRCENT397836]. **MALAYSIA: Pahang:** Kuala Tahan, Taman Negara N.P., 200m, *4°22'59"N*, *102°24'4"E*, 20–21.vi.1990, J. Heraty, rainforest, H098 [1♀, UCRC: UCRCENT498565].

***Trichospilus vorax* Bouček**

Additional material examined: GABON: Haut-Ogooué Province: Franceville, *1°37'39"S*, *13°35'54"E*, iii.1978, Videau, host: *Eldana saccharina*, host plant: sugar cane [2?, ANIC: UCRCENT238626, 238627]. **REPUBLIC OF CONGO: Dept. Pool: Iboubikro**, Lesio-Loun Pk., 340m, 3°16'11"S, 15°28'16"E, 25.viii.2008, M. Sharkey, Malaise trap [4♀, UCRC: UCRCENT257844, 257845, 257867, 257894].

***Trichospilus* sp.**

RUSSIA: Primorsky Krai: Gornotayozhnoye, Mountain-Taiga Station, 300m, 43°39'25"N, 132°08'37"E, M. V. Michailovskaya [1♀, UCRC: UCRCENT252366 (**D2108**)].

19. *Vagus* Perry n. gen. - Fig. 3.48

Type species: *Cirrospilus ambiguus* (Hansson & LaSalle) [examined], 1996: 195; holotype ♀, by original designation. Locality: Tanzania, Uluguru Mountains, near Morogoro. Depository: BMNH, NHMUK10202159.

Diagnosis: *Vagus* is most easily recognized by the complete notaulus that extends to the anterior margin of the axilla (Fig. 3.48D, F), and propodeum that lacks a median carina (Fig. 3.48D); no other genus in Cirrospilini has this combination of characters. *Cirrospilus* is similar, but a median carina on the propodeum is present, and the notaulus extends to the posterior half of the axilla (Fig. 3.18F). *Pseudiglyphus* also possess a notaulus that extends to the anterior margin of the axilla, however, a median carina on the propodeum is present (Fig. 3.42D), and is a drab brown, whereas *Vagus* is metallic.

Description: Female: metallic green or blue on head and mesosoma. Yellow color on mesosoma present. Fore wing hyaline.

Head: malar sulcus present. Tentorial pits indistinct. Clypeus normal, linear. Upper ocular sulcus present. Frontal suture present. Vertex normal, not vaulted; large,

paired setae absent; small, scattered setae present. Carina posterior to vertex absent. Occipital carina absent.

Antenna: torulus with dorsal margin above ventral margin of compound eye. Scape not extending to vertex. 2 funiculars. 3 clavomeres.

Body: mesoscutum with deep-reticulate sculpturing. Notaulus complete, extending to anterior half of axilla. Axilla advanced anteriorly more than 75% of longitudinal length past anterior margin of transscutal articulation. Mesoscutellum with submedian grooves present and straight or slightly curved posteriorly, not meeting medially; 2 pairs of setae - anterior pair of setae shorter than posterior pair of setae. Dorsellum not extending posteriorly over propodeum. Propodeum normal, not constricted medially; median carina, plicae, and costula absent; lateral basal groove absent. Gaster sessile. Petiole with ventral carina or carinae absent. First gastral tergite collar with median depression or sulcus. Metacoxa smooth or with thin, shallow sculpturing.

Fore wing: basal fold setose. Cubital fold basally setose, and straight or only slightly curved to meet basal fold. Parastigma smoothly connecting with submarginal vein but extending slightly into basal fold. Uncus originating on stigma by more than its own length from stigmal apex. Speculum present with few or no setae within. Admarginal setae present. Postmarginal vein more than 1.0X but less than 1.5X length of stigmal vein.

Male as female.

Remarks: There are examined host records of *Vagus ambiguus* parasitizing "*Uroplata girardi?"* (Coleoptera: Chrysomelidae) on *Lantana camara* (Verbeneaceae), however, both *U. girardi* and *Ophiomyia camarae* Spencer (Diptera: Agromyzidae) were released as biological control agents against *L. camara* in South Africa (April *et al.* 2011), and this plant material may have been infested by both species. Both of these species are leaf miners during the larval phase, and therefore it is not conclusive that these host records are accurate. However, as leaf miner parasitoids are often niche specific, rather than host specific (Perry & Heraty 2019), these host records may be valid.

Hosts: COLEOPTERA: Chrysomelidae: *Uroplata girardi* Pic on *Lantana camara*. **DIPTERA: Agromyzidae:** *Calycomyza lantanae* (Frick) on *L. camara; Liriomyza trifolii* (Burgess).

Distribution (Fig. 3.49)**: Afrotropic:** Kenya, Mozambique, South Africa, Tanzania. **Australasian:** Australia (QLD, SA, WA). **Indomalay:** India, Indonesia, Malaysia, Taiwan, Vietnam.

Etymology: *Vagus* is Latin for wanderer, referring to the difficulty in placing *Vagus ambiguus* in the correct genus.

Taxonomic Summary:

1. *Vagus ambiguus* (Hansson & LaSalle) **n. comb.**

Material Examined:

***Vagus ambiguus* (Hansson & LaSalle)**

Paratypes: INDIA: Madyha Pradesh: Gwalior, 212m, *26°13'15"N*, *78°10'56"E*, 1958, O. S. Bindra [1♀, USNM: UCRCENT471381]. **Tamil Nadu:** Chennai (Madras), *13°04'57"N*, *80°16'19"E*, 2.xi.1979, Z. Bouček [1♀, BMNH: NHMUK10371758]. **SOUTH AFRICA: KwaZulu Natal:** Winkelspruit, La Lucia, 85m, *29°44'59"S*, *31°03'31"E*, 16.i.1986, H. de Beers, host: *Calycomyza lantanae*, host plant: *Lantana camara* [3♀, SANC: UCRCENT294722 – 294724]. **TAIWAN:** Ta-k'eng ("Taken" on label), *23°57'31"N*, *120°44'26"E*, 7.x.1992, C. C. Chien, host: *Liriomyza trifolii* [1♀, BMNH: NHMUK10371756]. **TANZANIA: Morogoro:** Sokoine Univeristy, *6°51'7"S*, *37°39'26"E*, 5–6.viii.1994, J. LaSalle & J. Ismay [1♂, BMNH: NHMUK10371757].

Additional material examined: AUSTRALIA: Queensland: 3 km NE of Mt. Webb, 15°02'6"S, 145°05'24"E, 30.iv–3.v.1981, I. D. Naumann, rainforest and rainforest margin [3♂, ANIC: UCRCENT238364 – 238366]. Annan River, 3km W by S Black Mt., *15°40'45"S*, *145°12'24"E*, 26–27.iv.1981, I. D. Naumann [1♂, ANIC: UCRCENT238363]. **INDIA:** Mangarai Forest Reserve, 638m, *11°04'24"N*, *76°49'4"E*, 28.ix.1979, T. Nadu [1♀, ANIC: UCRCENT238347]. **Karnataka:** 25 km W. of Mudigere, *13°08'45"N*, *75°24'57"E*, 28.x–3.xi.1979, J S. Noyes [1♂, BMNH:

NMHUK10371760]. **INDONESIA: Java:** Bogor, *6°35'0"S*, *106°47'0"E*, 2.vii–5.vi.1996, S. L. Heydon & S. Fung [1♀, UCDC: UCRCENT477998]. Bogor, Cisarua, 913m, *6°41'15"S*, *106°56'34"E*, 21.viii.1997, A. Rauf, host plant: snowpea [1♀, ANIC: UCRCENT238346]. Cisarua, 913m, *6°41'15"S*, *106°56'34"E*, 8.iii.1998, A. Rauf, host plant: broccoli [3♀, ANIC: UCRCENT238343 – 238345]. **KENYA: Kajiado**, Ewaso Ngira River, ICIPE field stn.at rd to Nguruman Escarpment, 672m, 1°50'53"S, 36°06'0"E, 26.ii–1.iv.1999, S. MIller, malaise trap [1♂ 9♀, USNM: UCRCENT471373 – 471380, 471694, 471695]. **MALAYSIA: Kedah: Pantai Kok**, Pulau Langkawi, 6°22'0"N, 99°42'0"E, 19–21.vi.1996, S. L. Heydon & S. Fung [2♂, UCDC: UCRCENT477994, 477995]. **Pulua Langkawi**, Pantai Tok, 243m, 6°22'0"N, 99°42'0"E, 19–21.vi.1996, S.L. Heydon & S. Fung [2♂, UCDC: UCRCENT477996, 477997]. **MOZAMBIQUE: Niassa:** Cuamba, Mituque, 631m, *14°43'47"S*, *36°37'39"E*, 7–26.ix.2008, M. Olmi, malaise trap [1♀, CNC: CNC508748]. **SOUTH AFRICA: Gauteng:** Pretoria, Rietondale, *25°43'49"S*, *28°13'44"E*, 2.ii.1993, S. Neser [31♀, SANC: UCRCENT294717 – 294720]. **KwaZulu-Natal:** La Mercy, 29°22'48"S, 31°04'48"E, 18.iv.2000, J.-R. Baars, host: *Uroplata girardi*, host plant: *Lantana camara* [3♀, SANC: UCRCENT294714 – 294716]. **VIETNAM: Hai Phong: An Hai**, Nam Son Village, 5m, *20°52'39"N*, *106°36'31"E*, 3.xi.1998, Hoa, host plant: tomato [1♂, ANIC: UCRCENT238359]. Tan tien village, 5m, *20°53'34"N*, *106°34'43"E*, 15.vii.1998, Thao, host plant: cucumber [1♀, ANIC: UCRCENT238354]. Tan tien village, 5m, *20°53'34"N*, *106°34'43"E*, 26.vi.1998, Thao [1♀, ANIC: UCRCENT238814];

3.xi.1998, Hoa, host plant: tomato [1♂, ANIC: UCRCENT023856]. **Hung Yen: My Van**, Tan Quang Village, *20°58'26"N*, *105°58'29"E*, 10.xi.1998, Tiep, host plant: cucumber [1♀, ANIC: UCRCENT238348]; 22.viii.1998, Tiep, host plant: cucumber [1♀, BMNH: NHMUK10371759]. Trung Trac Village, 5m, *20°56'28"N*, *106°00'39"E*, 10.xi.1998, Tiep, host plant: cucumber [1♂ 4♀ 1?, ANIC: UCRCENT238349 – 238353, 238357]. Vinh Khuc Village, *20°55'50"N*, *105°59'51"E*, 29.ix.1998, Tiep, host plant: beans [1♂ 1♀, ANIC: UCRCENT238355, 238358].

Vagus* sp. nr. *ambiguus

AUSTRALIA: Queensland: 1.6km SE Chillagoe, on Rd. to Mareeba, *17°10'17"S*, *144°31'39"E*, 3.iv.1992, E. C. Dahms, G. Sarnes [1♂, QM: UCRCENT241938]. Tea Tree Cave, 4km SE Chillagoe, 381m, 17°11'0"S, 144°34'0"E, 26.iv.1997, C. J. Burwell [2♂, QM: UCRCENT241936, 241937]. **South Australia:** 12km E by N Morgan, 34°00'36"S, 139°29'24"E, 12.xi.1987, I. Naumann, J. Cardale, on or near flowers of Myoporum [1♀, ANIC: UCRCENT238360]. 48km E by N Nullarbor, 31°13'48"S, 131°14'24"E, 16.xi.1981, I. D. Naumann, J. C. Cardale [1♂, ANIC: UCRCENT238361]. nr. Moonabbie Range, 192m, 33°10'12"S, 137°06'0"E, 28.xi.1992, I. D. Naumann, J. C. Cardale [1♀, ANIC: UCRCENT238362]. **Western Australia:** Stirling Range N.P., White Gum Flats picnic area, 301m, 34°24'10"S, 117°54'31"E, 4.xii.2009, R. Waterworth, open eucalyptus forest, sweep, M09-065 [1♀, UCRC: UCRCENT414584 (**D3868**)].

20. ***Zagrammosoma*** **Ashmead** - Fig. 3.50

Hippocephalus Ashmead, 1888: 7. Type species: *Hippocephalus multilineatus* Ashmead [examined]; holotype ♀, by monotypy. Locality: USA, Kansas, Riley County. Depository: USNM, Type No. 27286.

Zagrammosoma Ashmead, 1904: 354. Replacement name for *Hippocephalus* Ashmead, preoccupied by *Hippocephalus* Swainson, 1839, later recognized as a junior synonym of *Percis* Scopoli, 1777 (Scorpaeniformes: Agonidae).

Zagrammatosoma Schulz, 1906: 142. Unjustified emendation. Corrected by Bouček, 1959: 172.

Mirzagrammosoma Girault, 1915b: 279. Type species *Mirzagrammosoma lineaticeps* Girault [examined]; holotype ♀, by monotypy. Locality: Mexico, Jilotepec. Depository: USNM, Type No. 19376. Synonymy by LaSalle, 1989: 232.

See Chapter 2 (Perry & Heraty accepted) for full description and revision of Zagrammosoma.

Diagnosis: *Zagrammosoma* is characterized by a vaulted vertex (Fig. 3.50A–C), notaulus that is complete and extends to the anterior margin of the axilla (Fig. 3.50J), a complete median carina on the propodeum that expands posteriorly (Fig. 3.3G), and infuscation on the fore wing (Fig. 3.50D–F). *Atoposoma* and

Pseudozagramma resemble Zagrammosoma, as these genera share the vaulted vertex, yellow body with dark patterns, and wing infuscations, however both of these genera have a notaulus that is either complete to the posterior half of the axilla (*Atoposoma*), or complete and extending to the transscutal articulation (*Pseudozagramma*). Both *Atoposoma* and *Pseudozagramma* lack a median carina on the propodeum.

Distribution (Fig. 3.51)**: Afrotropic:** Kenya**,** Oman, Réunion Island, Saudi Arabia, South Africa, United Arab Emirates, Zimbabwe. **Australasian:** Australia (ACT, NSW, NT, QLD, SA, WA). **Indo-Malay:** Thailand. **Nearctic:** Canada (AB, BC, NB, ON, SK, YK), Mexico (CO, GR, EM, OA, PU, SL), USA (AK, AR, AZ, CA, CO, CT, FL, IA, ID, IN, KS, KY, LA, MA, MD, MO, MS, MT, NC, NJ, NM, NV, OR, PA, SD, TN, TX, UT, VA, VI, WA, Washington D.C.). **Neotropical:** Argentina, Bahamas, Barbados, Belize, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador (Galapagos), El Salvador, Guatemala, Haiti, Honduras, Jamaica, Mexico (BS, GR, JA, MI, NL, OA, SI, TM, VE), Peru, Trinidad & Tobago, USA (FL, PR), Venezuela. **Oceania:** USA (HI). **Palearctic:** Austria, Bulgaria, China, France, Greece, Hungary, Iran, Israel, Italy, Kazakhstan, Moldova, Russia, Serbia, Turkey, Turkmenistan.

Taxonomic Summary:

1. *Zagrammosoma americanum* Girault

2. *Zagrammosoma buselus* (Walker)
3. *Zagrammosoma calvini* Perry
4. *Zagrammosoma centrolineatum* Crawford
5. *Zagrammosoma crowei* (Kerrich)
6. *Zagrammosoma deliae* Perry
7. *Zagrammosoma flavolineatum* Crawford
8. *Zagrammosoma galapagoense* Perry
9. *Zagrammosoma headricki* Perry
10. *Zagrammosoma hobbesi* LaSalle
11. *Zagrammosoma interlineatum* Girault
12. *Zagrammosoma intermedium* Gordh
13. *Zagrammosoma latilineatum* Ubaidillah
14. *Zagrammosoma lineaticeps* (Girault)
15. *Zagrammosoma melinum* Gordh
16. *Zagrammosoma metallicum* Perry
17. *Zagrammosoma multilineatum* (Ashmead)
18. *Zagrammosoma occidentale* Perry
19. *Zagrammosoma seini* Wolcott
20. *Zagrammosoma talitzkii (*Bouček)
21. *Zagrammosoma trifurcatum* Perry
22. *Zagrammosoma villosum* Perry
23. *Zagrammosoma velerii* Yefremova
24. *Zagrammosoma yanegai* Perry

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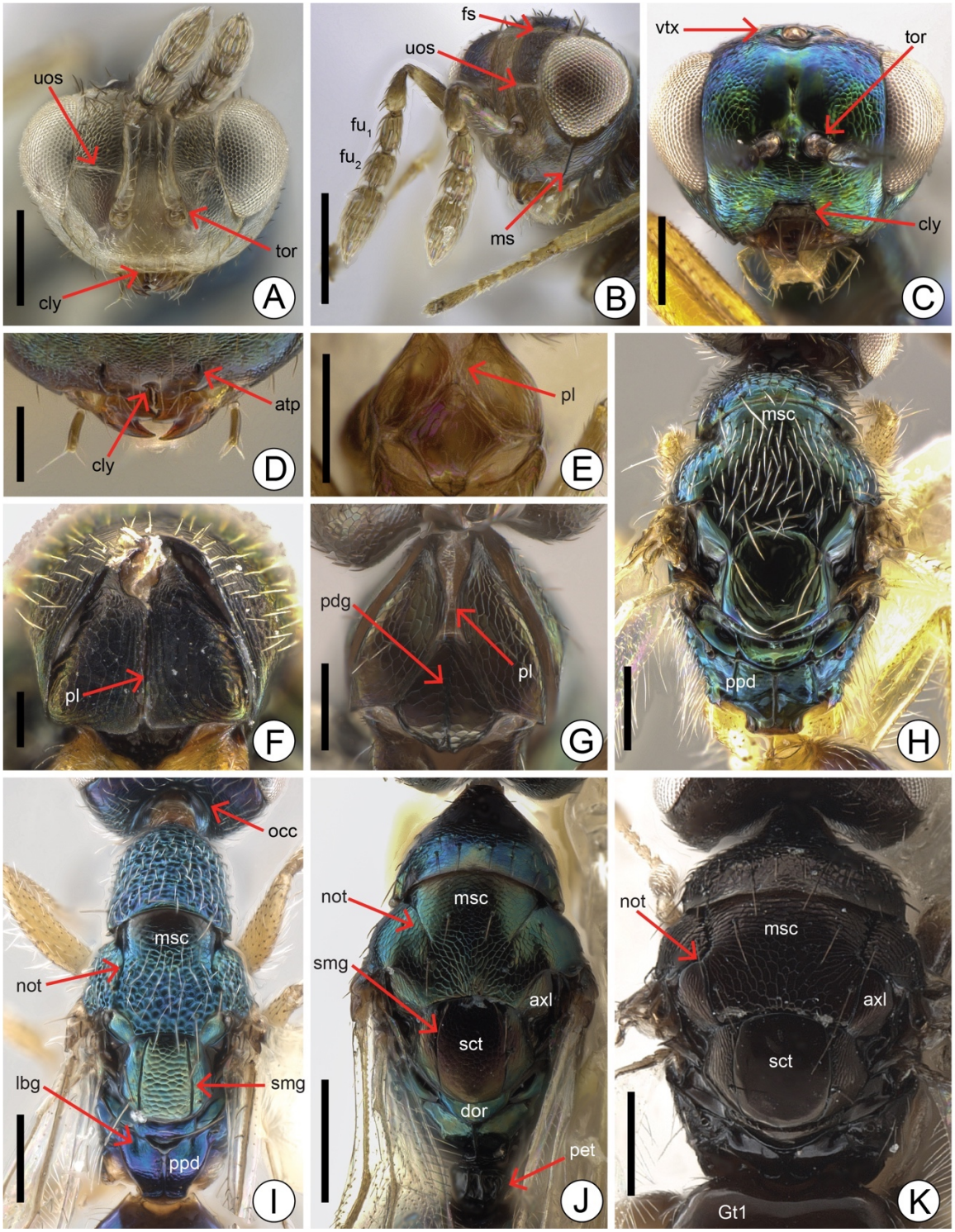
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Fig. 3.1

Fig. 3.1. Morphological characters. (A–D) head: (A) *Cirrospilus* nr. *cinctithorax* D3642, (B) *Cirrospilus* sp. D3751, (C) *Bellerus* sp. D3743, (D) *Aulogymnus* sp. D4983. (E–G) mesosoma ventral: (E) *Melittobiopsis ereunetiphila* D5314, (F) *Pnigalio* sp. RP10134, (G) *Cirrospilus* sp. D3672. (H–K) mesosoma dorsal: (H) *Pnigalio* sp. D3645, (I) *Naumanniola* sp. D4174, (J) *Meruacesa cuprata* UCRCENT 416903, (K) *Pseudiglyphus grotiusi* UCRCENT 416901. Scale bar: A–C, E–K = 0.2mm; D = 0.1mm.

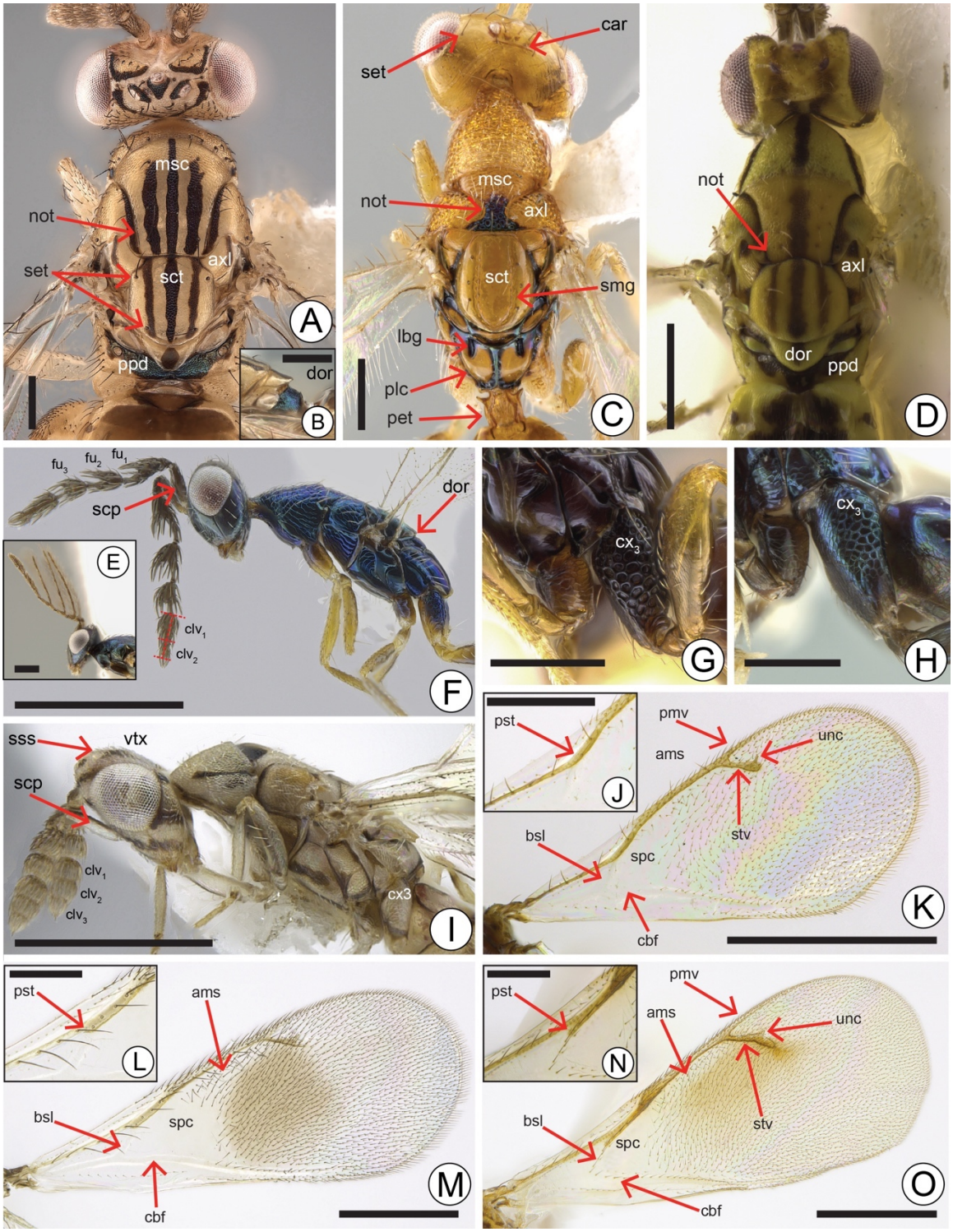
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Fig. 3.2

Fig. 3.2. Morphological characters. (A–D) mesosoma: (A) *Gyrolasella* sp. D4676 dorsal, (B): *Gyrolasella* sp. D4676, lateral: (C) *Gallowayia picta* D4670 dorsal. (D) *Pseuzagrammosoma coachellae* dorsal. (E) head lateral: *Sympiesis* sp. UCRCENT 155451. (F) mesosoma lateral: *Naumanniola* sp. D3994. (G–H) metacoxa: (G) *Ascotolinx reticoxa* D6720. (H) *Eulophus* sp. D3644, (I) mesosoma lateral: *Atoposoma variegatum* D3669. (J–O) wings dorsal: (J, K) *Pseudiglyphus grotiusi* D4661, (L, M) *Cirrospilus* nr. *cinctithorax* D3642, (N, O) *Aulogymnus* sp. 4690. Scale bar: A–E, G, H, J, L, N = 0.2mm; F, I, K, M, O = 0.5mm.

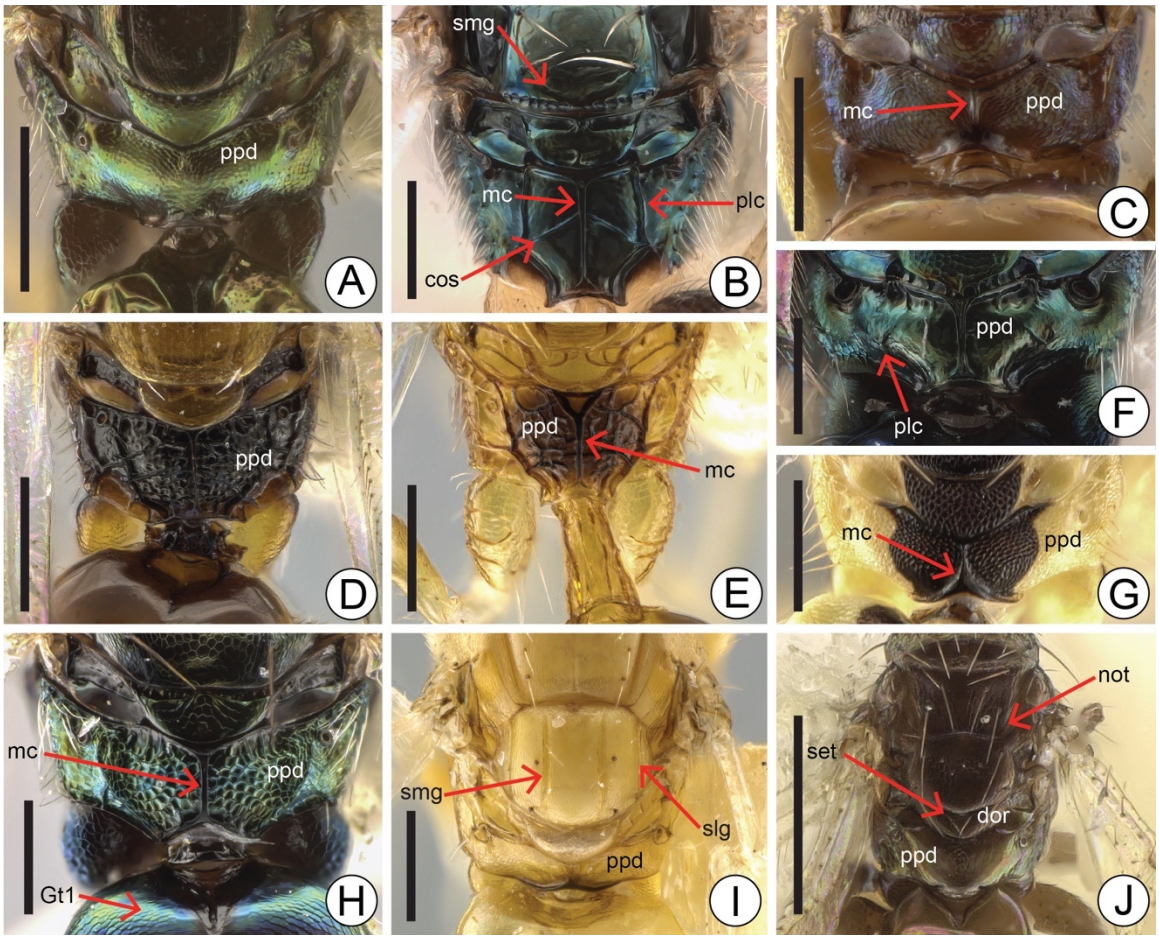


Fig. 3.3. Morphological characters. (A–J) mesosoma dorsal: (A) *Diglyphus* sp. 3997, (B) *Pnigalio* sp. D3645, (C) *Aulogymnus* sp. D4983, (D) *Cirrospilus* sp. D4987, (E) *Cirrospilus* sp. D6709, (F) *Sympiesis* sp. D3646, (G) *Zagrammosoma centrolineatum* D4112, (H) *Cirrospilus* nr. *cinctithorax* D3642, (I) *Aprostocetus* sp. D3659, (J) *Melittobiopsis ereunetiphila* UCRCENT 238662. Scale bar: A–J = 0.2mm.

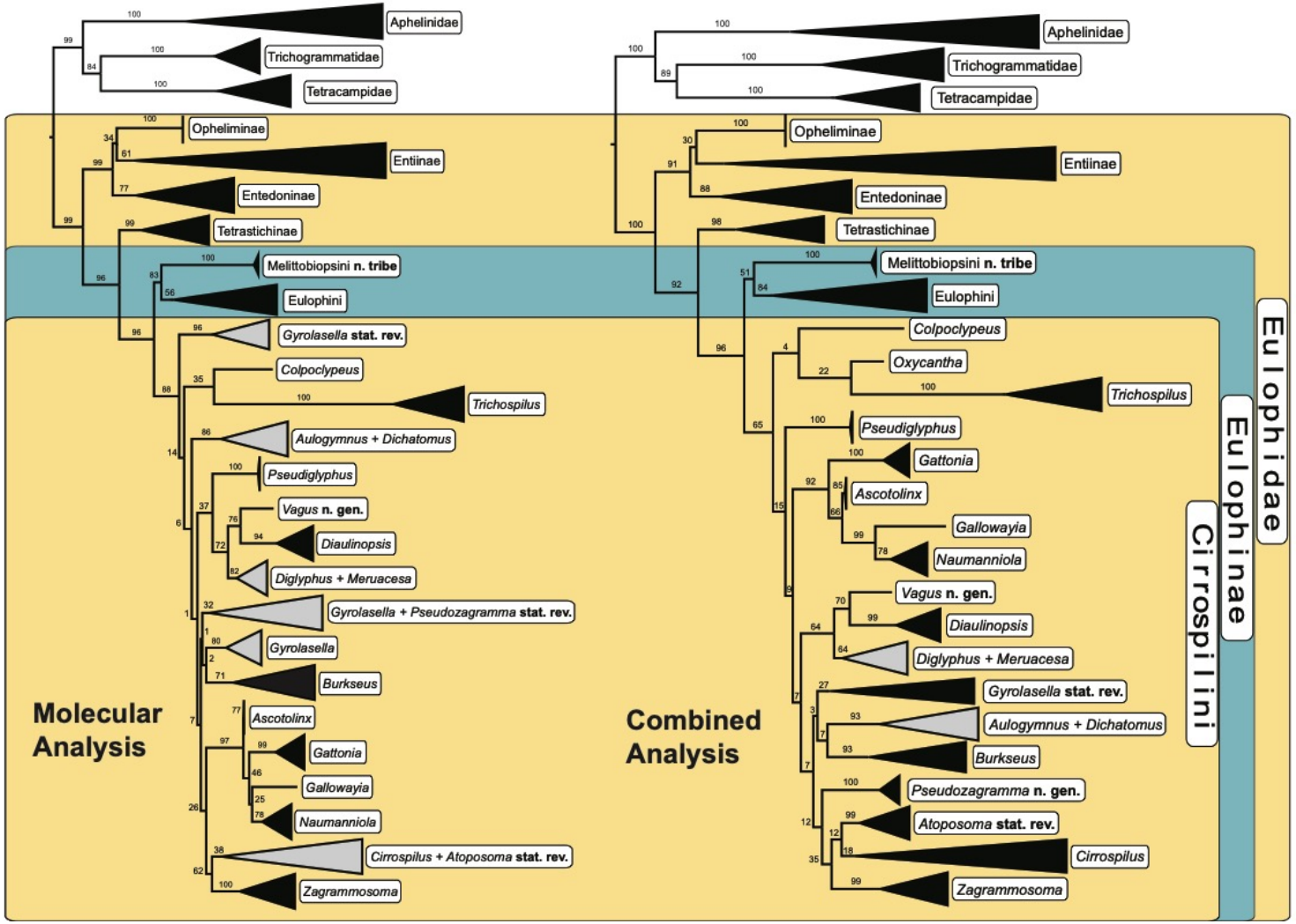
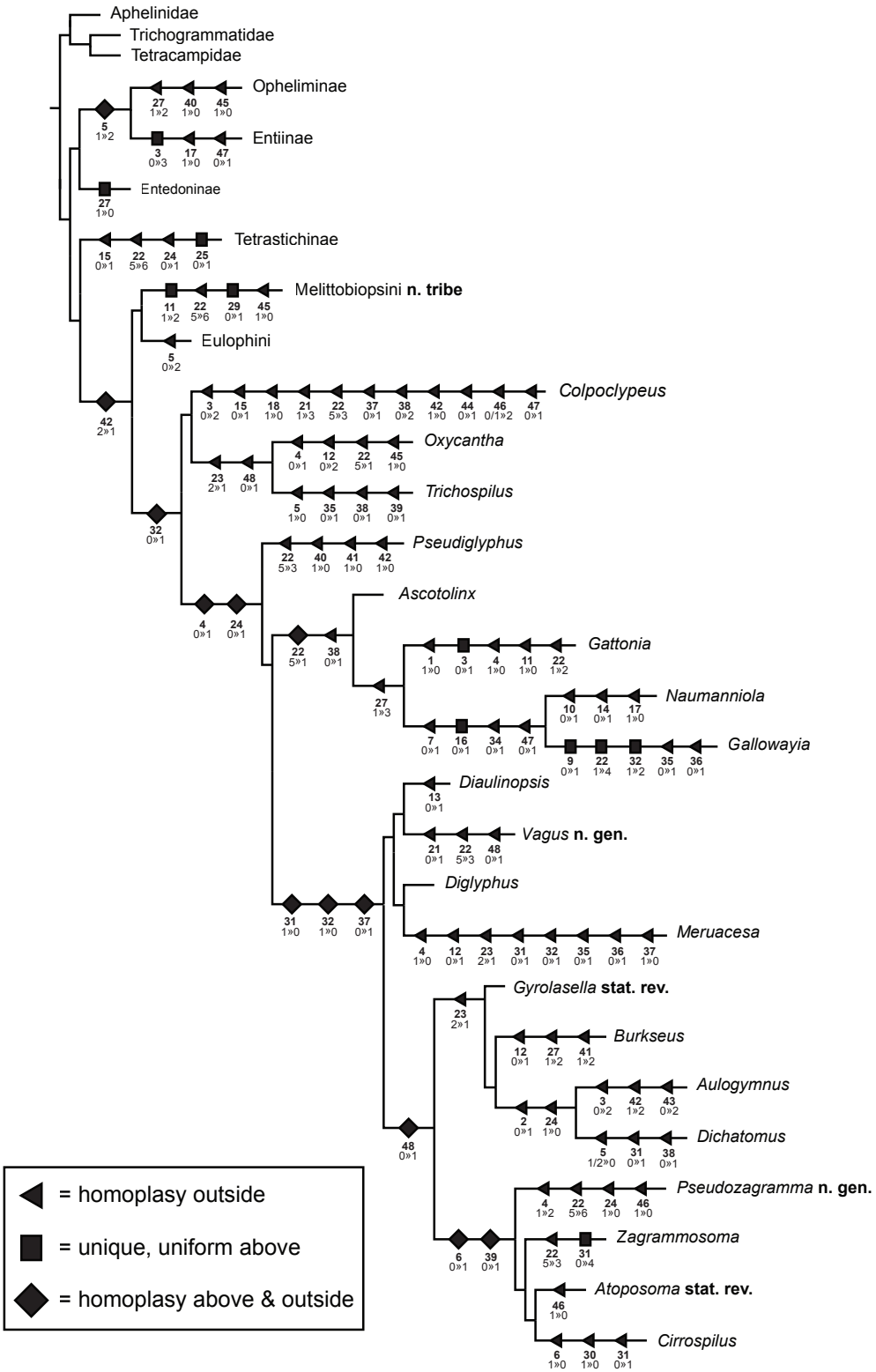


Fig. 3.4. Simplified molecular-only (A) and combined (B) ML analyses.


Aphelinidae
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Tetracampidae
Opheliminae
Entiinae
Entedoninae
Tetrastichinae
Melittobiopsini n. tribe
Eulophini
Colpoclypeus
Oxycantha
Trichospilus
Pseudiglyphus
Ascotolinx
Gattonia
Naumanniola
Gallowayia
Diaulinopsis
Vagus n. gen.
Diglyphus
Meruacesa
Gyrolasella stat. rev.
Burkseus
Aulogymnus
Dichatomus
Pseudozagramma n. gen.
Zagrammosoma
Atoposoma stat. rev.
Cirrospilus
= homoplasy outside
= unique, uniform above
= homoplasy above & outside

Fig. 3.5

Fig. 3.5. MacClade output using the simplified combined ML tree. Unambiguous changes shown. Characters are listed below each symbol, and character state changes below characters.

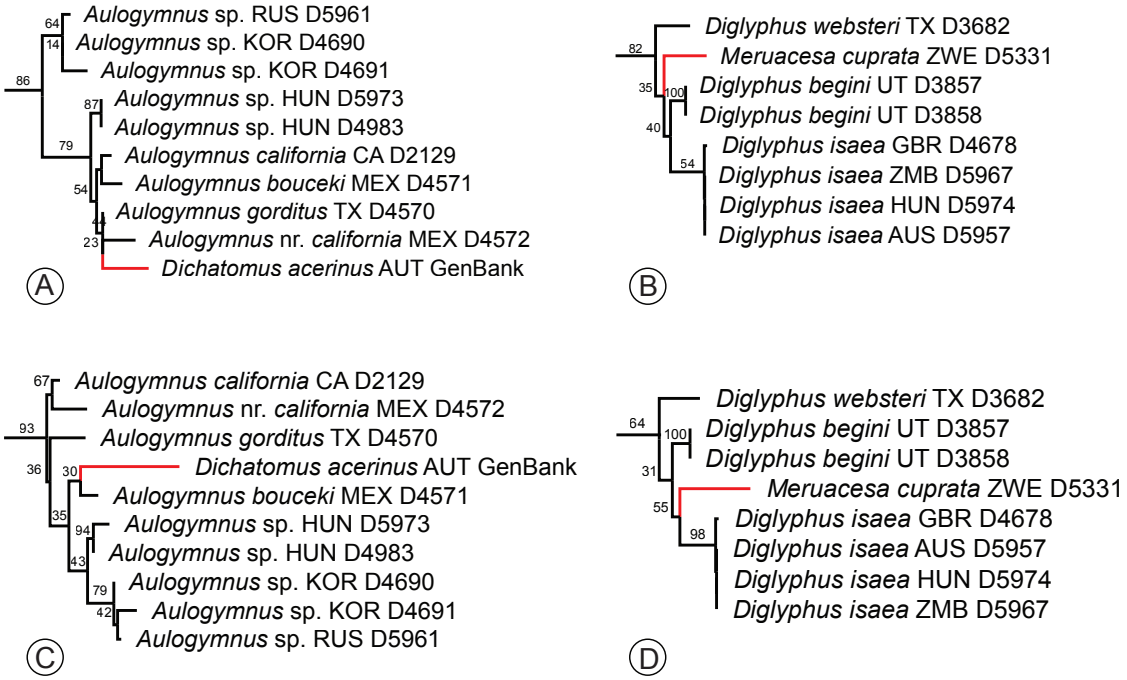

Fig. 3.6. Detail of two paraphyletic groups: *Aulogymnus* + *Dichatomus*, *Diglyphus* + *Meruacesa*. (A–B) molecular only analysis; (C–D) combined analysis.

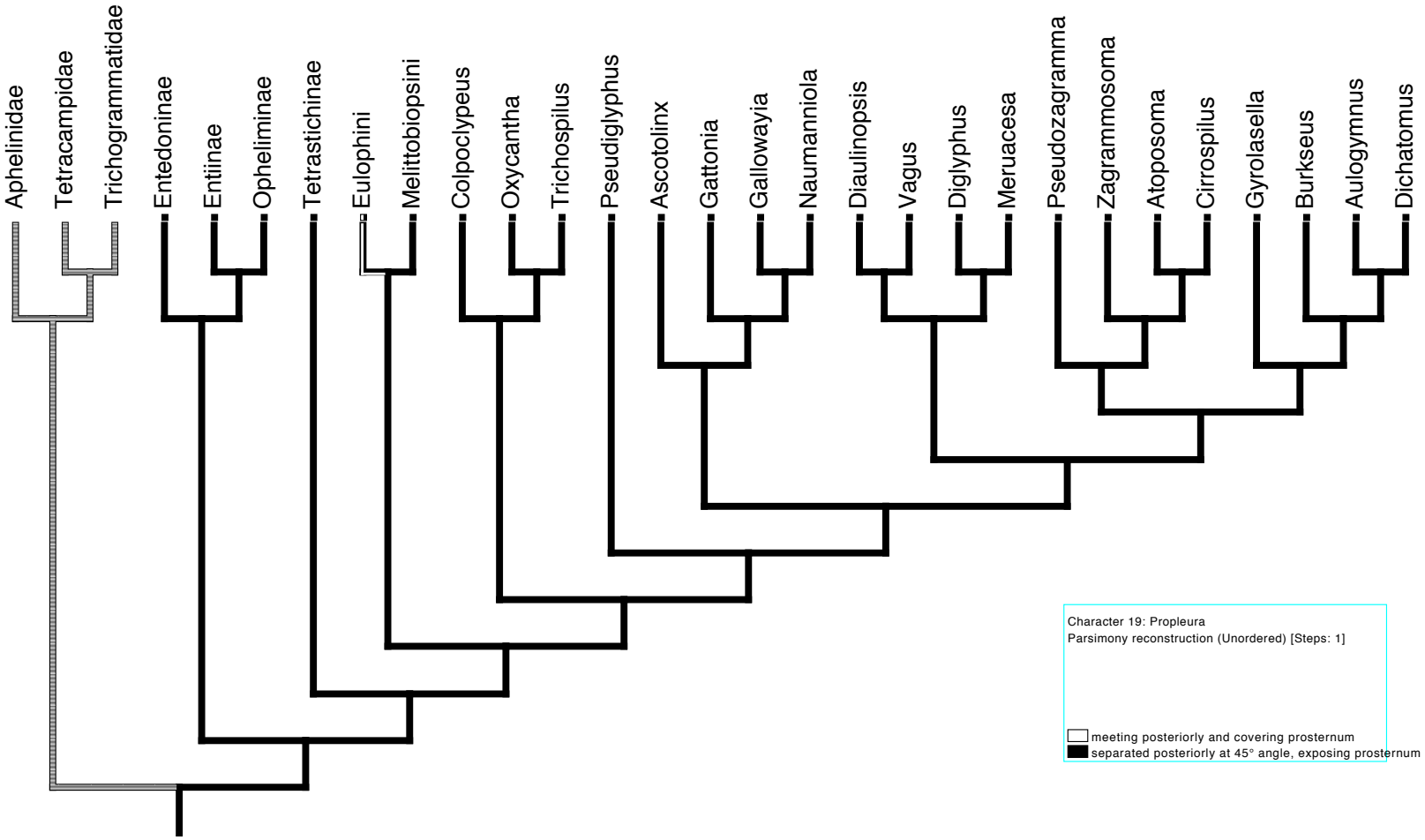

Fig. 3.7. Mesquite analysis of character 19, propleura separation. The propleura meeting posteriorly and covering the prosternum is only found in Eulophini, however, this tribe also has genera that possess propleura that are separated posteriorly.

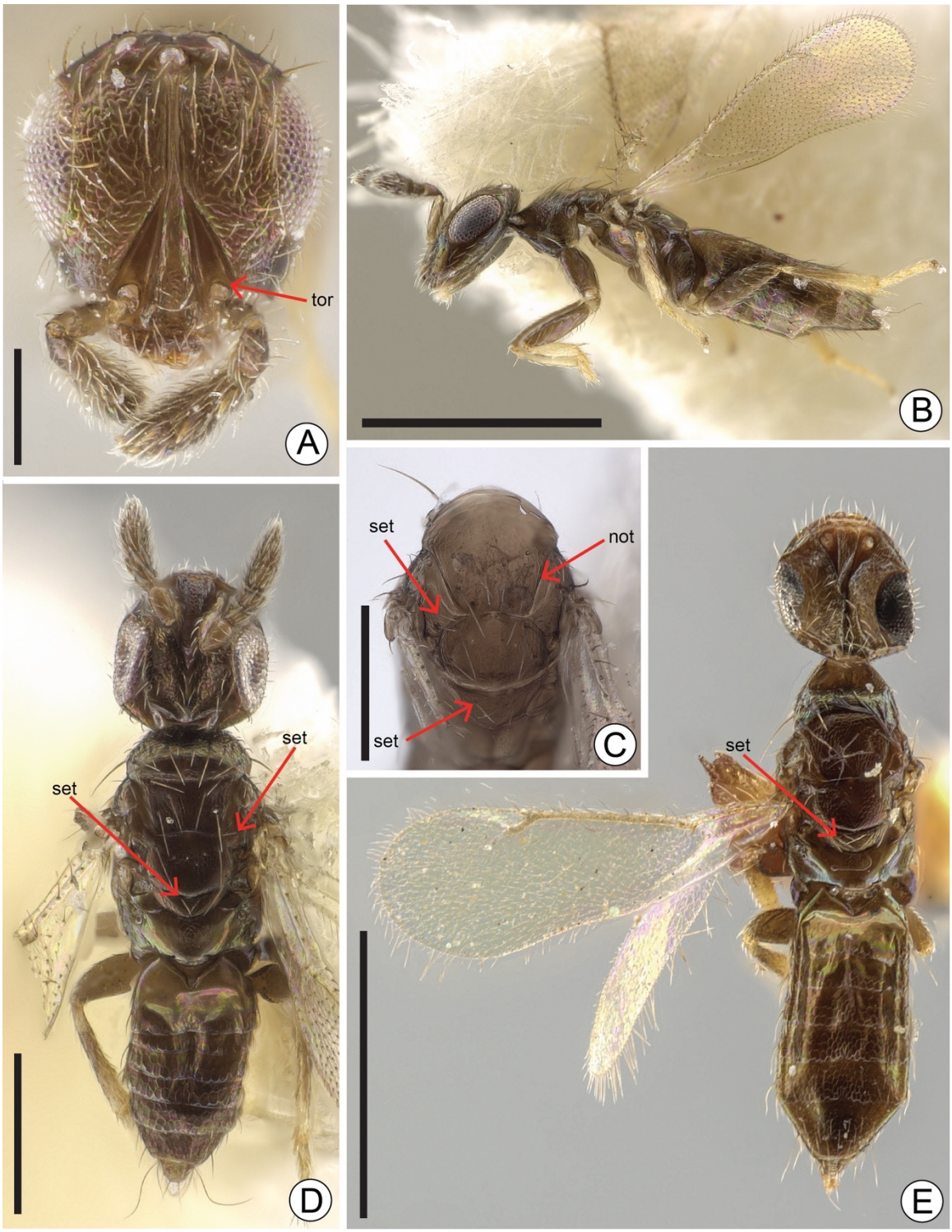

Fig. 3.8. *Melittobiopsis ereunetiphila*: (A) head frontal (B) habitus lateral, (C) mesosoma dorsal, (D–E) habitus dorsal: (D) ♂, (E) ♀ paratype UCRCENT 416906. Scale bar: A = 0.1mm; B, F = 0.5mm; C, D = 0.2mm.

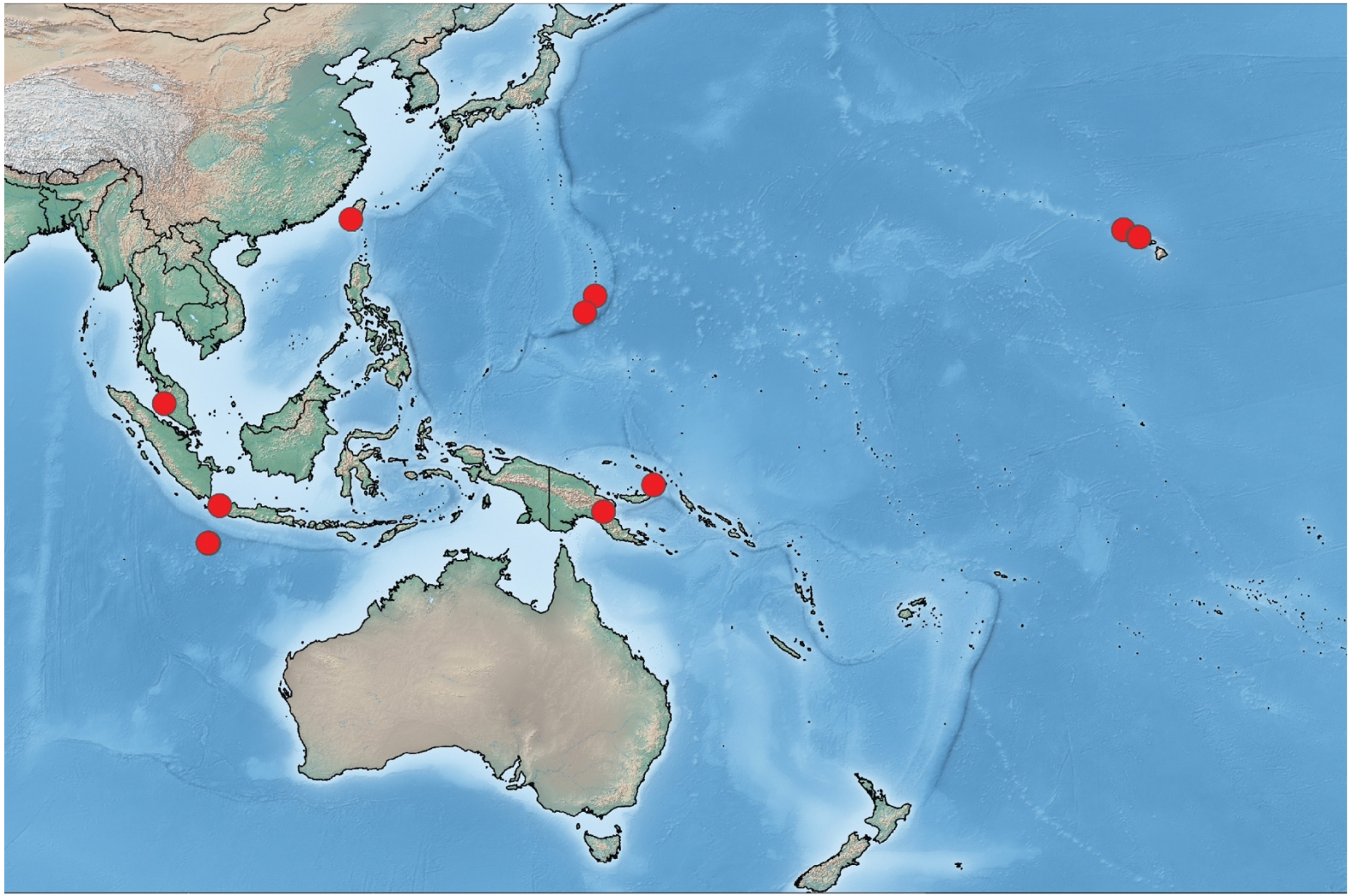

Fig. 3.9. Distribution of *Melittobiopsis ereunetiphila*.

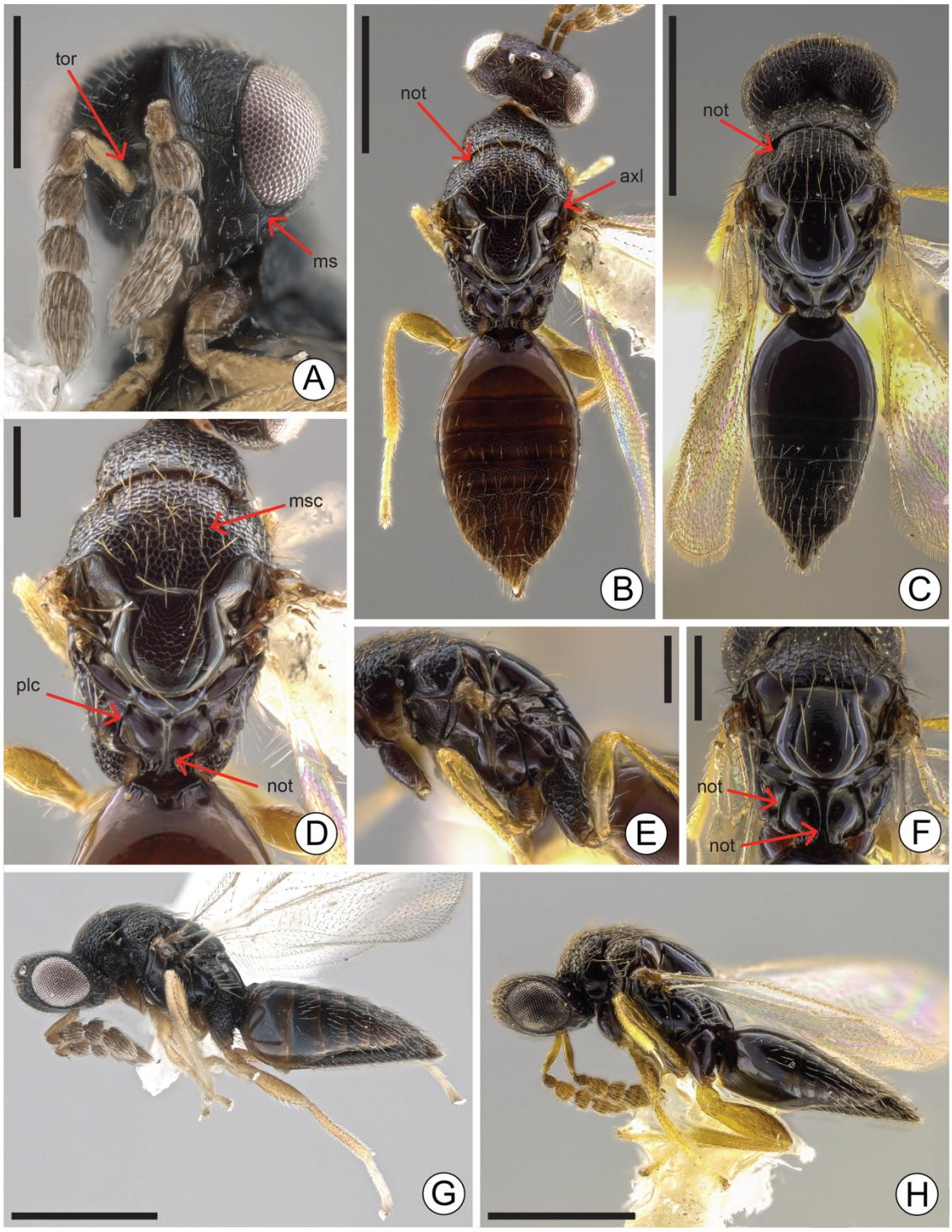

Fig. 3.10. *Ascotolinx*: *A.reticoxa* (A) head frontal, (B) habitus dorsal, (D) mesosoma dorsal, (E) mesosoma lateral, (G) habitus lateral. *A. funeralis* (C) habitus dorsal, (F) mesosoma dorsal, (H) habitus lateral. Scale bar: A, D–F = 0.2mm; B, C, G, H = 0.5mm.

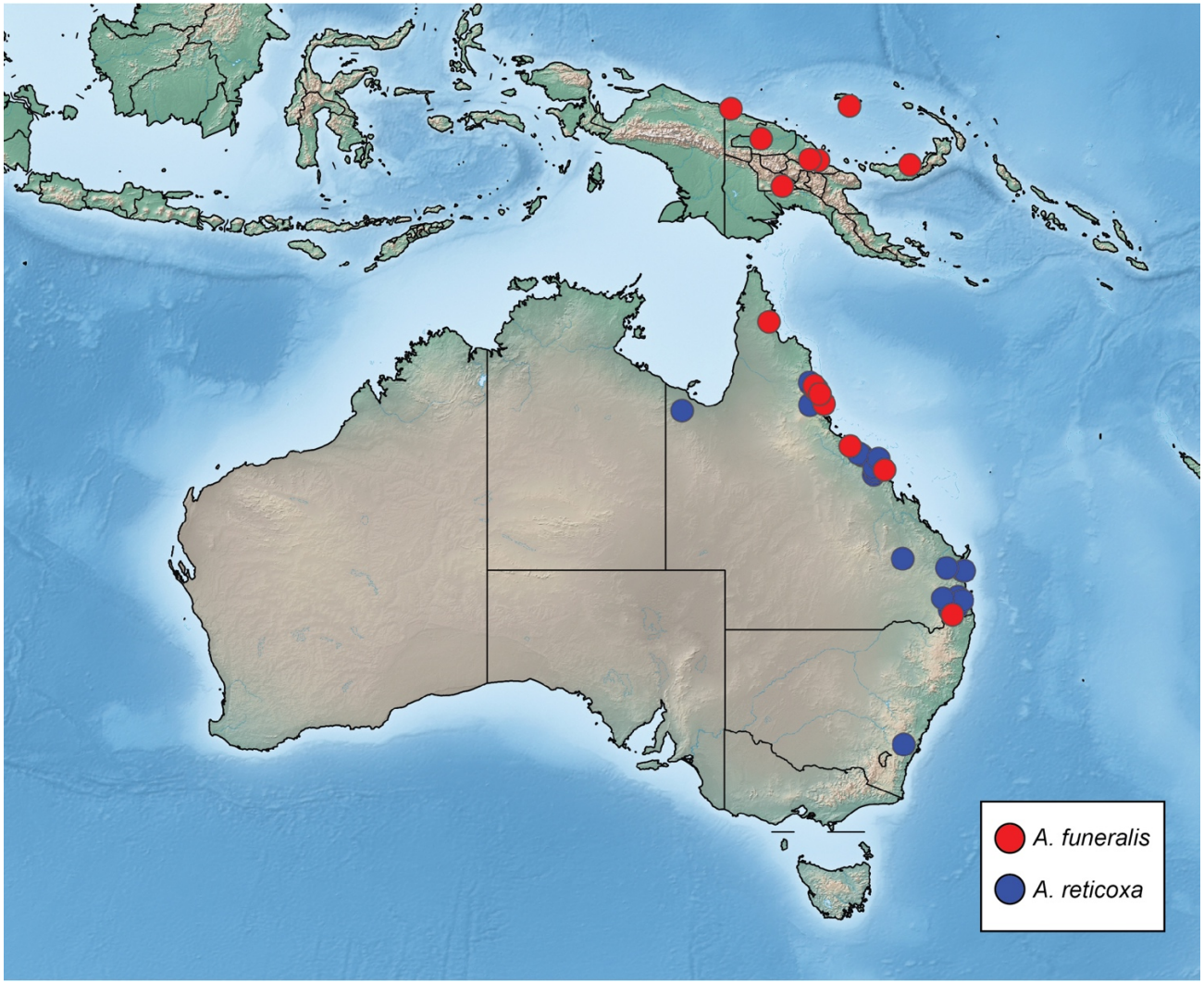

Fig. 3.11. Distribution of *Ascotolinx.*

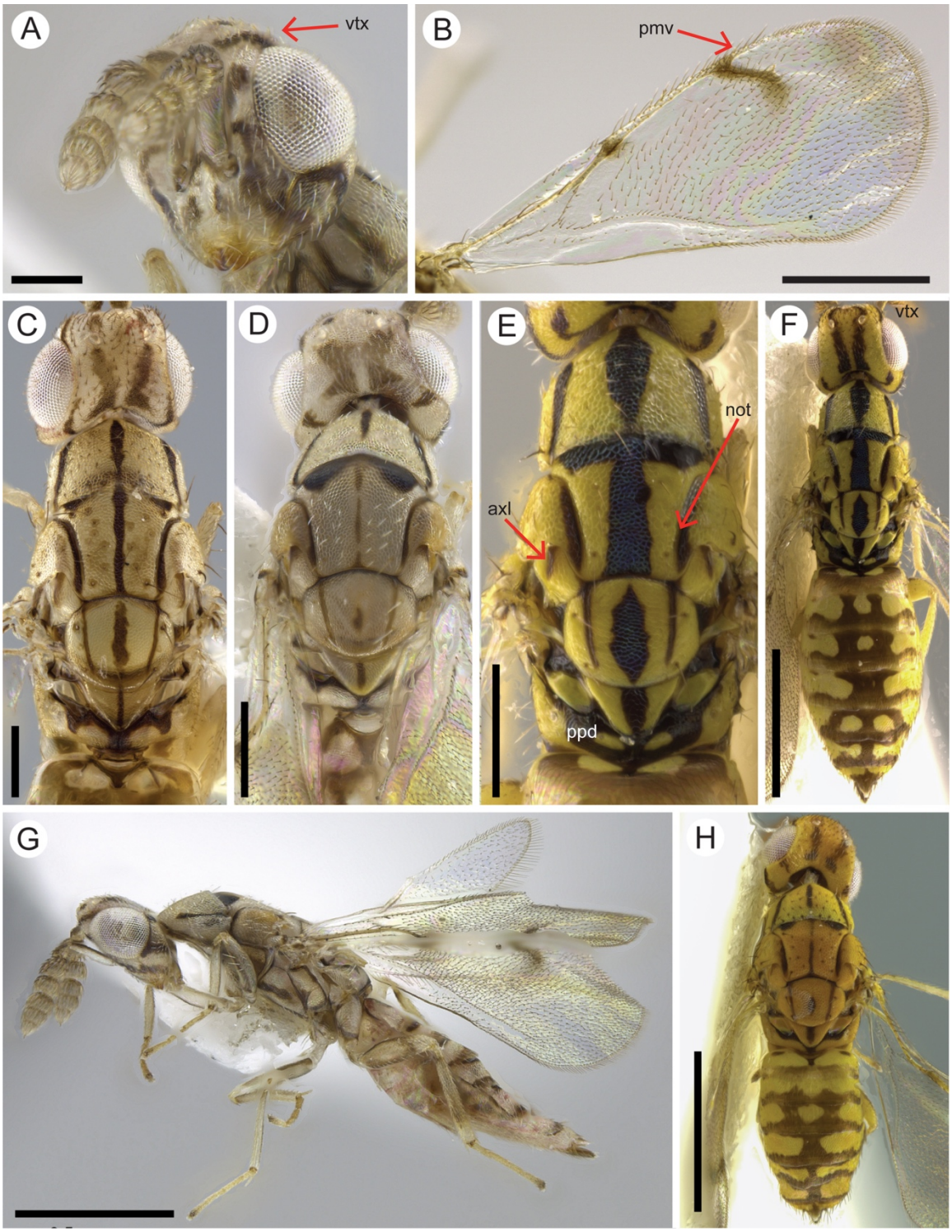

Fig. 3.12. *Atoposoma:* (A) head frontal: *A. variegatum;* (B) wing: *A.* sp. AD; (C–E) mesosoma dorsal: (C) *A.* sp. AD, (D) *A. variegatum*, (E) *A.* sp. AA; (F) habitus dorsal: *A.* sp. AA; (G) habitus lateral: *A. variegatum;* (H) habitus dorsal: *A.* sp. AC. Scale bar: A = 0.1mm; B–H = 0.5mm.

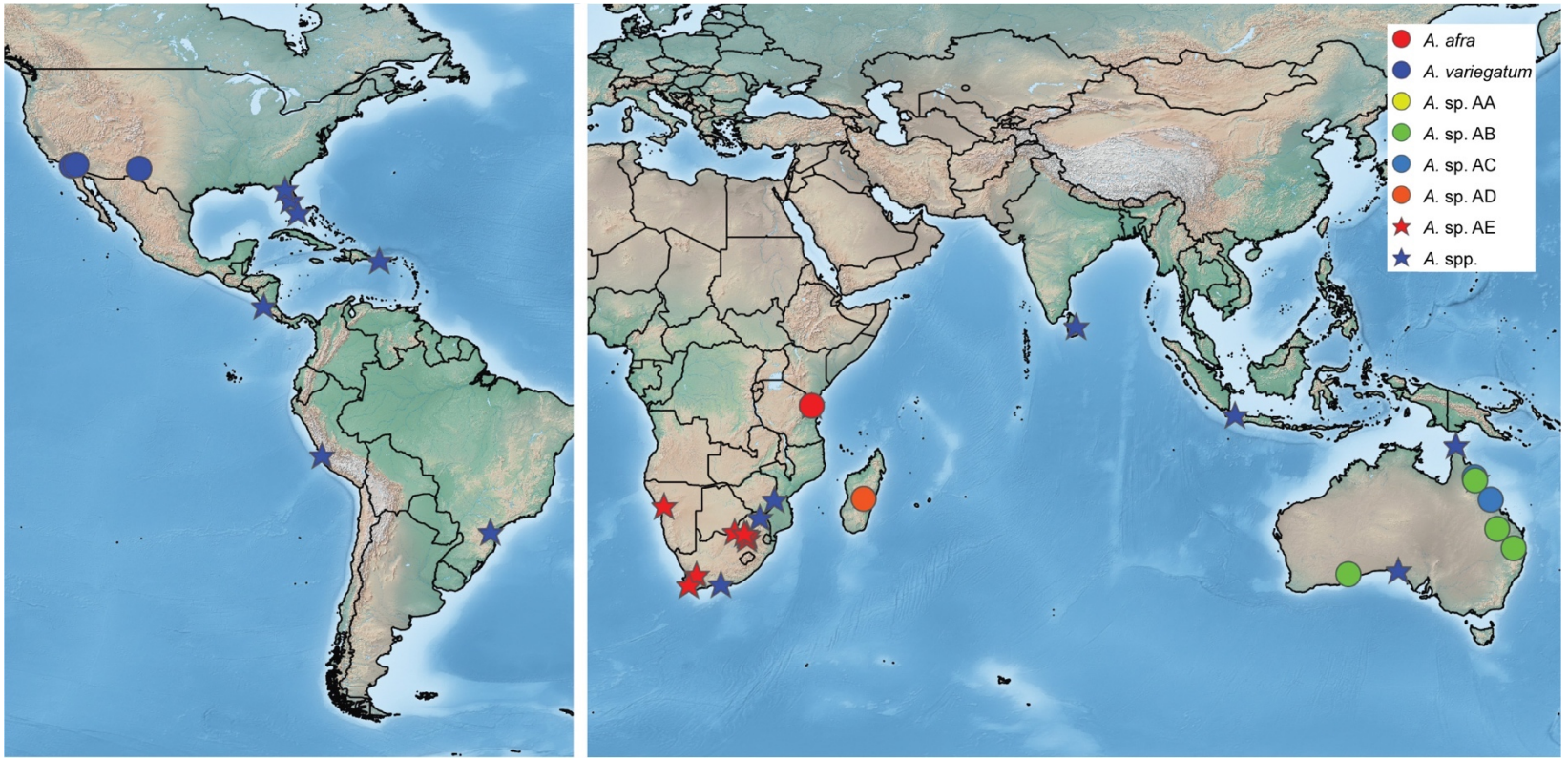

Fig. 3.13. Distribution of *Atoposoma.*

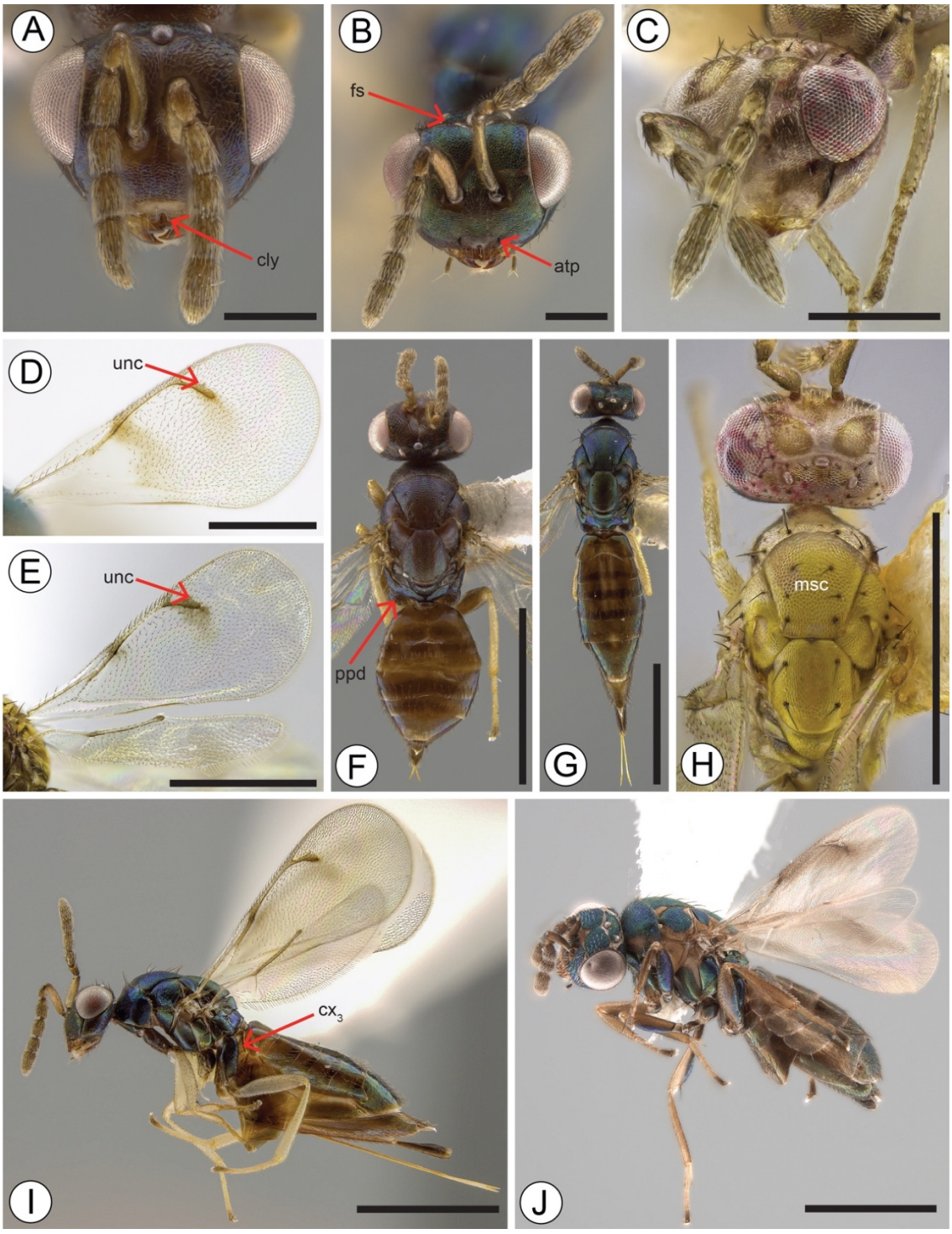

Fig. 3.14. *Aulogymnus:* (A–C) head: *A*. sp. D4983, (B) *A. bouceki*, (C) *A. californica*; (D) forewing: *A.* sp. D5973, (E) fore and hind wing: *A. californica*; (F–G) habitus dorsal: (F) A. sp. D4983, (G) *A.* bouceki; (H) mesosoma dorsal: *A. californica*; (I–J) habitus lateral: (I) *A. bouceki*, (J) *A. gorditus*. Scale bar: A–C = 0.2mm; D–E, H = 0.5mm; F–G, I–J = 1.0mm.

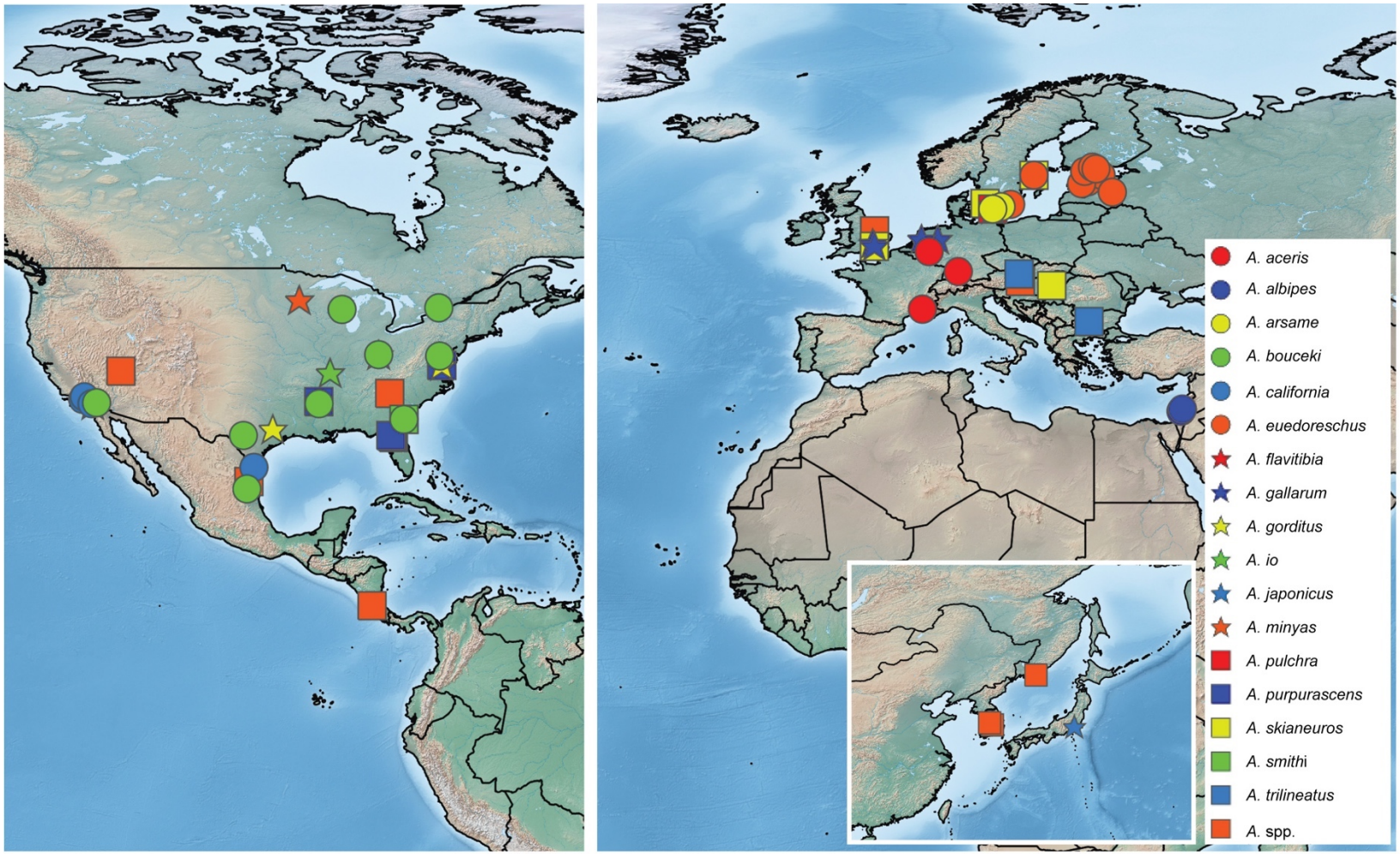

Fig. 3.15. Distribution of *Aulogymnus*

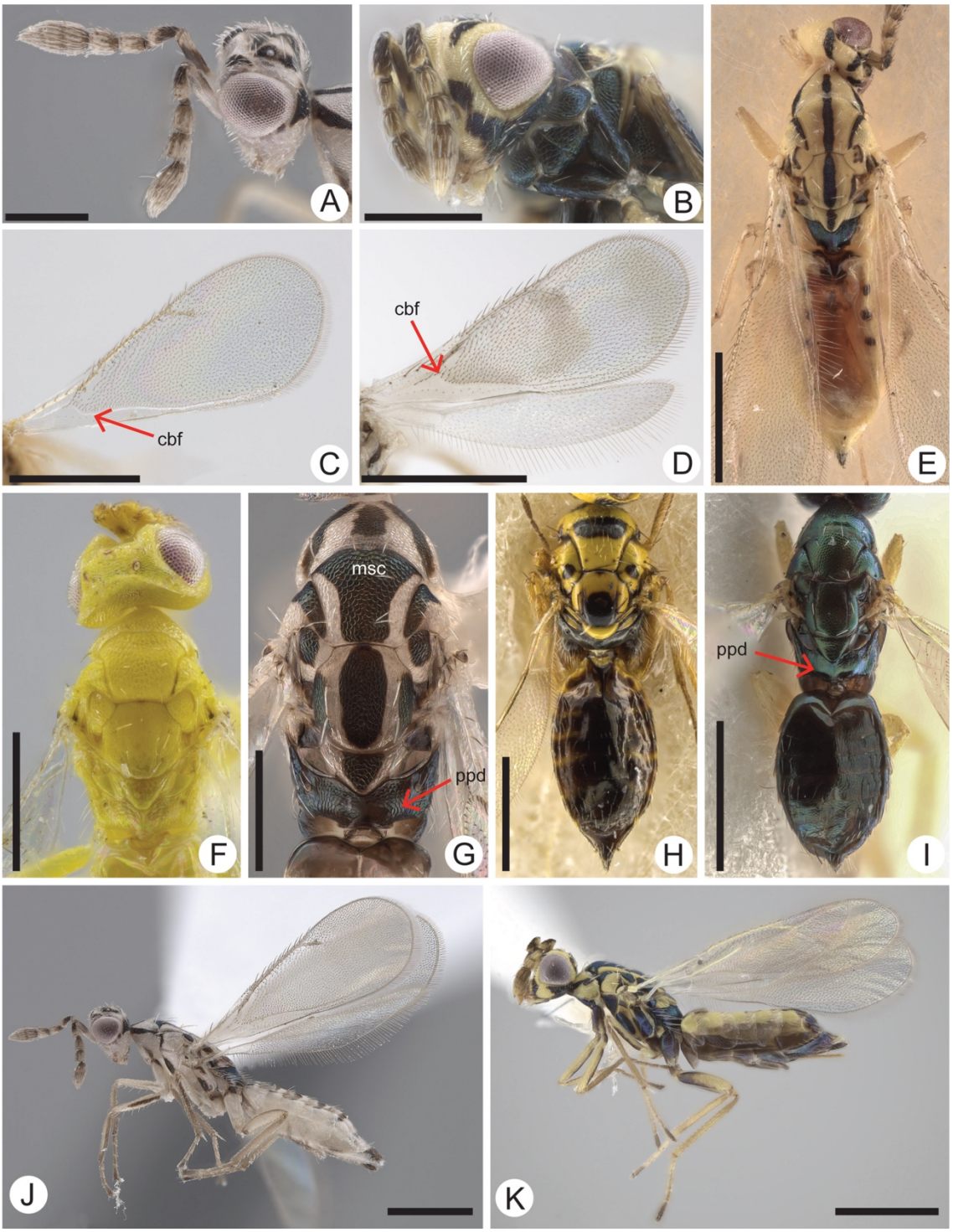

Fig. 3.16. *Burkseus:* (A–B) head: (A) *B. robustus*, (B) *B. vittatus*; (C) forewing: *B. vittatus*, (D) fore and hind wing: *B. sigillatus;* (E) dorsal aspect: *B. elongatus*; (F–G) mesosoma dorsal: (F) *B. vittatus* (light form), (G) *B. flavoviridis*; (H–I) body dorsal: (H) *B. staryi*, (I) *B. singa*; (J–K) habitus lateral: (J) *B. robustus*, (K) *B. flavoviridis*. Scale bar: A–B, F–G = 0.2mm; C–E, H–K = 0.5mm.

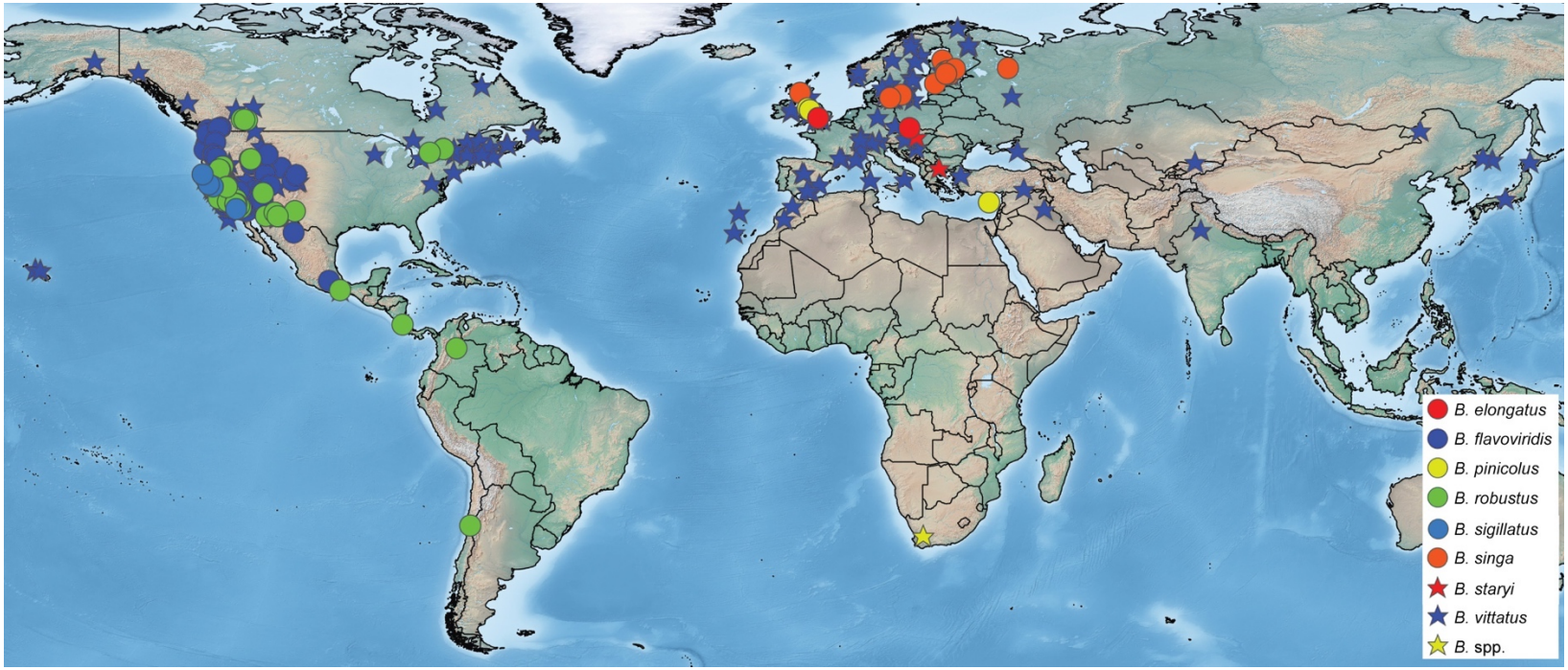

Fig. 3.17. Distribution of *Burkseus.*

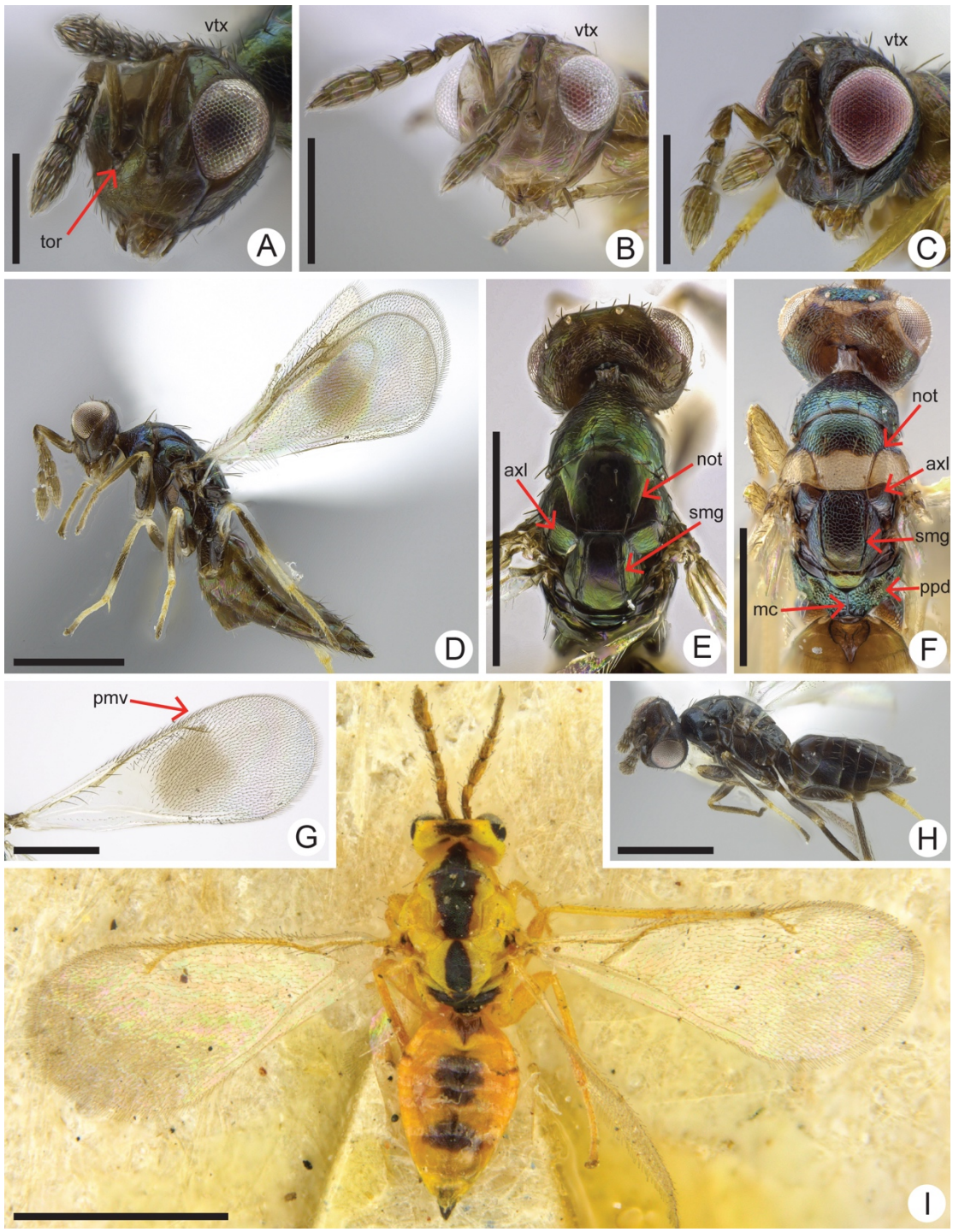

Fig. 3.18. *Cirrospilus:* (A–C) head: (A) *C.* sp. D3672, (B) *C.* sp. D4151, (C) *C.* sp. D3996; (D) habitus lateral: *C.* sp. D3751; (E–F) mesosoma dorsal: (E) *C.* sp. D3673, (F) *C.* nr. *cinctithorax* D4989; (G) forewing: *C.* sp. D3642; (H) lateral aspect: *C.* sp. D3677; (I) habitus dorsal: *C. elegantissimus* (J. Hogan, HDOU). Scale bar: A–C, E–F = 0.2mm; D, G–H = 0.5mm; I = 1.0mm.

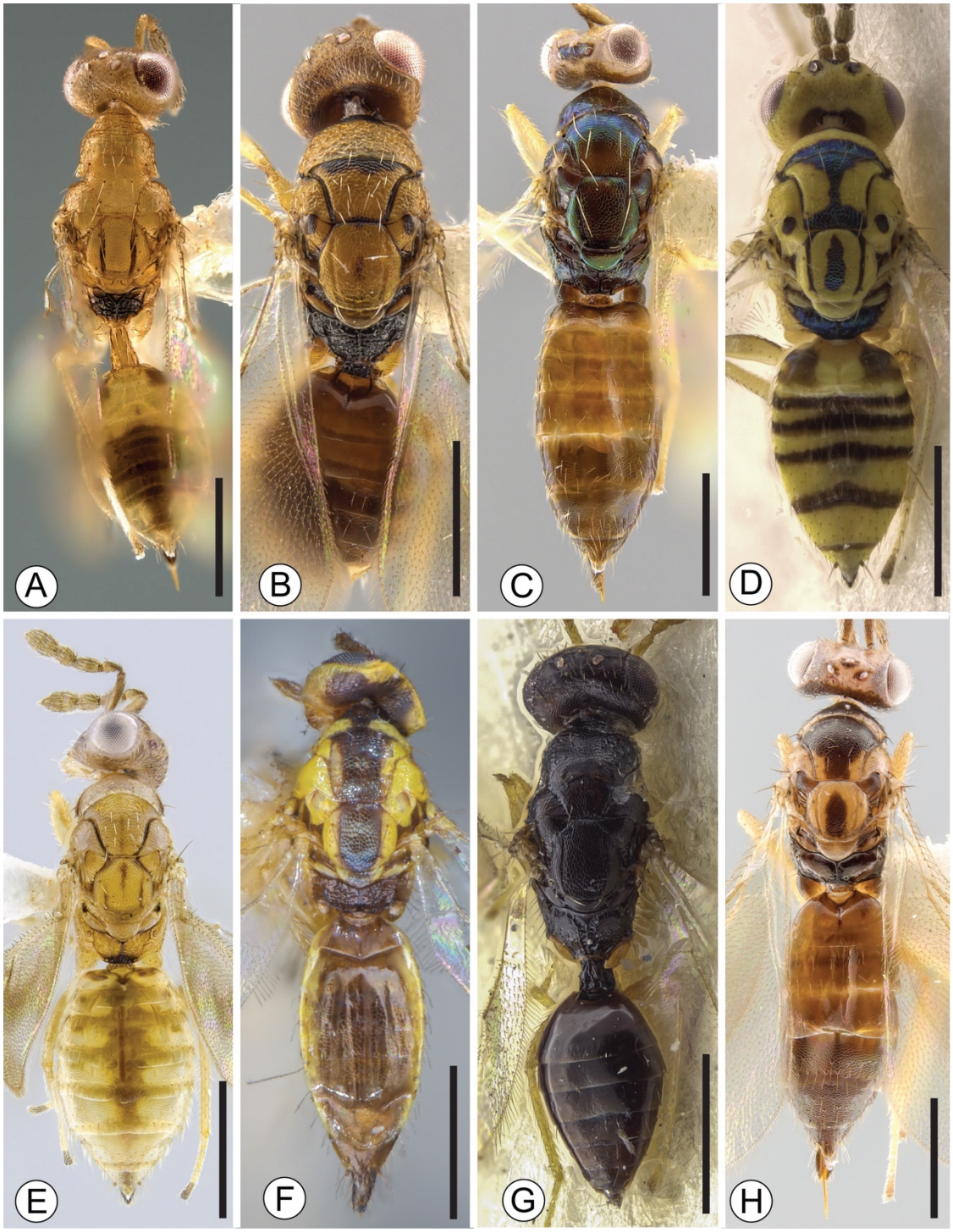

Fig. 3.19. *Cirrospilus:* (A–H) dorsal aspect: (A) *C.* sp. D6709, (B) *C.* sp. D4987, (C) *C.* sp. D5970, (D*) C. floridensis*, (E) *C.* sp. D3867, (F) *C. longifasciatus*, (G) *C. silvicolus*, (H) *C.* sp. D5964. Scale bar = 0.5mm.

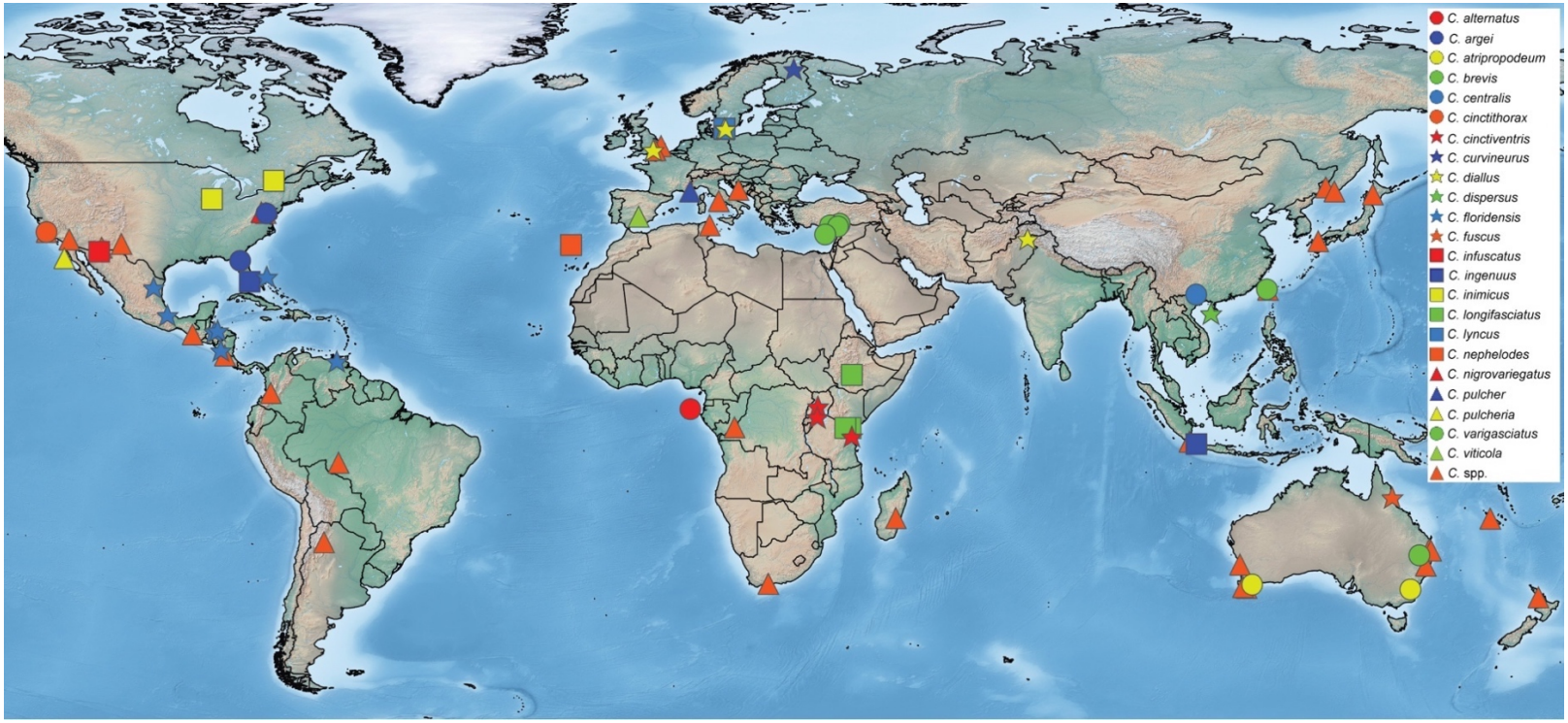

Fig. 3.20. Distribution of *Cirrospilus.*

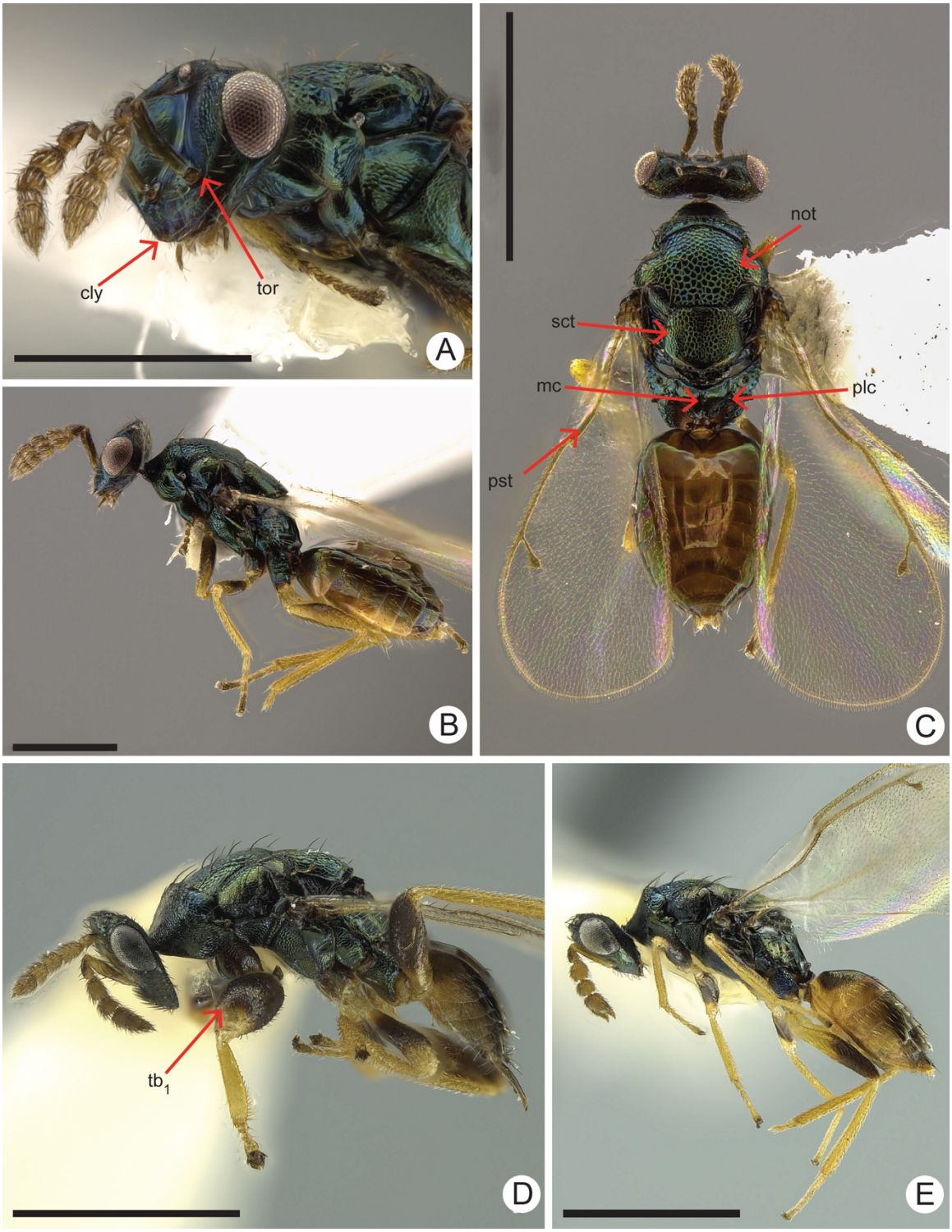

Fig. 3.21. *Colpoclypeus:* (A–C) *C. florus*: (A) head, (B) habitus lateral, (C) habitus dorsal; (D–E) *C. michoacanensis*: (D–E) lateral aspect: (D) ♂, (E) ♀. Scale bar: A–B = 0.5mm; C–E = 1.0mm.

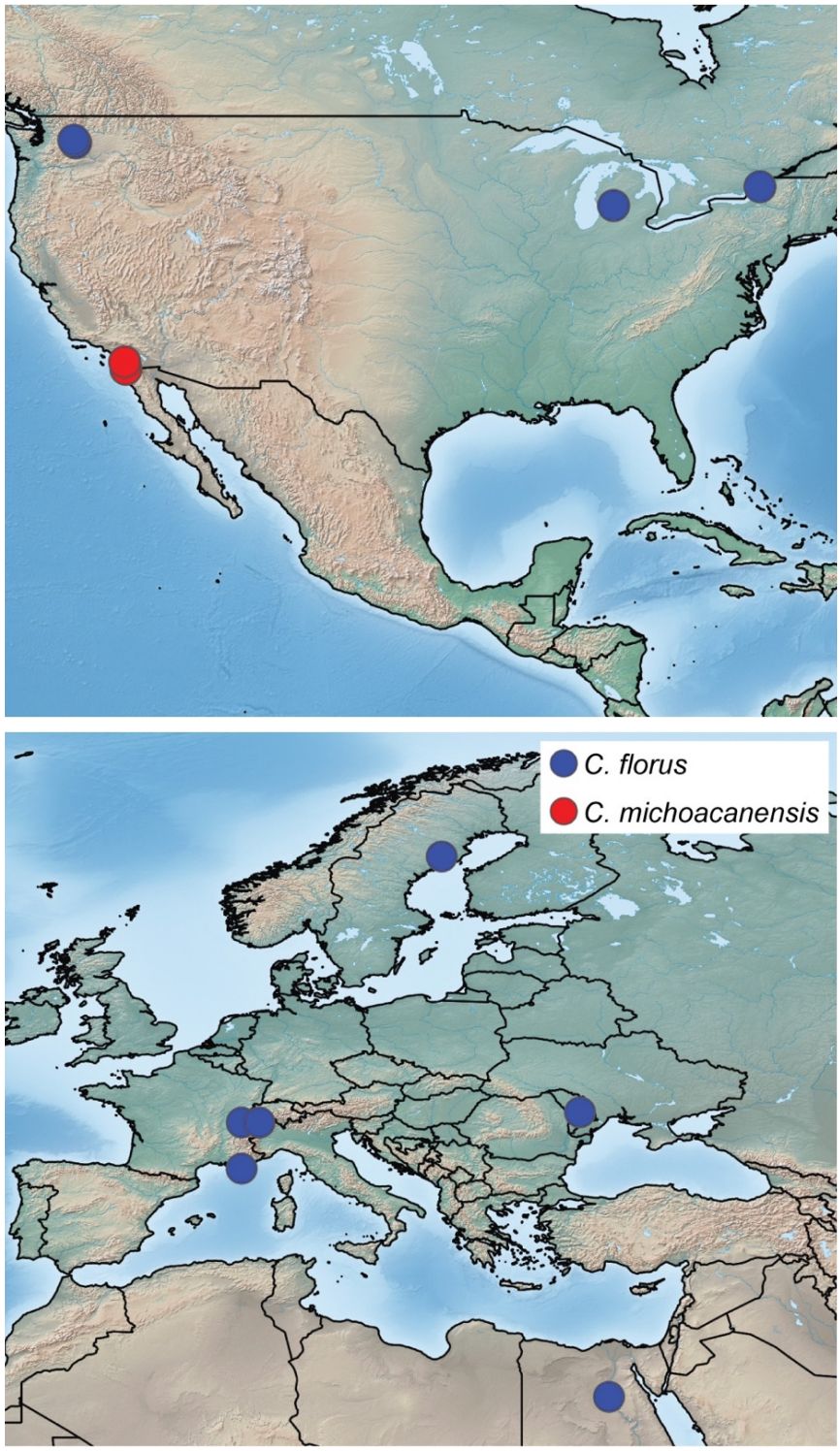

Fig. 3.22. Distribution of *Colpoclypeus.*

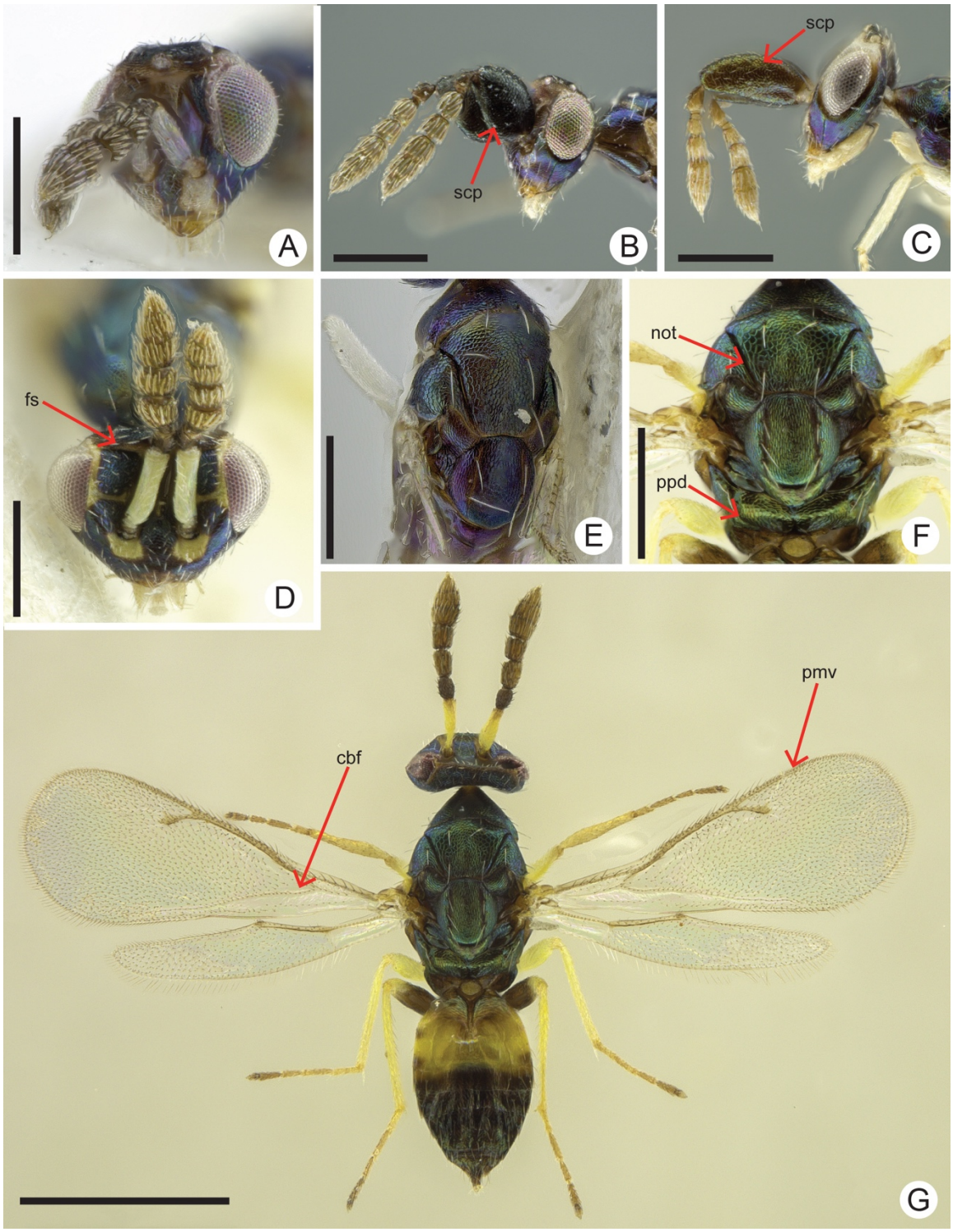

Fig. 3.23. *Diaulinopsis:* (A–D) head: (A) *D*. sp. D3862, (B) *D. arenaria* ♂, (C) *D. albimaxilla* ♂, (D) *D. arenaria*; (E–F) mesosoma dorsal: (E) *D*. sp. D3862, (F) *D. arenaria;* (G) habitus dorsal: *D. arenaria*. Scale bar: A–F = 0.2mm; G = 0.5mm.

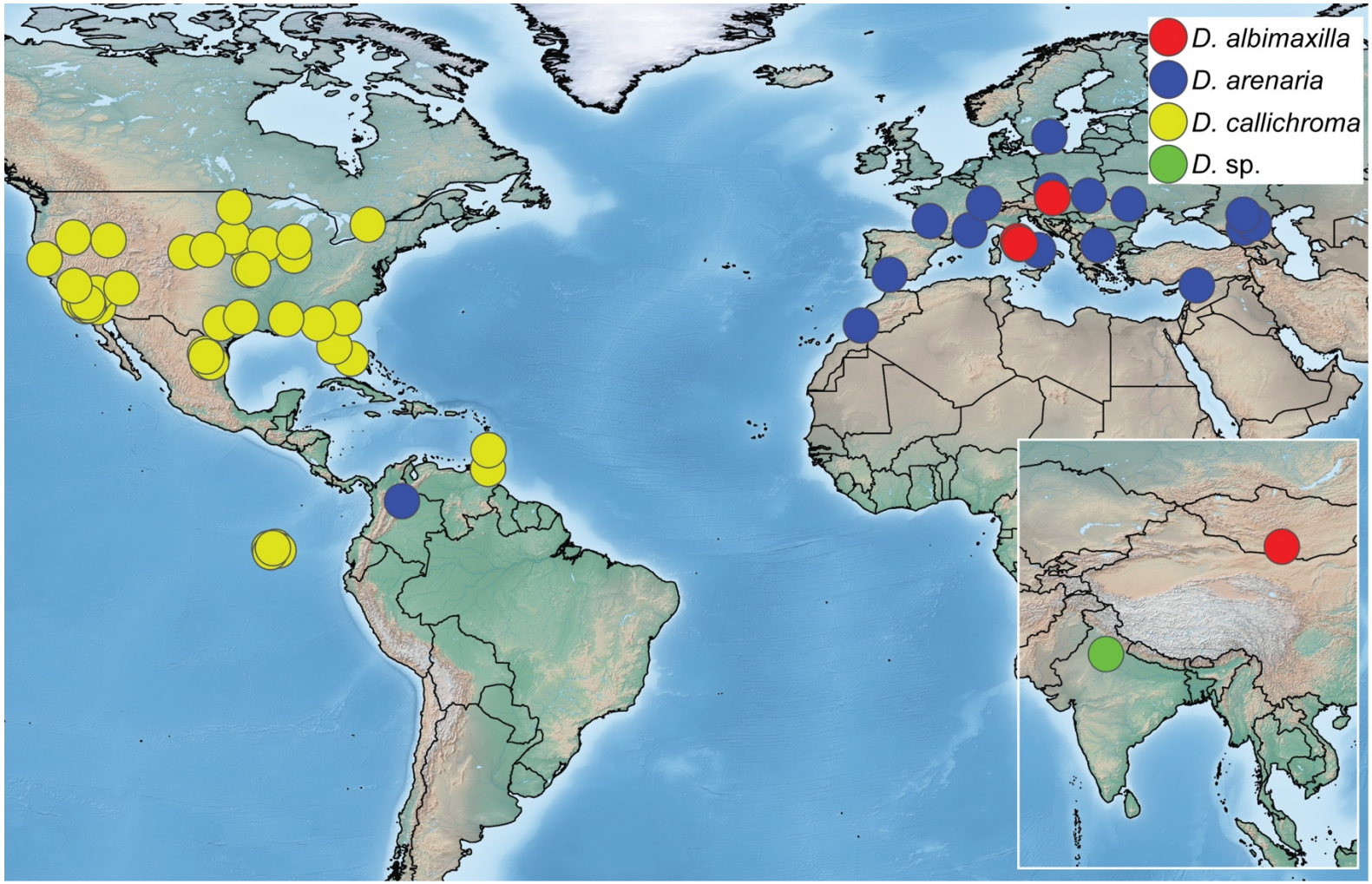

Fig. 3.24. Distribution of *Diaulinopsis.*

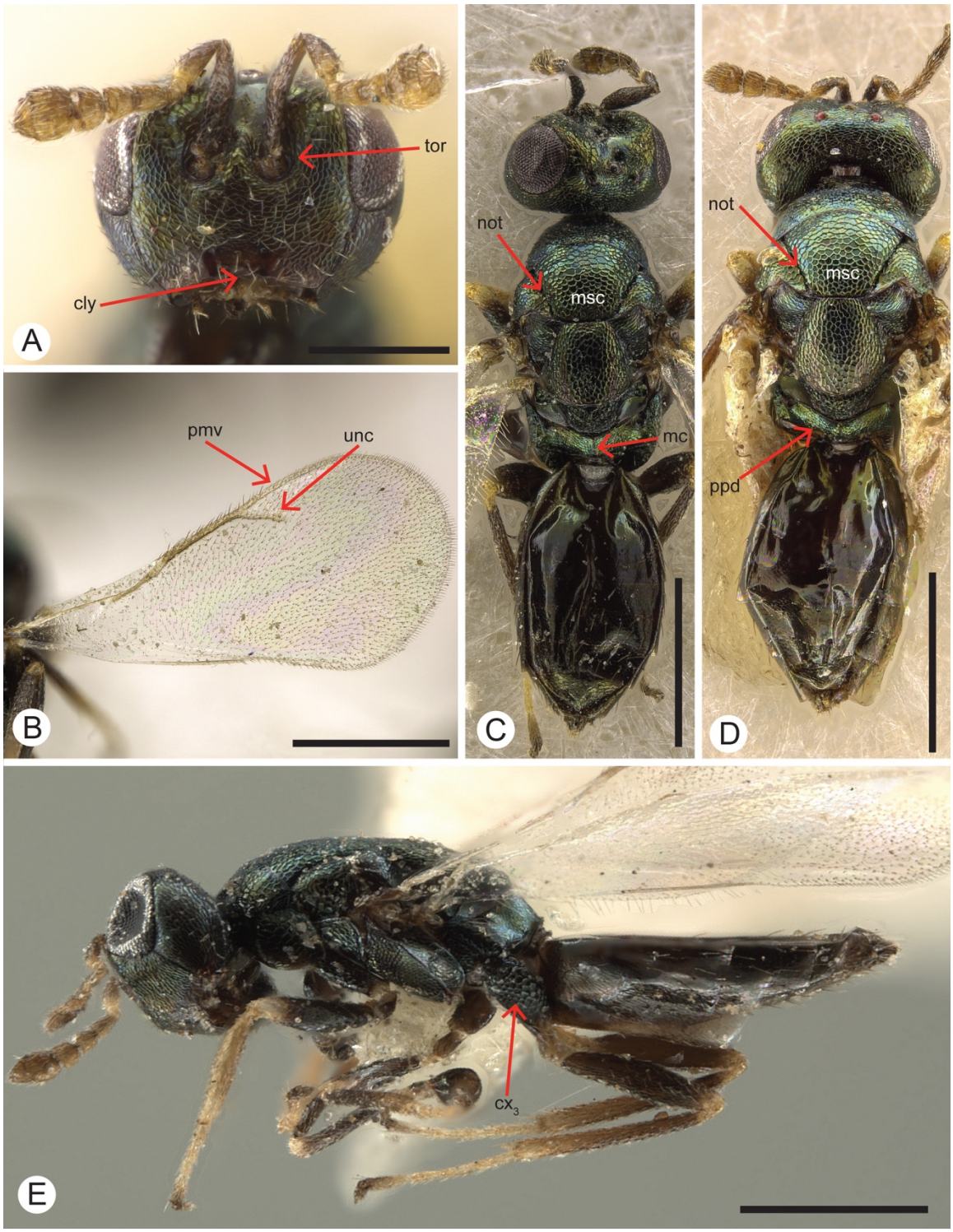

Fig. 3.25. *Dichatomus acerinus:* (A) head; (B) fore wing; (C–D) dorsal aspect: (C) ♀, (D) ♂; (E) lateral aspect. Scale bar: A = 0.2mm; B–E = 0.5mm.

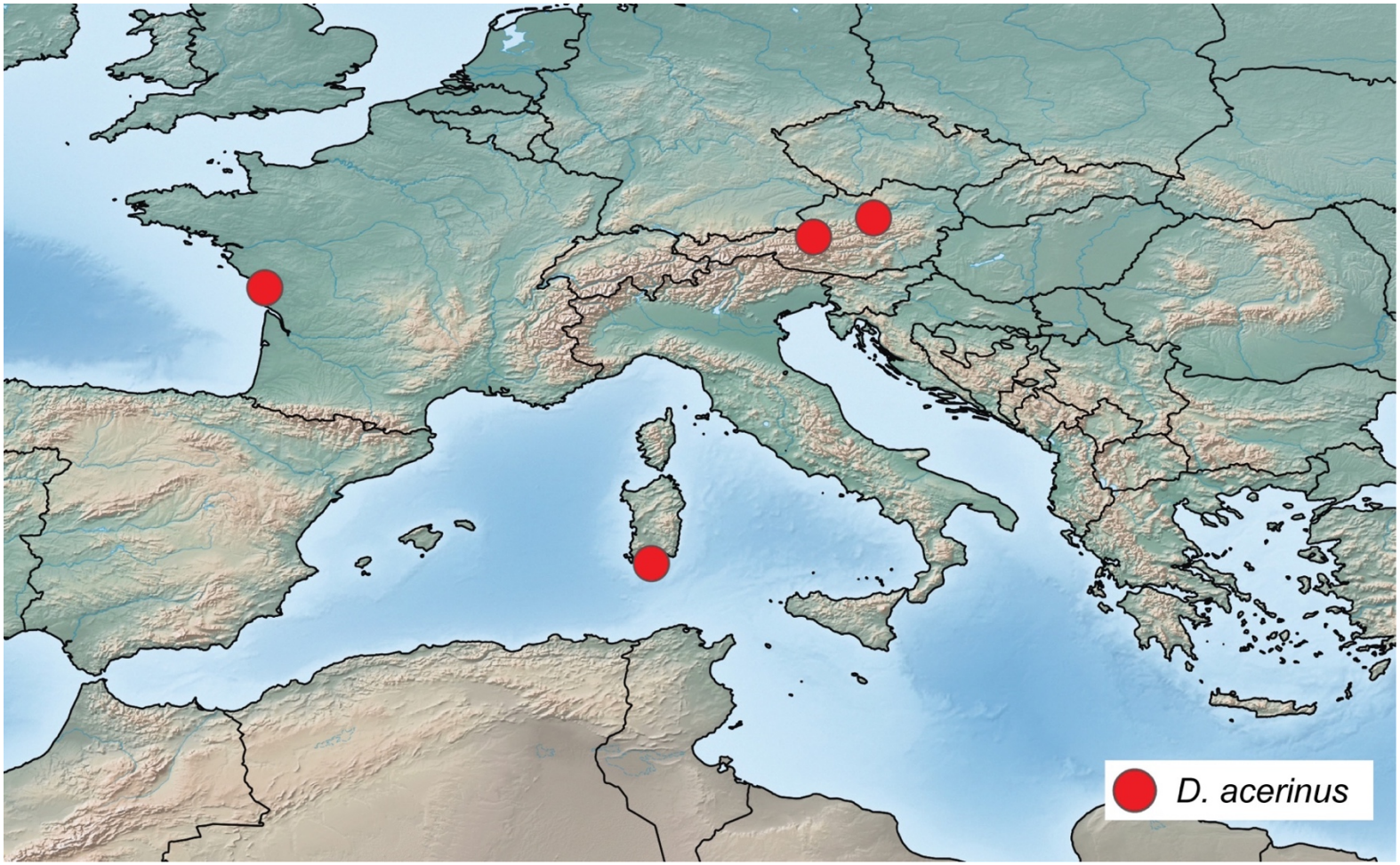

Fig. 3.26. Distribution of *Dichatomus.*

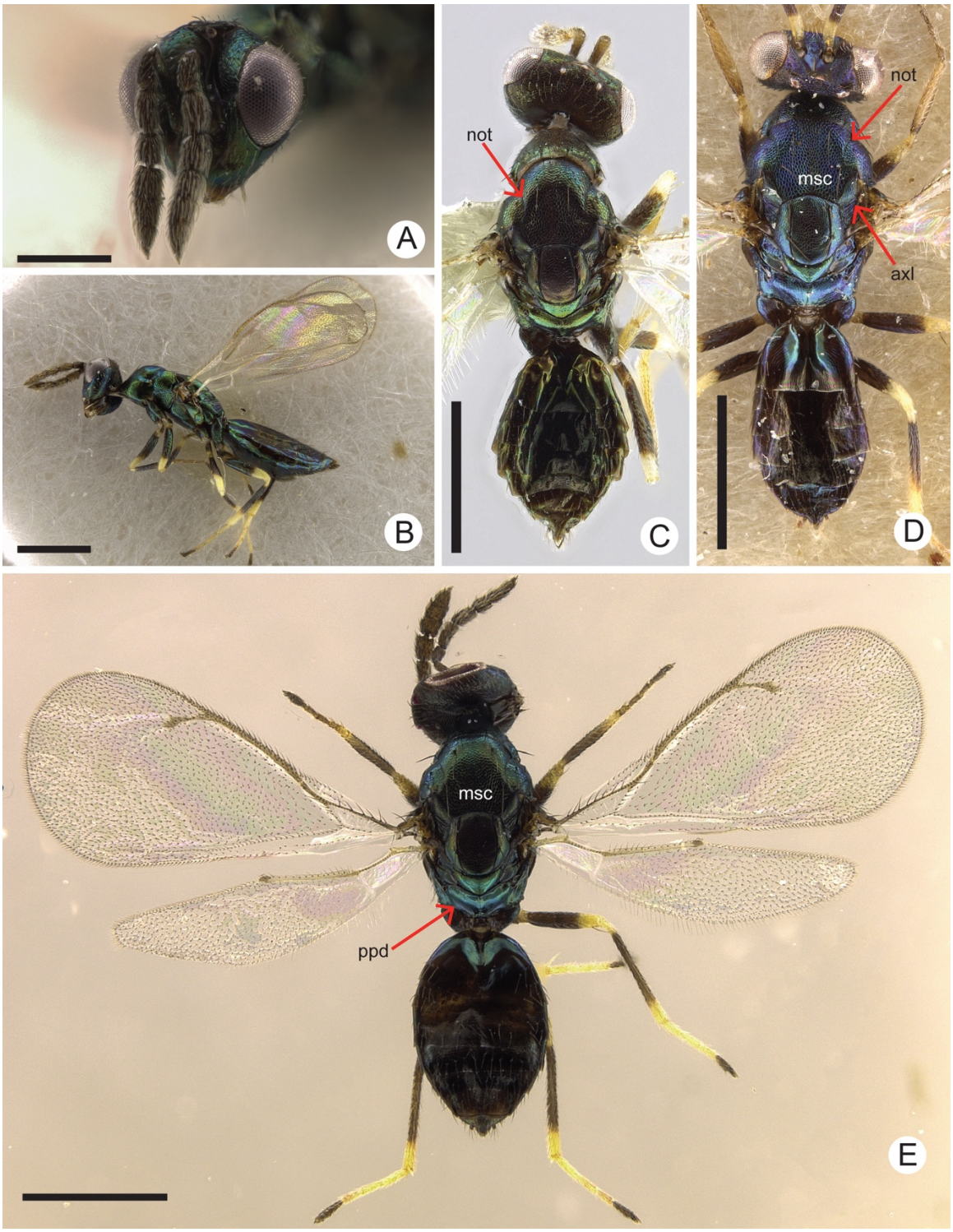

Fig. 27. *Diglyphus:* (A) head: D. guptai; (B) habitus lateral: *D. crassinervis*; (C–D) dorsal aspect: (C) *D. begini*, (D) *D. poppoea*; (E) habitus dorsal, *D. minoeus*. Scale bar: A = 0.2mm; B–E = 0.5mm.

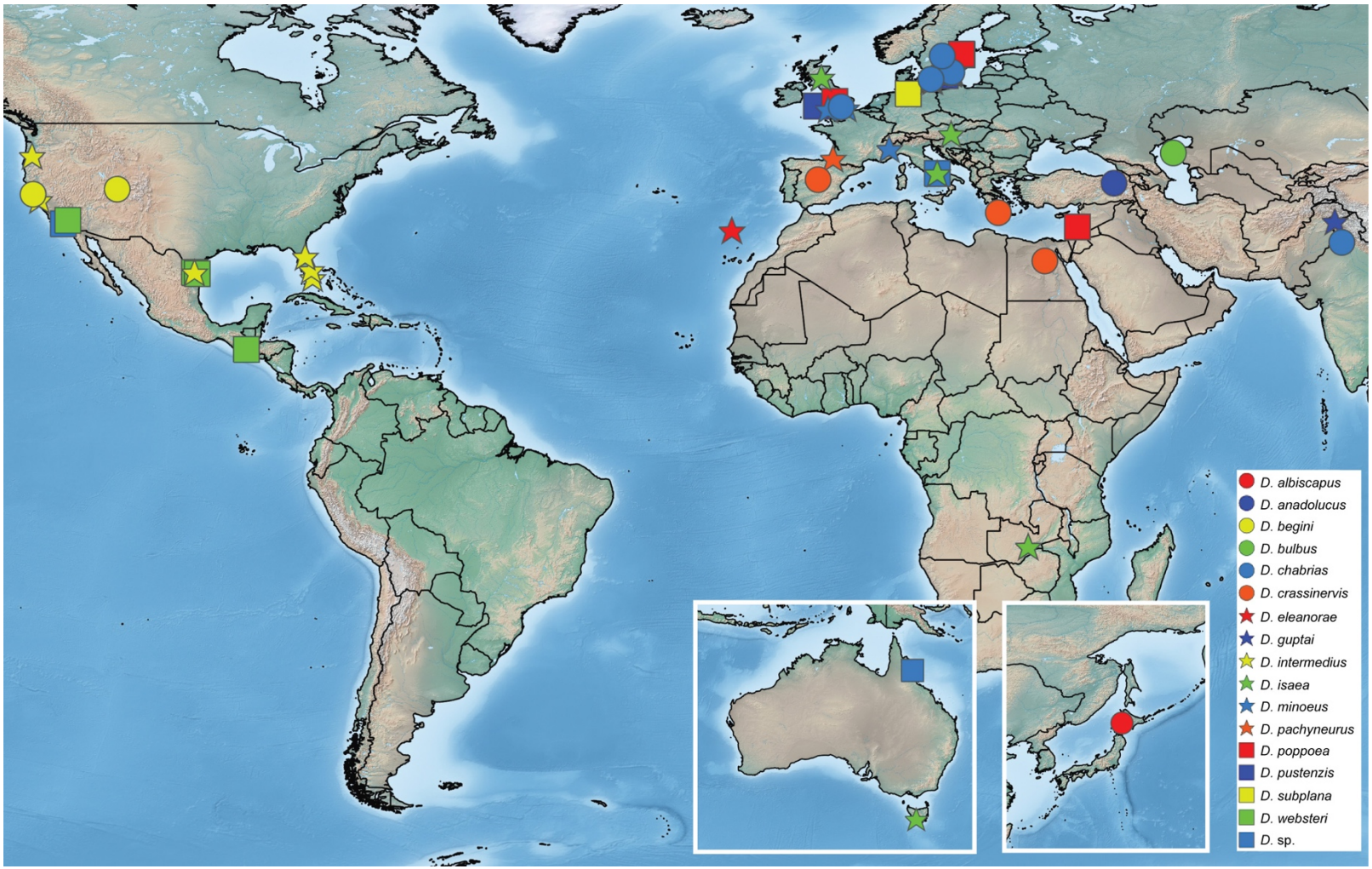

Fig. 3.28. Distribution of *Diglyphus.*

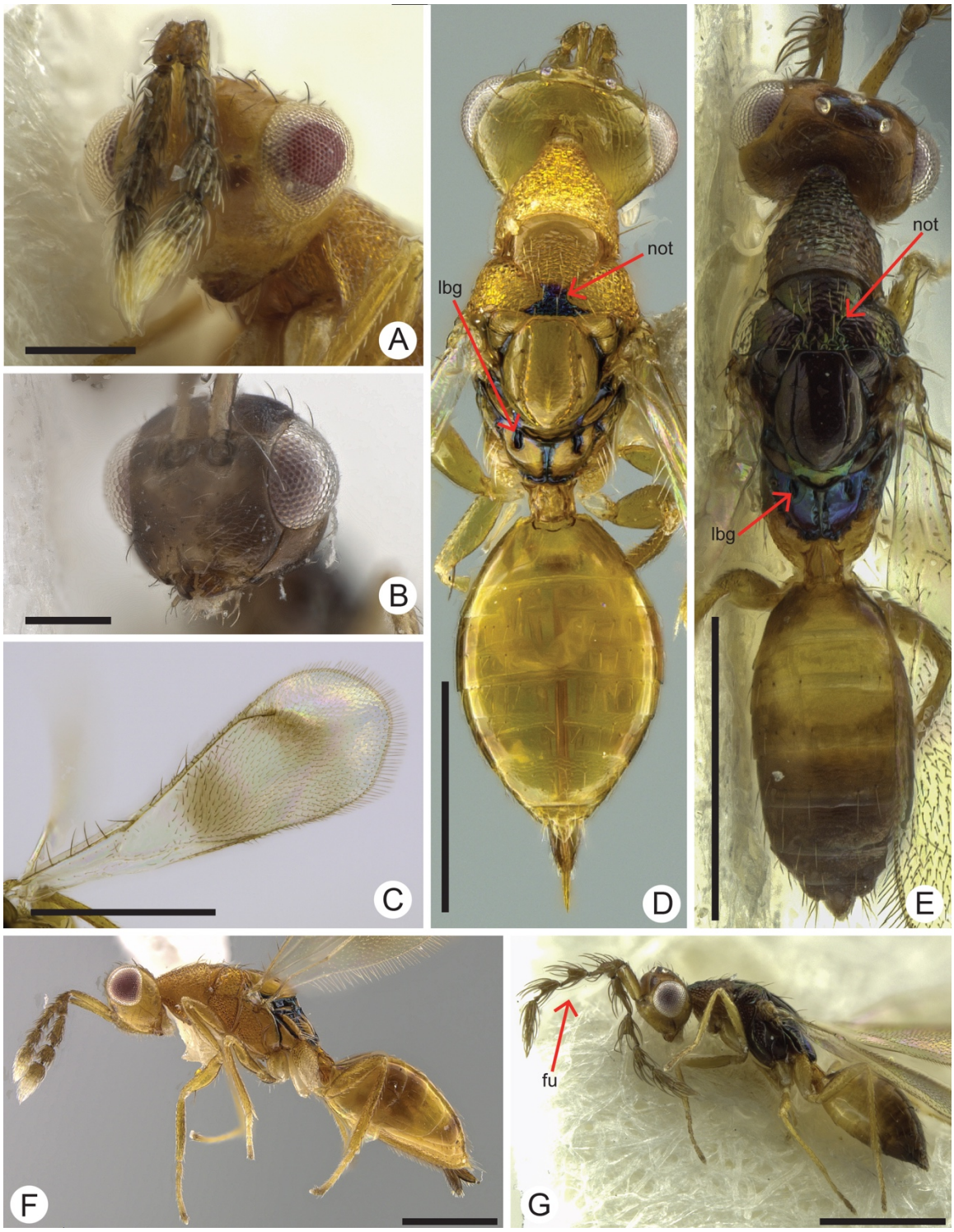

Fig. 3.29. *Gallowayia picta:* (A–B) head: (A) ♀, (B) ♂; (C) fore wing; (D–E) dorsal aspect: (D) ♀, (E) ♂; (F–G) lateral aspect: (F) ♀, (G) ♂. Scale bar: A = 0.2mm; B = 0.1mm; C–G = 0.5mm.

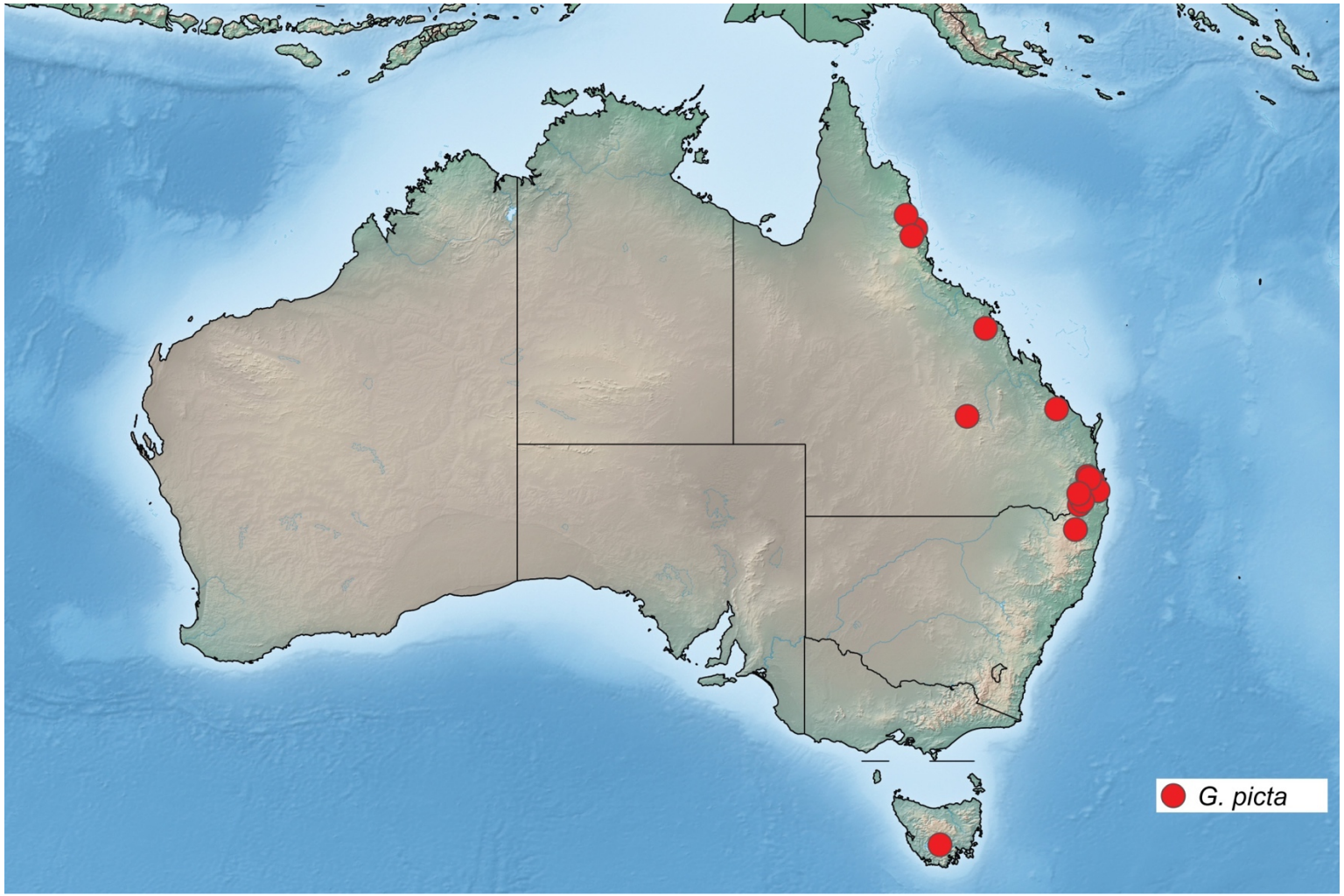

Fig. 3.30. Distribution of *Gallowayia.*

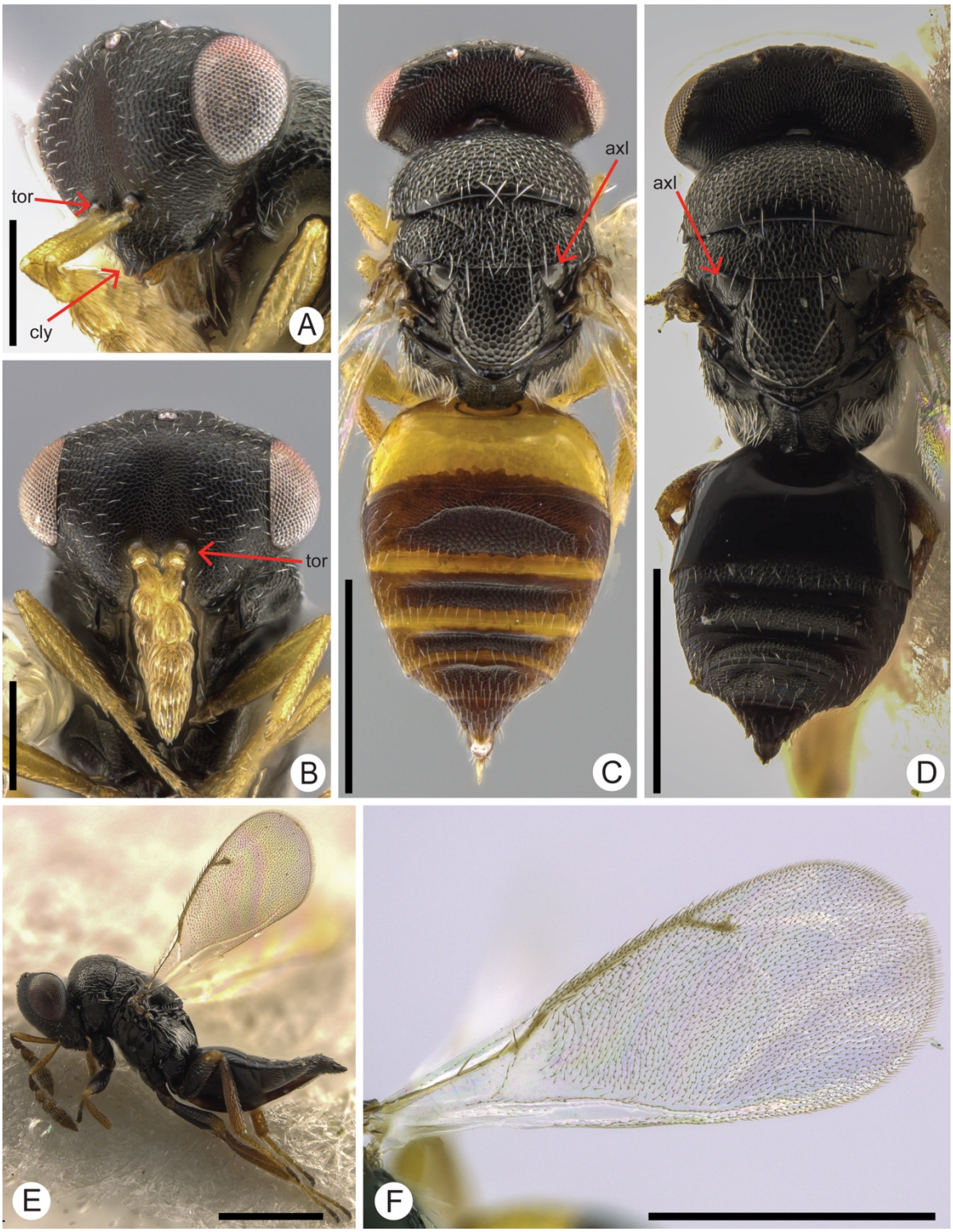

Fig. 3.31. *Gattonia:* (A–B) head: *G. basifura;* (C–D) dorsal aspect: (C) *G. basifura,* (D) *G. nigra*; (E) habitus lateral: *G. nigra*; (F) fore wing: *G. basifura*. Scale bar: A–B = 0.2mm; C–F = 0.5mm.

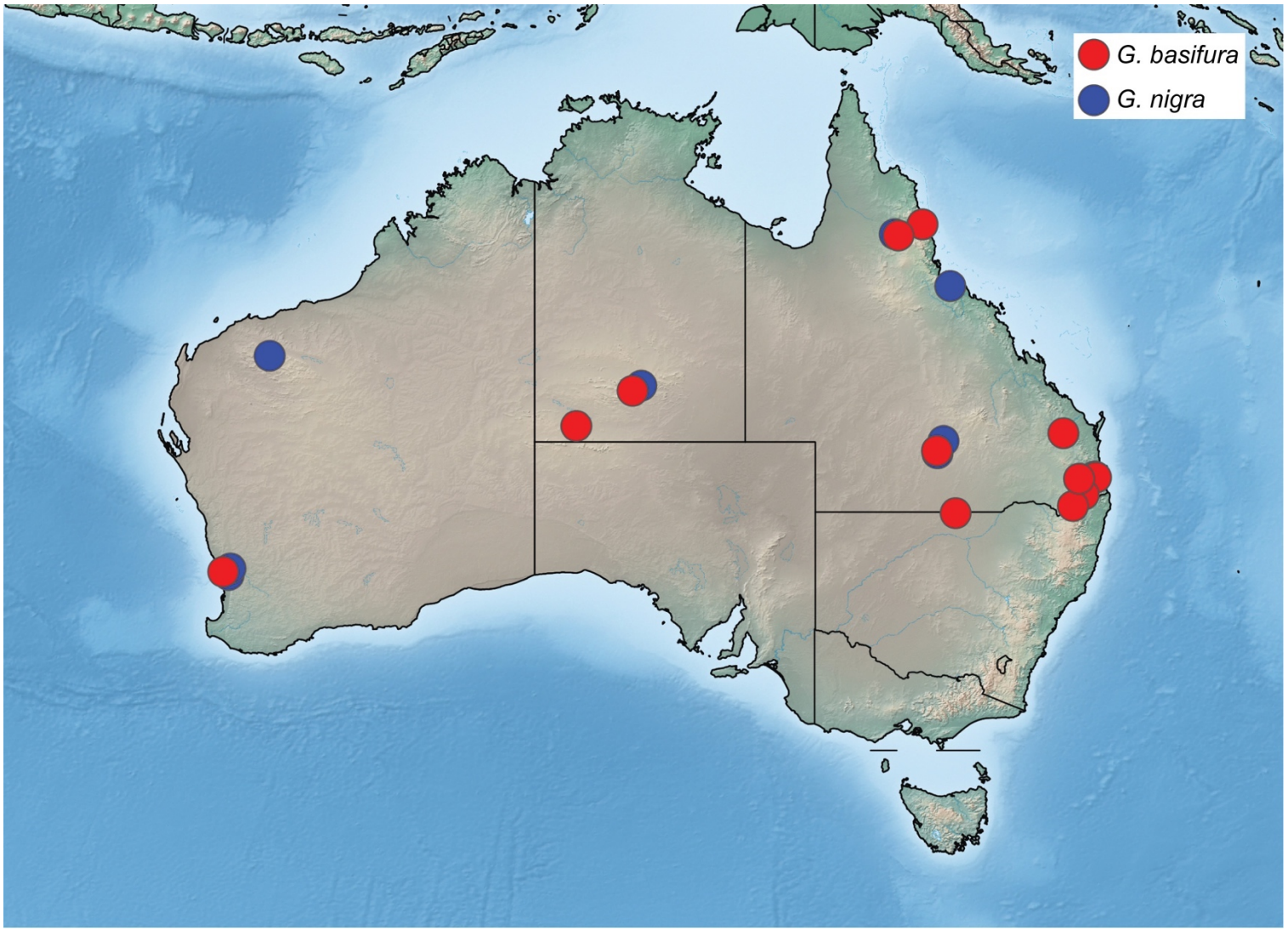

Fig. 3.32. Distribution of *Gattonia.*

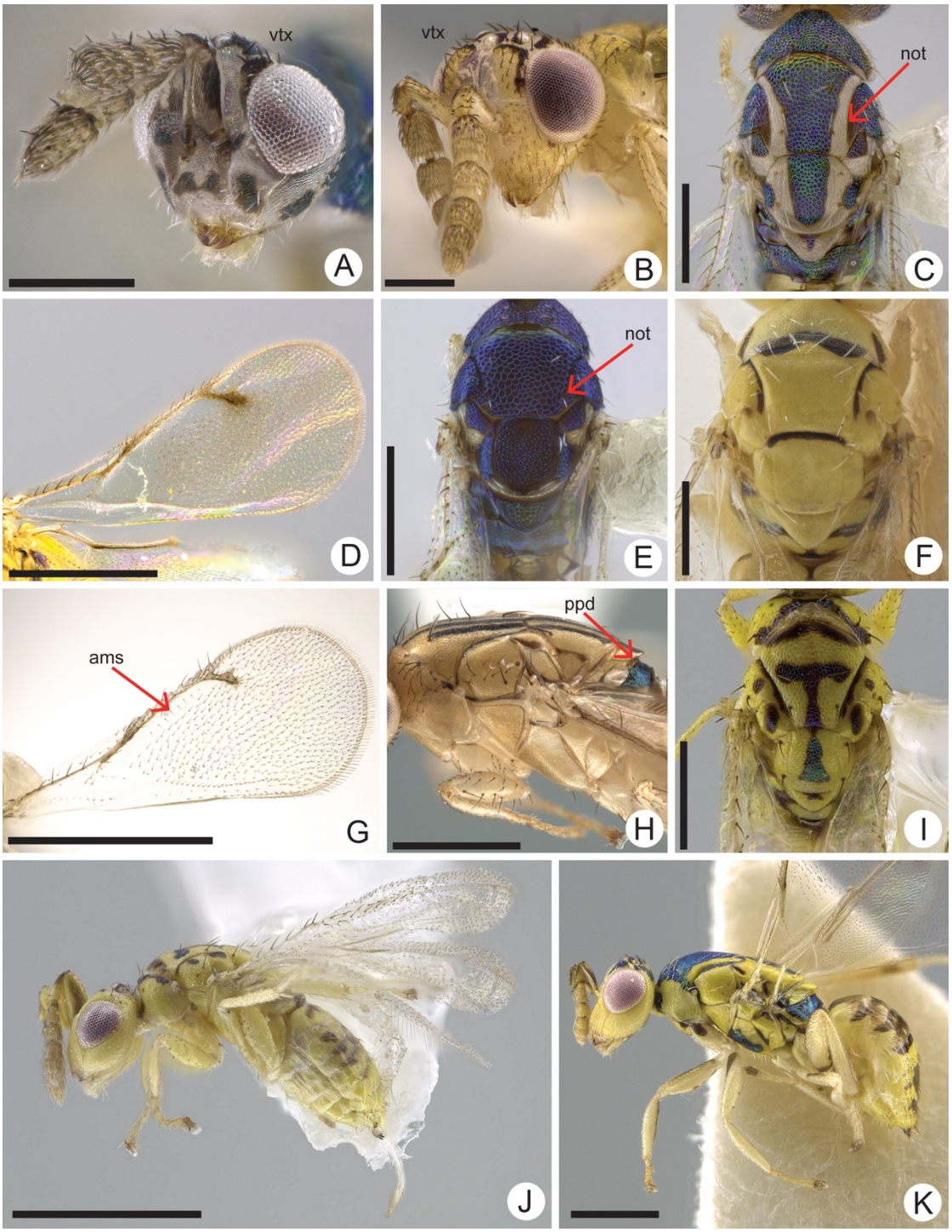

Fig. 3.33. *Gyrolasella:* (A–B) head: (A) *G.* nr. *margiscutellum* D4153, (B) *G.* sp. D4697; (C) mesosoma dorsal: *G*. nr. *542urkseus* D3865; (D) forewing: *G*. sp. D5100; (E–F) mesosoma dorsal: *G*. sp. D3864, (F) *G*. sp. UCRCENT416902; (G) fore and hind wing: *G*. sp. D4548; (H) mesosoma lateral: *G*. sp. D4676; (I) mesosoma dorsal: *G*. nr. *tau*; (J–K) lateral aspect: (J) *G*. nr. *tau*, (K) *G*. nr. *festivus*. Scale bar: A–C, E–F, I = 0.2mm; D, G, H, J–K = 0.5mm.

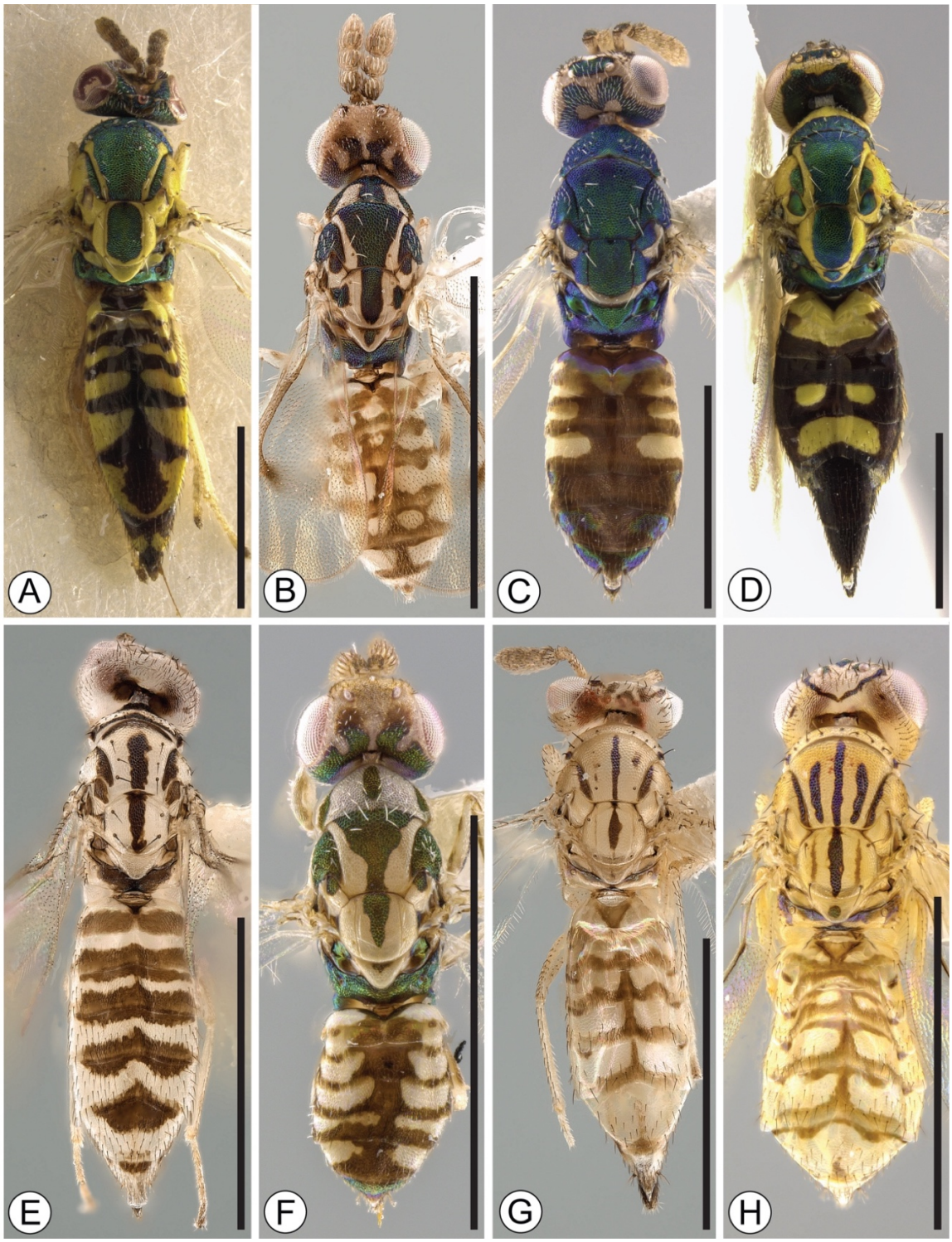

Fig. 3.34. *Gyrolasella:* (A–H) dorsal aspect: (A) *G. occipitus*, (B) *G*. sp. D5103, (C) *G. margiscutellum*, (D) *G*. sp. UCRCENT491673, (E) *G*. sp. D4977, (F) *G*. sp. D4673, (G) *G*. sp. 5109, (H) *G*. sp. D5100. Scale bar = 1.0mm.

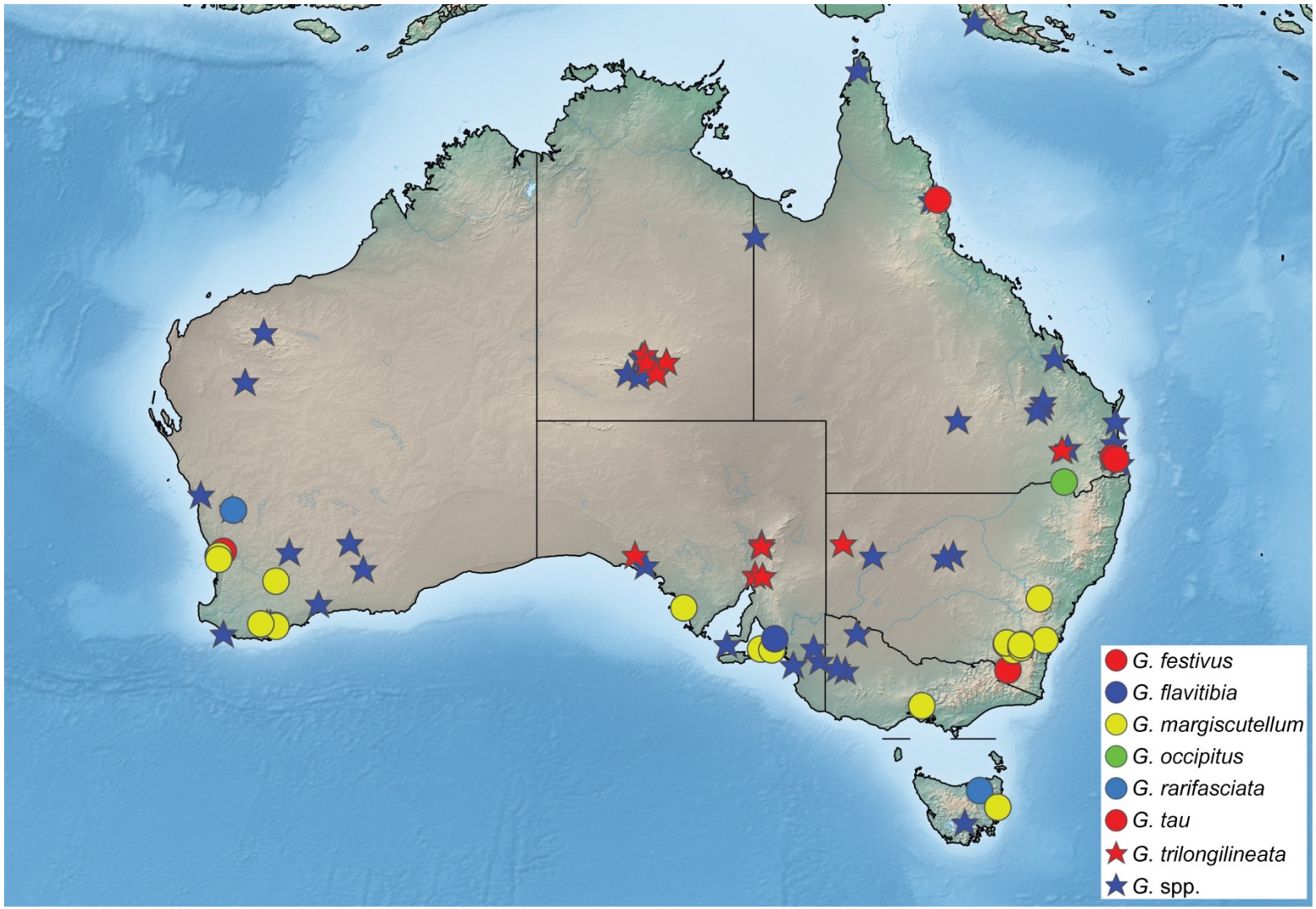

Fig. 3.35. Distribution of *Gyrolasella.*

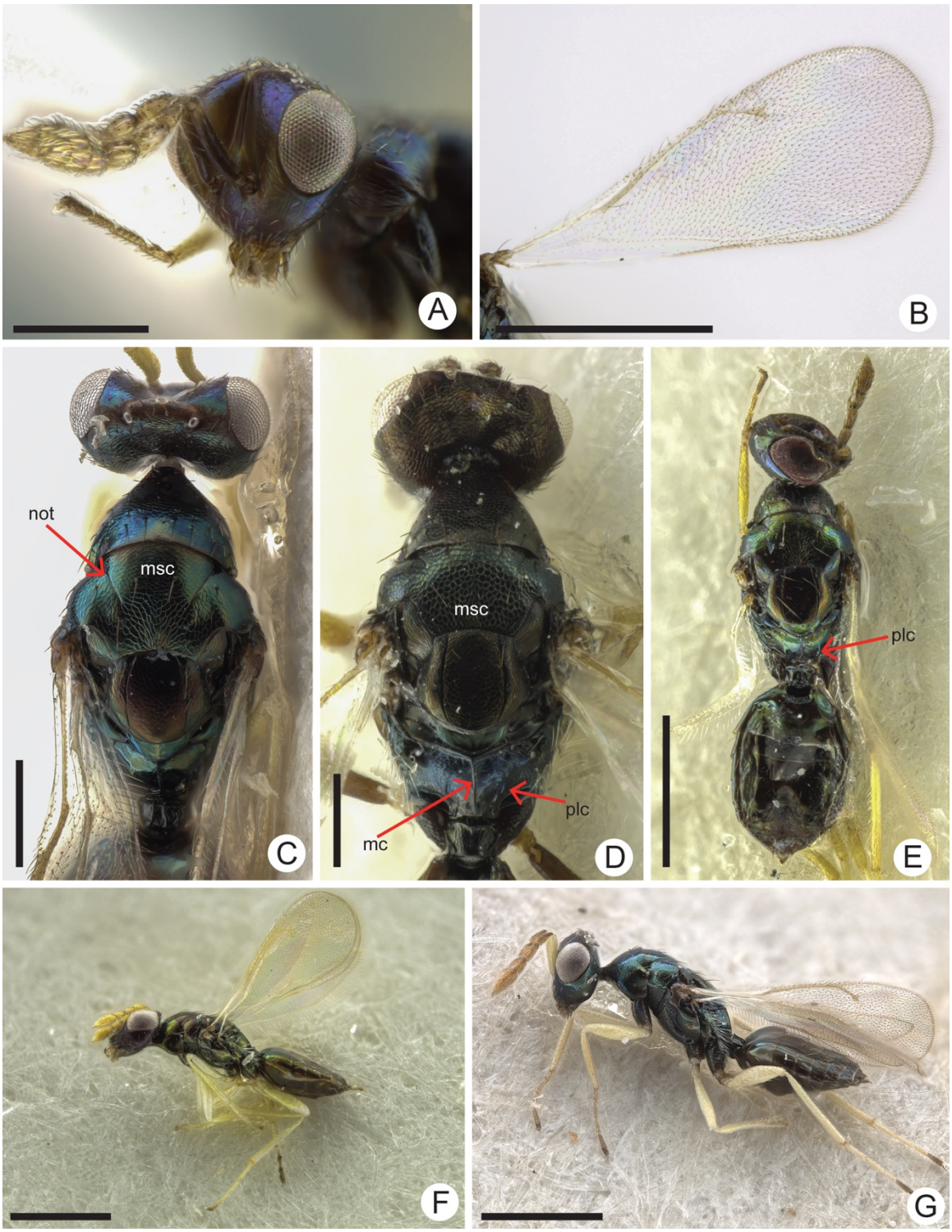

Fig. 3.36. *Meruacesa:* (A) head: *M. cuprata*; (B) fore wing: *M. cuprata*; (C–D) mesosoma dorsal: (C) *M. cuprata*, (D) *M. camerouensis;* (E) dorsal aspect: *M. liriomyzae;* (F–G) habitus lateral: *M. cuprata* ♂. Scale bar: A, C–D = 0.2mm; B, E–G = 0.5mm.

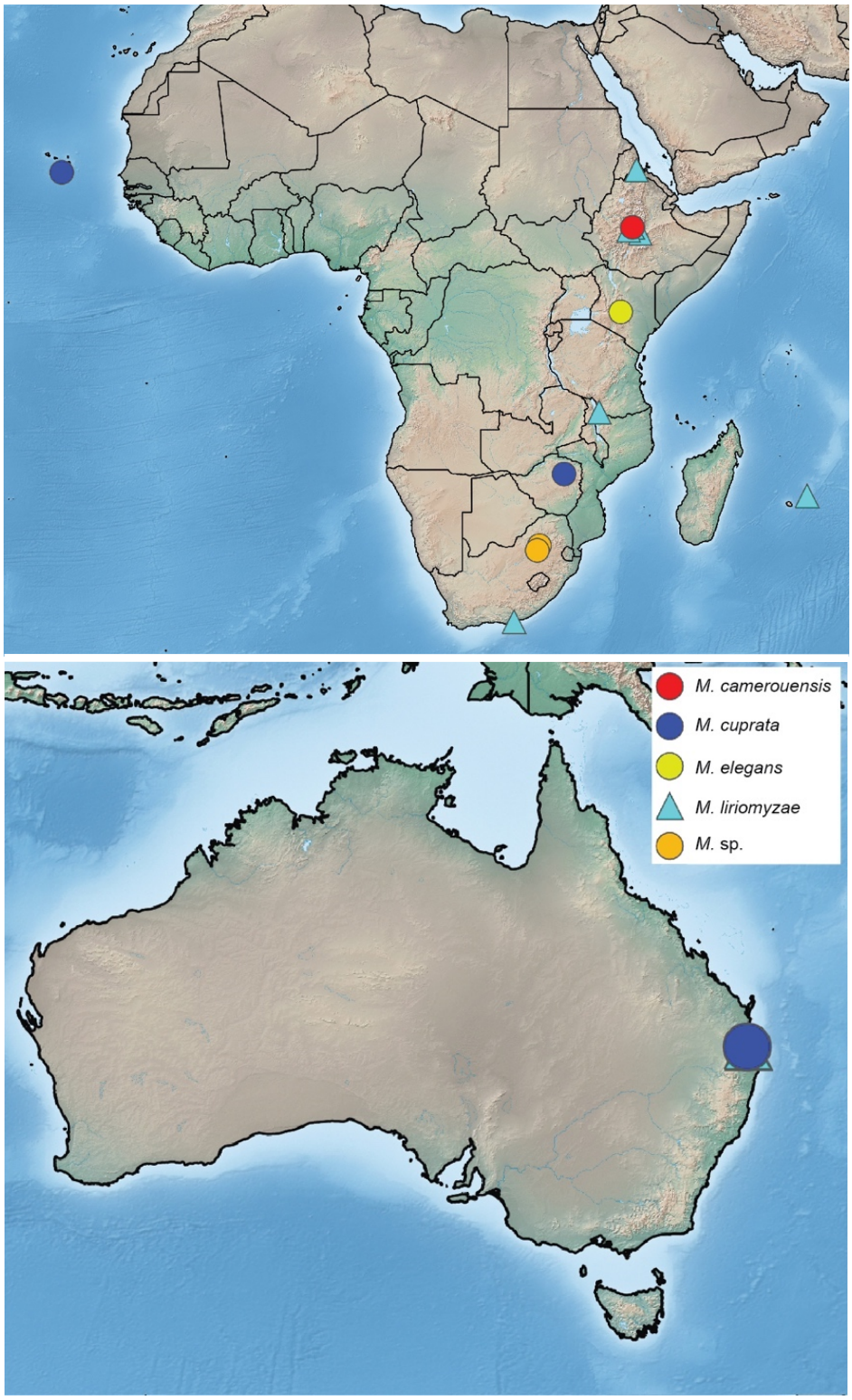

Fig. 3.37. Distribution of *Meruacesa.*

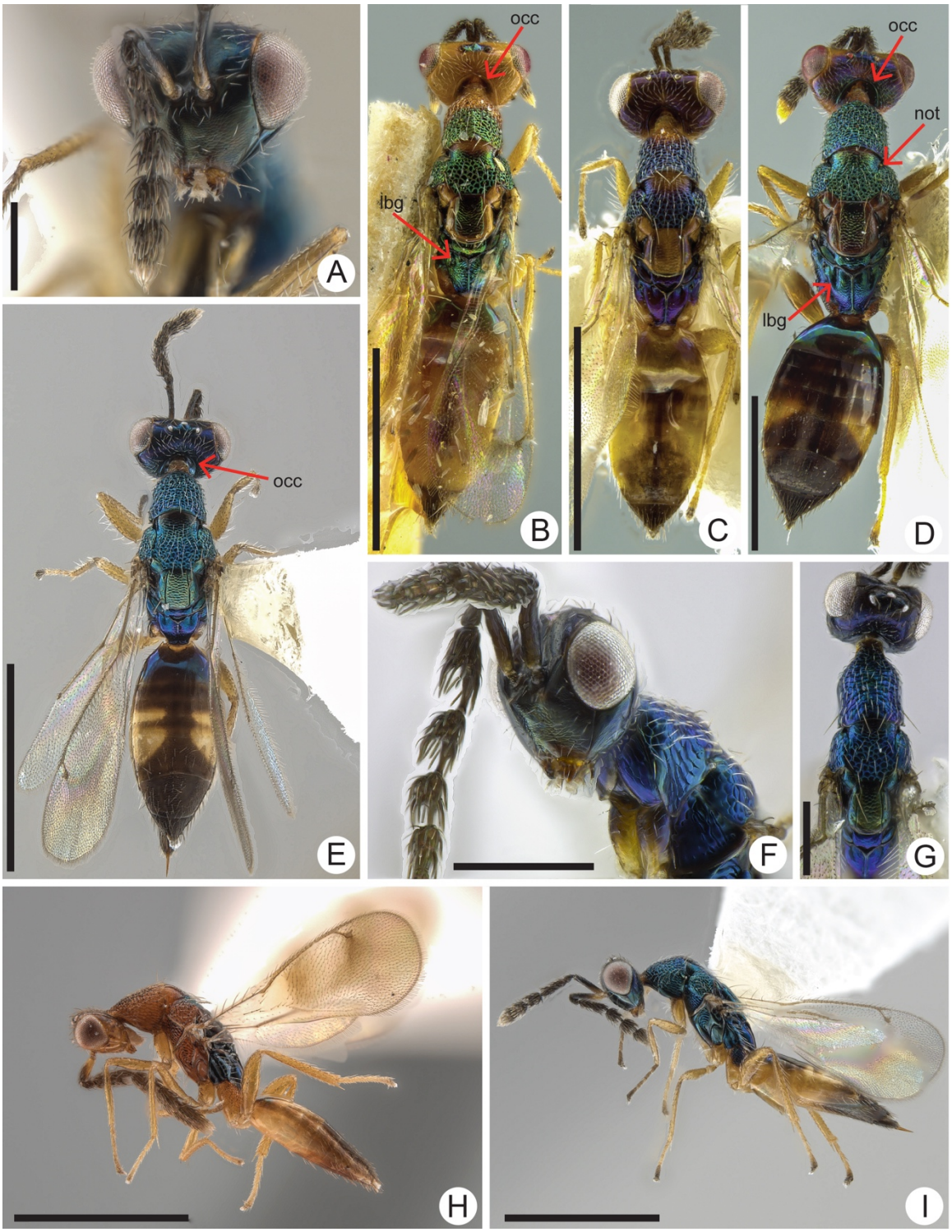

Fig. 3.38. *Naumanniola:* (A) head: *N*. sp. D4174; (B–E) dorsal aspect: (B–D) *N. varians* (B-holotype), (E) *N*. sp. D4174; (F) head: *N*. sp. ♂ D3994; (G) mesosoma dorsal: *N*. sp. ♂ D3994; (H–I) habitus lateral: (H) *N. varians* ♂, (I) *N*. sp D4174. Scale bar: A, F–G = 0.2mm; B–E, H–I = 1.0mm.

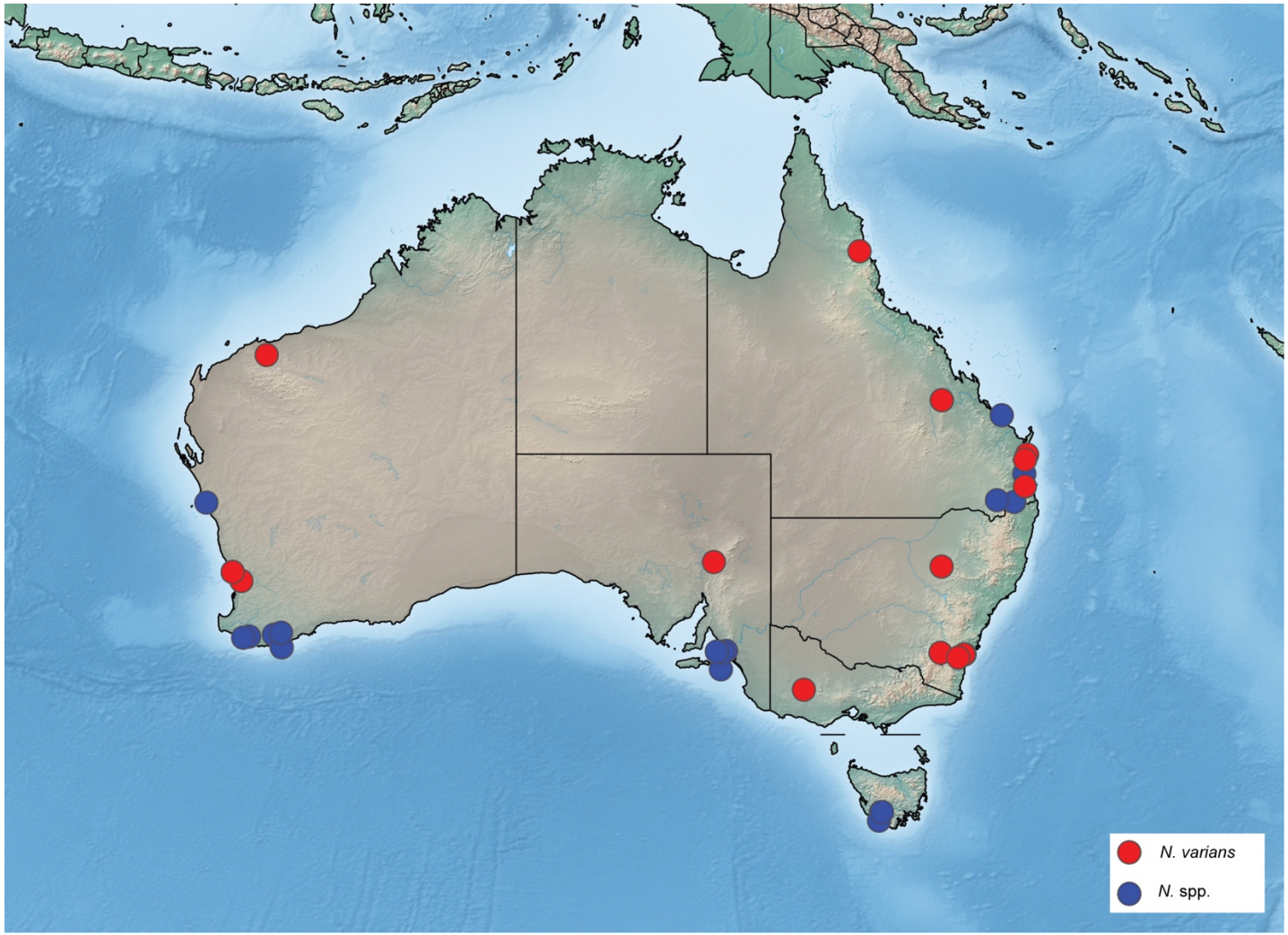

Fig. 3.39. Distribution of *Naumanniola.*

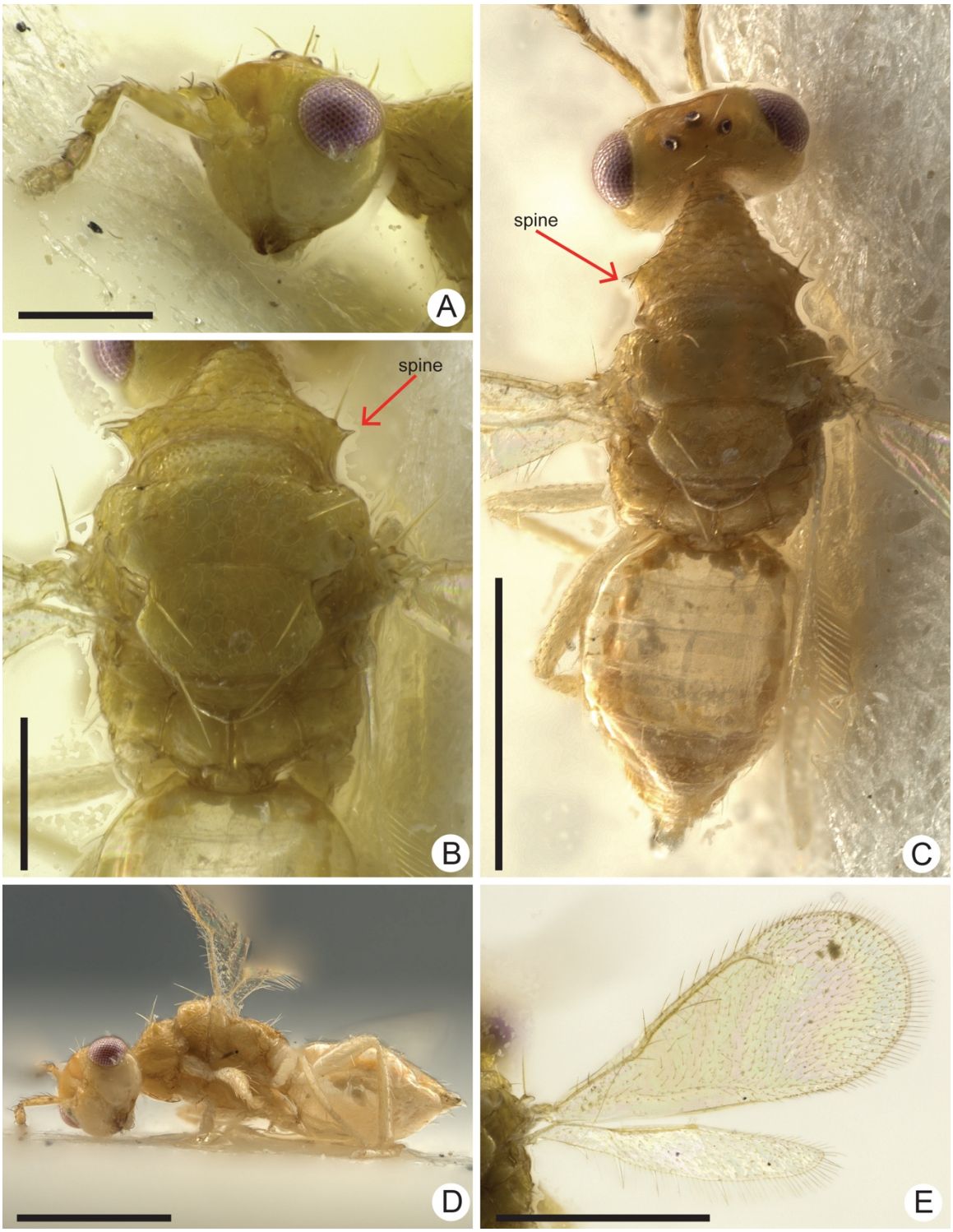

Fig. 3.40. *Oxycantha darwini* ♂ paratype: (A) head, (B) mesosoma dorsal; (C) dorsal aspect, (D) ventral aspect, (E) fore and hind wing. Scale bar: A–B = 0.2mm; D–E = 0.5mm.

Fig. 3.41. Distribution of *Oxycantha.*

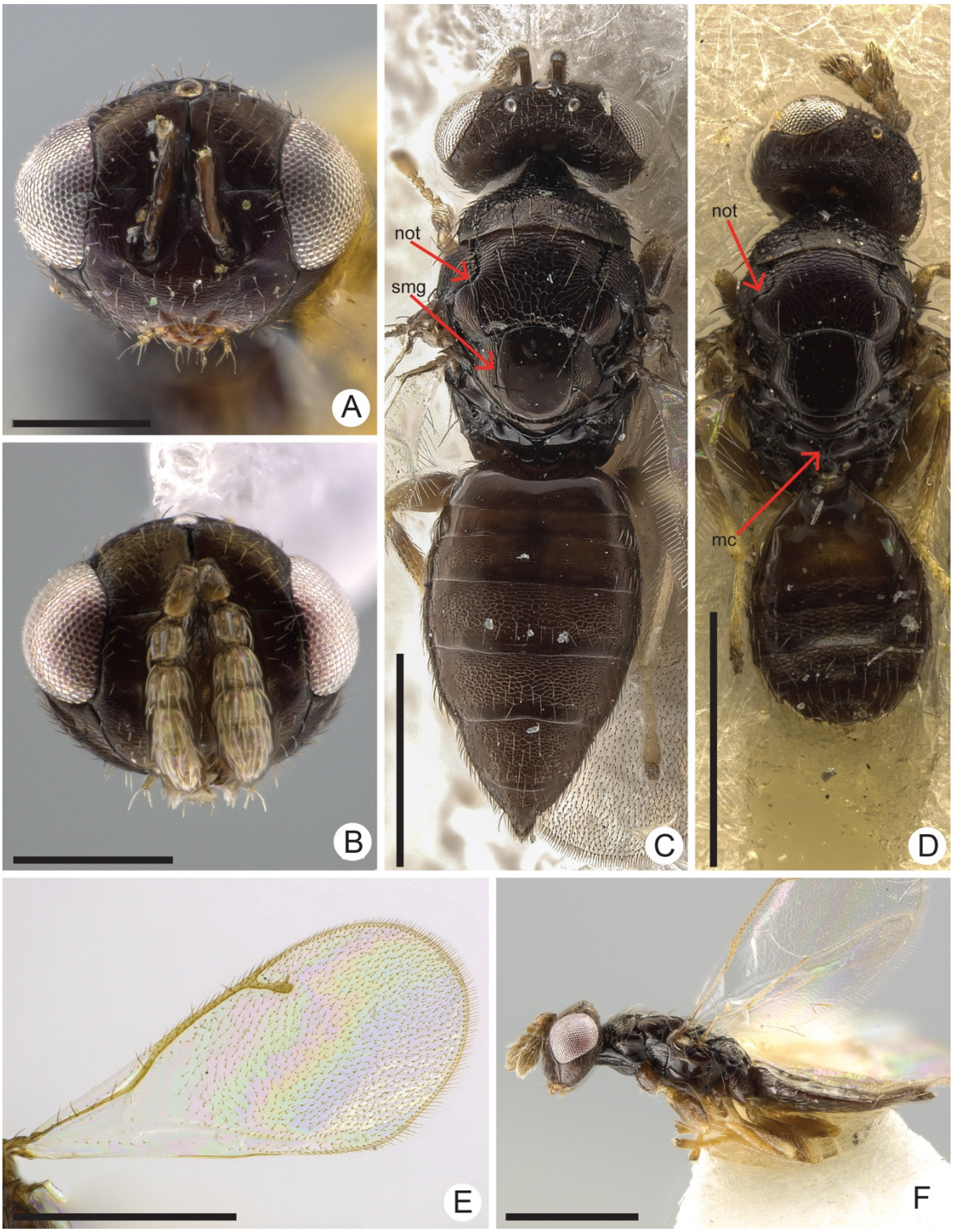

Fig. 3.42. *Pseudiglyphus grotiusi:* (A–B) head; (C–D) dorsal aspect: (C) ♀, (D) ♂; (E) fore wing; (F) lateral aspect. Scale bar: A–B = 0.2mm; C–F = 0.5mm.

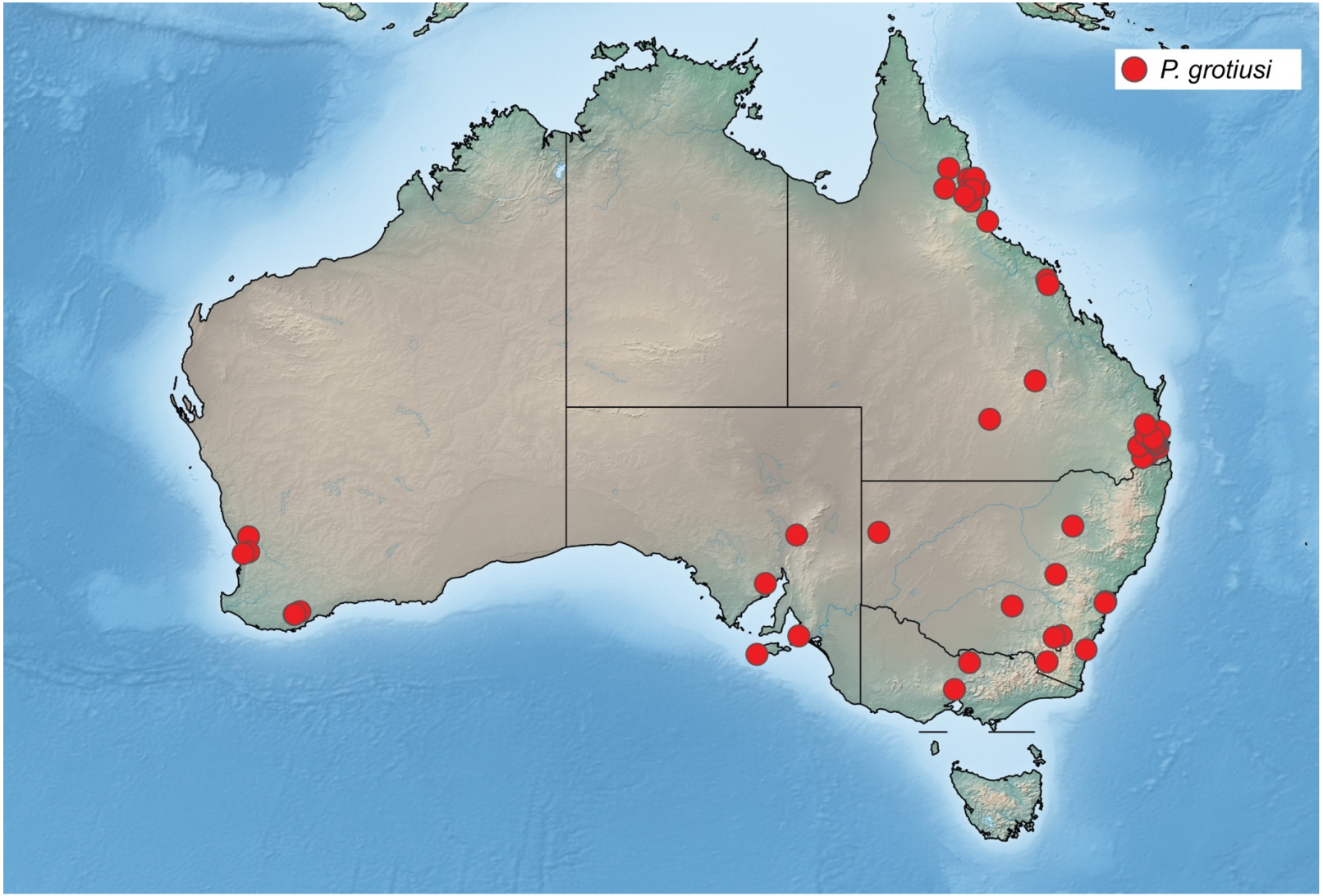

Fig. 3.43. Distribution of *Pseudiglyphus.*

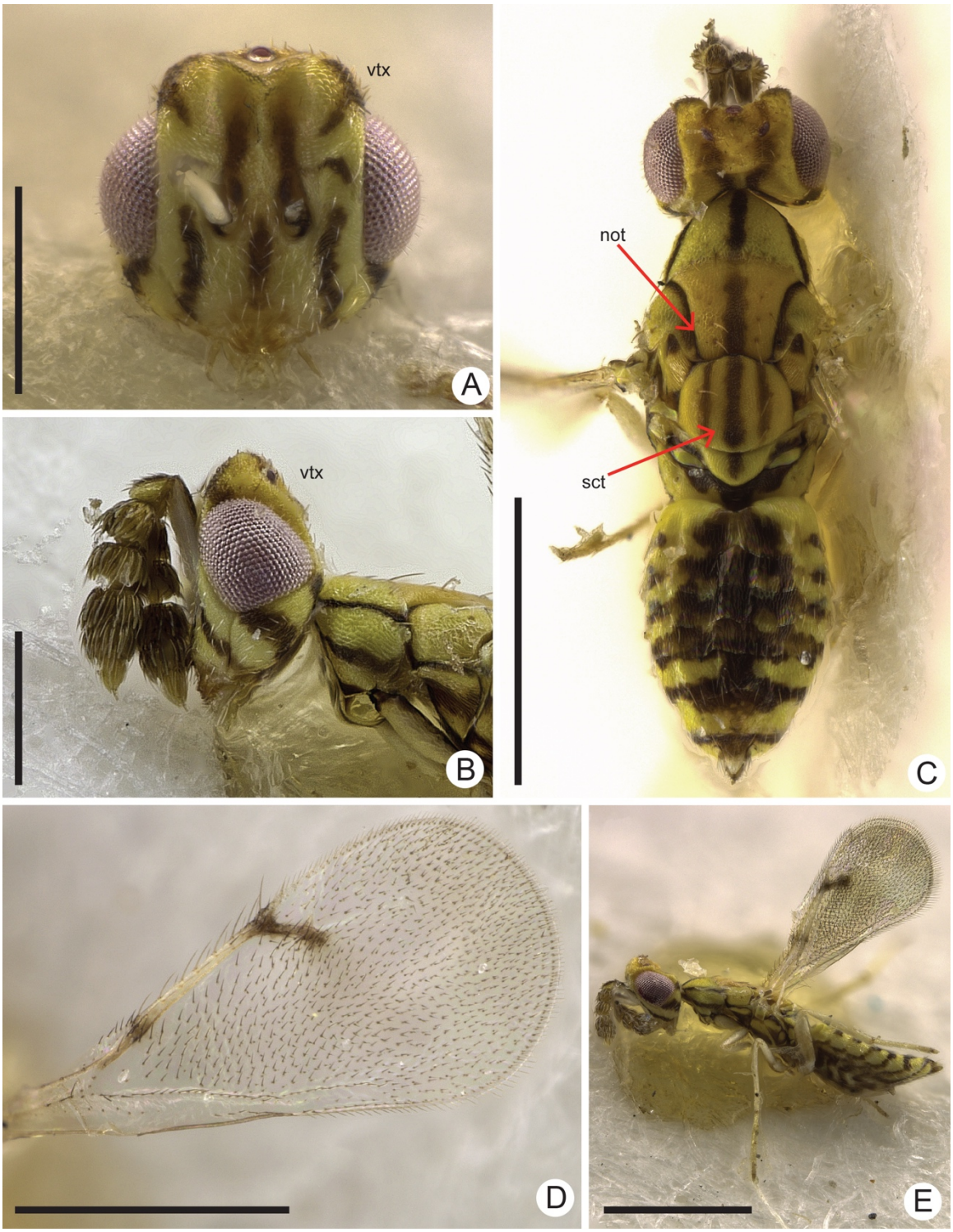

Fig. 3.44. *Pseudozagramma coachellae*: (A–B) head: (A) frontal aspect, (B) lateral aspect; (C) dorsal aspect; (D) fore wing; (E) habitus lateral. Scale bar: A–B = 0.2mm; C–E = 0.5mm.

Fig. 3.45. Distribution of *Pseudozagramma coachellae.*

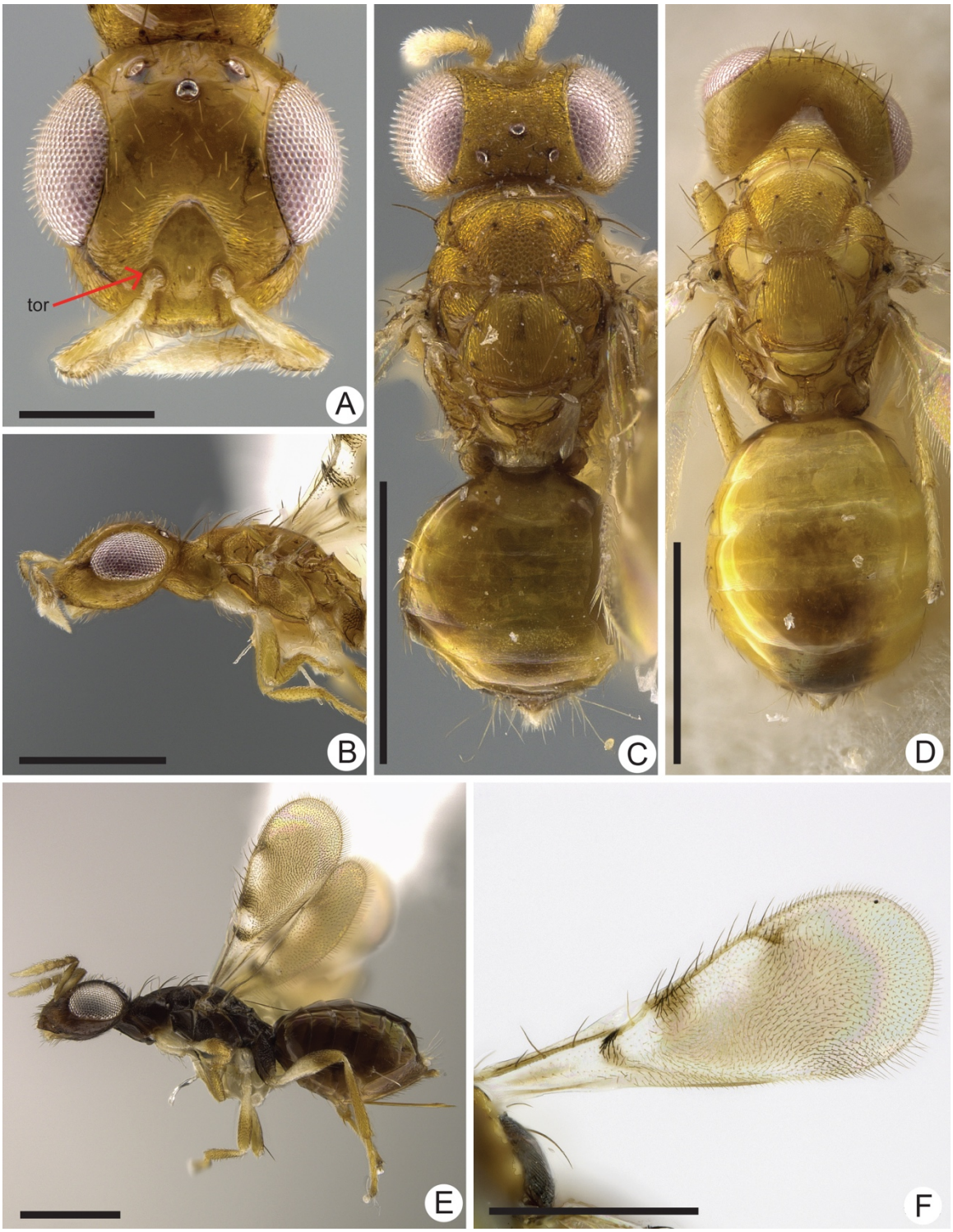

Fig. 3.46. *Trichospilus:* (A) head: *T. pupivorus;* (B) head and mesosoma lateral aspect: *T. pupivorus;* (C–D) dorsal aspect: (C) *T. striatus*, (D) *T. diatraeae;* (E) habitus lateral: *T. vorax*; (F) fore wing: *T. vorax*. Scale bar: A = 0.2mm; B–F = 0.5mm.

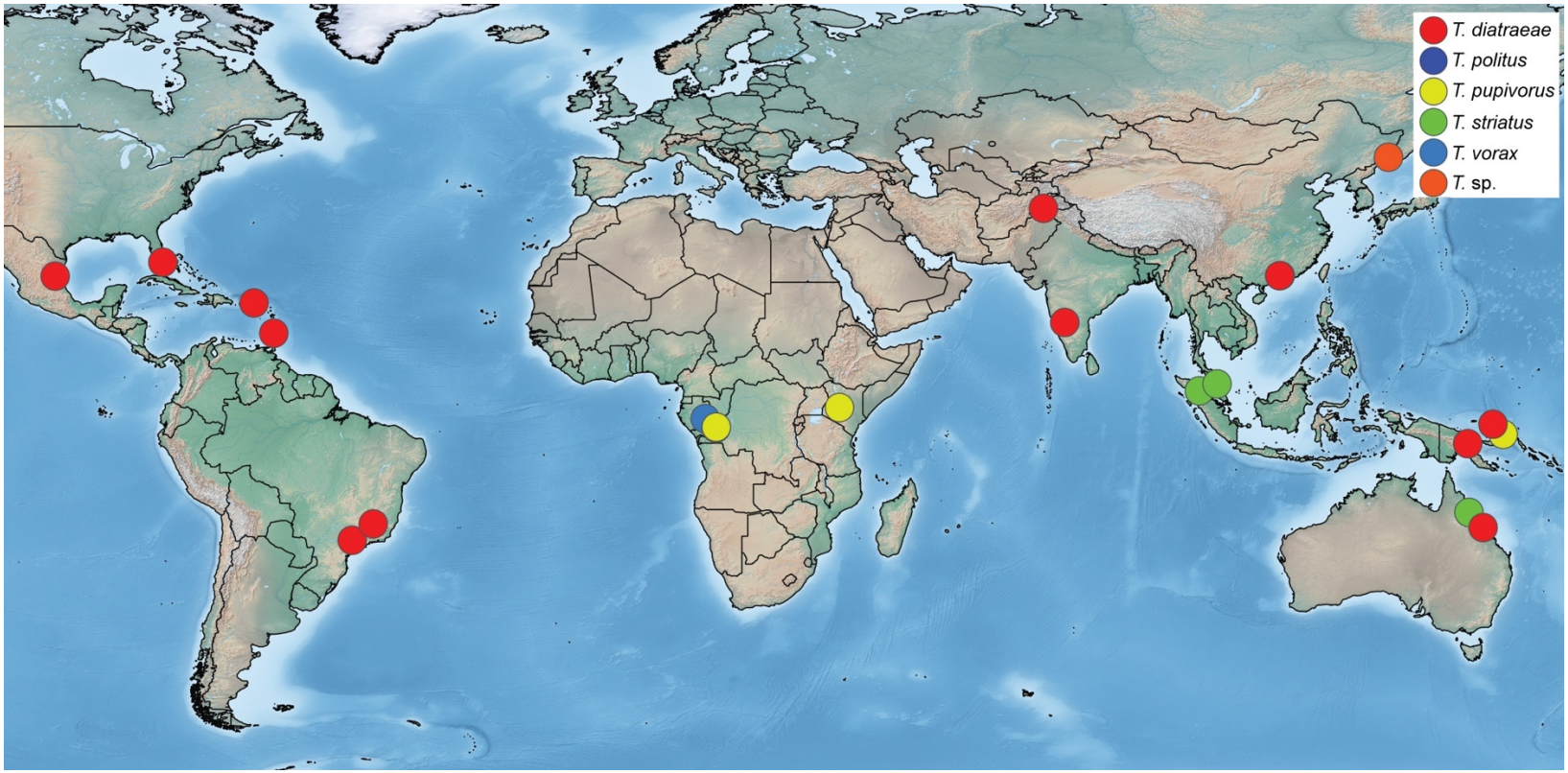

Fig. 3.47. Distribution of *Trichospilus.*

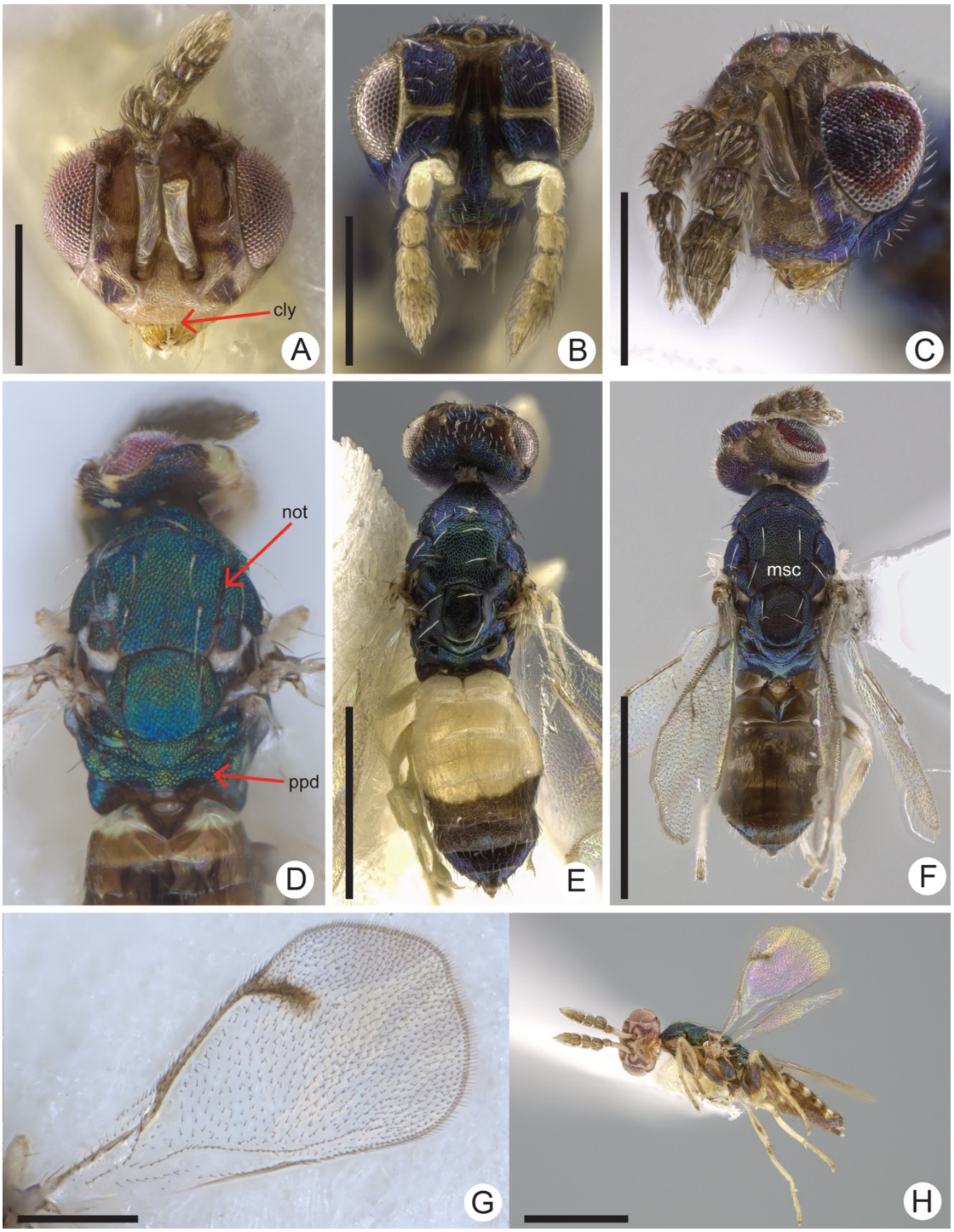

Fig. 3.48. *Vagus:* (A–C) head: (A) *V. ambiguus,* (B) *V*. nr. *ambiguus* UCRCENT241937, (C) *V*. nr. *ambiguus* D3868; (D) mesosoma: *V. ambiguus* holotype; (E–F) dorsal aspect: (E) *V*. nr. *ambiguus* UCRCENT241937, (F) *V*. nr. *ambiguus* D3868; (G) fore wing: *V. ambiguus* holotype; (H) habitus lateral: *V. ambiguus*. Scale bar: A–C, G = 0.2mm. D = n/a, taken at BMNH, and scale bar not embedded; E–F, H = 0.5mm.

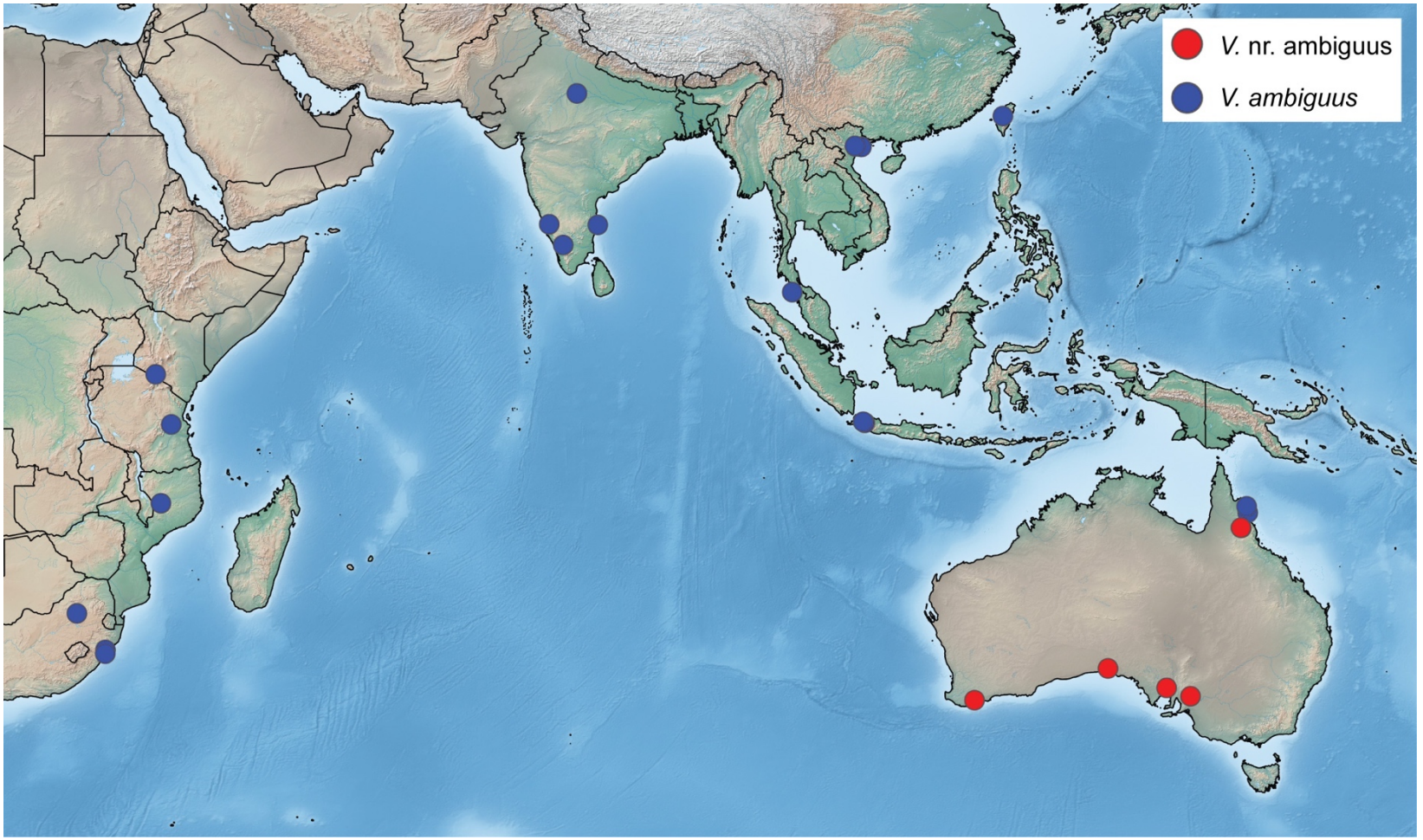

Fig. 3.49. Distribution of *Vagus.*

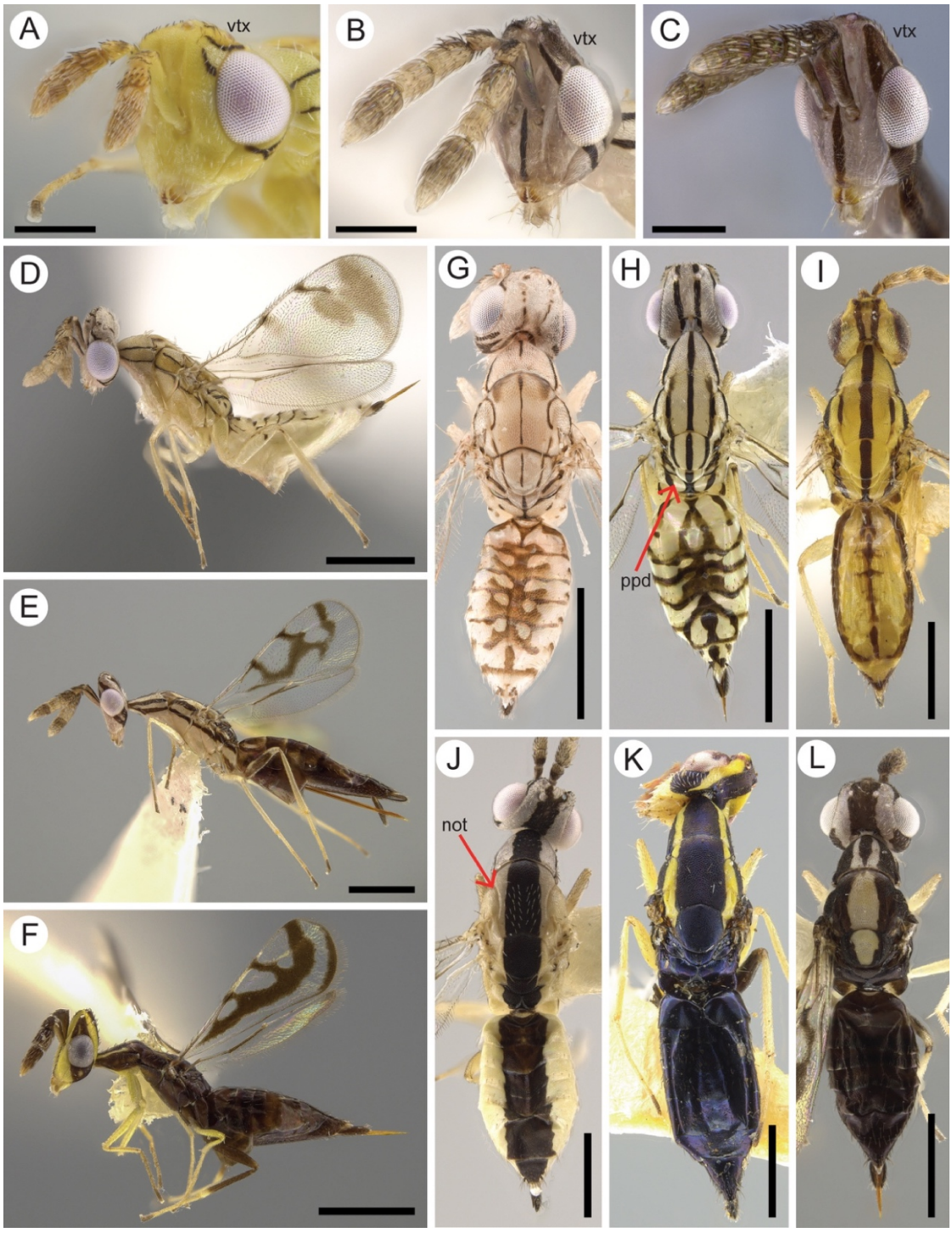

Fig. 3.50. *Zagrammosoma:* (A–C) head: (A) *Z. melinum*, (B) *Z. multilineatum*, (C) *Z. lineaticeps*; (D–F) habitus lateral: (D) *Z. americanum*, (E) *Z. trifurcatum*, (F) Z. lineaticeps; (G–L) lateral aspect: (G) *Z. americanum*, (H) *Z. multilineatum*, (I) *Z. seini*, (J) *Z. centrolineatum*, (K) *Z. metallicum*, (L) *Z. flavolineatum*. Scale bar: A–C = 0.2mm; D–L = 0.5mm.

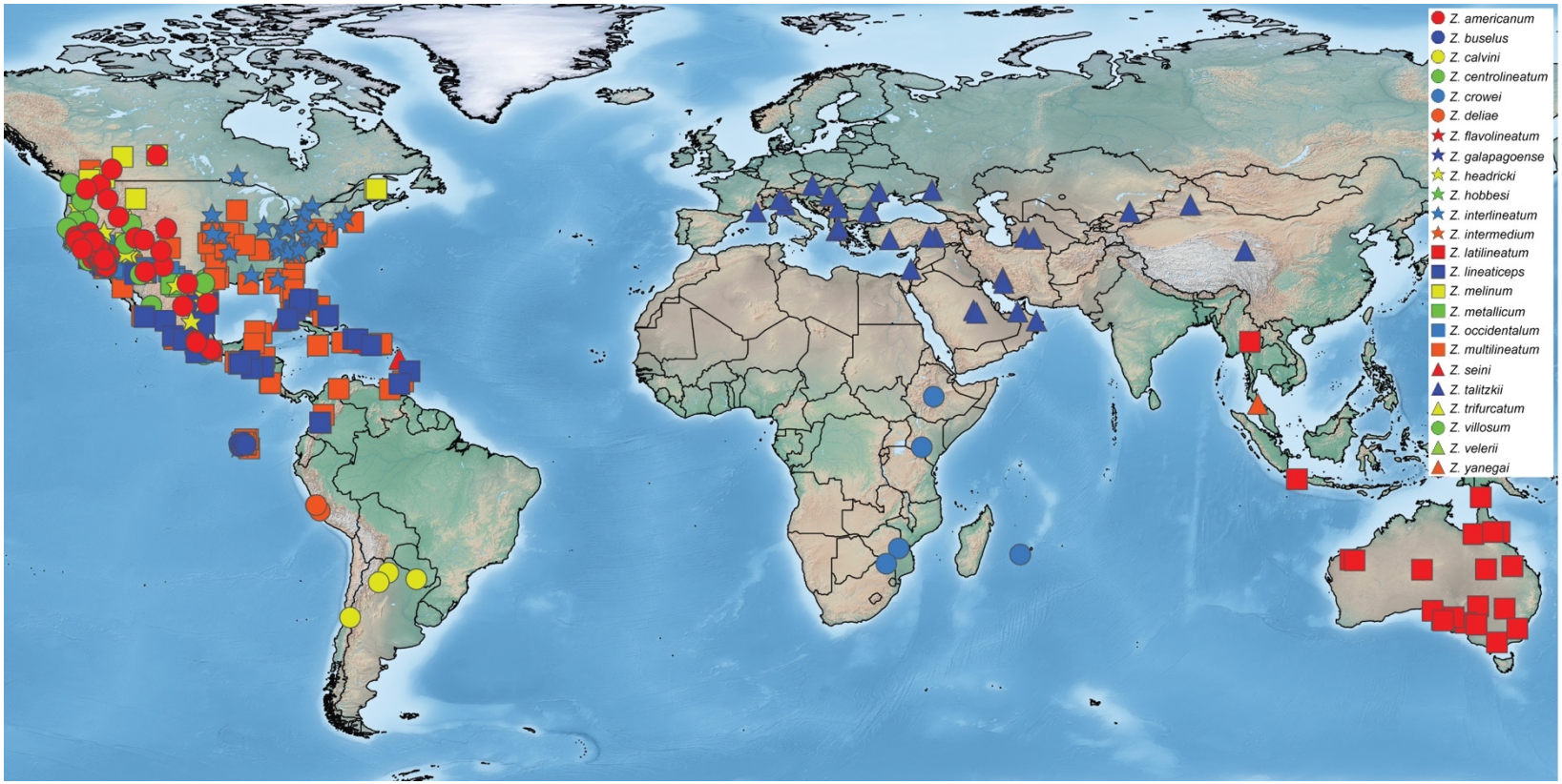

Fig. 3.51. Distribution of *Zagrammosoma.*

Table 3.1. Taxa used in the combined and molecular analyses. An "X" denotes sequences included in the analyses.

Taxon	D#	Locality	Morph	18S	D2	D3-5	ITS2	COI
Aprostocetus sp.	D0098	USA: California	–	X	X	X	–	–
Aprostocetus sp.	D3659	USA: California	X	–	X	X	–	X
Aprostocetus sp.	D3661	USA: California	X	–	X	X	–	–
Ascotolinx reticoxa	D6719	Australia	X	X	X	X	X	–
Ascotolinx reticoxa	D6720	Australia	X	–	X	X	X	–
Astichus mirrisimus	D0695	Australia	X	X	X	X	–	–
Atoposoma variegatus	D3753	USA: California	X	X	X	X	–	X
Atoposoma variegatus	D3664	USA: California	X	–	X	X	–	–
Atoposoma variegatus	D3667	USA: California	X	–	X	X	–	–
Atoposoma variegatus	D3669	USA: New Mexico	X	–	X	X	–	X
Aulogymnus acerinus	GenBank	Austria	X	–	X	–	–	–
Aulogymnus bouceki	D4571	Mexico	X	–	X	X	–	–
Aulogymnus california	D2129	USA: California	X	–	X	X	–	–
Aulogymnus gorditus	D4570	USA: Texas	X	–	X	X	–	X
Aulogymnus nr. california	D4572	Mexico	X	–	X	X	–	–
Aulogymnus sp.	D4983	Hungary	X	–	X	–	–	–
Aulogymnus sp.	D5973	Hungary	X	–	X	X	X	–
Aulogymnus sp.	D4690	South Korea	X	X	X	X	–	–
Aulogymnus sp.	D4691	South Korea	X	–	X	X	–	–
Aulogymnus sp.	D5961	Russia	X	–	X	X	–	X
Bellerus sp.	D2028	Chile	X	X	X	X	–	–
Bellerus sp.	D3743	Chile	X	–	X	X	–	X
Burkseus flavoviridis	D4679	USA: Arizona	X	–	X	X	X	X
Burkseus flavoviridis	D3791	USA: California	X	–	X	X	X	X
Burkseus flavoviridis	D4169	USA: California	X	–	X	X	X	–
Burkseus flavoviridis	D4171	USA: California	X	–	X	X	X	X
Burkseus flavoviridis	D4172	USA: California	X	–	X	X	X	–
Burkseus flavoviridis	D4175	USA: California	X	–	X	X	X	–
Burkseus flavoviridis	D4176	USA: California	X	X	X	X	X	X
Burkseus flavoviridis	D4683	Canada	X	–	X	X	–	–
Burkseus flavoviridis	D4682	USA: Utah	X	–	X	X	–	–
Burkseus nr. vittatus	D6703	South Africa	X	–	X	X	–	–
Burkseus nr. vittatus	D6704	South Africa	X	–	X	X	–	X
Burkseus robustus	D4580	USA: Arizona	X	–	X	X	X	X
Burkseus robustus	D4581	USA: Arizona	X	–	X	X	X	–
Burkseus robustus	D4680	USA: Arizona	X	–	X	X	X	X
Burkseus robustus	D4740	USA: California	X	–	X	X	–	X
Burkseus robustus	D5326	USA: California	X	–	X	X	–	–
Burkseus robustus	D6705	Chile	X	–	X	–	–	–
Burkseus robustus	D4591	Colombia	X	–	X	X	X	–
Burkseus robustus	D3674	USA: New Mexico	X	–	X	X	X	X
Burkseus robustus	D3675	USA: New Mexico	X	–	X	X	X	–
Burkseus sigillatus	D4738	USA: California	X	–	X	X	X	X
Burkseus vittatus	D3640	USA: California	X	–	X	X	X	X
Burkseus vittatus	D3665	USA: California	X	–	X	X	X	–
Burkseus vittatus	D3666	USA: California	X	–	X	X	–	–
Burkseus vittatus	D3993	USA: California	X	–	X	X	X	X
Burkseus vittatus	D4173	USA: California	X	–	X	X	X	–
Burkseus vittatus	D4177	USA: California	X	X	X	X	X	X
Burkseus vittatus	D5320	Canada	X	–	X	X	–	–
Burkseus vittatus	D4699	Swizterland	X	–	X	X	X	X
Burkseus vittatus	D5101	Hungary	X	–	X	X	X	–
Burkseus vittatus	D4559	United Kingdom	X	–	X	X	X	–
Burkseus vittatus	D5113	United Kingdom	X	–	X	X	X	–
Ceratogramma magnificum	D1220	Chile	–	X	X	X	–	–
Ceratogramma masneri	D1226	Costa Rica	–	X	X	X	–	–
Chrysocharis sp.	D3638	USA: California	X	–	X	X	–	X
Chrysocharis sp.	D3647	USA: California	X	–	X	X	–	X
Cirrospilus nr. *cinctithorax*	D3642	USA: California	X	–	X	X	–	X
Cirrospilus nr. *cinctithorax*	D4989	Guatemala	X	–	X	–	–	–
Cirrospilus petiolatus	D6717	Greece	X	X	X	X	X	–

Table 3.1 cont.

Taxon	D#	Locality	Morph	18S	D2	D3-5	ITS2	COI
Cirrospilus petiolatus	GenBank	Jordan	–	–	X	–	–	–
Cirrospilus silvicolus	D6715	Australia	X	–	X	X	X	–
Cirrospilus sp.	D3751	Argentina	X	–	X	X	–	–
Cirrospilus sp.	D3867	Australia	X	–	X	X	–	–
Cirrospilus sp.	D3998	Australia	X	X	X	X	–	X
Cirrospilus sp.	D4151	Australia	X	–	X	X	–	–
Cirrospilus sp.	D6722	Australia	X	–	X	X	X	–
Cirrospilus sp.	D3996	USA: California	X	–	X	X	–	–
Cirrospilus sp.	D3672	USA: New Mexico	X	X	X	X	–	–
Cirrospilus sp.	D3673	USA: New Mexico	X	–	X	X	–	–
Cirrospilus sp.	D3676	USA: New Mexico	X	–	X	X	–	–
Cirrospilus sp.	D3677	USA: New Mexico	X	–	X	X	–	–
Cirrospilus sp.	D4987	New Zealand	X	–	X	X	X	X
Cirrospilus sp.	D4995	Tunisia	X	–	X	X	X	X
Cirrospilus sp.	D6707	Hungary	X	–	X	X	–	X
Cirrospilus sp.	D5963	United Kingdom	X	–	X	X	X	X
Cirrospilus sp.	D5966	United Kingdom	X	X	X	X	X	–
Cirrospilus sp.	D5964	United Kingdom	X	–	X	X	X	X
Cirrospilus sp.	D5965	United Kingdom	X	–	X	X	X	X
Cirrospilus sp.	D5970	United Kingdom	X	–	X	X	X	X
Cirrospilus sp.	D6709	Costa Rica	X	–	X	X	X	X
Closterocerus utahensis	D3639	USA: California	X	–	X	X	–	X
Closterocerus utahensis	D3641	USA: California	X	–	X	X	–	X
Colpoclypeus florus	D2229	SWE	X	–	X	X	–	X
Dasyomphale chilensis	D2189	Chile	X	X	X	X	–	–
Diaulinopsis arenaria	D3862	India	X	X	X	X	–	–
Diaulinopsis arenaria	GenBank	Syria	–	–	X	–	–	–
Diaulinopsis sp.	D5976	USA: Texas	X	–	X	–	–	X
Dicladocerus westwoodi	D2171	Italy	X	–	X	X	–	–
Diglyphus begini	D3857	USA: Utah	X	–	X	X	X	–
Diglyphus begini	D3858	USA: Utah	X	–	X	X	X	–
Diglyphus isaea	D5957	Australia	X	–	X	–	–	–
Diglyphus isaea	D4678	United Kingdom	X	X	X	X	–	X
Diglyphus isaea	D5974	Hungary	X	–	X	X	X	X
Diglyphus isaea	D5967	Zimbabwe	X	–	X	–	–	–
Diglyphus websteri	D3682	USA: Texas	X	–	X	X	X	X
Elasmus polistis	D0137	USA: California	X	X	X	X	–	–
Epiclerus sp.	D0152	Sudan	–	X	X	X	–	–
Encarsia smithi	D0299	USA: Hawaii	–	X	X	X	–	–
Encarsia sophia	D0218	Ethiopia	–	X	X	X	–	–
Epiclerus sp.	D3729	Honduras	–	–	X	X	–	–
Epiclerus sp.	D1540	Italy	–	–	X	X	–	–
Euderus sp.	D0703	Australia	–	X	X	X	–	–
Eulophidae sp.	D6710	NZL	X	–	X	–	X	–
Eulophus sp.	D3644	USA: California	X	–	X	X	–	X
Eulophus sp.	D3646	USA: California	X	–	X	X	–	X
Eulophus sp.	D1619	Russia	–	X	X	X	–	–
Euplectrus sp.	D3788	Colombia	X	–	X	X	–	X
Foersterella reptans	D1558	Italy	–	X	X	X	–	–
Gallowayia picta	D6708	Australia	X	X	X	X	–	–
Gattonia basifura	D6718	Australia	X	–	X	–	–	–
Gattonia nigra	D4674	Australia	X	–	X	X	–	–
Gyrolasella coachellae	D3663	USA: California	X	–	X	X	–	–
Gyrolasella coachellae	D1647	USA: California	X	X	X	X	–	–
Gyrolasella coachellae	D3859	USA: Texas	X	–	X	X	–	X
Gyrolasella margiscutellum	D4662	Australia	X	–	X	X	–	–
Gyrolasella nr. *burkseus*	D3865	Australia	X	–	X	X	–	X
Gyrolasella nr. *burkseus*	D3866	Australia	X	X	X	X	X	X
Gyrolasella nr. *burkseus*	D4152	Australia	X	–	X	X	–	–
Gyrolasella nr. *burkseus*	D5103	Australia	X	–	X	X	X	–
Gyrolasella nr. *zagrammosoma*	D4673	Australia	X	–	X	X	–	–

Table 3.1 cont.

Taxon	D#	Locality	Morph	18S	D2	D3-5	ITS2	COI
Gyrolasella sp.	D3864	Australia	X	–	X	X	–	–
Gyrolasella sp.	D4153	Australia	X	–	X	X	–	–
Gyrolasella sp.	D4154	Australia	X	X	X	X	X	X
Gyrolasella sp.	D4697	Australia	X	–	X	X	–	–
Gyrolasella sp.	D4977	Australia	X	–	X	X	X	X
Gyrolasella sp.	D5100	Australia	X	X	X	X	X	X
Gyrolasella sp.	D5106	Australia	X	–	X	X	X	–
Gyrolasella sp.	D5109	Australia	X	–	X	X	X	–
Hadrotrichodes waukheon	D2585	USA: California	–	X	X	X	–	–
Heratya ambiguus	D3868	Australia	X	X	X	X	–	–
Hubbardiella sp.	D0806	Honduras	–	X	X	X	–	–
Melittobiopsis ereunetiphila	D4675	Papua New Guinea	X	–	X	X	–	–
Melittobiopsis ereunetiphila	D5314	Taiwan	X	–	X	X	–	–
Melittobiopsis ereunetiphila	D5315	Taiwan	X	X	X	X	–	X
Meruacesa sp.	D5331	Zimbabwe	X	X	X	X	–	X
Minotetrastichus nr. *platanellus*	D3995	USA: California	X	–	X	X	–	X
Naumanniola sp.	D3994	Australia	X	–	X	X	–	X
Naumanniola sp.	D4174	Australia	X	X	X	X	–	X
Naumanniola sp.	D5956	Australia	X	–	X	X	–	–
Naumanniola varians	D4671	Australia	X	–	X	X	–	X
Neochrysocharis formosa	D3844	USA: California	X	–	X	X	–	X
Neochrysocharis sp.	D3863	India	X	–	X	X	–	X
Neochrysocharis sp.	D5977	Italy	X	–	X	–	–	X
Neochrysocharis sp.	D3860	USA: Texas	–	–	X	X	–	X
Ophelimus maskelli	D4237	USA: California	X	–	X	X	–	X
Ophelimus maskelli	D1559	Italy	X	X	X	X	–	–
Paracrias pubicornis	D3787	Peru	X	–	X	X	–	X
Perditorulus sp.	D3678	USA: New Mexico	X	–	X	X	–	–
Pnigalio sp.	D1497	USA: California	X	X	X	X	–	–
Pnigalio sp.	D3643	USA: California	X	–	X	X	–	X
Pnigalio sp.	D3645	USA: California	X	–	X	X	–	X
Pseudiglyphus grotiusi	D4223	Australia	X	–	X	X	–	X
Pseudiglyphus grotiusi	D4225	Australia	X	X	X	X	–	X
Pseudiglyphus grotiusi	D4661	Australia	X	–	X	X	–	–
Selitrichodes neseri	D4209	USA: California	X	X	X	X	–	X
Sympiesis sp.	D3790	USA: California	X	–	X	X	–	X
Tetracampe sp.	D1629	Russia	–	X	X	X	–	–
Trichospilus sp.	D5333	Australia	X	X	X	X	–	–
Trichospilus sp.	D4978	China	X	X	X	–	–	–
Trichospilus sp.	D2108	Russia	–	–	X	X	–	–
Zagrammosoma americanum	D4116	USA: California	X	–	X	X	X	X
Zagrammosoma americanum	D4117	USA: California	X	–	X	X	–	X
Zagrammosoma americanum	D5937	USA: California	X	–	X	–	X	–
Zagrammosoma americanum	D5938	USA: California	X	–	X	–	–	–
Zagrammosoma americanum	D5909	Mexico	X	–	X	–	X	–
Zagrammosoma americanum	D3670	USA: New Mexico	X	–	X	X	X	X
Zagrammosoma americanum	D3671	USA: New Mexico	X	–	X	X	X	X
Zagrammosoma buselus	D4692	Ecuador	X	–	X	X	–	–
Zagrammosoma buselus	GenBank	Ecuador	X	–	X	–	–	–
Zagrammosoma calvini	D5939	Argentina	X	–	X	–	X	–
Zagrammosoma calvini	D5884	Chile	X	–	X	–	X	–
Zagrammosoma centrolineatum	D4112	USA: California	X	–	X	X	X	X
Zagrammosoma flavolineatum	D3668	USA: California	X	–	X	X	X	–
Zagrammosoma flavolineatum	D3840	USA: California	X	–	X	X	X	X
Zagrammosoma flavolineatum	D4111	USA: California	X	–	X	X	X	X
Zagrammosoma headricki	D4573	Mexico	X	–	X	X	X	–
Zagrammosoma headricki	D3861	USA: Texas	X	–	X	X	X	X
Zagrammosoma hobbesi	D3703	USA: California	X	–	X	X	X	X
Zagrammosoma hobbesi	D4000	USA: California	X	–	X	X	X	X
Zagrammosoma intermedium	D4115	USA: California	X	–	X	X	X	X
Zagrammosoma latilineatum	D4672	Australia	X	–	X	X	–	–

Table 3.1 cont.

Taxon	D#	Locality	Morph	18S	D2	D3-5	ITS2	COI
Zagrammosoma latilineatum	D5328	Australia	X	–	X	X	–	X
Zagrammosoma latilineatum	D5332	Australia	X	–	X	X	–	–
Zagrammosoma lineaticeps	D5934	Dominican Republic	X	–	X	–	X	–
Zagrammosoma melinum	D5896	USA: Alaska	X	–	X	–	X	–
Zagrammosoma melinum	D5895	Canada	X	–	X	–	X	–
Zagrammosoma melinum	D5916	USA: Montana	X	–	X	–	X	–
Zagrammosoma metallicum	D4569	USA: Texas	X	–	X	X	X	X
Zagrammosoma multilineatum	D4113	USA: California	X	X	X	X	X	X
Zagrammosoma multilineatum	D5329	Costa Rica	X	–	X	X	–	–
Zagrammosoma multilineatum	D4601	USA: Massachusetts	X	–	X	X	X	–
Zagrammosoma multilineatum	D5890	Bahamas	X	–	X	–	X	–
Zagrammosoma occidentale	D5932	USA: Arizona	X	–	X	–	X	–
Zagrammosoma occidentale	D0111	USA: California	X	X	X	X	–	–
Zagrammosoma occidentale	D3660	USA: California	X	–	X	X	X	–
Zagrammosoma occidentale	D4576	USA: California	X	–	X	X	X	–
Zagrammosoma occidentale	D4578	USA: California	X	–	X	X	X	–
Zagrammosoma talitzkii	D4739	China	X	–	X	X	–	X
Zagrammosoma talitzkii	D4545	Israel	X	–	X	X	X	X
Zagrammosoma talitzkii	D4546	Israel	X	–	X	X	X	X
Zagrammosoma trifurcatum	D4592	USA: California	X	–	X	X	X	X
Zagrammosoma trifurcatum	D4600	USA: California	X	–	X	X	X	X
Zagrammosoma velerii	D4685	Bahamas	X	–	X	X	–	X
Zagrammosoma villosum	D5935	USA: Arizona	X	–	X	–	X	–
Zagrammosoma villosum	D3679	USA: Texas	X	–	X	X	X	X
Zagrammosoma villosum	D3681	USA: Texas	X	–	X	X	X	X

Table 3.2. Primers used in the analyses with references.

Gene	Primer	Sequence	References
18S	18SF	5'-AAA TTA CCC CAC TCC CGG CA-3'	Heraty *et al.* 2011 (called 18S-441 F)
	18SR	5'-TGG TGA GGT TTC CCG TGT T-3'	Heraty *et al.* 2011 (called 18S-1299 RF)
28S D2	D2 F	5'-CGG GTT GCT TGA GAG TGC AGC-3'	Campbell *et al.*, 2000; Murray *et al.*, 2013
	D2Ra	5'-CTC CTT GGT TCC GTG TTT C-3'	Campbell *et al.*, 2000; Murray *et al.*, 2013
28S D3-5	D3Fa	5'-TTG AAA CAC GGA CCA AGG AG-3'	Nunn *et al* ., 1996; Murray *et al.*, 2013
	D5Ra	5'-CGC CAG TTC TGC TTA CCA-3'	Nunn *et al* ., 1996; Murray *et al.*, 2013
ITS2	ITS2F	5'-TGT GAA CTG CAG GAC ACA TG-3'	Campbell *et al.*, 2000; Ciociola et al., 2001
	ITS2R2	5'-TCT CGC CTG CTC TGA GGT-3'	Polihronakis, 2009; Hill & O'Malley, 2010
COI	NJ F	5'-TAT ATT TTA ATY TWC CWG GAT TTG G-3'	Simon *et al.,* 1994; Murray *et al.*, 2013
	MD R	5'-ATT GCA AAT ACT GCA CCT AT-3'	Dowton & Austin, 1997; Murray *et al.*, 2013

Table 3.3. Morphological matrix of all specimens used in the combined analysis.

Taxon	D#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
		Character Number																																															
Aprostocetus sp.	D3659	1	0	0	0	1	0	0	1	0	0	1	0	?	1	?	?	1	?	1	1	1	6	2	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1
Aprostocetus sp.	D3661	1	0	0	?	1	0	0	1	0	0	1	0	0	?	1	0	?	1	1	1	1	6	2	1	1	1	2	0	0	1	1	1	0	0	0	0	0	0	0	1	1	2	0	0	1	0	0	1
Ascotolinx reticoxa	D6719	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	3	1	2	2	0	1	1	0	0	0	1	1	0	0	0	0	0	1	1	1	1	1	0	0	1	1	0	0
Ascotolinx reticoxa	D6720	1	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	3	1	2	2	0	1	2	0	0	0	1	1	0	0	0	0	0	1	1	1	1	1	0	0	1	1	0	0
Astichus mirrisimus	D0695	1	0	3	0	2	0	0	1	0	0	1	0	?	2	?	?	0	?	1	1	3	6	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	2	0	0	1	2	1	0
Atoposoma variegatum	D3664	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	2	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	1
Atoposoma variegatum	D3667	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	2	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	1
Atoposoma variegatum	D3753	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	2	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	1
Atoposoma variegatum	D3669	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	2	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	1
Aulogymnus bouceki	D4571	1	1	2	1	1	0	0	1	0	0	1	1	0	1	?	0	0	?	1	1	1	5	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	2	2	0	1	2	1	0
Aulogymnus california	D2129	1	1	?	1	1	0	0	1	0	0	1	1	0	0	1	0	1	0	1	1	1	5	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	2	2	0	1	2	0	1
Aulogymnus gorditus	D4570	1	1	2	1	1	0	0	1	0	0	1	0	0	0	?	0	1	?	1	1	3	5	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	1	2	2	1	1	2	1	1
Aulogymnus nr. california	D4572	1	1	2	1	1	0	1	1	0	0	1	1	0	0	?	0	1	?	1	1	1	5	1	0	0	1	2	0	0	1	0	0	0	0	0	0	1	0	1	1	1	2	2	0	1	2	0	1
Aulogymnus sp.	D4983	1	1	2	0	1	0	0	1	0	0	1	1	0	1	?	0	0	?	1	1	1	5	1	0	0	1	1	0	0	1	3	0	0	0	0	0	1	0	1	1	1	2	2	0	1	2	1	0
Aulogymnus sp.	D5973	1	1	2	0	2	0	0	1	0	0	1	1	0	1	?	0	0	?	1	1	1	5	1	0	0	1	?	0	0	1	3	0	0	0	0	0	1	0	1	0	0	2	2	0	1	2	1	0
Aulogymnus sp.	D4690	1	1	2	0	1	0	0	1	0	0	1	0	0	1	?	0	0	?	1	1	1	5	1	0	0	1	1	0	0	1	3	0	0	0	0	0	1	0	1	1	1	2	2	0	1	2	1	1
Aulogymnus sp.	D4691	1	1	2	0	1	0	0	1	0	0	1	0	0	1	?	0	0	?	1	1	1	5	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	2	2	0	1	2	1	1
Aulogymnus sp.	D5961	1	1	2	0	1	0	0	1	0	0	1	0	0	1	?	0	0	?	1	1	1	5	1	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	2	2	0	1	2	1	1
Bellerus sp.	D2028	1	0	3	0	0	0	0	1	0	0	1	2	?	3	?	?	0	?	1	1	1	5	1	0	0	1	1	0	0	0	1	1	0	0	0	0	1	0	0	1	1	1	0	0	1	3	1	0
Bellerus sp.	D3743	1	0	3	0	0	0	0	1	0	0	1	2	?	3	?	?	0	?	1	1	1	5	1	0	0	1	1	0	0	0	1	1	0	0	0	0	1	0	0	1	1	1	0	0	1	3	1	0
Burkseus flavoviridis	D4679	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D3791	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D4169	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D4171	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D4172	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D4175	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D4176	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D4683	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus flavoviridis	D4682	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	3	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus nr. *vittatus*	D6703	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus nr. *vittatus*	D6704	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus robustus	D4580	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus robustus	D4581	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus robustus	D4680	1	0	0	1	2	0	1	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus robustus	D4740	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus robustus	D5326	1	0	0	1	2	0	1	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus robustus	D6705	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus robustus	D4591	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	1	1	2	1	0	0	0	1	1	1
Burkseus robustus	D3674	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus robustus	D3675	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	0	1	1	1
Burkseus sigillatus	D4738	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	1	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D3640	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D3665	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	0	1

Table 3.3. cont.

Taxon	D#	Character Number																																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Burkseus vittatus	D3666	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	0	1
Burkseus vittatus	D3993	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D4173	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D4177	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D5320	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D4699	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D5101	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D4559	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Burkseus vittatus	D5113	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	0	0	1	1	1	1
Chrysocharis sp.	D3638	1	0	0	0	0	0	0	1	0	0	1	0	?	1	?	?	0	?	1	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	1	2	1	0
Chrysocharis sp.	D3647	1	0	0	0	0	0	0	1	0	0	1	0	?	1	?	?	0	?	1	1	1	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	1	2	1	0
Cirrospilus nr. *cinctithorax*	D3642	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	1	0	0	0	0	1	1	1	0	0	1	1	0	1	1	1	1
Cirrospilus nr. *cinctithorax*	D4989	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	1	0	0	0	0	1	1	1	0	0	1	1	0	1	1	1	1
Cirrospilus petiolatus	D6717	1	1	0	2	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	0	1	0	1	1	0	0	0	1	3	0	0	1	1	0	0	0	1	1	1	0	0	1	1	0	0
Cirrospilus silvicolus	D6715	1	1	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	0	1	0	1	1	0	0	0	1	1	0	0	1	1	0	0	0	1	1	1	0	0	1	1	0	0
Cirrospilus sp.	D6709	1	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	0	1	0	1	3	0	0	0	1	1	0	0	1	1	0	2	1	1	1	1	1	0	1	2	0	1
Cirrospilus sp.	D3751	1	0	0	1	1	0	1	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	0	1	1	0	1	1	0	1	1	1	0
Cirrospilus sp.	D3867	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Cirrospilus sp.	D3998	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Cirrospilus sp.	D4151	1	0	0	1	1	0	0	1	0	0	1	2	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	2	1	1	1	0	0
Cirrospilus sp.	D6722	1	0	0	1	2	0	1	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	0	1	1	0	0	0	0	1	0	0	1	1	1	0	0	1	2	0	1
Cirrospilus sp.	D3996	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	1	1	0	1	1	0	0
Cirrospilus sp.	D6707	1	0	0	0	1	0	0	1	0	0	1	2	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	0	1	3	0	0	0	0	1	0	0	1	1	1	1	0	1	2	0	1
Cirrospilus sp.	D3672	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	1	0
Cirrospilus sp.	D3673	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	1	0
Cirrospilus sp.	D3676	1	0	?	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	1	1	0	1	1	0	0
Cirrospilus sp.	D3677	1	0	?	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	0	1	0	0	1	1	0	1	1	0	0
Cirrospilus sp.	D4987	1	0	0	1	2	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Cirrospilus sp.	D4995	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	1	1	1	1	1
Cirrospilus sp.	D5963	1	0	0	2	0	0	0	1	0	0	1	2	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	1	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	1
Cirrospilus sp.	D5964	1	0	0	2	2	0	0	1	0	0	1	2	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	0	1
Cirrospilus sp.	D5965	1	0	0	0	0	0	1	1	0	0	1	2	0	0	0	0	1	1	1	1	1	5	1	1	0	1	2	0	0	0	1	0	0	0	0	0	1	0	0	1	1	1	1	1	1	2	0	1
Cirrospilus sp.	D5966	1	0	0	0	2	0	0	1	0	0	1	2	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	0	1	3	0	0	0	0	1	0	0	1	1	1	0	1	1	2	0	1
Cirrospilus sp.	D5970	1	0	0	0	0	0	1	1	0	0	1	2	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	0	1	0	0	0	0	0	1	2	0	1	1	1	1	1	1	1	1	1
Closterocerus utahensis	D3639	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	2	1	0	0	0	1	0
Closterocerus utahensis	D3641	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	2	1	0	0	0	1	0
Colpoclypeus florus	D2229	1	0	2	0	1	0	1	1	0	0	0	0	0	0	1	0	1	0	1	1	3	3	2	0	0	1	1	0	0	0	1	1	0	0	0	0	1	2	0	1	1	0	0	1	1	2	1	0
Dasyomphale chilensis	D2189	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	0	2	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	2	2	1	1	3	1	0
Diaulinopsis arenaria	D3862	1	0	0	1	1	0	0	1	0	0	1	0	1	0	0	0	1	1	1	1	1	5	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	3	1	0
Diaulinopsis sp.	D5976	1	0	0	1	1	0	0	1	0	0	1	2	1	0	0	0	1	1	1	1	1	5	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	3	1	0
Dichatomus acerinus	GenBank	1	1	0	0	0	0	0	1	0	0	1	0	0	1	1	0	0	0	1	1	3	5	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	1	1	1	0	0	1	3	1	0
Dicladocerus westwoodi	D2171	1	0	0	0	1	0	0	1	0	0	1	0	0	1	2	2	1	0	1	1	3	1	2	0	0	1	2	0	0	0	1	1	0	0	0	0	1	0	0	1	1	1	1	0	1	3	1	0
Diglyphus begini	D3857	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	3	1	0

Table 3.3. cont.

		Character Number																																													
Taxon	**D#**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
Diglyphus begini	D3858	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	3	1	0
Diglyphus isaea	D5957	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	1	1	1	1	1	0
Diglyphus isaea	D4678	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	1	1	1	1	1	0
Diglyphus isaea	D5974	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	1	1	1	1	1	0
Diglyphus isaea	D5967	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	2	1	1	1	1	1	1	0
Diglyphus websteri	D3682	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	1	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	2	1	0
Elasmus polistis	D0137	0	0	0	0	0	0	0	1	0	1	1	0	0	1	2	2	1	0	0	1	1	1	2	0	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	1	1	3	0	1
Eulophidae sp.	D6710	1	0	0	0	0	0	1	1	0	0	1	1	?	2	?	?	0	?	0	0	1	3	1	2	0	1	?	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	1	0	1	3	1	0
Eulophus sp.	D3644	1	0	0	0	1	0	1	1	0	0	1	0	?	2	?	?	0	?	0	0	3	0	1	0	0	1	3	0	0	0	1	3	0	0	0	0	0	2	0	1	1	1	0	0	1	3	1	0
Eulophus sp.	D3646	1	0	0	0	1	0	0	1	0	0	1	0	?	2	?	?	0	?	0	0	3	0	1	0	0	1	?	0	0	0	1	3	0	0	0	0	0	2	0	1	1	0	0	0	1	3	1	0
Euplectrus sp.	D3788	1	0	0	0	0	0	0	0	0	0	0	2	1	?	2	0	?	0	0	0	1	5	0	0	0	1	?	0	0	0	1	1	0	0	1	0	0	0	0	1	1	1	0	0	1	2	0	0
Gallowayia picta	D6708	1	0	0	1	1	0	1	1	1	0	1	2	0	0	1	1	1	0	1	1	1	4	1	2	0	1	3	0	0	0	1	2	0	1	1	1	0	1	1	1	1	1	0	0	1	1	1	1
Gattonia basifura	D6718	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	0	1	0	1	3	0	0	0	1	1	0	0	0	0	0	1	0	1	1	1	0	0	1	1	0	0
Gattonia nigra	D4674	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	1	2	2	0	1	0	1	?	0	0	0	1	1	0	0	0	0	0	1	0	1	1	1	0	0	1	1	0	0
Gyrolasella margiscutellum	D4662	1	0	0	2	2	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	3	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	2	1	1	0	1	1	1	1
Gyrolasella nr. *burkseus*	D3865	1	0	0	2	1	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	3	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1
Gyrolasella nr. *burkseus*	D3866	1	0	0	2	1	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	3	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1
Gyrolasella nr. *burkseus*	D4152	1	0	0	?	1	0	0	1	0	0	1	?	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	2	1	1
Gyrolasella nr. *burkseus*	D5103	1	?	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	3	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1
Gyrolasella nr. *zagrammosoma*	D4673	1	0	0	2	1	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	1	0	1	0	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	1	1
Gyrolasella sp.	D3864	1	0	0	?	?	0	0	1	0	0	1	?	0	0	0	0	1	1	1	1	3	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	1	1
Gyrolasella sp.	D4153	1	0	0	2	?	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	3	5	1	1	0	1	1	?	0	1	0	0	0	0	0	0	?	0	0	1	1	1	0	0	1	1	1	1
Gyrolasella sp.	D4154	1	0	0	1	1	?	1	1	0	0	1	?	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	2	1	1
Gyrolasella sp.	D4697	1	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	0	0	1	2	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	2	0	1	2	1	1
Gyrolasella sp.	D4977	1	0	0	2	1	0	1	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	1
Gyrolasella sp.	D5100	1	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	0	0	1	?	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	2	0	1	1	1	1
Gyrolasella sp.	D5106	1	0	0	2	1	0	1	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	1
Gyrolasella sp.	D5109	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	5	1	1	0	1	?	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1	1
Hadrotrichodes waukheon	D2585	1	0	0	0	1	0	0	1	0	1	1	0	?	1	?	?	1	?	1	1	1	6	1	1	1	1	3	0	0	0	1	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0
Melittobiopsis ereunetiphila	D4675	1	0	0	0	1	0	1	1	0	0	2	0	0	0	0	0	1	1	1	0	1	6	2	0	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0
Melittobiopsis ereunetiphila	D5314	1	0	0	0	1	0	1	1	0	0	2	0	0	0	0	0	1	1	1	0	1	6	2	0	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0
Melittobiopsis ereunetiphila	D5315	1	0	0	0	1	0	1	1	0	0	2	0	0	0	0	0	1	1	1	0	1	6	2	0	0	1	3	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0
Meruacesa cuprata	D5331	1	0	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	2	1	1	0	1	1	0	0	0	1	1	0	0	1	1	0	0	0	1	1	1	0	1	1	1	1	0
Minotetrastichus nr. platanellus	D3995	1	0	0	0	1	0	0	1	0	0	1	0	?	1	?	?	1	?	1	1	1	6	2	1	1	1	2	0	0	0	2	0	0	0	0	0	0	0	0	1	1	2	0	1	1	0	1	1
Naumanniola sp.	D3994	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	1	0	0	1	1	2	1	2	1	0	1	3	0	0	0	1	0	0	1	0	0	0	1	0	1	1	1	0	0	1	1	1	0
Naumanniola sp.	D4174	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	1	0	0	1	1	2	1	2	1	0	1	3	0	0	0	1	0	0	1	0	0	0	1	0	1	1	1	0	0	1	1	1	0
Naumanniola sp.	D5956	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	1	0	0	1	1	2	1	2	1	0	1	?	0	0	0	1	0	0	1	0	0	0	1	0	1	1	1	0	0	1	1	1	0
Naumanniola varians	D4671	1	0	0	1	1	0	1	1	0	1	1	1	0	1	1	1	0	0	1	1	2	1	1	2	0	1	3	0	0	0	1	1	0	1	0	0	0	1	1	1	1	1	0	0	1	2	1	1
Neochrysocharis formosa	D3844	1	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	1	1	1	1	3	6	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	2	1	0	1	2	1	0
Neochrysocharis sp.	D3863	1	0	0	0	1	0	0	1	0	0	1	0	?	1	?	?	1	?	1	1	3	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	2	1	0	1	2	1	0
Neochrysocharis sp.	D5977	1	0	0	0	1	0	0	1	0	0	1	0	?	0	?	?	1	?	1	1	3	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	2	1	0	0	1	1	0
Neochrysocharis sp.	D3860	1	0	0	0	1	0	0	1	0	0	1	0	0	?	0	0	?	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0	1	1	1	0
Ophelimus maskelli	D4237	1	0	0	0	2	0	0	1	0	0	1	0	0	4	4	0	1	1	1	1	1	5	1	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	0

Table 3.3. cont.

		Character Number																																													
Taxon	**D#**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
Ophelimus maskelli	D1559	1	0	0	0	2	0	0	1	0	0	1	0	0	4	4	0	1	1	1	1	1	5	1	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	3	0	0
Oxycantha darwini	Paratype	1	0	0	1	1	0	1	1	0	0	1	2	0	0	0	0	1	1	1	1	1	1	1	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1
Paracrias pubicornis	D3787	1	0	0	1	0	0	0	1	0	1	1	0	0	?	2	0	?	0	?	?	3	2	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0
Perditorulus sp.	D3678	1	0	0	0	1	0	0	1	0	0	1	0	?	1	?	?	0	?	1	1	1	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	2	1	0	0	1	0	0
Pnigalio sp.	D1497	?	?	?	?	?	?	?	?	?	?	?	?	0	?	?	2	?	?	0	0	2	0	1	0	0	1	?	0	0	0	1	1	1	0	0	0	?	0	0	1	1	0	0	0	1	3	1	0
Pnigalio sp.	D3643	1	0	0	0	2	0	1	1	0	0	1	0	0	2	?	2	0	?	0	0	2	0	2	0	0	1	1	0	0	0	1	1	1	0	0	0	0	0	0	1	1	0	1	0	1	3	1	0
Pnigalio sp.	D3645	1	0	0	0	1	0	1	1	0	0	1	0	0	2	?	2	0	?	0	0	0	0	1	2	0	1	3	0	0	0	1	1	1	0	0	0	0	0	0	1	1	0	0	0	1	3	1	0
Pseudiglyphus grotiusi	D4223	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Pseudiglyphus grotiusi	D4225	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Pseudiglyphus grotiusi	D4661	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Pseudozagramma cinctithorax	D3879	1	0	0	1	1	0	0	1	0	0	1	1	0	0	0	0	1	1	1	1	1	5	1	1	0	1	1	0	0	0	1	3	0	0	0	0	1	0	0	1	1	?	0	0	1	1	1	1
Pseudozagramma coachellae	D3663	1	0	0	2	1	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	6	2	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	1
Pseudozagramma coachellae	D1647	1	0	0	2	1	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	6	2	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	1
Pseudozagramma coachellae	D3859	1	0	0	2	1	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	6	2	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	1
Selitrichodes neseri	D4209	1	0	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	1	1	1	1	6	2	1	1	1	2	0	0	1	1	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0
Sympiesis sp.	D3790	1	0	0	0	2	0	0	1	0	0	1	1	0	?	2	1	?	0	0	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	3	1	0
Trichospilus sp.	D5333	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	5	1	0	0	1	1	0	0	0	1	1	0	0	1	0	0	1	1	1	1	1	0	0	1	1	0	1
Trichospilus sp.	D4978	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	5	1	0	0	1	1	0	0	0	1	1	0	0	1	0	0	1	1	1	1	1	0	0	1	1	0	1
Vagus nr. *ambiguus*	D3868	1	0	0	1	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	3	3	2	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	2	1	1
Zagrammosoma americanum	D4116	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma americanum	D4117	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma americanum	D5937	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma americanum	D5938	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma americanum	D5909	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma americanum	D3670	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma americanum	D3671	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma buselus	D4692	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma buselus	Genbank	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	?	0	1	1	0	1
Zagrammosoma calvini	D5939	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma calvini	D5884	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma centrolineatum	D4112	1	0	0	0	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma flavolineatum	D3668	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	1
Zagrammosoma flavolineatum	D3840	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma flavolineatum	D4111	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma headricki	D4573	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma headricki	D3861	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma hobbesi	D3703	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma hobbesi	D4000	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma intermedium	D4115	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma latilineatum	D4672	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma latilineatum	D5328	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma latilineatum	D5332	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma lineaticeps	D5934	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	0	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1

Table 3.3. cont.

Taxon	D#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
		Character Number																																															
Zagrammosoma melinum	D5896	1	0	0	2	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma melinum	D5895	1	0	0	2	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma melinum	D5916	1	0	0	2	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma metallicum	D4569	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	1
Zagrammosoma multilineatum	D5890	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	0	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma multilineatum	D4113	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma multilineatum	D5329	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	0	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma multilineatum	D4601	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	0	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma occidentale	D5932	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma occidentale	D0111	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma occidentale	D3660	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma occidentale	D4576	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma occidentale	D4578	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	1
Zagrammosoma talitzkii	D4739	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	0	1	1	0	0	1	0	1
Zagrammosoma talitzkii	D4545	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	0	1	1	0	0	1	0	1
Zagrammosoma talitzkii	D4546	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	0	1	1	0	0	1	0	1
Zagrammosoma trifurcatum	D4592	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma trifurcatum	D4600	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma velerii	D4685	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	0	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma villosum	D5935	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma villosum	D3679	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1
Zagrammosoma villosum	D3681	1	0	0	1	2	1	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	3	2	1	0	1	1	0	0	1	4	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	0	1

Table 3.4. Summary of host orders and families by genus of Cirrospilini. See genus descriptions for detailed host and host plant records.

Genus	Host Order	Host Families
1. *Ascotolinx*	**Lepidoptera:**	Gracillariidae
	Unknown:	leaf miner
2. *Atoposoma*	**Diptera:**	Agromyzidae
	Lepidoptera:	Lyonetiidae, Gracillariidae
	Hemiptera:	See host section for notes on these records
	Unknown:	leaf miner
3. *Aulogymnus*	**Hymenoptera:**	Cynipidae
	Unknown:	gall
4. *Burkseus*	**Coleoptera:**	Apionidae, Curculionidae
	Diptera:	Agromyzidae, Cecidomyiidae
	Hymenoptera:	Braconidae, Diprionidae, Tenthredinidae,
	Lepidoptera:	Gelechiidae, Gracillariidae, Heliozelidae, Lyonetiidae, Nepticulidae, Yponomeutidae
5. *Cirrospilus*	**Diptera:**	Agromyzidae
	Hymenoptera:	Argidae, Ichneumonidae, Tenthredinidae
	Lepidoptera:	Gracillariidae, Lyonetiidae, Saturniidae, Tischeriidae
	Unknown:	gall, leaf miner
6. *Colpoclypeus*	**Lepidoptera:**	Tortricidae
	Hemiptera:	Psyllidae – See host section for notes on these records
7. *Diaulinopsis*	**Diptera:**	Agromyzidae
	Unknown:	leaf miner
8. *Dichatomus*	**Hymenoptera:**	Cynipidae
	Unknown:	gall
9. *Diglyphus*	**Diptera:**	Agromyzidae
	Unknown:	leaf miner
10. *Gallowayia*	**No host records**	
11. *Gattonia*	**No host records**	
12. *Gyrolasella*	**Coleoptera:**	Chrysomelidae
	Hymenoptera:	Pergidae
	Lepidoptera:	Elachistidae, Gracillariidae
	Unknown:	gall, leaf miner
13. *Meruacesa*	**Diptera:**	Agromyzidae
	Unknown:	leaf miner
14. *Naumanniola*	**Lepidoptera:**	Elachistidae – First host records for Naumanniola
15. *Oxycantha*	**No host records**	
16. *Pseudiglyphus*	**Unknown:**	leaf miner
17. *Pseudozagramma*	**Lepidoptera:**	Gracillariidae
18. *Trichospilus*	**Diptera:**	Tachinidae
	Hymenoptera:	Tenthredinidae
	Lepidoptera:	Noctuidae, Nymphalidae, Pyralidae, Xylorictidae
	Orthoptera:	Tettigoniidae - See host section for notes on these records
19. *Vagus*	**Coleoptera:**	Chrysomelidae – See host section for notes on these records
	Diptera:	Agromyzidae
20. *Zagrammosoma*	**Coleoptera:**	Buprestidae, Chrysomelidae, Curculionidae
	Diptera:	Agromyzidae, Cecidomyiidae
	Hymenoptera:	Tenthredinidae
	Lepidoptera:	Bucculatricidae, Coleophoridae, Cosmopteridídae, Elachistidae, Gelechiidae, Gracillariidae, Heliozelidae, Lyonetiidae, Pyralidae, Tischeriidae
	Hemiptera:	Aphididae, Psyllidae – See in Chapter 2 for notes on these records

Supplemental Information

Chapter 1

Material examined:

***Burkseus flavoviridis*:**

CANADA: British Columbia: Beacon Hill Park, Victoria, 24m, *48°24'46"N*, *123°21'48"W*, 18.x.1953, O. Peck [1♀, CNC: CNC506602]. Coquihalla Pass, Zopkios Ridge, 1219m, *49°35'39"N*, *121°06'58"W*, 9.vii.1988, J.C. Cardale [1♀, ANIC: UCRCENT238529]. Kentucky-Allene Prov P, Hwy 5, 57km N Princeton, 1096m, 49°45'0"N, 120°40'0"W, 10.vii.1986, H. Goulet, Pine, grass [1♀, CNC: CNC508648-**D4683**]. **Vancouver**, Point Grey, 75m, *49°15'21"N*, *123°11'59"W*, vii.1973, J.R. Vockeroth [1♀, CNC: CNC508544]. **MEXICO: Chihuahua:** Chihuahaua, 1433m, *28°38'47"N*, *106°03'13"W*, v.1932, A. Dampf, 284-32, host plant: Alfalfa [1♀, USNM: UCRCENT471310]. **Morelos:** Tlayacapan, 1654m, *18°57'43"N*, *98°59'0"W*, 29.x.1982, A. Gonzalez, screen sweep [1♀, UCRC: UCRCENT416546]. **USA: Arizona:** Salt River Valley, 382m, *33°29'46"N*, *111°51'37"W*, iii.1950, E.A. Taylor, T.C. 9618 [3♂ 3♀, USNM: UCRCENT471411–471416]. **Coconino Co.**, 5 mi. W Williams, 2013m, *35°13'57"N*, *112°17'23"W*, 14.viii.1983, G. Gordh [3♀, UCRC: UCRCENT416552, 416553, 416567]. Jacob Lake, 13 mi. S, 2682m, *36°33'47"N*, *112°10'14"W*, 26.vi.1993, J.D. Pinto, sweep [3♀, CNC: CNC508603–508606, 508645-**D4679**]. **Graham Co.**, Coronado National Forest, Pinaleno Mts., Snow Flat, 2690m, 32°39'16"N, 109°51'49"W, 19.viii.2001, J.B. Woolley, 2001/083 [1♂ 1♀, UCRC: UCRCENT416555-**D4590**, 478938-**D4741**]. **Pima Co.**, Kitt Peak Rd., Coyote Mtns. 5km SW jct Hwy 86 & 386,

31°58'52"N, 111°36'5"W, 2–12.v.2006, M.E. Irwin, damp wash, malaise trap [1♀, UCRC: UCRCENT499465]. **Yavapai Co.**, W of Seligman, 1600m, 35°20'0"N, 112°54'50"W, 27.vii.2008, S. Triapitsyn [1♀, UCRC: UCRCENT250522]. **California: Contra Costa Co.**, Marsh Creek Rd., 150m, *37°53'6"N*, *121°49'57"W*, 1.xii.1983, D. L. Wagner, JAP 83A11, host: *Stigmella*, host plant: *Prunus* [1♀, USNM: UCRCENT471297]. Tilden Regional Park, *37°53'33"N*, *122°14'31"W*, 2.v.1982, J.B. Whitfield [1♀, UCRC: UCRCENT485836]. **El Dorado Co.**, Fallen Leaf Lake, 1976m, *38°53'59"N*, *120°03'10"W*, 2–4.vii.1983, David L. Wagner, JAP 83G21, host: *Cameraria*, host plant: *Quercus vaccinifolia* [1♀, USNM: UCRCENT471296]. **Humboldt Co.**, Petrolia, 519m, *40°19'30"N*, *124°17'10"W*, 9.vi.1984, J.D. Pinto [5♂ 2♀, UCRC: UCRCENT416547, 416549, 485788–485792]. **Imperial Co.**, Brawley, -34m, 32°58'43"N, 115°31'46"W, 10.iii.1959, E.I. Schlinger [5♂, UCRC: UCRCENT485801–485805]. Brawley, -34m, 32°58'43"N, 115°31'46"W, 29.i.1959, E.I. Schlinger, host plant: *Medicago sativa* [1♂ 6♀, UCRC: UCRCENT485783–485787, 485806, 485807]. **Inyo Co.**, Alabama Hills nr. Lone Pine, 1297m, *36°36'28"N*, *118°05'59"W*, 13.x.1988, J.D. Pinto [3♀, ANIC: UCRCENT238525–238527]. China Lake Naval WC, Coso Mtns., Silver Peak Springs Westside, 1998m, *36°08'54"N*, *117°43'6"W*, 27.vii.1999, M. Gates [3♀, UCRC: UCRCENT62009, UCRC: 0062014, 62029]. Death Valley Natl. Monument, Cottonwood Canyon (15 mi W Stovepipe Wells), *36°34'24"N*, *117°18'48"W*, 31.iii.1984, E.E. Grissell, host plant: *Encelia* sp. [1♂ 1♀, USNM: UCRCENT471419, 471420]. Death Valley Natl. Monument, Titus Canyon (2 mi E.

Red Pass), 1527m, *36°49'44"N*, *117°00'29"W*, 24.iii.1984, E.E. Grissell, host plant: *Purshia mexicana* [2♀, USNM: UCRCENT471422, 471423]. Open grassy upper end of McGee Meadow, T 2S R 29E, S 1, *37°48'12"N*, *118°43'59"W*, 8.ix.1991 [1♀, UCRC: UCRCENT485839]. S Coso Peak, 2340m, 36°11'42"N, 117°43'21"W, 17.vii.1999, M. Gates [5♀, UCRC: UCRCENT106896, 107041, 107051, 107059, 107065]. Warm Sulfur Springs, 315m, 36°07'9"N, 117°12'54"W, 22.iii.2002, A.K. Owen, yellow pan trap [1♂, UCRC: UCRCENT121011]. Wild Horse Cyn. W. Silver Park, 2085m, 36°08'50"N, 117°43'23"W, 17.vii.1999, M. Gates [2♀, UCRC: UCRCENT61919, 61920]. **Kern Co.**, 12 mi. S Bakersfield, 92m, *35°10'42"N*, *119°00'16"W*, 2.vi.1958, E. I. Schlinger, Alfalfa field, vacuum [1♀, USNM: UCRCENT371295]. Cawelo, 132m, *35°30'5"N*, *119°09'53"W*, 22.vii.1958, E.I. Schlinger, host: *Liriomyza* sp., host plant: *Medicago sativa* [1♀, UCRC: UCRCENT416537]. **Los Angeles Co.**, Calabasas, 417m, *34°07'51"N*, *118°39'6"W*, 27 .xii.1982, M.K. Sears, host plant: *Rhamnus crocea* [2♀, UCRC: UCRCENT416543, 416544]. Lakewood, *33°51'12"N*, *118°07'59"W*, 11.vi.1958 [1♀, UCRC: UCRCENT485800]. Lancaster, 720m, *34°41'26"N*, *118°08'40"W*, 6.vi.1958, E. I. Schlinger, alfalfa field, Vacuum [1♂, USNM: UCRCENT471303]. San Pedro; 3171 N. Gaffey Rd. Defense Fuel Support Point, 8m, 33°46'33"N, 118°17'46"W, 27.xii.2001–13.i.2002, J. George, Coastal sage scrub, malaise trap [3♀, UCRC: UCRCENT416569, 416570, 485779]. San Pedro; 3171 N. Gaffey Rd. Defense Fuel Support Point, 8m, 33°46'33"N, 118°17'46"W, 6–13.i.2002, J. George, Coastal sage scrub, malaise trap [12♀, UCRC: UCRCENT416564,

485765–485775]. San Pedro; 3171 N. Gaffey Rd. Defense Fuel Support Point, 8m, 33°46'33"N, 118°17'46"W, 8–16.xi.2001, J. George, coastal sage scrub [3♀, UCRC: UCRCENT485776–485778]. **Marin Co.**, US Hwy 1, 6 mi S. Valley Ford, *38°17'35"N*, *122°55'37"W*, 4.iv.2002, Buffington & Munro, sweep [1♀, UCRC: UCRCENT485730]. **Mariposa Co.**, Yosemite National Park, 2514m, *37°48'48"N*, *119°31'49"W*, vi–viii.1937, J.S. Yuill, Hop. U.S. 32255F [1♀, USNM: UCRCENT471399]. **Mendocino Co.**, 5 km N Westport, 16m, 39°40'35"N, 123°47'22"W, 7.vii.1997, S.L. Heydon, coastal bluff [2♂ 2♀, UCDC: UCRCENT415821, 415822, 477868, 477869]. **Modoc Co.**, 10 mi N Cedar Pass (USFS Block II), 2251m, *41°41'0"N*, *120°17'17"W*, 17.vii.1974, *Abies concolor* [2♀, EMEC: EMEC84205, 084206]. 12 mi S Cedar Pass (USFS Block VII), 2055m, *41°24'59"N*, *120°16'33"W*, 5.vii.1974, *Abies concolor* [1♀, EMEC: EMEC84204]. 3 mi S Cedar Pass (USFS Block VII), 2211m, *41°31'10"N*, *120°17'5"W*, 6.vii.1974, *Abies concolor* [3♀, EMEC: EMEC84203, 084207, 084208]. 5.6 mi. N Fandango Pass, 1910m, *41°52'49"N*, *120°01'12"W*, 22.vii.1992, J.D. Pinto, mesic meadow (*Salix*, etc.) [2♂ 2♀, CNC: CNC508593–508596]. 9 mi NE Adin (USFS Block XI), 1451m, *41°19'14"N*, *120°54'9"W*, 24.vi.1974, *Abies concolor* [1♀, EMEC: EMEC84189]. **Mono Co.**, 1 km E Walker, 1700m, 38°30'6"N, 119°27'7"W, 15.v.2004, willow, sweep [2♀, UCDC: UCRCENT415835, 415836]. **Orange Co.**, Huntington Beach, 13m, *33°39'40"N*, *117°59'57"W*, 23.vi.1985, H.E. Andersen [1♀, UCRC: UCRCENT485793]. **Riverside Co.**, Ag-Ops BC Grove (UCR), 346m, *33°58'21"N*, *117°19'5"W*, 11.x.2007, R. Luck, #30, host: *Phyllocnistis citrella*, host

plant: Lemon [1♀, UCRC: UCRCENT485171]. Corn Spring, 450m, 33°37'33"N, 115°19'30"W, 19–22.iv.2011, M.E Irwin, sandy wash near *Prosopis*, malaise trap [1♂ 1♀, UCRC: UCRCENT485703, 485704]. Harford Springs Park, 623m, 33°48'6"N, 117°20'41"W, 26.iii.2010, D. Yanega, open scrub and grassland, sweep [2♂, UCRC: UCRCENT323186, 323261]. Homeland, 492m, *33°44'36"N*, *117°06'34"W*, 20.ii.1982, H. Andersen [4♂ 1♀, UCRC: UCRCENT485813–485817]. Homeland, 492m, *33°44'36"N*, *117°06'34"W*, 6.iii.1982, H. Andersen [5♂, UCRC: UCRCENT485808–485812]. Joshua Tree Natl. Pk., along 10.0 km wash to Smith Water Cyn., 1333–1366m, 34°01'20"N, 116°17'11"W, 26.iv.2013, S. Triapitsyn [1♂, UCRC: UCRCENT499468]. Lake Skinner, NE end, 487m, 33°36'7"N, 117°02'5"W, 21.v–4.vi.1996, J.D. Pinto, coastal sage scrub, malaise trap, MET B11 BURNED [1♂, UCRC: UCRCENT485796]. Menifee Vly. (hills on W. end), 549m, 33°39'0"N, 117°13'0"W, 1–29.ii.1996, J.D. Pinto, MALAISE TRAP [1♂, UCRC: UCRCENT485838]. P.L. Boyd Des. Res. Center, 3.5 mi. S Palm Desert, 289m, *33°38'55"N*, *116°22'41"W*, 10–22.xii.1969, S. Frommer & R. Worley, malaise trap [2♀, UCRC: UCRCENT073447, 073448]. Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W, 17–24.v.2008, G. Pratt, malaise trap [1♂, UCRC: UCRCENT410529-**D3791**]. Thermal Plaza nursery, -44m, *33°28'5"N*, *116°06'4"W*, 29.xi.2006, R. Luck, #25, host: *Phyllocnistis citrella*, host plant: Grapefruit [8♀, UCRC: UCRCENT292816, 292842, 292855, 292894, 292895, 485172, 491705-**D4171**, 491706-**D4172**]. Thousand Palms Canyon, S. of Oasis, 149m, *33°49'58"N*, *116°18'40"W*, 17.xi.1995, M. Gates, G95/155 [3♀, UCRC:

UCRCENT416541, 416542, 416545]. UC Motte Reserve, W of Perris, *33°48'2"N*, *117°15'18"W*, 18–25.ii.1997, M. Gates & D. Hawks, MALAISE TRAP [9♂ 4♀, UCRC: UCRCENT485818–485830]. Wildwood Cyn., 1100m, 34°00'24"N, 116°58'13"W, 12.iii.2003, D. Yanega, Ceanothus [3♂, UCRC: UCRCENT485700–485702]. **San Bernardino Co.**, 10 mi S Hesperia, *34°19'11"N*, *117°17'20"W*, 7.v.1980, G. Gordh [1♂, UCRC: UCRCENT485781]. 26.5 mi E 29 Palms, 531m, *34°05'37"N*, *115°35'45"W*, 14.x.1983, J.D. Pinto [1♀, UCRC: UCRCENT485837]. 27.5 mi E 29 Palms, 543m, *34°05'11"N*, *115°34'53"W*, 24.x.1986, J. LaSalle [1♀, ANIC: UCRCENT238528]. 2N93 @ Green Spring Creek, 2266m, 34°13'7"N, 116°48'18"W, 9.vi.2005, J.D. Pinto [1♀, UCRC: UCRCENT120525]. 8 mi. E. Phelan, Baldy Mesa, 1111m, *34°25'34"N*, *117°25'56"W*, 1–8.iv.1981, J.T. Huber, in pan trap [1♀, UCRC: UCRCENT416568]. Cajon Summit, Summit Valley, *34°19'36"N*, *117°25'42"W*, 14.x.1978, J. Lasalle [1♀, UCRC: UCRCENT485835]. Clark's Pass, 591m, *34°04'24"N*, *115°33'11"W*, 16.x.1985, J.C. Hall [1♀, UCRC: UCRCENT485797]. Fisk Creek Trail, San Bernardino Natl. For., 2462m, *34°07'29"N*, *116°46'49"W*, 30.vii.1981, G. Gordh [1♀, UCRC: UCRCENT416550]. Lytle Creek Village, 1044m, 34°15'43"N, 117°30'0"W, 7.iv.2006, R. Rakitov [1♂, UCRC: UCRCENT485782]. Mill Creek Canyon, 1500m, *34°05'29"N*, *116°56'25"W*, 8.iv.1996, M. Gates, Upper surface serpentine leaf miner, LM96-56, host plant: *Cercocarpus ledifolius* [1♀, UCRC: UCRCENT416539]. Mill Creek Canyon, 1500m, *34°05'29"N*, *116°56'25"W*, 8.iv.1996, M. Gates, Upper surface serpentine leaf miner, LM96-57, host plant: *Cercocarpus ledifolius* [1♀, UCRC:

UCRCENT416540-D]. UC Granite Mtns Reserve, Granite Cove, 1300m, *34°46'57"N*, *115°39'15"W*, 13–20.iv.1997, M.W. Gates, malaise trap [1♂, UCRC: UCRCENT065092]. **San Diego Co.**, Borrego Valley, 150m, *33°12'41"N*, *116°18'58"W*, 22.iv.1981, G. Gordh [2♀, UCRC: UCRCENT416565, 416566]. Pala, 37020 Magee Rd. Fluor Ranch, 395m, 33°23'17"N, 117°02'29"W, 8.viii.2006, T. Shea, #7, host: *Phyllocnistis citrella*, host plant: grapefruit [1♀, UCRC: UCRCENT491708-**D4176**]. Pauma, Rutz grove, 374m, 33°20'14"N, 116°58'57"W, 10.viii.2009, P. Pacheco, #95, host: *Phyllocnistis citrella*, host plant: Lemon [2♀, UCRC: UCRCENT275067, 275068]. **San Francisco**, Sigmund Stern Grove, 494m, *37°44'7"N*, *122°28'42"W*, 14.ix.1956, H.B. Leech, host: *Apion proclive*, host plant: *LuPinus arboretus* [1♂, CASC: UCRCENT417568]. **San Mateo Co.**, San Bruno Mtns. Radio Tower Rd., 315m, *37°41'25"N*, *122°26'23"W*, 1.ii.1981, D. L. Wagner, JAP 81A20, host: *Stigmella*, host plant: *Ceanothus* [2♀, USNM: UCRCENT471298, 471299]. **Santa Barbara Co.**, Santa Cruz Island, *34°00'33"N*, *119°46'9"W*, 21.x.1970, R.D. Goeden & D.W. Ricker, host plant: *Ambrosia chamissonis* [1♀, UCRC: UCRCENT485780]. T 4N, R 27W, S 23, *34°30'0"N*, *119°40'53"W*, 22.iv.1969, R.D. Goeden & D.W. Ricker, host plant: Ambrosia psilostachya [1♀, UCRC: UCRCENT485794]. **Sierra Co.**, 12 km WNW Sierraville, 1987 m, 39°37'2"N, 120°30'17"W, 8.viii.1998, S.L. Heydon, meadow by stream [2♀, UCDC: UCRCENT415823, 415824]. Yuba Pass, 21km S Portola, 2050m, *39°37'2"N*, *120°29'22"W*, 8.viii.1998, S.L. Heydon [1♀, UCDC: UCRCENT477854]. **Solano Co.**, Cold Canyon Reserve, 11 km W Winters, 98m,

38°30'28"N, *122°05'49"W*, 1.i.2000, S.L. Heydon [1♀, UCDC: UCRCENT415833]. **Tulare Co.**, 1/4-mile E Ave. 304 & Rd. 196, Kikpatrick, 125m, 36°20'26"N, 119°07'46"W, 16.xii.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Pomelo [1♀, UCRC: UCRCENT237316]. 1/4-mile E Ave. 304 & Rd. 196, Kikpatrick, 125m, 36°20'26"N, 119°07'46"W, 3.xii.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Citrus [2♂, UCRC: UCRCENT237322, 237317]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Pomelo [1♂, UCRC: UCRCENT237320]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host plant: Thong De [2♀, UCRC: UCRCENT237313, 491707]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Citrus [1♀, UCRC: UCRCENT237312]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Pomelo [2♀, UCRC: UCRCENT237313, 491707]. SE corner Ave. 200 & Rd. 180, Fisher, 102m, 36°09'6"N, 119°10'10"W, 18.xi.2009, S. Kharrat, host: *Marmara gulosa,* host plant: Citrus [1♀, UCRC: UCRCENT237314].**Ventura Co.**, Lake Piru, 350m, *34°28'2"N*, *118°45'45"W*, 16.ii.1996, M. Gates, G96/006 [1♀, UCRC: UCRCENT416538]. Oxnard, 15m, *34°11'47"N*, *119°09'33"W*, 20.v.1963, L.C. Hall, vacuum sample [13♀, UCRC: UCRCENT312408–312419, 485798]. Ventura, Limoneira ranch Blk U5t, 88m, *34°21'1"N*, *119°08'0"W*, 12.x.2008, B. Faber, #77, host: *Phyllocnistis citrella*, host plant: Lemon [1♀, UCRC: UCRCENT275053]. **Yolo Co.**, Coyote Gulch Exper. Ecosystem, 2km SW Davis,

17m, *38°31'38"N*, *121°46'59"W*, 19.x–9.xi.2001, L.S. Kimsey, MALAISE TRAP [1♂ 1♀, UCDC: UCRCENT415832, 477850]. Davis, 16m, *38°32'36"N*, *121°44'8"W*, 15.x.1960, L.W. Shainberg, host: *Liriomyza munda* [1♂, UCDC: UCRCENT415834]. Davis, 16m, *38°32'36"N*, *121°44'8"W*, 5.x.1950, F. Morishita [4♀, UCRC: UCRCENT485831–485834]. **Colorado: Boulder Co.**, 1 km sw Allenspark, 2800m, *40°11'21"N*, *105°32'13"W*, 12.vii.1993, S.L. Heydon [3♀, UCDC: UCRCENT477851–477853]. **Lake Co.**, along Arkansas River, 3 km N Grande, 2749m, *39°04'7"N*, *106°16'37"W*, 8.vii.1992, S.L. Heydon [1♀, UCDC: UCRCENT415838]. **Idaho:** 1961m, *43°23'14"N*, *114°39'10"W*, 29.vii.1950, host: *Recurvaria milleri* [3♀, CNC: CNC506587, 506588, 508542]. Targhee, 1848m, *44°15'51"N*, *111°17'6"W*, 16.vii.1953, J.H. McLeod, host: leafminer, host plant: Cottonwood [13♀, CNC: CNC506589–506601]. **Camas Co.,** Hwy 20, 1545m, 43°20'31"N, 114°51'46"W, 3.viii.2015, A. Baker & J. Witter, AB15.046 [1♀, UCRC: UCRCENT416558-**D4593**]. **Lincoln Co.**, Kimama, 1325m, *42°48'49"N*, *113°52'13"W*, 16.v.1931, Hinnenkamp [1♀, USNM: UCRCENT471302]. **Twin Falls Co.**, Hollister, Plot 5, inside, 1380m, *42°21'12"N*, *114°34'27"W*, 26.vi.1931, D. E. Fox [1♀, USNM: UCRCENT471300]. Hub Butte, Pole 29 trap 2, 1403m, *42°25'53"N*, *114°28'57"W*, 22.v.1931, Wind Vane Trap [1♀, USNM: UCRCENT471301]. **Nevada: Washoe Co.**, 6 km NW Pleasant Valley, 1850m, 39°22'50"N, 119°51'0"W, 29.vii.2003, S.L. Heydon [1♀, UCDC: UCRCENT415830]. nr Mt. Rose Summit, 5 km NE Incline Village, 2680m, 39°18'28"N, 119°54'31"W, 29.vii.2003, S.L. Heydon [1♂ 2♀, UCDC:

UCRCENT415825–415827]. **Oregon: Deschutes Co.**, Little Deschutes River (Rosland), *43°42'5"N*, *121°30'12"W*, 18.viii.1984, Schauff & Grissell, riverside meadow [1♂, USNM: UCRCENT471426]. **Lane Co.**, H.J. Andrews Exp. For. (Road 320), 692m, *44°14'55"N*, *122°11'33"W*, 17.viii.1984, M.E. Schauff & E.E. Grissell, Spiraea-Acer bog [1♂, USNM: UCRCENT471424]. H.J. Andrews Exp. For. Frissell Point, 1479m, *44°12'57"N*, *122°06'3"W*, 15.viii.1984, M.E. Schauff & E.E. Grissell, roadside vegetation [1♀, USNM: UCRCENT471425]. **Tillamook Co.**, 4 km W Sandlake, 446m, *45°16'10"N*, *123°54'10"W*, 2.vii.1991, S.L. Heydon [10♀, UCDC: UCRCENT477858–477867]. **Utah: Garfield Co.**, Wikiup Pass, Henry Mtns., *38°05'42"N*, *110°46'42"W*, 27.viii.1981, E.E. Grissell, host plant: Artemesia [1♀, USNM: UCRCENT471427]. **Kane Co.**, Kanab, 1498m, *37°02'46"N*, *112°32'4"W*, 6.ix.1997, G.F. Knowlton, alfalfa [1♀, USNM: UCRCENT471398]. **Piute Co.**, 12.5 km W Junction, 2956m, 38°13'48"N, 112°21'30"W, 9.viii.1998, L. Baptiste, meadow, sweep [1♀, UCDC: UCRCENT415829]. Benton Flats, 13 km W Junction, 2946m, 38°13'51"N, 112°21'2"W, 9.viii.1998 [1♀, UCDC: UCRCENT415828]. **Salt Lake Co.**, Salt Lake City, 1302m, *40°42'40"N*, *111°52'32"W*, L. P. Rockwood [1♀, USNM: UCRCENT471309]. **Utah Co.**, Orem, 1200 N 800 W, 1445m, *40°19'9"N*, *111°42'55"W*, 16.i.1984, B. A. Barrett, host: *Phyllonorycter elmaella*, host plant: *Malus* sp. [1♀, USNM: UCRCENT471311]. **Washington Co.**, Snow canyon St. Park ~1 mi. N Ivins, 986m, *37°11'37"N*, *113°38'47"W*, 29.iii.1989, J.D. Pinto, Rhus, Oak, Fraxinus [5♂, CNC: CNC508576-**D5322**, 508642–508644, 508647-**D4682**].

Washington: Mt. Rainier Natl. Park, Van Trump Park, 1500–1800m, *46°47'51"N*, *121°46'46"W*, 29.vii.1985, L. Masner, subalpine meadow & forest below, screen sweep [1♀, CNC: CNC508577-**D5323**]. **Wyoming: Sweetwater Co.**, 11.6 mi. E Point of Rocks, 2174m, *41°38'45"N*, *108°34'34"W*, 30.viii.1983, J.D. Pinto [1♀, UCRC: UCRCENT416554].

***Burkseus robustus* n. sp.:**

CANADA: Alberta: Mount Eisenhower (Castle Mountain), Banff Natl. Park, 2230m, *51°18'49"N*, *115°55'32"W*, 11.vii.1958, R.W. Stark, host: *Apantales* sp [1♀, CNC: CNC506626]. Mount Eisenhower (Castle Mountain), Banff Natl. Park, 2230m, *51°18'49"N*, *115°55'32"W*, 18.vii.1958, R.W. Stark, host: *Apantales* sp [3♀, CNC: CNC506623–506625]. Mount Girouard, Banff Natl. Park, 2239m, *51°13'47"N*, *115°25'32"W*, 10.vii.1957, R.W. Stark, host: *Apantales* sp [1♀, CNC: CNC506617]. Mount Girouard, Banff Natl. Park, 2239m, *51°13'47"N*, *115°25'32"W*, 17.vii.1958, R.W. Stark, host: *Apantales* sp [2♀, CNC: CNC506618, 506619]. Mount Girouard, Banff Natl. Park, 2239m, *51°13'47"N*, *115°25'32"W*, 21.vii.1958, R.W. Stark, host: *Apantales* sp [2♀, CNC: CNC506620, 506621]. Mount Girouard, Banff Natl. Park, 2239m, *51°13'47"N*, *115°25'32"W*, 25.vii.1958, R.W. Stark, host: *Apantales* sp [1♀, CNC: CNC506622]. **British Columbia:** Cathedral Mountain, Yoho Natl. Park, 1584m, *51°24'51"N*, *116°25'37"W*, 28.vii.1958, R.W. Stark, host: *Apantales* sp [4♀, CNC: CNC506612–506615]. **Ontario:** Dunrobin, 62m, *45°25'20"N*, *76°01'8"W*, 25.vi.1941, O. Peck [1♀, CNC:

CNC506609]. Minden Lindsay, 282m, *44°41'55"N*, *78°48'9"W*, 1961, C.D. Miller, 61-799, host: *Ocnerostoma* sp. [5♂ 2♀, CNC: CNC506628, 506630–506635]. **CHILE: Elquí:** 26 km S. Vicuña, *30°11'24"S*, *70°39'39"W*, 29.x.1992, D. Rozen, A. Sharkov, Snyder [1♀, CNC: CNC508744]. **COSTA RICA: Alajuela Prov.:** P.N. Volcan Poas, 2500m, *10°10'11"N*, *84°13'54"W*, 23.iv.1988, P. Hanson [1?, BMNH: NHMUK10353801]. **MEXICO: Oaxaca:** Pasajuego, 1555m, *17°04'34"N*, *96°44'31"W*, 23.x.1974, host plant: *Pinus* sp [1♀, BMNH: NHMUK10353561]. **USA: Arizona: Cochise Co.**, Chiricahua Mtns., Rustler Park, 2785m, *31°53'12"N*, *109°16'46"W*, 15.viii.1982, G. Gibson [1♀, CNC: CNC506610]. Chiricahua Mts, SWRS swimming pool, 1525m, *31°53'1"N*, *109°12'19"W*, 5.v.1980, V. Roth [1♂, CNC: CNC506616]. Chiricahua Mts., 0.4 mi. S Onion Saddle, 2362m, 31°55'41"N, 109°15'47"W, 21.viii.2000, B. Rodriguez, screen sweep, 2000/078 [1♀, UCRC: UCRCENT416523-**D4581**]. **Coconino Co.**, Jacob Lake, 13 mi. S, 2682m, *36°33'47"N*, *112°10'14"W*, 26.vi.1993, J.D. Pinto, sweep [1♂ 5♀, CNC: CNC508597–508602]. **Graham Co.**, Coronado National Forest, Pinaleno Mts., Snow Flat, 2690m, 32°39'16"N, 109°51'49"W, 19.viii.2001, J.B. Woolley, 2001/083 [1♀, UCRC: UCRCENT312431-**D4580**]. **Pima Co.**, Kitt Peak Rd., Coyote Mtns. 5km SW jct Hwy 86 & 386, 31°58'52"N, 111°36'5"W, 2–12.v.2006, M.E. Irwin, damp wash, malaise trap [1♀, UCRC: UCRCENT499464]. **California: Alameda Co.**, UC Berkeley Campus, 97m, *37°52'18"N*, *122°15'25"W*, 6.v.1960, R. Stark, host: *Coleotechnites*, host plant: *Pinus radiata* [2♀, EMEC: EMEC84186, 084187]. **Kern Co.**, 15 mi. SE Maricopa, Marian Campground, 2020m, *34°52'50"N*,

119°13'1"W, 25.vi.1987, D.B. Wahl [1♀, ANIC: UCRCENT238530]. **Los Angeles Co.**, Jackson Lake, 1870m, *34°23'24"N*, *117°43'40"W*, 27.ix.1981, J.T. Huber [1♀, UCRC: UCRCENT499467]. **Mariposa Co.**, Forsyth Pass, Yosemite N.P., 2744m, *37°46'14"N*, *119°27'52"W*, 11.viii.1937, D. DeLeon, host: *Recurvaria* sp, host plant: *Pinus contorta* [1♀, USNM: UCRCENT471421]. Polly Dome, Yosemite Natl. Park, 2846m, *37°51'23"N*, *119°26'53"W*, 21.vii.1959, A. Telford & S. MacDonald, *Abies magnifica* [2♀, EMEC: EMEC84183]. Tenaya Lake, 2497m, *37°50'0"N*, *119°27'54"W*, 1.vii.1953, G. R. Struble, host plant: *Pinus contorta* [5♀, USNM: UCRCENT471294, 471330–471333]. Tenaya Lake, 2497m, *37°50'0"N*, *119°27'54"W*, 10.vii.1951, J.H. McLeod, host: *Recurvaria*, host plant: *Pinus contorta* [1♀, CNC: CNC506608]. Tenaya Lake, 2497m, *37°50'0"N*, *119°27'54"W*, 10.vii.1953, J.H. McLeod, host: *Recurvaria*, host plant: *Pinus contorta* [7♀, CNC: CNC506603–506607, 508543, 508545]. Yosemite National Park, 2514m, *37°48'48"N*, *119°31'49"W*, vi–viii.1937, J.S. Yuill, Hop. U.S. 32255F, host: *Recurvaria milleri* [4♀, USNM: UCRCENT471400–471403]. **Modoc Co.**, 10 mi E Adin (USFS Block XII), 1947m, *41°11'11"N*, *120°45'51"W*, 12.vii.1974, *Abies concolor* [1♀, EMEC: EMEC84201]. 2 mi NW Fandango Pk. (USFS Block 1), 2009m, *41°53'1"N*, *120°16'0"W*, 26.vi.1974, *Abies concolor* [1♀, EMEC: EMEC84202]. Roney Flat, T3 Top, 1490m, *41°18'32"N*, *120°56'16"W*, 21.iv.1976, D.L. Dahlsten, host plant: *Abies concolor* [1♀, EMEC: EMEC84303]. Yellowjacket 772, 1858m, *41°11'34"N*, *120°45'21"W*, 6.vii.1976, D.L. Dahlsten, host plant: *Abies concolor* [2♀, EMEC: EMEC84302]. **Riverside Co.**, Cherry Valley, 853m,

33°58'12"N, *116°58'41"W*, 18.v.1938, Christenson, No. 6866 [1♀, USNM: UCRCENT471291]. San Bernardino Natl. For., Morris Ranch Rd., 0.4 miles E. Hwy. 74, 1400m, 33°37'6"N, 116°37'20"W, 15.v.2011, R.L. Zuparko, host plant: *Pinus jeffreyi*? [1♀, EMEC: EMEC84318]. **San Bernardino Co.**, Baldy Mesa, 7 mi E Phelan, *34°25'37"N*, *117°29'45"W*, 9–13.iv.1981, J.T. Huber [1♀, UCRC: UCRCENT485748]. San Gabriel Mts., Cucamonga Wilderness Area, btwn Cucamonga & Etiwanda Peaks, *35°13'35"N*, *117°34'44"W*, 26.viii.1989, J.D. Pinto [4♀, UCRC: UCRCENT485743, 485744, 485746, 485747]. **San Francisco Co.**, San Francisco, Golden Gate Park. Strybing Arboretum (S.F. Botanical Gardens), John Muir Nature Trail, 63m, *37°45'59"N*, *122°28'11"W*, 13.viii.1992, P.H. Arnaud, Jr., sweep, host plant: *Pinus radiata* [2♀, CASC: UCRCENT417569, 417570]. San Francisco, Golden Gate Park, 77m, *37°46'5"N*, *122°28'44"W*, 1924, E. Walther, host: *Argyresthia pilatella* [8♀, UCRC: UCRCENT312401–312407, 485764]. **San Luis Obispo Co.**, Cambria, Kenneth S. Norris Rancho Marino Res., 41–112m, 35°32'15"N, 121°05'4"W, 2–3.vii.2016, S.V. Triapitsyn, sweep, host plant: *Pinus radiata* [1♀, UCRC: UCRCENT478937]. **Santa Barbara Co.**, Bates Canyon, Los Padres Natl. For., 893m, *34°57'6"N*, *119°54'27"W*, 3.v.1969, P. Opler, host: *Stigmella*, host plant: Chrysolepis [1♀, EMEC: EMEC84209]. **Tulare Co.**, Ash Mtn. Power Stn., 506m, *36°29'30"N*, *118°49'50"W*, 5.iii.1983, J.A. Halstead [1♀, CNC: CNC506627]. **Tuolumne Co.**, Tuolumne Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, 14.viii.1958, A.D. Telford, host: *Coleotechnites milleri*, host plant: *Pinus contorta* var. *murrayana* [1♂, EMEC: EMEC84185]. Tuolumne

Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, 3–31.viii.1957, G.R. Struble, 37510A, host plant: *Pinus contorta* [1♂ 1♀, USNM: UCRCENT471404, 471405]. Tuolumne Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, vii–ix.1955, G.R. Struble, 34029L, host plant: *Pinus contorta* [2♀, USNM: UCRCENT471406, 471407]. Tuolumne Meadows, Yosemite Natl. Park, 2617m, *37°52'34"N*, *119°22'16"W*, vii–ix.1955, G.R. Struble, 34029M, host plant: *Pinus contorta* [1♂, USNM: UCRCENT471410]. **Idaho:** 1961m, *43°23'14"N*, *114°39'10"W*, 24.i.1950, host: *Recurvaria milleri* [1♀, CNC: CNC508653]. **New Mexico: Hidalgo Co.**, 14.9 km W Animes, 1340m, *31°55'9"N*, *108°56'31"W*, 26.vii.1982, G. Gibson [1♀, CNC: CNC506611].

***Burkseus singa*:**

ESTONIA: Saaremaa, Asuka, 20m, *58°34'0"N*, *22°28'33"E*, 2.vi.1990, M. Koponen [1♀, MZH: UCRCENT513263]. **FINLAND: Etalä-Savo: Mikkelin**, 6837: 3503, *61°38'45"N*, *37°03'37"E*, 1.viii.1983, M. Koponen [7♀ 9♂, MZH: UCRCENT513264–513268]. **Pertunmaa**, 6820: 3470, *61°29'28"N*, *26°26'38"E* [2♀, MZH: UCRCENT513269, 513270]. **Southern Finland: Janakkala**, 6766: 3367, 142m, *60°55'49"N*, *24°33'0"E*, 12.vi.1983, M. Koponen [1♀, MZH: UCRCENT513253]. 6766: 3381, 133m, *60°59'28"N*, *24°48'52"E*, 7.vii.1983, M. Koponen [1♂ 13♀, MZH: UCRCENT513249–513252]. 6766: 3381, 142m, *60°59'28"N*, *24°48'52"E*, 20.vi.1983, M. Koponen [1♀, MZH: UCRCENT513254]. 6766: 3387, *60°59'33"N*, *24°55'3"E*, 5.vii.1976, M. Koponen [1♀, MZH:

UCRCENT513248]. **Lammi**, 6771: 3391, 115m, *61°02'18"N*, *25°59'33"E*, 10.vii.1975, M. Koponen [1♀, MZH: UCRCENT513259]. 6773: 3394, *61°03'34"N*, *25°02'44"E*, 14.vii.1975, M. Koponen [1♀, MZH: UCRCENT513243]. 6775: 3395, 144m, *61°04'30"N*, *25°03'41"E*, 11.vii.1975, M. Koponen [1♀, MZH: UCRCENT513258]. **Southern Ostrobothnia: Vimpeli**, 7015: 3346, *63°12'25"N*, *23°55'59"E*, 18.viii.1982, M. Koponen [1♂ 1♀, MZH: UCRCENT513246, 513247]. **Uusimaa: Espoo**, 6692: 3371, *60°19'25"N*, *24°40'17"E*, 25.vii.1983, M. Koponen [1♀, MZH: UCRCENT513261, 513262]. **Hyvinkää**, 6714: 3372, 110m, *60°31'8"N*, *24°40'24"E*, 26.viii.1992, M. Koponen [1♂ 1♀, MZH: UCRCENT513276, 513277]. 6716: 3374, 110m, *60°32'23"N*, *24°42'45"E*, 31.vii.1984, M. Koponen [1♀, MZH: UCRCENT513256, 513257]. 6716: 3374, *60°32'23"N*, *24°42'45"E*, 16.viii.1975, M. Koponen [1♀, MZH: UCRCENT513255]. 6718: 3372, 105m, *60°33'23"N*, *24°40'21"E*, 11.vii.1992, M. Koponen [2♂ 1♀, MZH: UCRCENT513273–513275]. 6718: 3372, 105m, *60°33'23"N*, *24°40'21"E*, 24.viii.1991, M. Koponen [1♀, MZH: UCRCENT513280]. 6718: 3372, 105m, *60°33'23"N*, *24°420'21"E*, 4.viii.1991, M. Koponen [1♂ 1♀, MZH: UCRCENT513278, 513279]. 6718: 3372, *60°33'23"N*, *24°40'21"E*, 31.vii.1991, M. Koponen [2♀ 3♂, MZH: UCRCENT513271, 513272]. **Sipoo**, 6688: 3400, *60°17'43"N*, *25°11'46"E*, 30.viii.1983, M. Koponen [1♀, MZH: UCRCENT513260]. **SWEDEN: Skåne**, Silvåkra, 55°41'0"N, 13°27'0"E, 24.viii.1983, C. Hansson, sweep [1♀, USNM: UCRCENT471418]. **Blekinge:** Rödeby, Gagnekulla, 97m, *56°18'53"N*, *15°41'0"E*, 30.viii.1953, A. Sundholm [1♀, BMNH: NHMUK10371837]. **UK: Scotland: Argyll & Bute**, Rannoch Moor,

56°42'8"N, *4°34'21"W*, 12.vii.1977, Noyes, Rogers, & Huddleston [1♀, BMNH: NHMUK10371836].

***Burkseus vittatus*:**

AUSTRIA: Tirol: Krossbach, 1100m, 47°04'47"N, 11°16'0"E, 1.vii.1960, W. Soyka, on window [2♀, UCRC: UCRCENT227148, 250859]. **CANADA: Alberta:** George Lake, nr. Barrhead, 697m, *53°56'59"N*, *114°06'4"W*, 4.viii.1993, S. Digweed, emerged 24viii.93, collected in leaf samples, UA93-27, host: *Fenusa pusilla* [1♀, ANIC: UCRCENT238537]. Hinton, 1045m, *53°23'48"N*, *117°35'59"W*, 15.vii.1992, S. Digweed, emerged 23.vii.92, collected in leaf samples, UA92-8, host: *Fenusa pusilla* [1♀, ANIC: UCRCENT238536]. Waterton Lakes Natl. Park, Crandell Lake, 1530m, 49°06'0"N, 113°55'0"W, 8.vii.1991, H. Goulet, prairie [28♂ 6♀, CNC: CNC508572, 508607–508639]. **British Columbia:** Cowichan Lake, 172m, *48°49'19"N*, *124°03'38"W*, 12.v.1941, K. Graham, host: *Marmara arbutiella* [1♀, CNC: CNC506509]. Maning Prov. Park, Blackwall Peak, 2000m, 49°05'0"N, 121°45'0"W, 7.vii.1986, H. Goulet [1♂, CNC: CNC506580]. Osoyoos, Mt. Kobau, 1760m, *49°06'34"N*, *119°40'9"N/A*, 29.v–3.vi.1991, D. Blades, C. Maier, SOCAP - SM1 [1♀, CNC: CNC508570]. Smithers, Hudson Bay Mts. 11 km to Seymour Lake, 917m, *54°44'41"N*, *127°16'47"W*, 20.vii.1983, J.P. Smith [1♀, CNC: CNC506550]. Vancouver, 58m, *49°15'8"N*, *123°05'37"W*, 1.vi.1939, G. Spencer, host: *Coptodisca arbutiella* [1♀, CNC: CNC506560]. Vancouver, 58m, *49°15'8"N*, *123°05'37"W*, 20.v.1940, host: *Coptodisca arbutiella* [1♂, CNC: CNC506545].

Vancouver, 58m, *49°15'8"N*, *123°05'37"W*, 24.v.1940, host: *Coptodisca arbutiella* [1♂, CNC: CNC506519]. Vancouver, 58m, *49°15'8"N*, *123°05'37"W*, 3.vi.1939, G. Spencer, host: *Coptodisca arbutiella* [2♀, USNM: UCRCENT471327, 471328]. Vancouver, 58m, *49°15'8"N*, *123°05'37"W*, 3.vi.1939, G. Spencer, host: eggs of *Neodiprion abietis*, host plant: Balsam Fir [2♀, USNM: UCRCENT471327, 471328]. Vancouver, 58m, *49°15'8"N*, *123°05'37"W*, v.1939, G. Spencer, host: *Coptodisca arbutiella* [2♂ 1♀, CNC: CNC506520–506522]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 20.v.1953, D.B. Waddell [2♀, CNC: CNC506636, 506637]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 22.v.1953, D.B. Waddell [3♀, CNC: CNC506638–506640]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 24.v.1953, D.B. Waddell [3♀, CNC: CNC506641–506643]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 27.v.1953, D.B. Waddell [4♀, CNC: CNC506644–506647]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 28.v.1953, D.B. Waddell [1♂ 2♀, CNC: CNC506648–506650]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 3.viii.1953, D.B. Waddell [7♂ 13♀, CNC: CNC506666–506685]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 30.viii.1953, D.B. Waddell [2♂ 6♀, CNC: CNC506694–506701]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 31.viii.1953, D.B. Waddell [3♂, CNC: CNC506702–506704]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 4.vi.1953, D.B. Waddell [6♂ 9♀, CNC: CNC506651–506665]. Victoria, 26m, *48°25'1"N*, *123°21'51"W*, 4.viii.1953, D.B. Waddell [2♂ 6♀, CNC: CNC506686–506693]. **New Brunswick:** 2 mi. W of Connors, 177m, *47°11'42"N*, *68°51'40"W*, 26.vii.1961, host: *Phyllocnistis populiella* [1♂, CNC: CNC506513]. Fredericton, 891m,

45°57'21"N, *66°39'53"W*, 18.vi.1950, host: *Argyresthia thuiella*, host plant: Thuja [1♀, CNC: CNC506514]. Fredericton, 891m, *45°57'21"N*, *66°39'53"W*, 20.vi.1950, host: *Argyresthia thuiella*, host plant: Thuja [1♀, CNC: CNC506515]. Fredericton, 891m, *45°57'21"N*, *66°39'53"W*, 6.vii.1950, host: *Argyresthia thuiella*, host plant: Thuja [1♂ 1♀, CNC: CNC506516, 506517]. Fredericton, 891m, *45°57'21"N*, *66°39'53"W*, 6.viii.1950, host: *Argyresthia thuiella*, host plant: Thuja [1♀, CNC: CNC506518]. **Charlotte Co.**, Pennfield Corner, 76m, *45°06'42"N*, *66°44'30"W*, vii.1997, D. O'Shea [4♀, CNC: CNC506483–506488]. **Newfoundland & Labrador:** Corner Brook area, 218m, 48°49'47"N, 58°03'44"W, 2002, G. Moreau, host: eggs of *Neodiprion abietis*, host plant: Balsam Fir [5♀, CNC: CNC506499–506508, USNM: UCRCENT471325]. Corner Brook area, 234m, 48°35'59"N, 58°06'23"W, 2002, G. Moreau, host: eggs of *Neodiprion abietis*, host plant: Balsam Fir [11♀, CNC: CNC506493–506498]. Corner Brook area, 257m, 48°35'59"N, 58°06'15"W, 2002, G. Moreau, host: eggs of *Neodiprion abietis*, host plant: Balsam Fir [6♀, CNC: CNC506490–506492, USNM: UCRCENT471326]. **Nova Scotia:** Hebron, 9m, *43°53'15"N*, *66°05'27"W*, 15.vii.1959, C.D. Miller, host: *Lithocolletis* sp, host plant: *Alnus crispa* [1♀, CNC: CNC506576]. **ON:** Bell's Corners, 107m, *45°19'23"N*, *75°48'46"W*, 9.vi.1954, T.N. Freeman, host: *Recurvaria* sp, host plant: Cedar [1♂, CNC: CNC506584]. Biscotasing, 410m, *47°17'58"N*, *82°06'11"W*, viii.1931, K.E. Schedl [4♀, CNC: CNC506523–506526]. Elmira, 360m, *43°36'0"N*, *80°33'46"W*, 15.viii.1966, host plant: *Prunus nigra* [2♂ 2♀, CNC: CNC506527–506530]. Elmira, 360m, *43°36'0"N*, *80°33'46"W*, 15.viii.1966, host: *Nepticula* sp,

host plant: *Prunus nigra* [2♂ 2♀, CNC: CNC506527–506530]. Elmira, 360m, *43°36'0"N*, *80°33'46"W*, 5.ix.1966, host: Nepticula sp., host plant: *Prunus nigra* [1♂ 3♀, CNC: CNC506531–506534]. **Ontario:** 3km N. Almonte, 154m, *45°15'12"N*, *76°11'49"W*, 3.vii–10.v.1986, Denis & Dumouchel, pan trap [1♀, CNC: CNC508555]. Ottawa, 80m, *45°23'26"N*, *75°42'16"W*, 10.vii.1951, O. Peck, wheat, Sweep [1♀, CNC: CNC506535]. Ottawa, 80m, *45°23'26"N*, *75°42'16"W*, 29.vi.1972, O. Peck, *Salix blanda* Wisconsin w/ *Euura atra*, Sweep [1♀, CNC: CNC508546]. Ottawa, 80m, *45°23'26"N*, *75°42'16"W*, 3.vii.1951, O. Peck, Alder, Sweep [3♀, CNC: CNC506536–506538]. Uplands, Ottawa, *45°15'14"N*, *75°33'34"W*, 19.vi.1951, O. Peck, sweep, host plant: Sweet Clover [1♀, CNC: CNC506511]. **Lanark Co.**, 7 km S.W. Carleton Place, 143m, *45°06'28"N*, *76°12'53"W*, 4–10.v.1981, S. Miller [1♂, CNC: CNC506489]. 7 km SW Carleton Pl., 143m, *45°06'28"N*, *76°12'53"W*, 20–25.vii.1980, S. Miller [10♀, CNC: CNC506567–506575, 508550]. **P.E.I.:** 4 km SE Stanley Bridge, 951m, 46°26'27"N, 63°24'47"W, 30.viii.1992, J. Heraty [3♀, UCRC: UCRCENT108089, 108111, 108176]. Harrington, 42m, *46°20'54"N*, *63°10'3"W*, 24.vii.1989, M.E.M Smith, potato field, yellow pan trap [1♀, CNC: CNC508573]. Harrington, 42m, *46°20'54"N*, *63°10'3"W*, 5–19.vi.1989, M.E.M Smith, potato field, pan trap [1♂, CNC: CNC508571]. **Quebec:** Aylmer, 80m, *45°23'26"N*, *75°42'16"W*, 2.viii.1960, C.D. Miller, host: *Chrysoesthia sexguttella*, host plant: *Chenopodium album* [1♂, CNC: CNC508547]. Chimo (Kuujjuaq), 29m, *58°06'15"N*, *68°25'2"W*, 17–18.viii.1969, W.R.M. Mason [1♀, CNC: CNC506583]. Fairy Lake, 68m,

45°26'19"N, *75°45'5"W*, 3.vi.1959, T.N. Freeman, host: *Coleotechnites gibsonella* [2♀, CNC: CNC506581, 506582]. James Bay Hwy, km 547, 138m, *53°20'37"N*, *77°28'10"W*, vi.1985, H. Goulet & D.R. Smith [1♂, CNC: CNC508591]. Macdonald College, 33m, *45°24'31"N*, *73°56'7"W*, 17.vii.1962, R.P. Rottinger, host: *Lithocolletis* sp, host plant: apple [1♀, CNC: CNC506578]. Sainte Anne de Bellevue, 37m, *45°24'26"N*, *73°56'46"W*, 30.vi.1962, R.P. Rottinger, host: *Lithocolletis*, host plant: crab apple [1♀, CNC: CNC506512]. Sainte-Foy, 81m, *46°46'59"N*, *71°17'3"W*, 28.viii.1956, host: *Caliroa cerasi* [1♀, CNC: CNC506510]. **Yukon:** Alaska Hwy. E. of Haines Junction, 664m, 60°50'47"N, 137°09'3"W, 7.vii.2006, Goulet & Boudreault, sweeping, #4 [1♀, CNC: CNC508574-**D5320**]. **CROATIA: Osijek-Baranja**, Osijek, 91m, *45°33'18"N*, *18°41'51"E*, 1967, Arčanin [3♀, USNM: UCRCENT471329]. Osijek, 91m, *45°33'18"N*, *18°41'51"E*, 1974, I. Ciglar, host: *Stigmella malella* [2♀, BMNH: NHMUK10353541]. **CZECH REPUBLIC:** Prague, Kunratice, 2000m, *50°01'8"N*, *14°28'41"E*, 3.ix.1964, P. Mikula [1♀, BMNH: NHMUK10353543]. **FINLAND:** Viiala, 101m, *61°12'41"N*, *23°46'26"E*, 1968, J. Viramo [1♀, BMNH: NHMUK10264066]. **Northern Ostrobothnia:** Kuusamo, Kiutaköngäs, 159m, *66°22'3"N*, *29°19'43"E*, 1967, J. Viramo [1♀, BMNH: NHMUK10264048]. Kuusamo, Mäkelä, 240m, *66°24'41"N*, *29°02'21"E*, 1964, J. Viramo [1♀, BMNH: NHMUK10264046]. Kuusamo, Säynäjäjoki, 261m, *65°56'36"N*, *29°08'22"E*, 1964, J. Viramo [1♀, BMNH: NHMUK10264047]. Kuusamo, Taivalköngäs, 163m, *66°24'30"N*, *29°11'36"E*, 1966, J. Viramo [1♀, BMNH: NHMUK10264068]. **Southern Finland:** Heinola,

Vierumäki, 58m, *60°21'37"N*, *25°02'25"E*, 1964, J. Viramo [1♀, BMNH: NHMUK10264067]. Porvoo, Hinthaara, 36m, *60°24'9"N*, *25°28'49"E*, 1965, J. Viramo [1♀, BMNH: NHMUK10264121]. Riihimäki, 97m, *60°44'10"N*, *24°45'46"E*, 1964, J. Viramo [1♀, BMNH: NHMUK10264049]. **Hausjärvi**, Hikiä, 99m, *60°45'15"N*, *24°54'38"E*, 20.viii.1963, J. Viramo [3♂ 16♀, BMNH: NHMUK10264040, 10264050–10264060, 10264064, 10264069, 10264072, 10264076–10264079]. **Utsjoki:** Kevo Res. Station, 166m, 69°45'0"N, 27°00'0"E, 24.vi.1989, H. Goulet [1♂ 6♀, CNC: CNC506554–506558, 508553, 508554]. **Uusimaa:** Mäntsälä, Hautjärvi, 84m, *60°42'47"N*, *25°28'56"E*, 1966, J. Viramo [4♂ 10♀, BMNH: NHMUK10264041–10264045, 10264061–10264063, 10264065, 10264070, 10264071, 10264073–10264075]. **FRANCE: Hérault:** Lac du Salagou, *43°38'38"N*, *3°22'25"E*, 1.viii.1988, Boucek [1♀, BMNH: NHMUK10353772]. opposite Vic La-Gardiole, 8 m, *43°29'14"N*, *3°48'13"E*, 23.iv.1978, J.T. Huber [1♀, CNC: CNC506544]. **Var Department:** St. Tropez, 14m, *43°16'0"N*, *6°38'28"E*, 6.vi.1980, Boucek [1♀, BMNH: NHMUK10353776]. **GERMANY:** Blankenburg, 209m, *51°47'40"N*, *10°57'23"E* [1♀, USNM: UCRCENT471397]. **Baden-Wurttemberg: Breisgau-Hochschwarzwald**, Hartheim, 205m, *47°56'16"N*, *7°37'47"E*, 22.iii.1961, G.W. Angalet, host plant: *Pinus* sp [2♀, USNM: UCRCENT471312, 471313]. **HUNGARY:** 4.5 km SW Koszeg, Meszes Völgy, 120m, 47°22'0"N, 16°31'0"E, 26.vi.2010, J.S. Noyes, BMNH(Ent) 2010-63 [2♀, BMNH: NHMUK10734416, 10734417]. Ferto-Hansag Nemzeti Park, 120m, 47°42'0"N, 17°12'0"E, 24.vi.2010, J.S. Noyes, BMNH(Ent) 2010-63 [12♀, BMNH:

NHMUK10734404–10734415]. Hansag-Focsatarna Nemzeti Park, 128m, 47°40'0"N, 16°51'0"E, 24.vi.2010, J.S. Noyes, BMNH (Ent) 2010-63 [1♀, BMNH: NHMUK10734422-**D5101**]. Hanság-focsatorna Nemzeti Park, 128m, 47°40'0"N, 16°51'0"E, 24.vi.2010, J.S. Noyes, BMNH(Ent) 2010-63 [1♀, BMNH: NHMUK10734403]. **INDIA: Haryana: Hisar**, Hisar, 214m, *29°08'58"N*, *75°43'12"E*, ii.1984, V.K. Kale, host: *Phytomyza* sp [1♂, BMNH: NHMUK10353551]. **IRAQ: Baghdad:** Baghdad, 39m, *33°18'43"N*, *44°20'55"E*, 13.iii.1971, M. Younis, host plant: *Ziziphus* [1♂, BMNH: NHMUK10264082]. **IRELAND:** Harold's Cross, Dublin, 29m, *53°19'28"N*, *6°16'44"W*, 9.x.1955, A.W. Stelfox [1♀, USNM: UCRCENT471389]. **Leinster: Wicklow**, Drumgoff, 426m, *52°56'31"N*, *6°22'35"W*, 17.x.1942 [1♀, BMNH: NHMUK10353562]. **ITALY: Calabria**, Caulonia, 1345m, *39°18'31"N*, *16°20'46"E*, 23.xi.1995, D. Benfatto, host: *Phyllocnistis citrella* [1♀, ANIC: UCRCENT238534]. **Sardinia:** Villasimiusa, 32m, *39°08'45"N*, *9°30'56"E*, vi.1975, Boucek [1♂, BMNH: NHMUK10353790]. **JAPAN: Hokkaido: Chitose**, Bibi, 25m, *42°48'3"N*, *141°41'11"E*, 9–16.v.1996, N. Kagesawa, PAN TRAP [1♀, CNC: CNC508548]. **Honshu: Gifu Pref.**, 39m, *35°25'14"N*, *136°45'53"E*, 16.vi.1974, K. Kanamitsu, host: *Coleophora* [1♀, USNM: UCRCENT471314]. **KYRGYZSTAN: Chuy:** Thon-Aryk (Boz-Peldek Mt.) Bishkek, 42°46'55"N, 74°34'11"E, 12.vi.1999, C.H. Dietrich, vacuum, 99-006-05 [1♀, UCDC: UCRCENT477907]. **MEXICO: Oaxaca:** Oaxaca, Swimming pool, 1555m, *17°03'39"N*, *96°43'19"W*, C.M. Yoshimoto [1♂, CNC: CNC508567]. **MOROCCO:** High Atlas, Ourika Valley, 1000m, *31°19'20"N*, *7°45'18"W*, 27–30.i.1966, host:

galls, host plant: *Phillyrea angustifolia* [1♀, BMNH: NHMUK10353540]. Rabat, 81m, *33°58'21"N*, *6°05'48"W*, 22.ii.1932, S. Kozlovsky, host: leaf miner, host plant: *Cynara scolymus* (Asparagus) [1♀, BMNH: NHMUK10353589]. **NORWAY: Hordaland**, Odda, Røldal, 397m, *59°49'57"N*, *6°49'13"E*, 4.viii.1972, K.J. Hedqvist [1♀, BMNH: NHMUK10264171]. **Vestlandet: Sogn og Fjordane**, Aurland, 80m, *60°53'58"N*, *7°12'54"E*, 14.viii.1965, O. Heikinheimo [1♀, MZH: UCRCENT513245]. **PORTUGAL: Madeira:** Caniço, 142m, *32°38'55"N*, *16°50'2"W*, 12.v.1997, A. Polaszek, host: *Phyllocnistis citrella* [1♀, ANIC: UCRCENT238532]. **RUSSIA: Krasnodar Krai:** Krasnodar, 27m, *45°02'13"N*, *38°59'13"E*, 5.ix.1968, M. Jpuskoba, host: *Stigmella malella* [6♀, BMNH: NHMUK10353544–10353547, 10353553]. **Moskow Region:** Pushkinko District, Mamontovka Sosnovka, 145m, *55°59'46"N*, *37°49'54"E*, 5–16.v.2001, E. Ya. Shouvakhina, MALAISE TRAP [1♀, UCRC: UCRCENT279782]. **Primorski Kray:** Ussuriysk District, Gornotayozhnoye, 170m, 43°39'36"N, 132°15'0"E, 5–20.x.2002, M.V. Michalovskaya, PAN TRAP [1♀, UCRC: UCRCENT156180]. **Primorskii Krai:** Korpad, C. 170km E Vladivostok, Floodplain of Prjamushka, 174m, 43°15'52"N, 134°07'45"E, 20–27.vi.2001, M. Quest, malaise trap, BMNH (E) 2009-59 [1♂, BMNH: NHMUK10734423]. **SCOTLAND:** Haddington, Whittingehame, 102m, *55°57'14"N*, *2°38'11"W*, 28.ix.1915, A. Balfour, Bred by J.H. Durrant, host plant: *Quercus ilex* [4♀, BMNH: NHMUK10353582, 10353588, 10353591, 10353593]. **SPAIN:** Elche, 97m, *38°16'9"N*, *0°42'48"W*, vi.1995, host: *Phyllocnistis citrella* [1♀, ANIC: UCRCENT238533]. Madrid, El Escorial, 1012m,

40°35'13"N, *4°08'51"W*, 24.x.1978 [3♀, BMNH: NHMUK10353559, 10353782, 10371806]. Madrid, El Pardo, 613m, *40°31'6"N*, *3°46'28"W*, 18.x.1978, J.S. Noyes [1♀, BMNH: NHMUK10353773]. Sierra Nevada, 2517m, *37°05'0"N*, *3°09'55"W*, 9.vi.1977, B.R. Pitkin [1♀, BMNH: NHMUK10353784]. **Andalusia: Almería**, Almería, 79m, *36°50'37"N*, *2°28'6"W*, iii.1983, C.I.E.A. 14909 [1♀, BMNH: NHMUK10264081]. **Canary Islands: La Palma**, Breña Baja, Los Cancajos, 23m, *28°38'51"N*, *17°45'32"W*, 26.iii.1998, M. Koponen [1♀, MZH: UCRCENT513244]. **SWEDEN: Blekinge**, Karlskrona, 13m, *56°09'33"N*, *15°35'12"E*, 12.v.1964, K.J. Hedqvist [1♂, BMNH: NHMUK10264118]. Listerby, 24m, *56°11'40"N*, *15°24'23"E*, 11.v.1964, K.J. Hedqvist [2♀, BMNH: NHMUK10264115, 10264116]. Lyckeby, 19m, *56°12'2"N*, *15°38'59"E*, 12.v.1964, K.J. Hedqvist [1♂, BMNH: NHMUK10264114]. **Jämtland**, Mattmar, 369m, *63°18'12"N*, *13°54'4"E*, 16.vii.1968, A. Sundholm [2♀, BMNH: NHMUK10264132, 10264133]. **Kalmar**, Blå Jungfrun, 69m, *57°15'10"N*, *16°47'34"E*, 23.vii.1978, K.J. Hedqvist [1♀, BMNH: NHMUK10264117]. Öland, Räpplinge, Svarteberga stn., 36m, *56°50'34"N*, *16°39'35"E*, 1.iv.1974, B. Gustavsson [1♂ 3♀, BMNH: NHMUK10264085, 10264091, 10264092, 10264124]. Öland, Räpplinge, Svarteberga stn., 36m, *56°50'34"N*, *16°39'35"E*, 5.iv.1974, B. Gustavsson [1♀, BMNH: NHMUK10264097]. **Norrbotten**, Kvikkjokk, 315m, *66°57'0"N*, *17°43'28"E*, 6.vii.1971, K.J. Hedqvist [1♀, BMNH: NHMUK10264093]. Racksund, 423m, *66°02'38"N*, *17°37'25"E*, 4.vii.1971, K.J. Hedqvist [1♀, BMNH: NHMUK10264094]. **Skane**, Brösarp, 51m, *55°43'32"N*, *14°05'37"E*, 18.vi.1986, K.J. Hedqvist [1♀,

BMNH: NHMUK10264173]. Vä, 28m, *55°59'24"N*, *14°04'59"E*, 6.ix.1968, K.J. Hedqvist [1♀, BMNH: NHMUK10264174]. Vitemölla, 9 m, *55°42'0"N*, *14°12'12"E*, 14.vii.1973, K.J. Hedqvist [1♀, BMNH: NHMUK10264172]. Rörum, 17m, *55°37'56"N*, *14°14'56"E*, 8.ix.1972, K.J. Hedqvist [1♀, BMNH: NHMUK10264095]. **Stockholm**, Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 1.iv.1960, K.J. Hedqvist [1♀, BMNH: NHMUK10264120]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 10.i.1979, K.J. Hedqvist, host plant: *Populus tremula* [1♂, BMNH: NHMUK10264140]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 14.ix.1984, K.J. Hedqvist [1♀, BMNH: NHMUK10264143]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 16.ix.1986, K.J. Hedqvist [1♀, BMNH: NHMUK10353528]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 17.ix.1959, K.J. Hedqvist [1♂, BMNH: NHMUK10264086]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 2.iv.1954, K.J. Hedqvist [3♀, BMNH: NHMUK10264109, 10264134, 10264135]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 2.iv.1954, K.J. Hedqvist, host: *Rhabdophaga rosaria* [3♀, BMNH: NHMUK10264109, 10264134, 10264135]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 2.x.1953, K.J. Hedqvist [1♀, BMNH: NHMUK10264129]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 25.viii.1973, K.J. Hedqvist [1♀, BMNH: NHMUK10264098]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 30.ix.1979, K.J. Hedqvist [1♀, BMNH: NHMUK10264131]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 30.ix.1987, K.J. Hedqvist [2♀, BMNH: NHMUK10353533, 10353534]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 30.viii.1959, K.J. Hedqvist [1♀, BMNH: NHMUK10264130]. Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 5.x.1986, K.J. Hedqvist [1♀, BMNH: NHMUK10353529].

Vallentuna, 18m, *59°32'3"N*, *18°05'6"E*, 7.x.1979, K.J. Hedqvist [3♀, BMNH: NHMUK10264108, 10264110, 10264122]. **Stockholm Co.**, Frösunda, 28m, *59°22'13"N*, *18°00'48"E*, 15.vii.1983, Aeschlimann [1♀, BMNH: NHMUK10353530]. **Kalmar:** Oland, Kastlösa, 38m, *56°27'28"N*, *16°25'58"E*, 19.vi.1972, K.J. Hedqvist [1♀, BMNH: NHMUK10264119]. Oland, Mockelmossen, 26m, *56°31'41"N*, *16°31'11"E*, 31.v.1988, K.J. Hedqvist [1♀, BMNH: NHMUK10264142]. Värnanäs, 2m, *56°29'20"N*, *16°09'21"E*, 4.ix.1928, K.J. Hedqvist [1♀, BMNH: NHMUK10264164]. **Oskarshamn**, Virkvarn, 37m, *57°20'4"N*, *16°28'52"E*, 12.vii.1961, K.J. Hedqvist [1♀, BMNH: NHMUK10264104]. **Kronoberg:** Småland, Älmhult, 155m, *56°32'54"N*, *14°08'51"E*, 12.x.1978, K.J. Hedqvist [1♀, BMNH: NHMUK10264125]. **Oland:** Morbylanga kommun: Gamia Skogsby (Kalkstad) “diversitetsangen”, 42m, 56°37'0"N, 16°30'27"E, 25.vi–13.vii.2003, J. Liljeblad, in meadow with bushes, malaise trap, ParentID1638 [1♀, UCRC: UCRCENT312387]. **Skane:** Åhus, 8m, *55°55'22"N*, *14°18'11"E*, 14.vi.1986, K.J. Hedqvist [1♀, BMNH: NHMUK10264101]. Åhus, 8m, *55°55'22"N*, *14°18'11"E*, 20.vii.1964, K.J. Hedqvist [2♀, BMNH: NHMUK10264144, 10264170]. Åhus, 8m, *55°55'22"N*, *14°18'11"E*, 22.vii.1960, K.J. Hedqvist [1♀, BMNH: NHMUK10264126]. Åhus, 8m, *55°55'22"N*, *14°18'11"E*, 30.vii.1978, K.J. Hedqvist [1♀, BMNH: NHMUK10353536]. Åhus, 8m, *55°55'22"N*, *14°18'11"E*, 4.ix.1963, K.J.Hedqvist [1♀, BMNH: NHMUK10264090]. Fyledalen, 43m, *55°32'51"N*, *13°52'9"E*, 17.vii.1975, K.J. Hedqvist [1♂ 2♀, BMNH: NHMUK10264141, 10264166, 10264169]. Horna, 10m, *55°47'49"N*, *14°17'2"E*, 6.x.1982, K.J.

Hedqvist [1♀, BMNH: NHMUK10264089]. Juleboda, 18m, *55°46'7"N*, *14°10'59"E*, 14.vi.1996, K.J. Hedqvist [1♀, BMNH: NHMUK10264163]. Kullaberg, 85m, *56°17'47"N*, *12°28'0"E*, 20.vi.1964, K.J. Hedqvist [1♀, BMNH: NHMUK10264087]. Lund, 49m, *55°42'16"N*, *13°11'35"E*, 15.vii.1978, C. Hansson, host: *Agromyza demeijeri*, host plant: *Laburnum anagyroides* [1♀, USNM: UCRCENT471316]. Lund, 49m, *55°42'16"N*, *13°11'35"E*, 29.vi.1978, C. Hansson, host: *Paraphytomyza hendeliana*, host plant: *Lonicera* sp. [1♂, USNM: UCRCENT471317]. Mölle, 28m, *56°16'56"N*, *12°30'10"E*, 17.vi.1975, K-J Hedqvist [2♂ 2♀, 10264136, 10264137, 10264165, 10264167]. Rörum, 85m, *56°17'47"N*, *12°28'0"E*, 8.ix.1972, K-J. Hedqvist [1♀, BMNH: NHMUK10264096]. Stenshuvud, 45m, *55°39'23"N*, *14°15'57"E*, 4.ix.1982, K.J. Hedqvist [1♀, BMNH: NHMUK10264139]. Vitemölla, 10m, *55°42'0"N*, *14°12'11"E*, 24.vii.1973, K.J. Hedqvist [1♀, BMNH: NHMUK10264083]. **Stockholm:** Bergianska trädgården, 8m, *59°22'7"N*, *18°03'0"E*, 14.x.1979, B. Gustafsson [1♀, BMNH: NHMUK10264112]. Ursvik, 29m, *59°23'0"N*, *17°58'2"E*, 2.x.1929, B. Gustafsson [1♀, BMNH: NHMUK10264113]. **Uppland:** Riksmuseet, 25m, *55°22'9"N*, *18°03'21"E*, 1.iv.1974, B. Gustavsson [1♀, BMNH: NHMUK10264123]. Riksmuseet, 25m, *55°22'9"N*, *18°03'21"E*, 19.ix.1972, B. Gustavsson, host: *Nepticula*, host plant: *Salix* sp. [1♀, BMNH: NHMUK10264084]. Riksmuseet, 25m, *55°22'9"N*, *18°03'21"E*, 7.iv.1975, B. Gustavsson [1♀, BMNH: NHMUK10264102]. Riksmuseet, 25m, *55°22'9"N*, *18°03'21"E*, 8.iv.1975, B. Gustavsson [1♀, BMNH: NHMUK10264105]. Riksmuseet, 25m, *55°22'9"N*, *18°03'21"E*, 9.iv.1975, B.

Gustavsson [2♀, BMNH: NHMUK10264099, 10264100]. **Uppsala**, Ericksberg, 27m, *59°50'42"N*, *17°36'36"E*, 11–18.viii.1986, F. Ronquist, PAN TRAP/MALAISE TRAP, host: *Coptodisca arbutiella* [1♀, CNC: CNC506546]. Ericksberg, 27m, *59°50'42"N*, *17°36'36"E*, 31.viii–9.ix.1986, F. Ronquist, PAN TRAP/MT [1♀, CNC: CNC508549]. **Västerbotten: Västerbotten Co.**, Hallnas, 196m, *64°18'29"N*, *19°37'21"E*, 12.ix.1963, K. J. Hedquist [1♀, BMNH: NHMUK10264107]. Hallnas, 196m, *64°18'29"N*, *19°37'21"E*, 14.vi.1959, K. J. Hedquist [2♀, BMNH: NHMUK10264127, 10264128]. Hallnas, 196m, *64°18'29"N*, *19°37'21"E*, 18.viii.1982, K. J. Hedquist [1♀, BMNH: NHMUK10264175]. Hallnas, 196m, *64°18'29"N*, *19°37'21"E*, 2.vii.1960, K. J. Hedquist [1♀, BMNH: NHMUK10264138]. Hallnas, 196m, *64°18'29"N*, *19°37'21"E*, 2.viii.1940, K. J. Hedquist [2♀, BMNH: NHMUK10264162, 10264168]. Hallnas, 196m, *64°18'29"N*, *19°37'21"E*, 3.vii.1960, K. J. Hedquist [1♀, BMNH: NHMUK10353535]. **Västergötland:** Ångermanland, Norrfällsviken, 27m, *62°58'48"N*, *18°31'6"E*, 11.viii.1961, K.J. Hedqvist [2♀, BMNH: NHMUK10264106, 10264111]. Göteborg, Kungssten, Sjöbergen, 42m, *57°41'0"N*, *11°53'43"E*, 29.ix.1977, M. Soderlund, Primarily Birch deciduous forest [1♀, BMNH: NHMUK10353532]. Kinnekulle, Österplana, 154m, *58°34'26"N*, *13°25'24"E*, 12.vi.1980, K.J. hedqvist [1♀, BMNH: NHMUK10353531]. **SWITZERLAND: Graubünden:** Oberengadin, S-chanf, 1683m, *46°36'43"N*, *9°58'51"E*, 12.viii.1971, Aeschlimann, host: *Ocnerostoma piniariella* [1♀, BMNH: NHMUK10353554]. **Maloja**, Samedan, 1722m, *46°32'2"N*, *9°52'20"E*, 6.vii.1949, host: *Ocnerostoma copiosella* [2♀, CNC: CNC506551,

506552]. **Jura:** Delémont, CABI, 1254m, 47°15'2"N, 7°29'15"E, 7.vi.1999, Goulet, Spruce & beech, photoecclector [1♀, CNC: CNC508590]. Delemont, CABI, 47°22'23"N, 7°19'29"E, 9–16.v.2014, J. Squire, forest edge, MALAISE TRAP [1♀, CNC: CNC508568]. **Solothurn:** Hinter Wiessenstein, 1225m, 47°15'10"N, 7°30'0"E, 17.vi.1999, Goulet & White, lush meadow, Photoeclector [12♀, CNC: CNC508579–508589, 508649-**D4699**]. Hinter Wiessenstein, 1250m, 45°15'2"N, 7°29'15"E, 24.vi.1999, H. Goulet, cow meadow [1♀, CNC: CNC506559]. **TURKEY: Balikesir:** Gönen, 43m, *40°06'7"N*, *27°39'26"E*, xi.1974, Oncuer, host: *Phyllonorycter* sp, host plant: Apple [1♂ 1♀, BMNH: NHMUK10264146, 10353552]. **Mardin:** Derik, 807m, *37°22'0"N*, *40°16'3"E*, 11.x.2002, host plant: *Solanum melongena* [1♀, ANIC: UCRCENT238535]. **UK: England:** Hampton, 14m, *51°24'54"N*, *0°21'55"W*, vi.1964, Boucek [1♀, BMNH: NHMUK10353542]. London, Putney, 20m, *51°27'34"N*, *0°12'59"W*, vii.1915, G.J. Arrow, host: leaf miner, host plant: *Chrysanthemum* [1♀, BMNH: NHMUK10353598]. Mortimer Forest, 250m, *52°20'32"N*, *2°45'1"W*, 10.vi.1959, host: Egg of *Anoplonyx destructor*, host plant: Larch [1♂, BMNH: NHMUK10264151]. Mortimer Forest, 250m, *52°20'32"N*, *2°45'1"W*, 8.vi.1959, host: Egg of *Anoplonyx destructor* [1♀, BMNH: NHMUK10264145]. **Buckinghamshire**, Burnham Beeches, 80m, *51°33'32"N*, *0°37'52"W*, 4.x.1975, Z. Boucek [2♀, BMNH: NHMUK10353537, 10353560]. Burnham Beeches, 80m, *51°33'32"N*, *0°37'52"W*, 8.v.1976, Z. Boucek [1♀, ANIC: UCRCENT238531, BMNH: NHMUK10353538]. **Greater London**, Bedford Park W., 6m, *51°29'54"N*, *0°15'20"W*, vii–viii.1915, J. Waterston, host:

Leucoptera laburnella, host plant: *Laburnum anagyroides* [6♀, BMNH: NHMUK10353565, 10353590, 10353594–10353597]. Middlesex, S. Kensington, 7m, *51°29'33"N*, *0°10'23"W*, viii.1923, O.G. Heath, host: dipteran leaf miner pupa, host plant: Artichoke [15♂ 29♀, BMNH: NHMUK10264147–10264150, 10264152–10264161, 10353548–10353550, 10353555–10353558, 10353563, 10353564, 10353566–10353581, 10353583–10353587]. **Hampshire Co.**, Hollom Down, 85m, 51°06'52"N, 1°37'2"W, 30.viii.2014, S.V. Triapitsyn, roadside A30 hwy, sweep [1♀, UCRC: UCRCENT416918-**D4559**]. **Surrey**, Barnes Common, 9m, *51°27'58"N*, *0°14'43"W*, 12.ix.2009, J.S. Noyes [2♀, BMNH: NHMUK10734421, 10734424-**D5113**]. Esher Commons, 38m, *51°20'56"N*, *0°23'3"W*, 30.v.1970, Z. Boucek [1♀, BMNH: NHMUK10353539]. Richmond Park, 32m, *51°26'31"N*, *0°16'59"W*, 1.ix.2009, J.S Noyes [2♂ 1♀, BMNH: NHMUK10734418–10734420]. **Surrey Co.**, Box Hill near Dorking, *51°15'13"N*, *0°18'45"W*, 4.ix.1988, J.S. Noyes [1♀, UCDC: UCRCENT477947]. **USA: Alaska: Denali**, Cantwell, Denali Hwy. Rt. 8 mi. 85–130, 701–915m, *63°02'59"N*, *145°55'51"W*, 24.vii.1984, S. & J. Peck, Car Net [6♀, CNC: CNC506539–506542, 506548, 508551]. **Arizona: Cochise Co.**, Chiricahua Mts, SWRS swimming pool, 1525m, *31°53'1"N*, *109°12'19"W*, 5.v.1980, V. Roth [1♂, CNC: CNC506579]. Hwy 80, E of Douglas, 1336m, 31°41'58"N, 109°07'35"W, 2.viii.2003, J. Heraty, *Chilopsis* & weeds, H03-077 [1♂, UCRC: UCRCENT416571]. **California: Contra Costa Co.**, Tilden Regional Park, off Nimitz trail, 323m, 37°54'49"N, 122°15'7"W, 5–6.vii.2002, A. Owen & T. Kim, Oak Scrub, PAN TRAP [1♀, UCRC: UCRCENT414587-**D3993**]. **Inyo Co.**, 22 mi

W Panamint Springs, 1433m, *36°20'1"N*, *117°44'13"W*, 7.v.1961, D.Q. Cavagnaro [1♂, UCDC: UCRCENT477849]. 31km ENE Big Pine, 1551m, *37°20'38"N*, *118°01'34"W*, 25.v.1994, S.L. Heydon, off *Encelia* [1♂, UCDC: UCRCENT477845]. Independence, 1185m, *36°48'12"N*, *118°12'1"W*, 3.ix.1968, S.E. Flanders, host: *Rhynchaenus*, host plant: Birch [1♀, UCRC: UCRCENT416535]. **Los Angeles Co.**, Claremont, 366m, *34°05'52"N*, *117°42'43"W*, Stahl, host: *Aleyrodes* sp (questionable host reference), host plant: *Ceanothus* [1♀, USNM: UCRCENT471396]. Claremont, 366m, *34°05'52"N*, *117°42'43"W*, Stahl, host: leaf miner, host plant: *Ceanothus* [2♀, USNM: UCRCENT471394–471395]. Claremont, 366m, *34°05'52"N*, *117°42'43"W*, Stahl, host: leaf miner, host plant: *Rhamnus californica* [2♂, USNM: UCRCENT471392–471393]. Compton, 23m, *33°53'41"N*, *118°13'02"W,* 1.iii.1912, Graf, "Bred from material *Aleyrodes*" questionable host reference, as no *Cirrospilus* or *Burkseus* species has been recorded as a parasitoid of Hemiptera) [1♂ USNM: Type No. 15632/USNMENT 01025272–Type of *Zagrammosoma nigrolineatum* Crawford]. Los Angeles, *34°03'1"N*, *118°12'37"W*, vi.1920 [1♀, UCRC: UCRENT00485756]. San Dimas Canyon, 4km from Foothill Blvd, 406m, *34°09'7"N*, *117°46'22"W*, 18.xii.1979, D. Bramlet [1♀, UCRC: UCRCENT416536]. San Dimas Canyon, 4km from Foothill Blvd, 406m, *34°09'7"N*, *117°46'22"W*, 9.vi.1979, D. Bramlet [1♀, UCRC: UCRCENT498916]. San Dimas Cyn. Rd., 2 mi N Foothill Blvd., *34°08'51"N*, *117°46'33"W*, 18.xii.1977, D. Bramlet [4♂ 2♀, UCRC: UCRCENT499469–499474]. San Pedro; 3171 N. Gaffey Rd. Defense Fuel

Support Point, 8m, 33°46'33"N, 118°17'46"W, 27.xii.2001–13.i.2002, J. George, Coastal sage scrub, malaise trap [1♀, UCRC: UCRCENT485759]. Shinn Rd. @ Lower San Antonio USFS Sta. Angeles National Forest, 760m, *34°10'44"N*, *117°40'32"W*, 31.xii.1977, D. Bramlet [2♀, UCRC: UCRCENT498917, 498918]. Westwood Hills, 148m, *34°04'16"N*, *118°27'32"W*, iv.1941, R.M. Bohart, Ex: Acc. 136 [3♀, UCDC: UCRCENT477904–477906]. **Mendocino Co.**, 10 km S Westport, 2m, *39°32'50"N*, *123°45'46"W*, 7.vii.1997, dune vegetation [1♂, UCDC: UCRCENT415831]. **Monterey Co.**, King City, 99m, *36°12'34"N*, *121°07'43"W*, 30.vii.1959, Miedlehauff, host: *Stigmella* sp. [1♀, USNM: UCRCENT471320]. **Orange Co.**, Anaheim, 48m, *33°50'10"N*, *117°54'44"W*, 14.viii.1930, S. Flanders, host: leaf miner, host plant: Sycamore [1♀, UCRC: UCRCENT485761]. **Riverside Co.**, Ag-Ops BC Grove (UCR), 346m, *33°58'21"N*, *117°19'5"W*, 11.x.2007, R. Luck, #30, host: *Phyllocnistis citrella*, host plant: lemon [1♀, UCRC: UCRCENT275274]. Ag-Ops, 305m, 33°58'20"N, 117°20'21"W, 1.xi.2008, R. Luck, #32, host: *Phyllocnistis citrella*, host plant: grapefruit [1♂ 1♀, UCRC: UCRCENT491701, 491703]. Ag-Ops, 305m, 33°58'20"N, 117°20'21"W, 1.xi.2008, R. Luck, #32, host: *Phyllocnistis citrella*, host plant: lemon [1♂ 1♀, UCRC: UCRCENT491701, 491703]. Ag-Ops, 305m, 33°58'20"N, 117°20'21"W, 23.ix.2007, R. Luck, #28, host: *Phyllocnistis citrella*, host plant: lemon [1♂, UCRC: UCRCENT292589]. Bautista Rd at Tripp Flats Road, 1170m, 33°36'16"N, 116°44'20"W, 15.v.2011, R.L. Zuparko, host plant: *Adenostoma sparsifolium* [1♀, EMEC: EMEC84319]. Harford Springs Park, 623m, 33°48'6"N, 117°20'41"W,

26.iii.2010, D. Yanega, open scrub and grassland, sweep [1♀, UCRC: UCRCENT323219]. Lake Skinner, NE end, 487m, 33°36'7"N, 117°02'5"W, 21.v–4.vi.1996, J.D. Pinto, coastal sage scrub, malaise trap, MET B11 BURNED [2♀, UCRC: UCRCENT485749, 485750]. Menifee Vly. (hills on W. end), 549m, 33°39'0"N, 117°13'0"W, 1–29.ii.1996, J.D. Pinto, MT [2♀, UCRC: UCRCENT485762, 485763]. Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W, 31.viii–7.ix.2008, G. Pratt, malaise trap [2♀, UCRC: UCRCENT357523-**D3665**, 357524-**D3666**]. Thermal Plaza nursery, -44m, *33°28'5"N*, *116°06'4"W*, 29.xi.2006, R. Luck, #25, host: *Phyllocnistis citrella*, host plant: grapefruit [2♂, UCRC: UCRCENT491702, 491704]. UC Motte Reserve, W of Perris, *33°48'2"N*, *117°15'18"W*, 18–25.ii.1997, M. Gates & D. Hawks, MALAISE TRAP [2♀, UCRC: UCRCENT485757, 485758]. **San Bernardino Co.**, 9 air mi S Baker, Sand Dunes, S Zzyzx Springs, 284m, *35°08'12"N*, *116°06'23"W*, 27.iv.1977, Ulrich, malaise trap [1♀, EMEC: EMEC84188]. Mormon Rocks, Hwy 138, 1034m, 34°19'10"N, 117°30'16"W, 8.v.2013, R. Perry, sweep [1♂, UCRC: UCRCENT485753]. Ontario, 308m, *34°03'55"N*, *117°39'3"W*, 16.v.1938, Christenson & Clancy, #6800 [1♀, USNM: UCRCENT471390]. **San Diego Co.**, Coachella Valley, 43m, *33°43'33"N*, *116°08'57"W*, 22.vii.2003, N. Smart, ex *Marmara gulosa* on grapefruit, reared [3♀, UCRC: UCRCENT416574–416576]. Collins Valley, Coyote Canyon Rd., 411m, *33°22'55"N*, *116°26'59"W*, 23.iii.1997, M. Gates & D. Hawks [1♂ 1♀, UCRC: UCRCENT416572, 416573]. Pauma, Rutz grove, 374m, *33°20'14"N*, *116°58'57"W*, 16.vii.2008, T. Shea, *Phyllocnistis citrella*

on Valencia, #34 [1♂, UCRC: UCRCENT275023-**D4173**]. Pauma, Rutz grove, 374m, *33°20'14"N*, *116°58'57"W*, 17.vii.2006, T.Shea, *Phyllocnistis citrella* on Eureka, #26 [2♀, UCRC: UCRCENT275097, 275099-**D4177**]. Pauma, Rutz grove, 374m, 33°20'14"N, 116°58'57"W, 6.vii.2006, T. Shea, host: *Phyllocnistis citrella*, host plant: Eureka lemon [1♂, UCRC: UCRCENT292751]. Pauma, Rutz grove, 374m, 33°20'14"N, 116°58'57"W, 8.viii.2006, P. Pacheco, #8, host: *Phyllocnistis citrella*, host plant: grapefruit [2♂, UCRC: UCRCENT275035, 292677]. San Diego, 57m, *32°44'0"N*, *117°08'33"W*, 1.xi.1972, Buckner & Kenyon [3♀, USNM: UCRCENT471386–471388]. **San Luis Obispo Co.**, Cal Poly, 84m, *35°18'0"N*, *120°40'2"W*, 16.ix.2010, R. Perry, reared [1♂, UCRC: UCRCENT312400]. nr. Cal Poly SLO, 85m, *35°18'4"N*, *120°40'2"W*, 17.ix.2010, R. Perry, reared, host plant: *Ailanthus altissima* [1♀, UCRC: UCRCENT355648-**D3640**]. **San Mateo Co.**, San Bruno Mtns. Radio Tower Rd., 315m, *37°41'25"N*, *122°26'23"W*, 1.ii.1981, D. L. Wagner, JAP 81A20, host: *Stigmella* sp., host plant: *Ceanothus* [1♂, USNM: UCRCENT471292]. **Santa Barbara Co.**, Buellton, 103m, *34°36'27"N*, *120°11'33"W*, 4.i.1983, H.E. Andersen, sweep [1♂ 1♀, UCRC: UCRCENT485751, 485752]. **Santa Clara Co.**, Stanford University, 25m, *37°25'44"N*, *122°10'6"W*, 16.v.1950, G. Ferris [1♀, USNM: UCRCENT471391]. **Santa Cruz Co.**, hills btw Corralitos and Pleasant Valley, 122m, *36°59'23"N*, *121°49'3"W*, 21.viii.1982, J.B. Woolley, host: *Nepticula* sp., host plant: *Prunus nigra* [1♂, CNC: CNC506782]. **Tulare Co.**, 1/4-mile E Ave. 304 & Rd. 196, Kikpatrick, 125m, 36°20'26"N, 119°07'46"W, 19.xi.2009, S. Kharrat, host: *Phyllocnistis citrella*, host plant: citrus

[1♂, UCRC: UCRCENT292529]. 1/4-mile E Ave. 304 & Rd. 196, Kikpatrick, 125m, 36°20'26"N, 119°07'46"W, 3.xii.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Citrus [2♂, UCRC: UCRCENT237323, 237324]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Citrus [5♂, UCRC: UCRCENT237318, 237321, 237325, 237319, 491709]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Pomelo [5♂, UCRC: UCRCENT237318, 237321, 237325, 237319, 491709]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host: *Marmara gulosa*, host plant: Citrus [5♂, UCRC: UCRCENT237318, 237321, 237325, 237319, 491709]. Lindcove Station Block 46, 154m, 36°21'19"N, 119°03'22"W, 18.xi.2009, S. Kharrat, host plant: Thong De [5♂, UCRC: UCRCENT237318, 237321, 237325, 237319, 491709]. **Ventura Co.**, Oxnard/Central & Rose NE, 34m, *34°14'51"N*, *119°08'33"W*, 30.vii.2008, Tom Roberts, *Phyllocnistis citrella* on Eureka lemons (bulk), rearing, #35 [1♀, UCRC: UCRENT00001418]. Santa Paula, 85m, *31°21'14"N*, *119°03'36"W*, 24.iv.1996, C.T. Dodds, host: leaf miner, host plant: Sycamore [1♂ 1♀, UCRC: UCRCENT485754, 485755]. **Colorado:** “1094” [1♀, USNM: UCRCENT471474]. **Boulder Co.**, 1 km NW Allenspark, 2625m, *40°11'54"N*, *105°32'19"W*, 12.vii.1993, S.L. Heydon [1♂, UCDC: UCRCENT477844]. **Clear Creek Co.**, Mt. Evans Wildlife Area, 2535m, *39°37'7"N*, *105°28'28"W*, 2.vii.2008, E. Drake, yellow pan trap [1♀, UCRC: UCRCENT319054]. **Grand Co.**, Rollins Pass Rd. 49km E Winter Park, 3290m,

39°54'0"N, 105°43'0"W, 3.viii.1999, S.L. Heydon, off Willow by Pond [3♀, UCDC: UCRCENT477846–477848]. **Park Co.**, along Fish Creek, 6 km S Lake George, 2565m, *38°55'18"N*, *105°20'52"W*, 7.viii.1992, S.L. Heydon, *Salix*, sweep [1♂, UCDC: UCRCENT477903]. **Teller Co.**, 7 mi. N Woodland Park, South Meadows Camp, 2389m, *39°03'52"N*, *105°05'49"W*, 21–28.vii.1977, S.J. Peck, willows along stream edge, MALISE TRAP [1♀, CNC: CNC508592]. **Hawaii: Honolulu**, Kaimuki, 62m, *21°16'43"N*, *157°48'3"W*, 1.iv.1922, host: Gracillaridae, host plant: *Xanthium* [1♂ 2♀, UCRC: UCRCENT416532–416534]. Kaimuki, 62m, *21°16'43"N*, *157°48'3"W*, 1.v.1922, host: Gracillaridae, host plant: *Xanthium* [2♂ 5♀, UCRC: UCRCENT416525–416531]. **Maui**, Mapulehu, 12m, *21°04'10"N*, *156°48'35"W*, 26.vi.1956, J.W. Beardsley, host: leafminer, host plant: Lantana [1♀, CNC: CNC506543]. **Idaho:** Targhee, 1848m, *44°15'51"N*, *111°17'6"W*, 16.vii.1953, J.H. McLeod, host: leafminer, host plant: Cottonwood [1♂ 5♀, CNC: CNC506561–506566]. **Maine: Hancock Co.**, Bar Harbor, 17m, *44°23'10"N*, *68°12'23"W*, 17.vii.1933, host: leaf miner (Lep.), host plant: *Thuja occidentalis* [1♀, USNM: UCRCENT471318]. Mt. Desert Island, 93m, *44°20'40"N*, *68°17'43"W*, 2.ix.1931, host: *Heterarthrus nemoratus* [1♂, USNM: UCRCENT471429]. Mt. Desert Island, 93m, *44°20'40"N*, *68°17'43"W*, 23.viii.1931, host: *Heterarthrus nemoratus* [1♂, USNM: UCRCENT471428]. **Penobscot Co.**, Dexter, 147m, *45°01'24"N*, *69°17'16"W*, 22.vi.1949, 49B22, host plant: *Thuja occidentalis* [2♀, USNM: UCRCENT471319]. Indian Town, 30m, *43°51'43"N*, *69°40'4"W*, 2.vi.1950, A. E. Brower, host plant: Poplar log [2♀, USNM: UCRCENT471321]. **Montana:**

Silver Bow Co., Butte, 1662m, *45°59'21"N*, *112°31'39"W*, 23.vii.1983, J.D. Pinto [1♀, UCRC: UCRCENT416524]. **Nevada: Washoe Co.**, 6 km E Washoe City, 2400m, 39°20'0"N, 119°52'10"W, 29.vi.2003, S.L. Heydon [2♀, UCDC: UCRCENT477901, 477902]. nr Mt. Rose Summit, 5 km NE Incline Village, 2680m, 39°18'28"N, 119°54'31"W, 29.vii.2003, S.L. Heydon [15♀, UCDC: UCRCENT477888–477900, 477909, 477910]. **White Pine Co.**, 45 km SSE Eureka, 2164m, *39°24'0"N*, *115°30'0"W*, 19.vii.1995, S.L. Heydon & R.M. Bohart [1♂, UCDC: UCRCENT415837]. **New Hampshire: Coös Co.,** Mount Washington, 1676m, *44°16'39"N*, *71°18'43"W*, 20.viii.1981, H. Goulet [1♀, CNC: CNC506577]. **New York:** In mined leaf, Carnation from Italy. By Plane, 22m, *40°46'5"N*, *73°58'25"W*, 22.iii.1950, ID Lot No. 50-2587, host plant: Carnation [1♀, USNM: UCRCENT471324]. **NY: Essex Co.**, Whiteface Mtns. summit 4800', 1463m, *44°21'58"N*, *73°54'13"W*, 30.vii.1979, E. E. Grissell & M. E. Schauff [1♀, USNM: UCRCENT471315]. **Oregon: Harney Co.**, 25 mi. N Fields, (road 205), 1403m, *42°33'18"N*, *118°56'31"W*, 9.vii.1999, J.D. Pinto, sweep [1♂, UCRC: UCRCENT416551]. **Lane Co.**, H.J. Andrews Exp. For. (Road 320), 692m, *44°14'55"N*, *122°11'33"W*, 17.viii.1984, M.E. Schauff & E.E. Grissell, Spiraea-Acer bog [1♀, USNM: UCRCENT471322]. H.J. Andrews Exp. For. Frissell Point, 1479m, *44°12'57"N*, *122°06'3"W*, 15.viii.1984, M.E. Schauff & E.E. Grissell, meadow [1♀, USNM: UCRCENT471323]. **Utah: San Juan Co.**, Abajo Mts., 4.2 mi SE Indian Creek, 2621m, *37°53'41"N*, *109°28'11"W*, 27.vi.1993, J.D. Pinto, sweep [1♂ 1♀, CNC: CNC506547, 506549]. **Washington Co.**, Snow canyon St.

Park ~1 mi. N Ivins, 986m, *37°11'37"N*, *113°38'47"W*, 29.iii.1989, J.D. Pinto, habitat: *Rhus*, Oak, *Fraxinus* [3♂, CNC: CNC508575, 508640, 508641]. **Virginia: Madison Co.**, Big Meadows, Shenandoah Nat. Park, 1061m, *38°30'58"N*, *78°26'9"W*, H. Goulet, meadow, sweep [1♀, CNC: CNC506553]. **Washington: Pierce Co.**, Puyallup, 43m, *47°10'32"N*, *122°18'28"W*, 28.viii.1948, L.L. Stitt [2♀, USNM: UCRCENT471382–471385]. **Wisconsin: Wood Co.**, Wisconsin Rapids, 322m, *44°22'48"N*, *89°47'38"W*, viii.1974, L.R. Lyons, host: eggs of *Neodiprion nanulus*, host plant: Red pine [2♀, CNC: CNC506585, 506586].

***Cirrospilus* sp. A (D3865: 3866):**

AUSTRALIA: Western Australia: D'Entrecasteaux N.P., Tookulup, Clifftop Walk, 71m, 34°49'55"S, 115°59'57"E, 8.xii.2009, J. Mottern, sweep, M09-101 [2♀, UCRC: UCRCENT414581-**D3865**, 414582-**D3866**].

***Cirrospilus* sp. B (D5106):**

AUSTRALIA: Australian Capital Territory: Namadgi N. Pk., Brindabella Mtns., Blundells Crk. Rd., 810m, 35°21'26"S, 148°50'1"E, 13.ii.1999, G. Gibson [1♀, CNC: CNC485176-**D4977**]. Namadgi N. Pk., Brindabella Mtns., Blundells Cr. Rd., 810m, 35°21'26"S, 148°50'1"E, 28.ii.1999, G. Gibson [CNC: CNC508561-**D5106**].

***Diglyphus begini* (Ashmead), 1804:**

USA: Utah: Grand Co., Green River along Hwy 70, 1223m, 38°59'42"N, 110°08'45"W, 10.v.2002, Buffington & Munro, disturbed riparian vegetation, sweeping [2♀, UCRC: UCRCENT414573-**D3857**, 414574-**D3858**].

***Diglyphus isaea* (Walker), 1838:**

USA: Texas: Hidalgo Co., S. of F.M. 2221 on Iowa Rd., 62m, 26°19'32"N, 98°24'34"W, 13.iv.2010, J. Mottern, acacia/mesquite scrub, sweep, M10-014 [1♀, UCRC: UCRCENT357540-**D3682**]

***Diglyphus* sp. (D3789):**

USA: California: Los Angeles Co., Angeles National Forest, 1614m, 34°15'19"N, 117°38'28"W, 16.vi.2009, J. Mottern, sweep, M09-010 [1♀, UCRC: UCRCENT410527-**D3789**].

***Zagrammosoma americanum* Girault, 1916:**

USA: California: Riverside Co., Whitewater, Canyon Rd. Dr., 546m, 33°57'30"N, 116°38'50"W, 18.vi.2013, R.K. Perry, sweep, RP13-008 [1F♀, UCRC: UCRCENT312379-**D4117**]. **New Mexico: Otero Co.**, Sacramento Mtns, High Rolls, 2123m, 32°57'0"N, 105°49'0"W, 1–10.v.2004, M.E. Irwin, dry wash, malaise trap [2F♀, UCRC: UCRCENT357528-**D3670**, 357529-**D3671**].

***Zagrammosoma hobbesi*, LaSalle, 1989:**

USA: California: San Bernardino Co., Mormon Rocks, Hwy 138, 1034m, *34°19'10"N*, *117°30'16"W*, 8.v.2013, R. Perry, sweep [1♀, UCRC: UCRCENT395931-**D3703**]. San Bernardino Natl. Forest, 985m, 34°06'2"N, 117°01'29"W, 7.iv.2014, R. Perry, RP14/005, sweep [1♀, UCRC: UCRCENT414594-**D4000**].

***Zagrammosoma* sp. (D3660, 4576):**

USA: California: Imperial Co., Hwy 98, nr. Sunrise Butte, 103m, 32°40'21"N, 115°50'57"W, 18.iii.2010, J. Mottern, desert scrub, sweep, M10-002 [1♂, UCRC: UCRCENT312429-**D4578**]. **Riverside Co.**, Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W, 31.vii–i7.ix.2008, G. Pratt, malaise trap [2♀ UCRC: UCRCENT357518-**D3660**, 312427-**D4576**].

***Zagrammosoma mirum* Girault, 1916:**

USA: California: Riverside Co., Terwilliger Rd. S. of Anza, 1269m, 33°27'32"N, 116°38'10"W, 31.viii–7.ix.2008, G. Pratt, malaise trap [1♀, UCRC: UCRCENT357526-**D3668**]. Whitewater, Canyon Rd. Dr., 546m, 33°57'30"N, 116°38'50"W, 18.vi.2013, J. Mottern, sweep, M13-025 [1♀, UCRC: UCRCENT410536-**D3840**].

Extra material examined: additional outgroup analysis

***Cirrospilus* incertae sedis: *Cirrospilus margiscutellum* (Girault), 1939**

AUSTRALIA: Victoria: Melbourne, 17m, *37°49'46"S*, *144°58'47"E*, 19.xii.1989, R. Wharton, ex: eucalyptus blotch mine [1♀, TAMU: UCRCENT426766-**D4662**]

***Cirrospilus* sp.**

AUSTRALIA: Australian Capital Territory: Canberra, Black Mountain, 35°16'0"S, 149°06'0"E, 7–13.xii.1998, G. Gibson, yellow pan trap [1♀, CNC: CNC508556-**D5100**]. **West Australia:** Stirling Range N.P., scenic lookout, 379m, 34°25'20"S, 117°55'59"E, 4.xii.2009, J. Mottern, sweep, M09-066 [1♀, UCRC: UCRCENT312386-**D4154**].

***Cirrospilus* s.s.:**

***Cirrospilus cinctithorax* (Girault), 1916**

USA: California: San Luis Obispo Co., Cal Poly SLO, lemon grove, 84m, 35°17'41"N, 120°40'15"W, 2.viii.2010, R.K. Perry, swp, RP10-008 [1♂, UCRC: UCRCENT414586-**D3879**].

***Cirrospilus* sp.**

ARGENTINA: Salta: 29 km NE Cafayate, 1525m, *25°58'49"S*, *65°45'2"W*, 2–4.x.2009, M.E. Erwin, in river basin, malaise [1♀, UCRC: UCRCENT395935-**D3751**]. **AUSTRALIA: West Australia:** D'Entrecasteaux N.P., Coastal Survivors Walk, 105m, 34°50'19"S, 116°00'17"E, 8.xii.2009, R. Waterworth, sweep, M09-100 [1♀, UCRC: UCRCENT414583-**D3867**]. **UK: England: Surrey**, Barnes

Common, 9m, *51°27'58"N*, *0°14'43"W*, 28.vii.2015, N. Dale-Skey, swp [1♀, BMNH: NHMUK10734436-**D5965**].

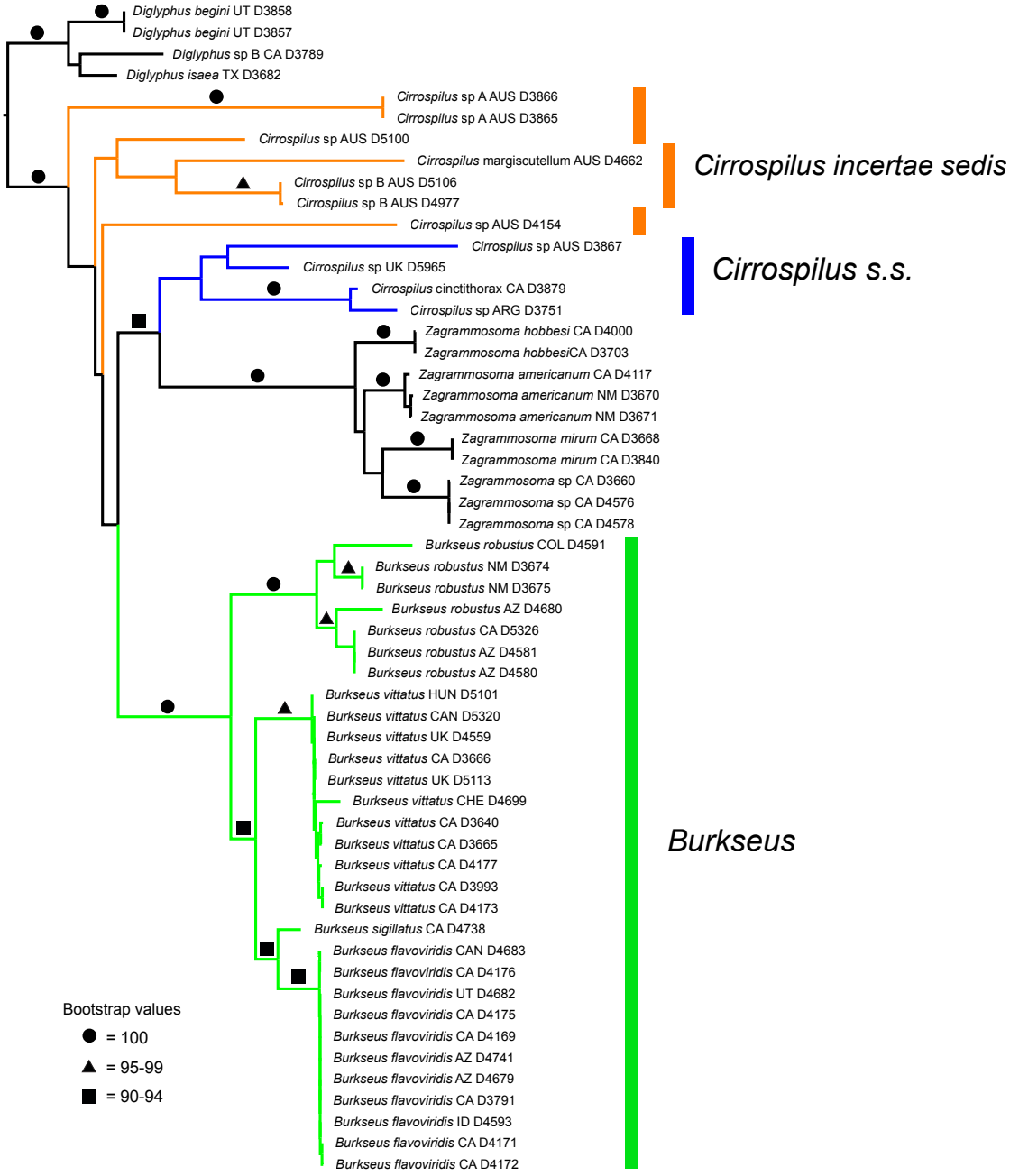

Fig. S1.1. Higher-level ML tree, using 4 gene regions: 28S D2, 28S D3-5, ITS2, COI.

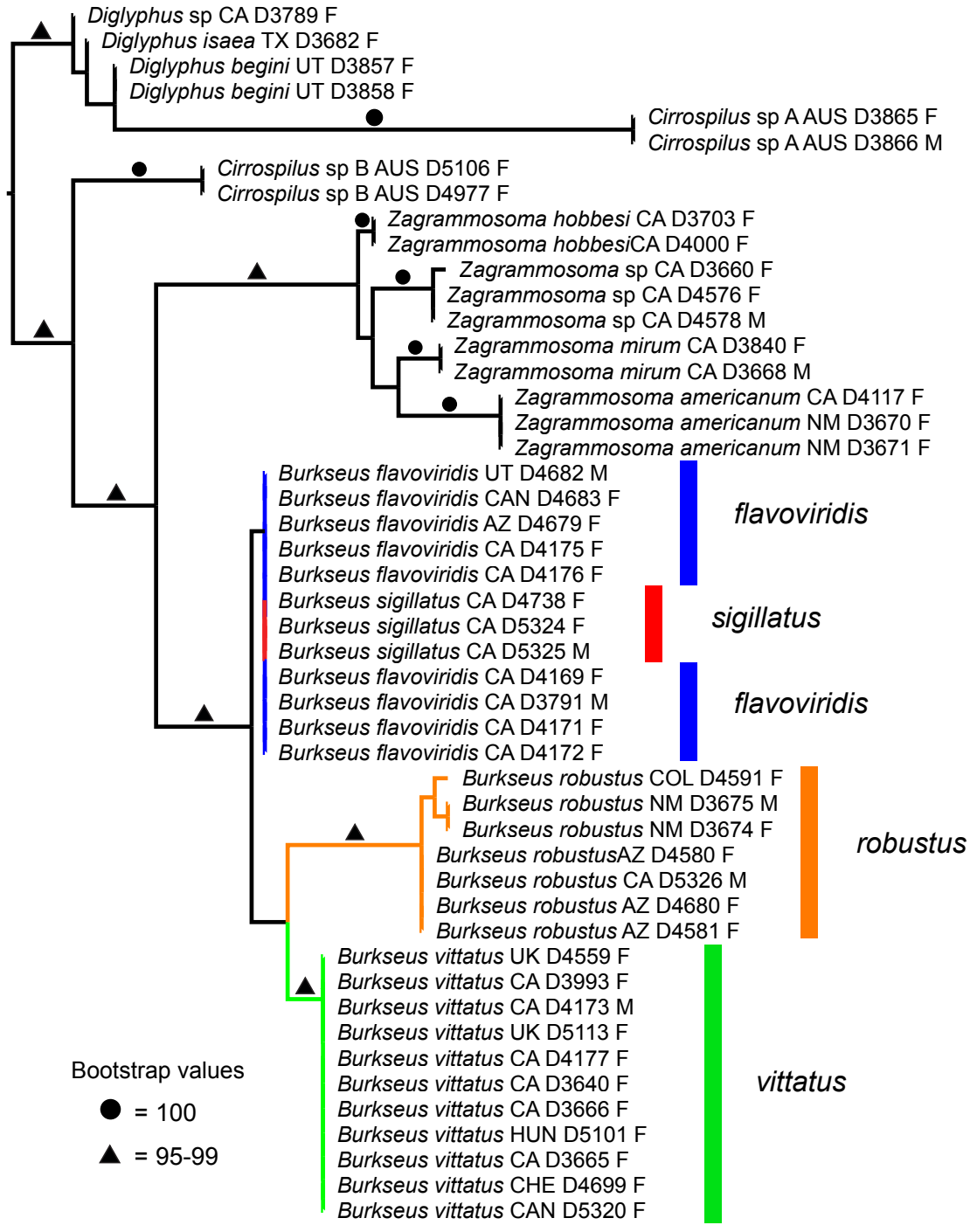

Fig. S1.2. 28S D2 + D3-5 ML tree.

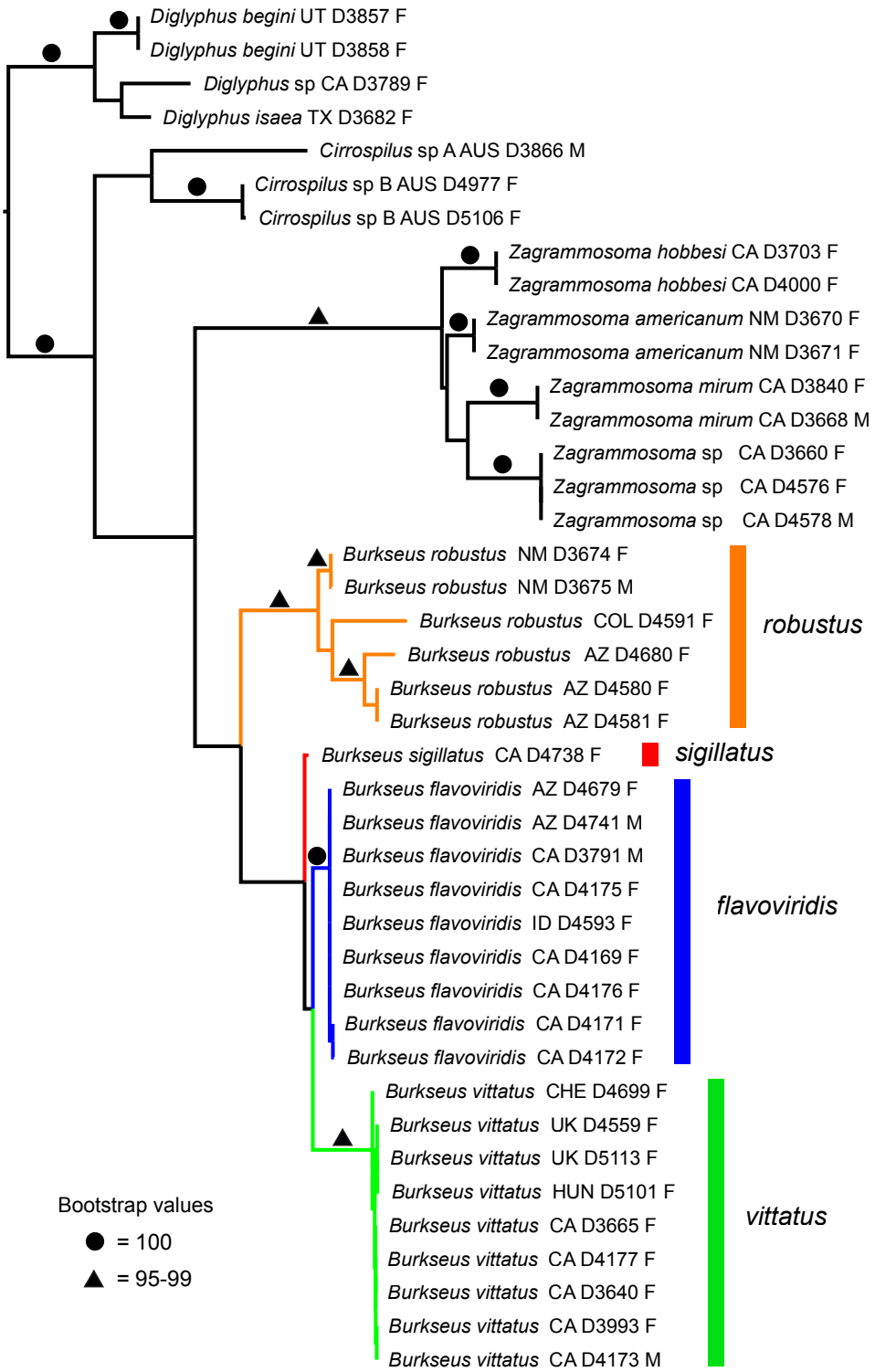

Fig. S1.3. ITS2 ML tree.

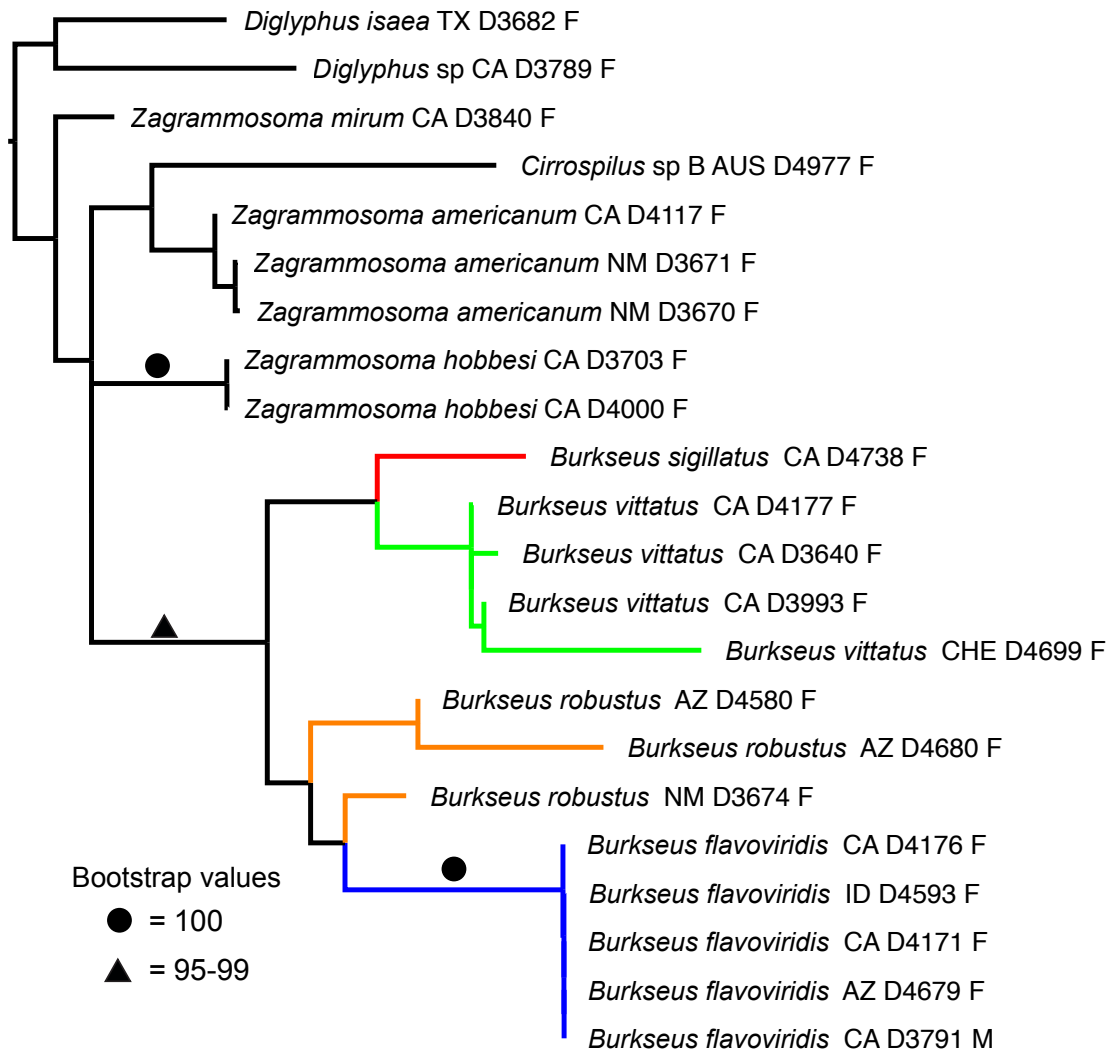

Fig. S1.4. COI ML tree.

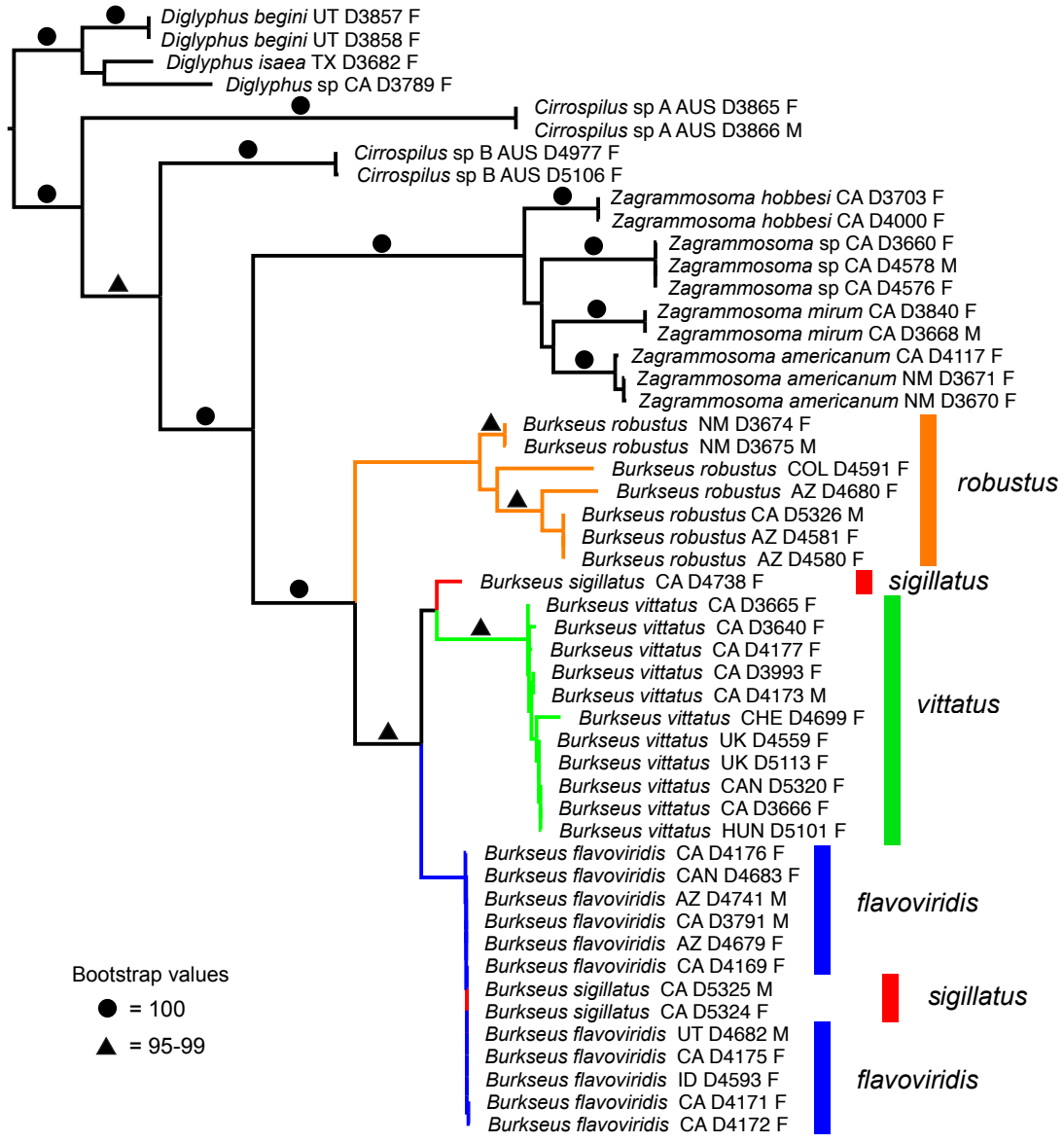

Fig. S1.5. ML tree of all gene regions: 28S D2, 28S D3-5, ITS2, COI.

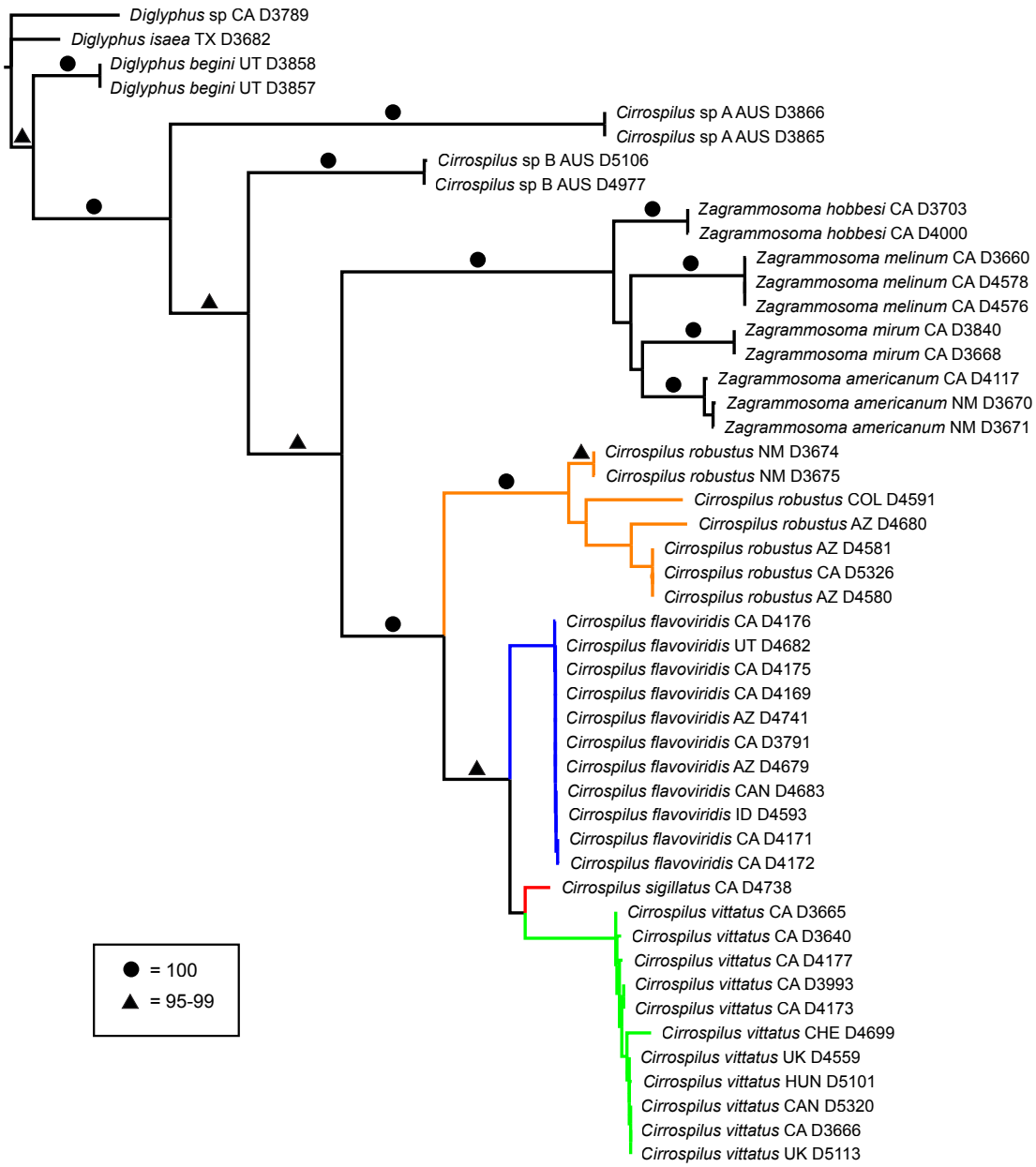

Fig. S1.6. Four gene molecular ML tree with *Burkseus sigillatus* **n. sp.** specimens D5324 and D5325 removed.

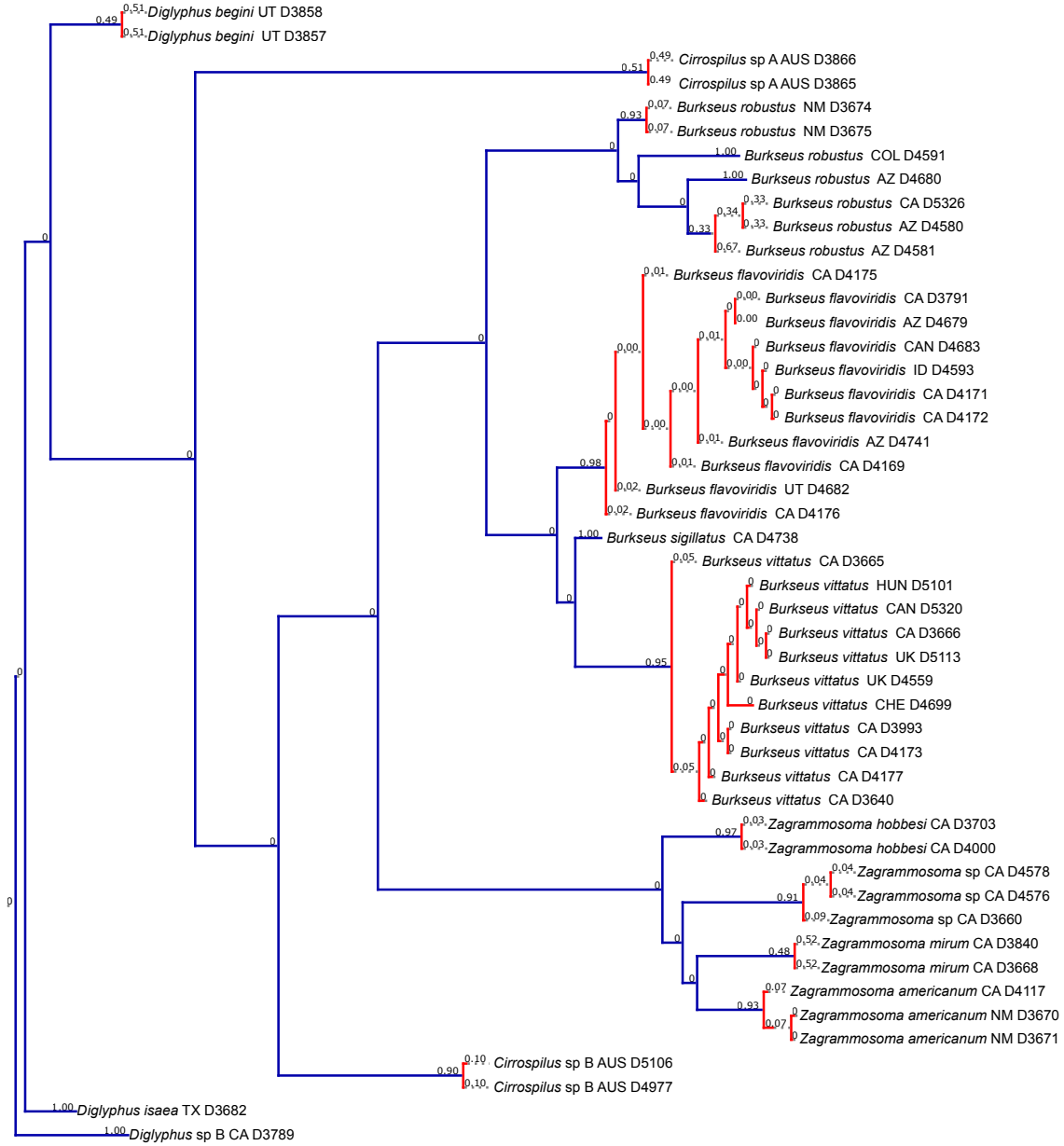

Fig. S1.7. bPTP results, with *Burkseus sigillatus* **n. sp.** specimens D5324 and 5325 removed. This analysis utilizes the 4 gene (28S D2, 28S D3-5, ITS2, COI-NJ) ML analysis. A change in color is indicative of a different species.

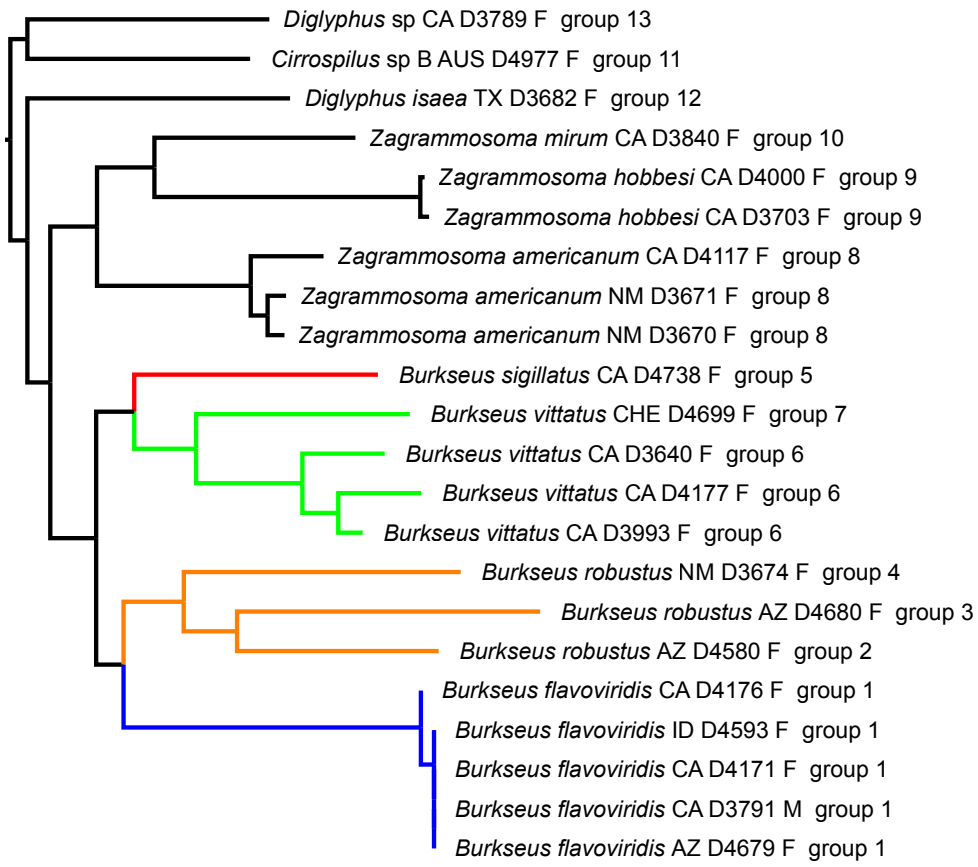

Fig. S1.8. Automatic Barcode Gap Discovery (ABGD) results, using COI-NJ. Group numbers refer to putative species recovered in the analysis.

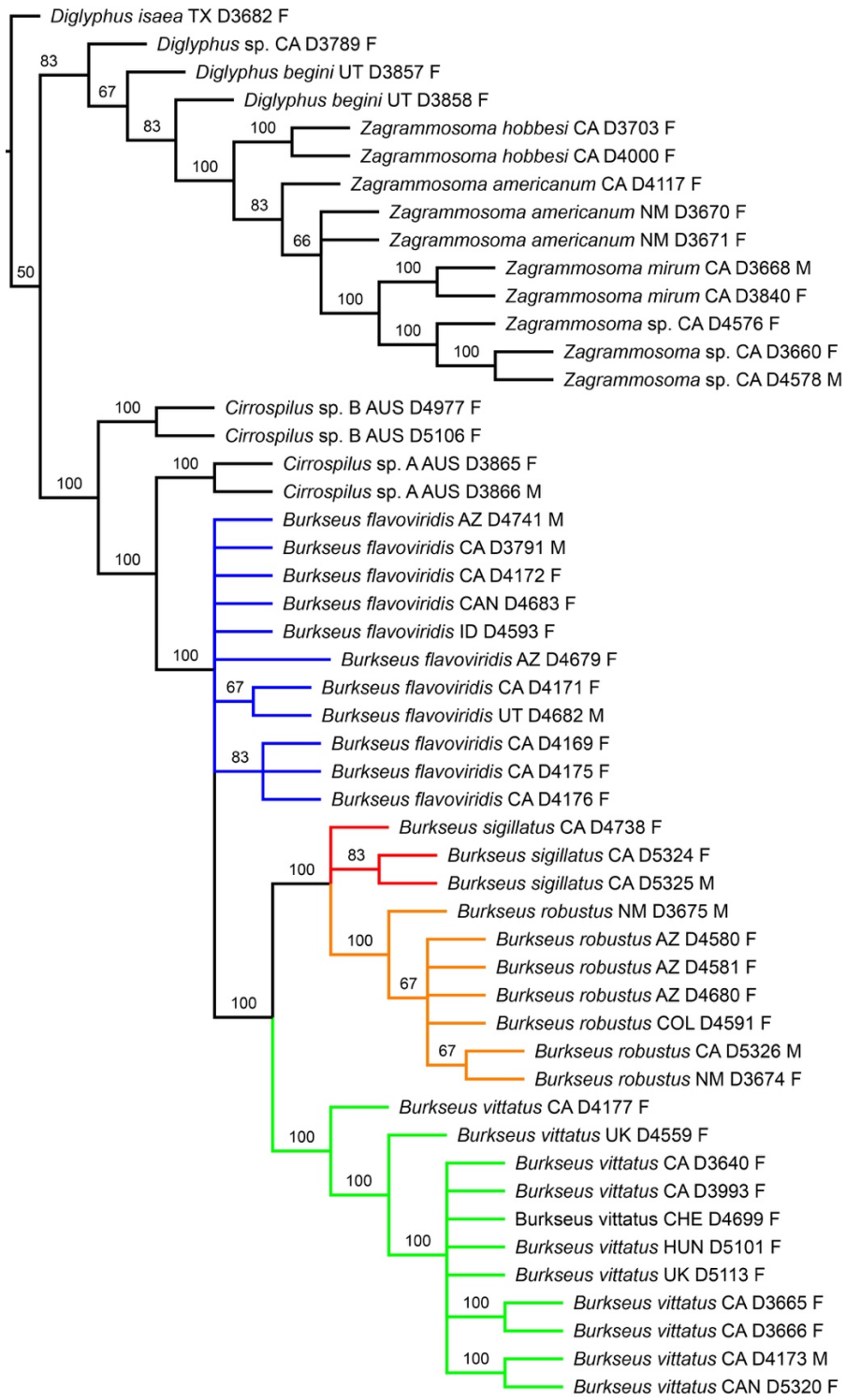

Fig. S1.9. Majority-rule consensus tree of 23 non-color morphological characters, with MR values above below corresponding branches. Constructed from 6 trees with a best score of 68, CI= 0.44, RI= 0.86.

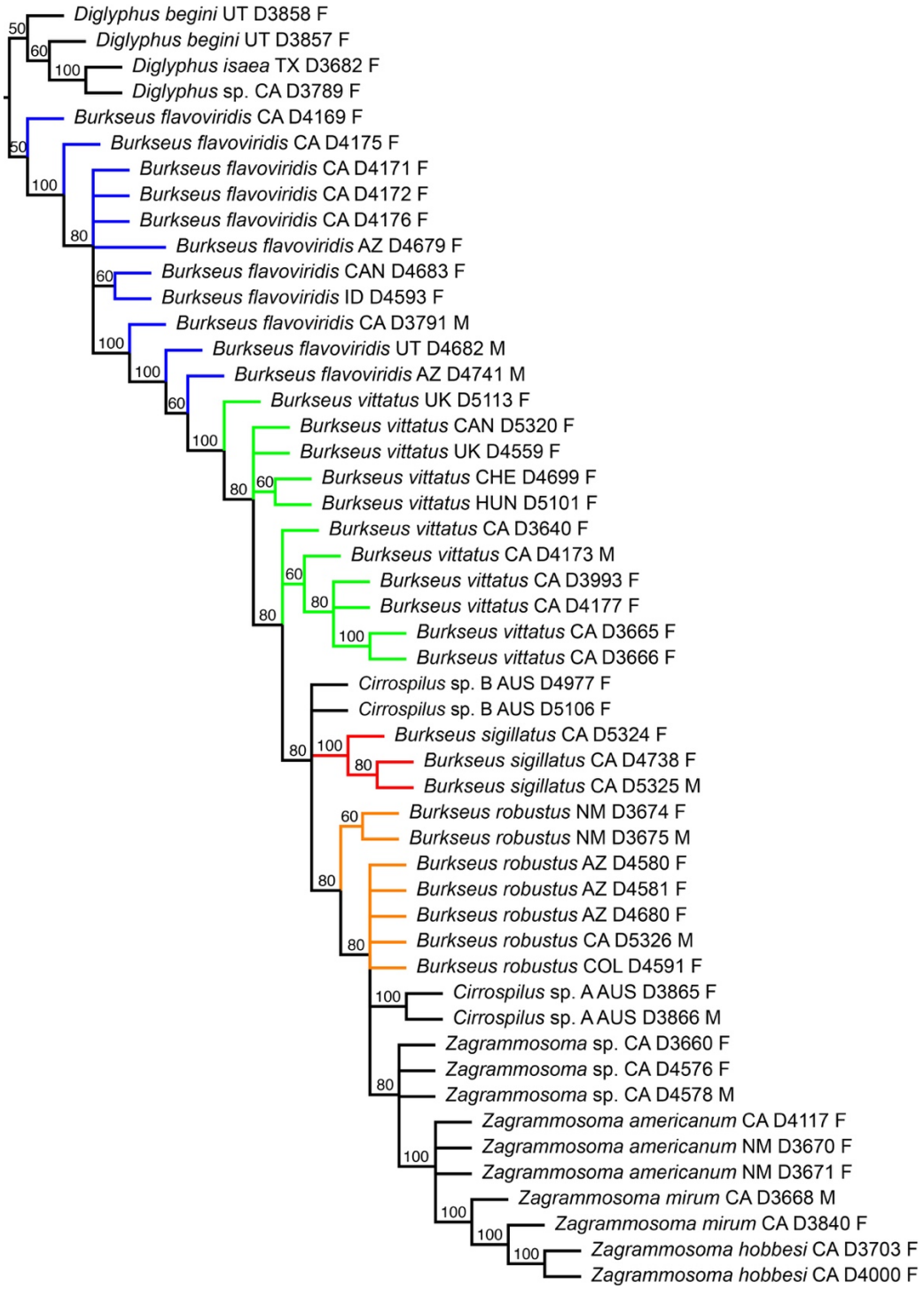

Fig. S1.10. Majority-rule consensus tree of 16 color characters, with MR values above branches. Constructed from 5 trees with a best score of 58, CI= 0.52, RI= 0.89.

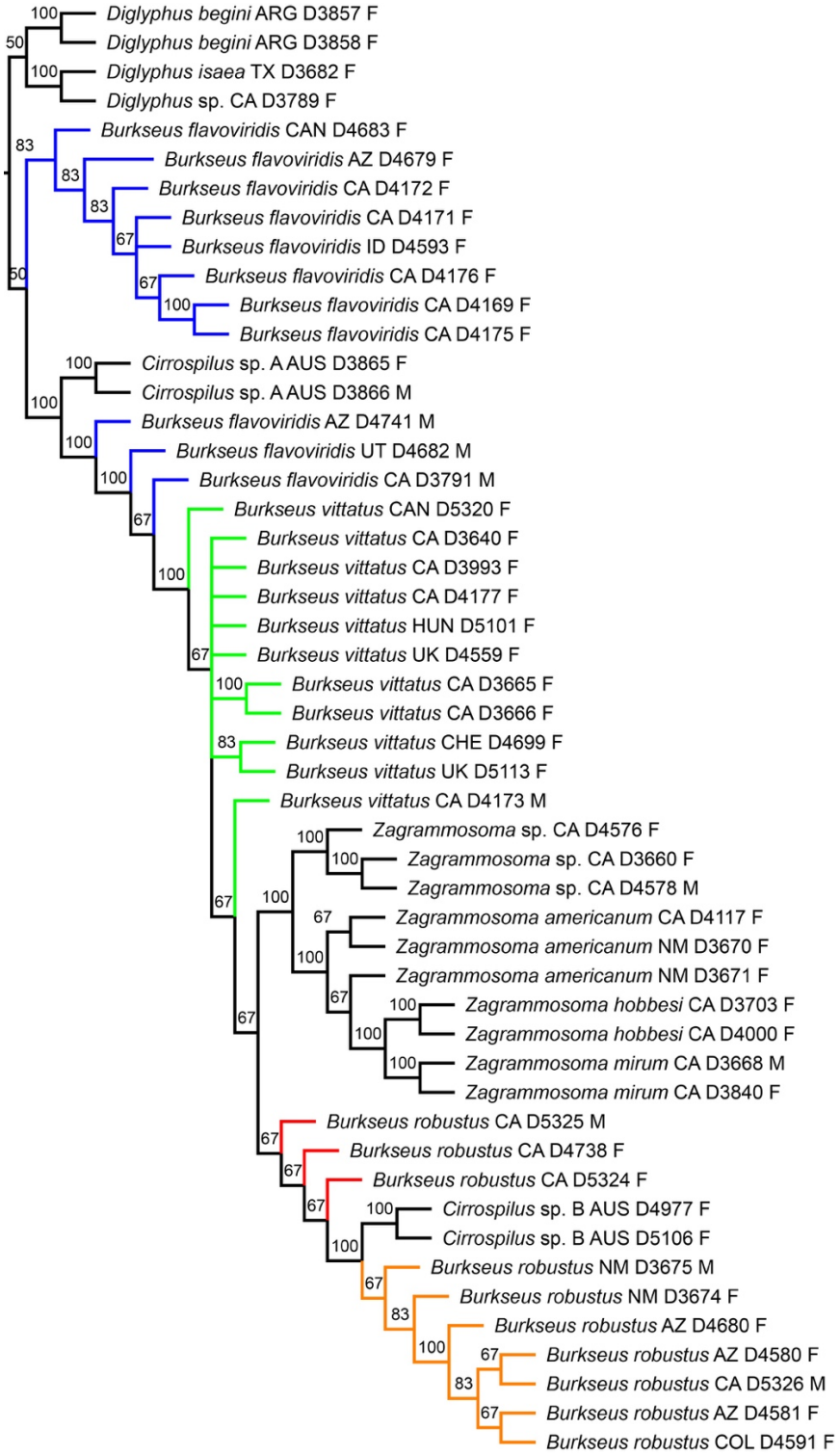

Fig. S1.11. Majority-rule consensus tree of 39 color and morphological characters, with MR values above corresponding branches. Constructed from 4 trees, with a best score of 171, CI= 0.38, RI= 0.84.

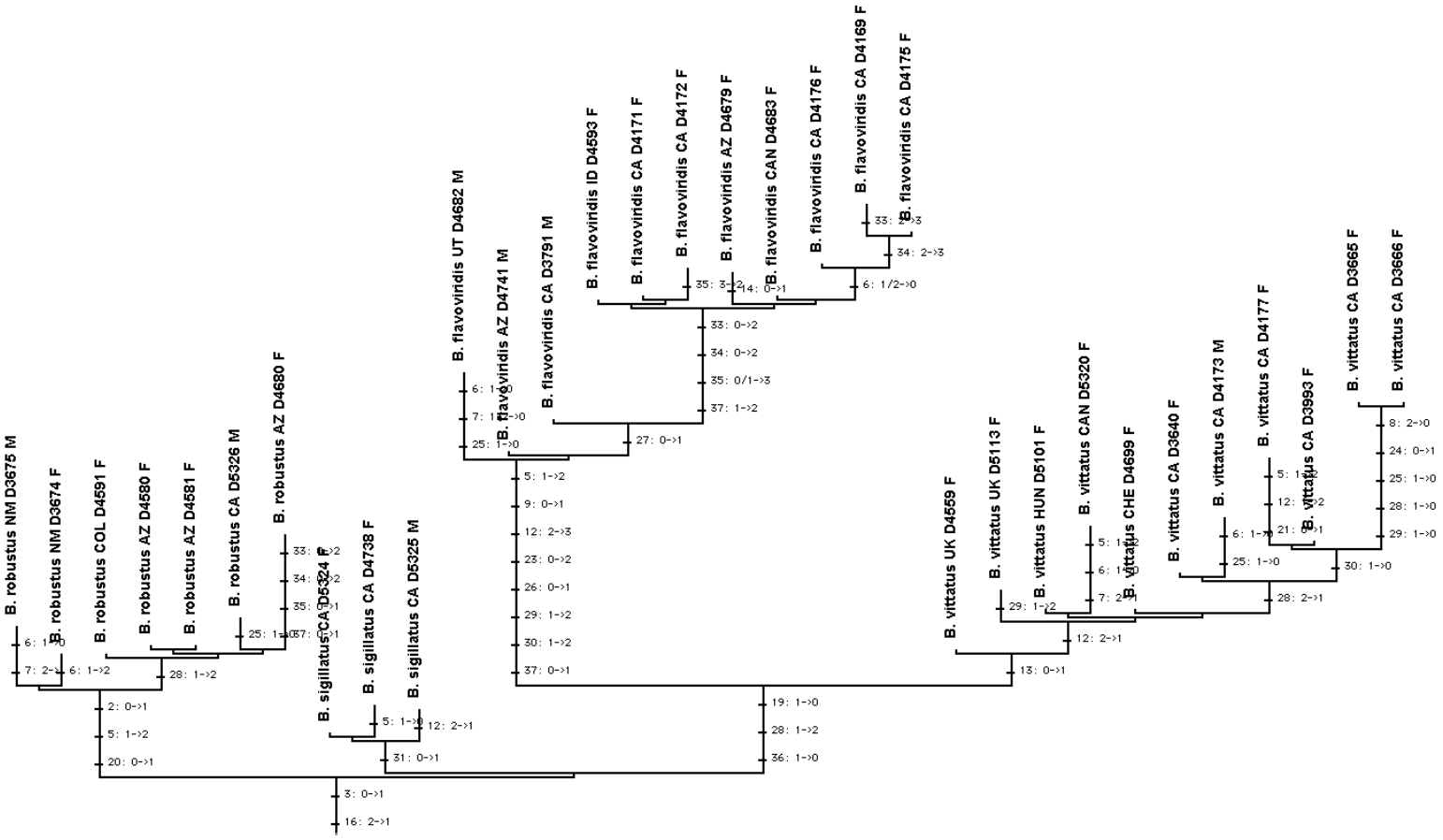

Fig. S1.12. Unambiguous morphological and color character states mapped onto the combined ML tree. Changes depicted as Character Number: State x -> State y.

Table S1.1. List of modified primers used, with references.

Gene	Primer	Sequence	References
28S D2	D2 F	5'-CGG GTT GCT TGA GAG TGC AGC-3'	(Campbell *et al.*, 2000; Murray *et al.*, 2013)
	D2Ra	5'-CTC CTT GGT TCC GTG TTT C-3'	(Campbell *et al.*, 2000; Murray *et al.*, 2013)
28SD3-5	D3Fa	5'-TTG AAA CAC GGA CCA AGG AG-3'	(Nunn *et al.*, 1996; Murray *et al.*, 2013)
	D5Ra	5'-CGC CAG TTC TGC TTA CCA-3'	(Nunn *et al.*, 1996; Murray *et al.*, 2013)
ITS2	ITS2F	5'-TGT GAA CTG CAG GAC ACA TG-3'	(Campbell *et al.*, 2000; Ciociola et al., 2001)
	ITS2R2	5'-TCT CGC CTG CTC TGA GGT-3'	(Polihronakis, 2009; Hill & O'Malley, 2010)
COI	NJ F	5'-TAT ATT TTA ATY TWC CWG GAT TTG G-3'	(Simon *et al.,* 1994; Murray *et al.*, 2013)
	MD R	5'-ATT GCA AAT ACT GCA CCT AT-3'	(Dowton & Austin, 1997; Murray *et al.*, 2013)

Table S1.2. Morphological matrix.

Taxon	1				5					10					15					20					25					30					35				39
Burkseus flavoviridis AZ D4679 F	0	0	1	0	2	2	1	2	1	1	1	3	0	1	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	2	2	3	2	1	-
Burkseus flavoviridis AZ D4741 M	0	0	1	0	2	2	2	2	1	1	1	3	0	0	1	1	0	-	0	0	0	0	2	0	1	1	0	2	2	2	0	0	0	0	0	1	1	-	1
Burkseus flavoviridis CA D3791 M	0	0	?	?	?	?	?	2	1	1	1	3	0	0	1	1	0	-	0	0	1	0	2	0	?	1	1	2	2	2	0	0	0	0	0	0	1	-	1
Burkseus flavoviridis CA D4169 F	0	0	1	0	2	0	1	2	1	1	1	3	0	0	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	3	3	3	2	1	-
Burkseus flavoviridis CA D4171 F	0	0	1	0	2	1	0	2	1	1	1	3	0	0	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	2	?	3	2	1	-
Burkseus flavoviridis CA D4172 F	0	0	1	0	?	?	?	2	1	1	1	3	0	0	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	2	2	2	2	1	-
Burkseus flavoviridis CA D4175 F	0	0	1	0	2	0	1	2	1	1	1	3	0	0	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	2	3	3	2	1	-
Burkseus flavoviridis CA D4176 F	0	0	1	0	2	0	1	2	1	1	1	3	0	0	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	2	2	3	2	1	-
Burkseus flavoviridis CAN D4683 F	0	0	1	0	2	2	1	2	1	1	1	3	0	0	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	2	2	3	2	1	-
Burkseus flavoviridis ID D4593 F	0	0	1	0	2	1	2	2	1	1	1	3	0	0	1	1	0	0	0	0	1	0	2	0	1	1	1	2	2	2	0	0	0	2	2	3	2	1	-
Burkseus flavoviridis UT D4682 M	0	0	1	0	2	0	0	2	1	1	1	3	0	0	1	1	0	-	0	0	1	0	2	0	0	1	0	2	2	2	0	0	0	0	0	0	1	-	1
Burkseus robustus AZ D4580 F	0	0	1	0	2	?	?	2	0	1	1	2	0	0	1	1	0	0	1	1	1	0	0	0	?	0	0	2	1	1	0	1	1	0	0	0	0	0	-
Burkseus robustus AZ D4581 F	0	0	1	0	2	1	2	2	0	1	1	2	0	0	1	1	0	0	1	1	1	0	0	0	1	0	0	2	1	1	0	1	1	0	0	0	0	0	-
Burkseus robustus AZ D4680 F	0	1	1	0	2	1	2	2	0	1	1	2	0	0	1	1	0	0	1	1	1	0	0	0	1	0	0	2	1	1	0	1	1	2	2	1	1	0	-
Burkseus robustus CA D5326 M	0	1	1	0	2	1	2	2	0	1	1	2	0	0	1	1	0	-	1	1	1	0	0	0	0	0	0	2	1	1	0	1	1	0	0	0	0	-	0
Burkseus robustus COL D4591 F	0	0	1	0	2	1	2	2	0	1	1	2	0	0	1	1	0	0	1	1	1	0	0	0	1	0	0	2	1	1	0	1	1	0	0	0	0	0	-
Burkseus robustus NM D3674 F	0	0	1	0	2	2	2	2	0	1	1	2	0	0	1	1	0	0	1	1	1	0	0	0	1	0	0	1	1	1	0	1	1	0	0	0	0	0	-
Burkseus robustus NM D3675 M	0	0	1	0	2	0	1	2	0	1	1	2	0	0	1	1	0	-	1	1	1	0	0	0	1	0	0	1	1	1	0	1	1	0	0	0	0	-	0
Burkseus sigillatus CA D4738 F	0	0	1	0	0	1	2	2	0	1	1	2	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	-
Burkseus sigillatus CA D5324 F	0	0	1	0	1	1	2	2	0	1	1	2	0	0	1	1	0	0	1	0	1	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	0	-
Burkseus sigillatus CA D5325 M	0	0	1	0	1	1	2	2	0	1	1	1	0	0	1	1	0	-	1	0	1	0	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	-	0
Cirrospilus sp A AUS D3865 F	0	0	0	1	0	2	1	2	1	1	1	3	0	0	1	2	0	0	1	0	1	0	0	0	1	1	0	2	2	1	0	1	1	0	0	3	2	0	-
Cirrospilus sp A AUS D3866 M	0	0	0	1	0	2	1	2	1	1	1	3	0	0	1	2	0	-	1	0	1	0	0	0	1	1	0	2	2	1	0	1	1	0	0	3	2	-	3
Cirrospilus sp B AUS D4977 F	0	1	0	0	2	0	1	3	0	1	1	3	0	1	1	2	0	0	1	0	2	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	-
Cirrospilus sp B AUS D5106 F	0	1	0	0	2	0	1	3	0	1	1	3	0	0	1	2	0	0	1	0	2	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	-
Burkseus vittatus CA D3640 F	0	0	1	0	1	1	2	2	0	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	-
Burkseus vittatus CA D3665 F	0	0	1	0	1	1	2	0	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Burkseus vittatus CA D3666 F	0	0	1	0	1	1	2	0	0	1	1	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
Burkseus vittatus CA D3993 F	0	0	1	0	1	1	2	2	0	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	-
Burkseus vittatus CA D4173 M	0	0	1	0	1	0	2	2	0	1	1	1	1	0	1	1	0	-	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	-	2
Burkseus vittatus CA D4177 F	0	0	1	0	2	1	2	2	0	1	1	2	1	0	1	1	0	0	0	0	2	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	-
Burkseus vittatus CAN D5320 F	0	0	1	0	2	0	1	2	0	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	2	1	1	0	0	0	0	0	0	0	0	-

Character Number

Table S1.2. Morphological matrix cont.

Character Number

Taxon	1				5					10					15					20					25					30					35			39
Burkseus vittatus CHE D4699 F	0	0	1	0	1	1	2	2	0	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	2	1	1	0	0	0	0	0	0	0	0	-
Burkseus vittatus HUN D5101 F	0	0	1	0	1	1	2	2	0	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	2	1	1	0	0	0	0	0	0	0	0	-
Burkseus vittatus UK D4559 F	0	0	1	0	1	1	2	2	0	1	1	2	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	2	1	1	0	0	0	0	0	0	0	0	-
Burkseus vittatus UK D5113 F	0	0	1	0	1	1	2	2	0	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	2	2	1	0	0	0	0	0	0	0	0	-
Diglyphus begini ARG D3857 F	0	0	0	0	1	2	1	2	0	2	0	2	0	0	1	2	0	0	0	0	2	0	1	0	2	3	1	0	2	3	0	0	0	3	3	3	2	1	-
Diglyphus begini ARG D3858 F	0	0	0	0	1	1	2	2	0	2	0	2	0	0	1	2	0	0	0	0	2	0	1	0	2	3	1	0	2	3	0	0	0	3	3	3	2	1	-
Diglyphus isaea TX D3682 F	0	0	0	0	2	2	1	2	0	2	0	2	0	0	1	2	0	0	0	0	2	0	0	0	2	3	1	0	2	3	0	1	0	3	3	3	2	1	-
Diglyphus sp CA D3789 F	0	0	0	0	2	2	1	2	0	2	0	2	0	0	1	2	0	0	0	0	2	0	2	0	2	3	1	0	2	3	0	1	0	3	3	3	2	1	-
Zagrammosoma americanum CA D4117 F	1	0	0	0	0	1	0	3	0	2	2	2	1	0	1	2	1	0	0	0	2	0	0	1	1	0	0	1	1	1	1	1	1	0	0	1	0	0	-
Zagrammosoma americanum NM D3670 F	1	0	0	0	0	2	2	3	0	2	2	2	1	0	1	2	1	0	0	0	2	0	0	1	1	0	0	1	1	1	1	1	1	0	0	1	0	0	-
Zagrammosoma americanum NM D3671 F	1	0	0	0	0	2	2	3	0	2	2	2	1	0	1	2	1	0	0	0	2	0	0	1	1	0	0	1	1	1	1	1	1	0	0	1	0	0	-
Zagrammosoma hobbesi CA D3703 F	1	0	0	0	1	2	2	0	0	2	2	1	1	0	1	2	1	1	0	0	0	0	1	1	1	3	1	0	2	3	1	1	1	0	0	3	2	1	-
Zagrammosoma hobbesi CA D4000 F	1	0	0	0	1	1	2	0	0	2	2	1	1	0	1	2	1	1	0	0	0	0	1	1	1	3	1	0	2	3	1	1	1	0	0	3	2	1	-
Zagrammosoma sp. CA D3660 F	1	0	0	1	0	2	2	3	0	2	2	1	0	0	1	2	1	0	0	0	2	1	0	1	1	0	0	2	1	1	1	1	1	0	0	0	0	0	-
Zagrammosoma sp. CA D4576 F	1	0	0	1	0	2	2	3	0	2	2	1	0	0	1	2	1	0	0	0	2	1	0	1	1	0	0	2	1	1	1	1	1	0	0	0	0	0	-
Zagrammosoma sp. CA D4578 M	1	0	0	1	0	2	2	3	0	2	2	1	0	0	1	2	1	-	0	0	2	1	0	1	1	0	0	2	1	1	1	1	1	0	0	0	0	-	3
Zagrammosoma mirum CA D3668 M	1	0	0	0	1	0	0	3	0	2	2	1	1	0	0	2	1	-	0	0	0	0	0	1	1	3	0	1	1	4	1	1	1	0	0	1	1	-	1
Zagrammosoma mirum CA D3840 F	1	0	0	0	1	2	2	3	0	2	2	1	1	0	0	2	1	0	0	0	0	0	0	1	1	3	0	0	2	4	1	1	1	0	0	1	1	1	-

Table S1.3. Summary of *Burkseus vittatus* host plant families and orders from specimens examined in this study.

Host Plants			
Order	**Family**	**Order**	**Family**
Asparagales	Asparagaceae	**Malphigiales**	Salicaceae
Asterales	Asteraceae	**Pinales**	Cupressaceae
Caryophyllales	Amaranthaceae		Pinaceae
	Caryophyllaceae	**Proteales**	Platanaceae
Dipsacales	Caprifoliaceae	**Rosales**	Rhamnaceae
Fabales	Fabaceae		Rosaceae
Fagales	Betulaceae	**Sapindales**	Rutaceae
	Fagaceae		Simaroubaceae
Lamiales	Oleaceae	**Solanales**	Solanaceae
	Verbenaceae		

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Chapter 3

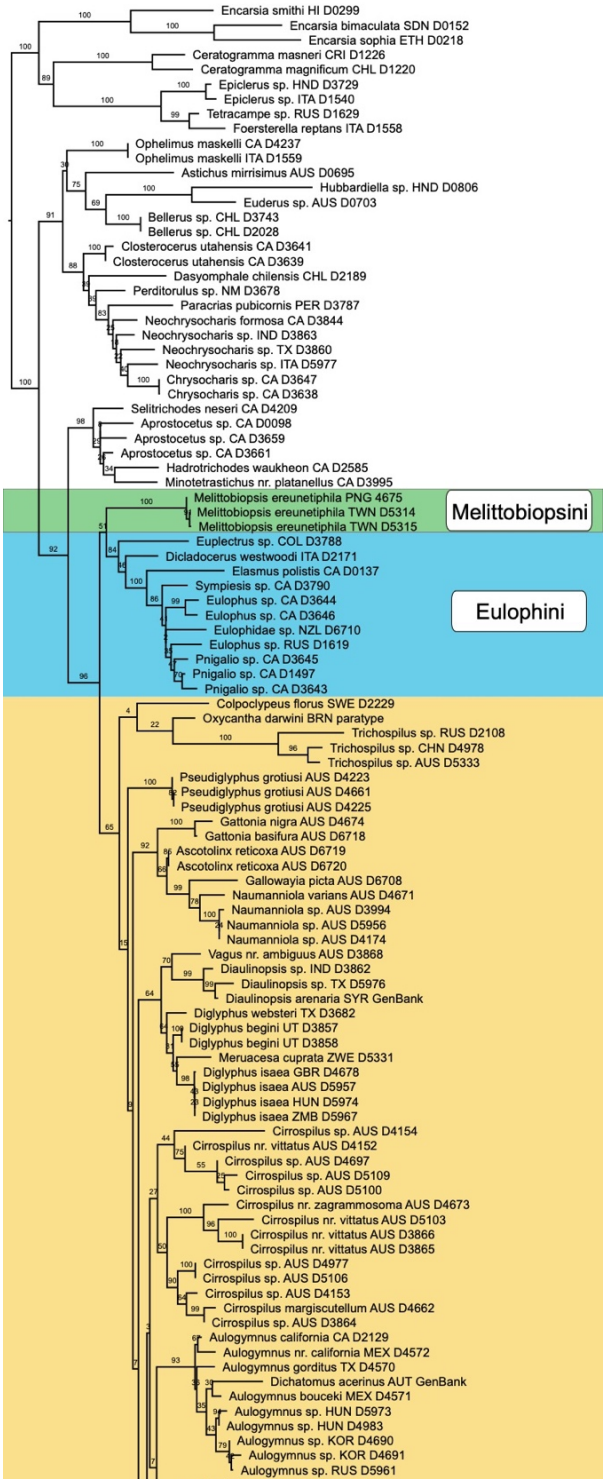

Fig. 3.S1. Complete combined morphological and molecular ML tree. Bootstrap values shown.

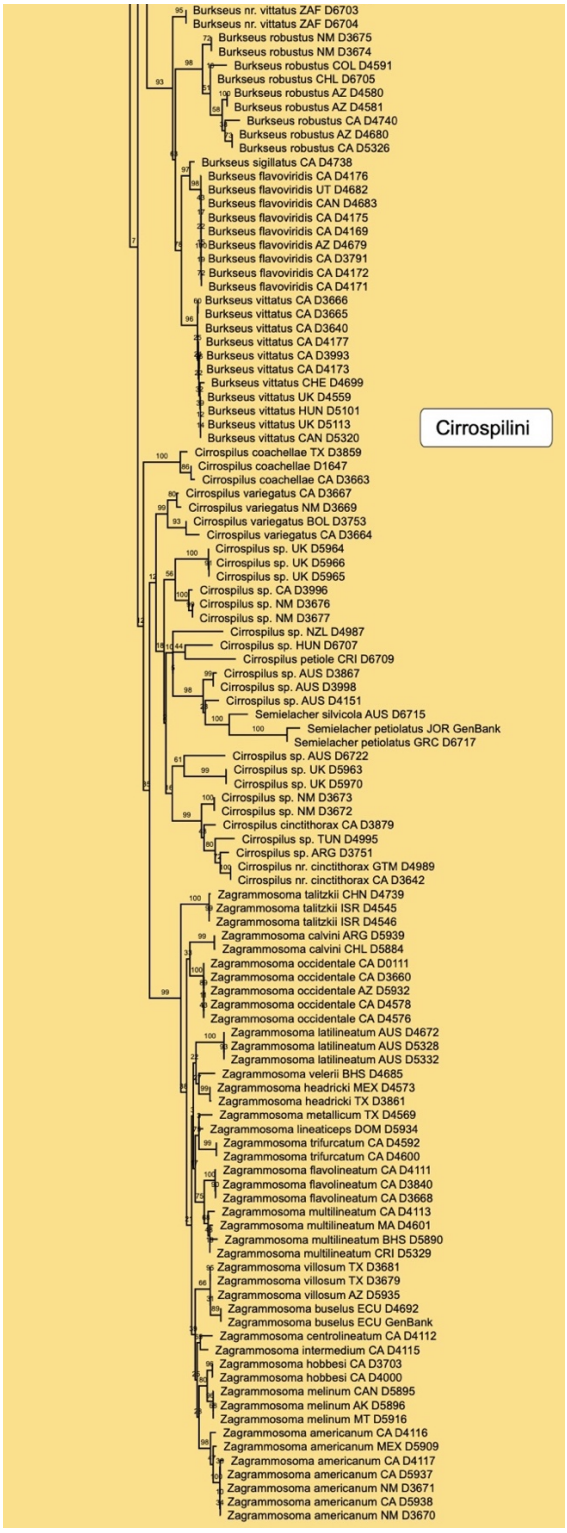
Burkseus nr. vittatus ZAF D6703
Burkseus nr. vittatus ZAF D6704
Burkseus robustus NM D3675
Burkseus robustus NM D3674
Burkseus robustus COL D4591
Burkseus robustus CHL D6705
Burkseus robustus AZ D4580
Burkseus robustus AZ D4581
Burkseus robustus CA D4740
Burkseus robustus AZ D4680
Burkseus robustus CA D5326
Burkseus sigillatus CA D4738
Burkseus flavoviridis CA D4176
Burkseus flavoviridis UT D4682
Burkseus flavoviridis CAN D4683
Burkseus flavoviridis CA D4175
Burkseus flavoviridis CA D4169
Burkseus flavoviridis AZ D4679
Burkseus flavoviridis CA D3791
Burkseus flavoviridis CA D4172
Burkseus flavoviridis CA D4171
Burkseus vittatus CA D3666
Burkseus vittatus CA D3665
Burkseus vittatus CA D3640
Burkseus vittatus CA D4177
Burkseus vittatus CA D3993
Burkseus vittatus CA D4173
Burkseus vittatus CHE D4699
Burkseus vittatus UK D4559
Burkseus vittatus HUN D5101
Burkseus vittatus UK D5113
Burkseus vittatus CAN D5320
Cirrospilini
Cirrospilus coachellae TX D3859
Cirrospilus coachellae D1647
Cirrospilus coachellae CA D3663
Cirrospilus variegatus CA D3667
Cirrospilus variegatus NM D3669
Cirrospilus variegatus BOL D3753
Cirrospilus variegatus CA D3664
Cirrospilus sp. UK D5964
Cirrospilus sp. UK D5966
Cirrospilus sp. UK D5965
Cirrospilus sp. CA D3996
Cirrospilus sp. NM D3676
Cirrospilus sp. NM D3677
Cirrospilus sp. NZL D4987
Cirrospilus sp. HUN D6707
Cirrospilus petiole CRI D6709
Cirrospilus sp. AUS D3867
Cirrospilus sp. AUS D3998
Cirrospilus sp. AUS D4151
Semielacher silvicola AUS D6715
Semielacher petiolatus JOR GenBank
Semielacher petiolatus GRC D6717
Cirrospilus sp. AUS D6722
Cirrospilus sp. UK D5963
Cirrospilus sp. UK D5970
Cirrospilus sp. NM D3673
Cirrospilus sp. NM D3672
Cirrospilus cinctithorax CA D3879
Cirrospilus sp. TUN D4995
Cirrospilus sp. ARG D3751
Cirrospilus nr. cinctithorax GTM D4989
Cirrospilus nr. cinctithorax CA D3642
Zagrammosoma talitzkii CHN D4739
Zagrammosoma talitzkii ISR D4545
Zagrammosoma talitzkii ISR D4546
Zagrammosoma calvini ARG D5939
Zagrammosoma calvini CHL D5884
Zagrammosoma occidentale CA D0111
Zagrammosoma occidentale CA D3660
Zagrammosoma occidentale AZ D5932
Zagrammosoma occidentale CA D4578
Zagrammosoma occidentale CA D4576
Zagrammosoma latilineatum AUS D4672
Zagrammosoma latilineatum AUS D5328
Zagrammosoma latilineatum AUS D5332
Zagrammosoma velerii BHS D4685
Zagrammosoma headricki MEX D4573
Zagrammosoma headricki TX D3861
Zagrammosoma metallicum TX D4569
Zagrammosoma lineaticeps DOM D5934
Zagrammosoma trifurcatum CA D4592
Zagrammosoma trifurcatum CA D4600
Zagrammosoma flavolineatum CA D4111
Zagrammosoma flavolineatum CA D3840
Zagrammosoma flavolineatum CA D3668
Zagrammosoma multilineatum CA D4113
Zagrammosoma multilineatum MA D4601
Zagrammosoma multilineatum BHS D5890
Zagrammosoma multilineatum CRI D5329
Zagrammosoma villosum TX D3681
Zagrammosoma villosum TX D3679
Zagrammosoma villosum AZ D5935
Zagrammosoma buselus ECU D4692
Zagrammosoma buselus ECU GenBank
Zagrammosoma centrolineatum CA D4112
Zagrammosoma intermedium CA D4115
Zagrammosoma hobbesi CA D3703
Zagrammosoma hobbesi CA D4000
Zagrammosoma melinum CAN D5895
Zagrammosoma melinum AK D5896
Zagrammosoma melinum MT D5916
Zagrammosoma americanum CA D4116
Zagrammosoma americanum MEX D5909
Zagrammosoma americanum CA D4117
Zagrammosoma americanum CA D5937
Zagrammosoma americanum NM D3671
Zagrammosoma americanum CA D5938
Zagrammosoma americanum NM D3670

Fig. 3.S1. cont.

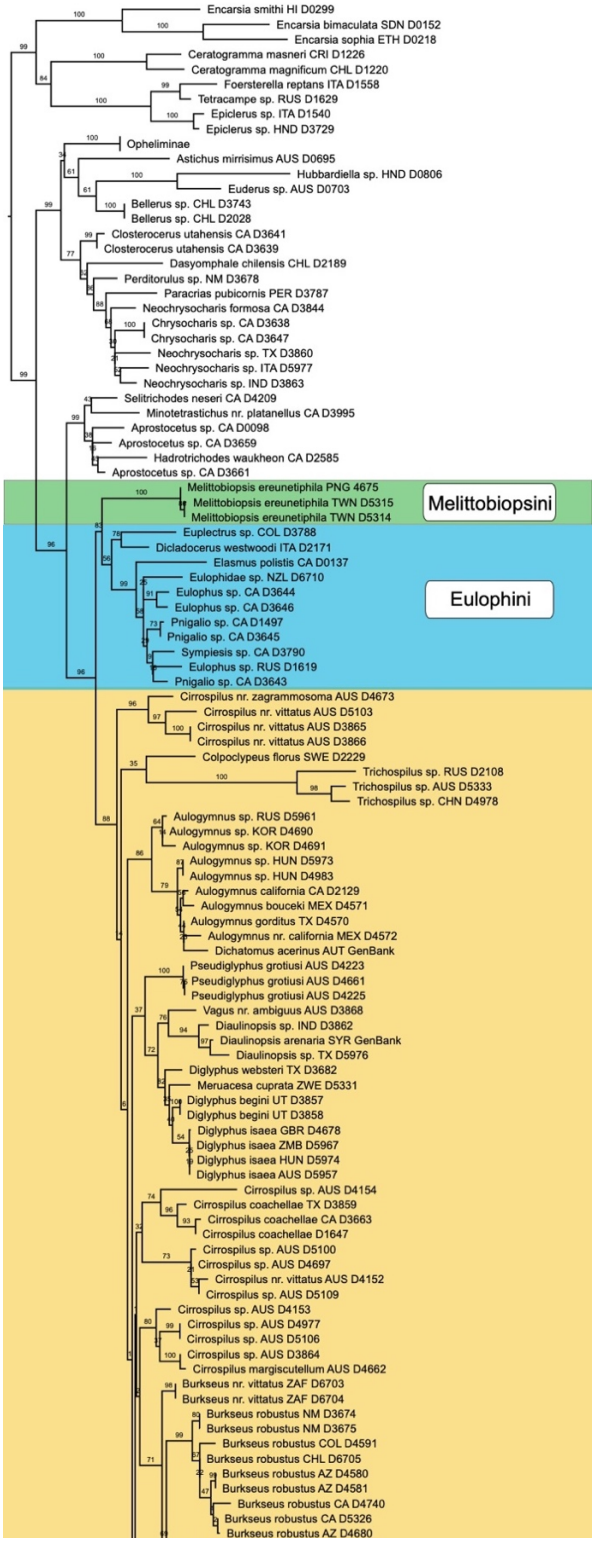

Fig. 3.S2. Complete molecular-only ML tree. Bootstrap values shown.


Cirrospilini
Burkseus sigillatus CA D4738
Burkseus flavoviridis UT D4682
Burkseus flavoviridis CA D4176
Burkseus flavoviridis CAN D4683
Burkseus flavoviridis CA D4175
Burkseus flavoviridis CA D4169
Burkseus flavoviridis AZ D4679
Burkseus flavoviridis CA D3791
Burkseus flavoviridis CA D4171
Burkseus flavoviridis CA D4172
Burkseus vittatus CA D3665
Burkseus vittatus CA D3640
Burkseus vittatus CA D4177
Burkseus vittatus CA D3993
Burkseus vittatus CA D4173
Burkseus vittatus CHE D4699
Burkseus vittatus UK D4559
Burkseus vittatus HUN D5101
Burkseus vittatus CAN D5320
Burkseus vittatus UK D5113
Burkseus vittatus CA D3666
Ascotolinx reticoxa AUS D6720
Ascotolinx reticoxa AUS D6719
Gattonia basifura AUS D6718
Gattonia nigra AUS D4674
Gallowayia picta AUS D6708
Naumanniola varians AUS D4671
Naumanniola sp. AUS D3994
Naumanniola sp. AUS D5956
Naumanniola sp. AUS D4174
Cirrospilus sp. AUS D4151
Cirrospilus sp. AUS D3867
Cirrospilus sp. AUS D3998
Semielacher silvicola AUS D6715
Semielacher petiolatus GRC D6717
Semielacher petiolatus JOR GenBank
Cirrospilus sp. NZL D4987
Cirrospilus sp. UK D5965
Cirrospilus sp. UK D5964
Cirrospilus sp. UK D5966
Cirrospilus sp. CA D3996
Cirrospilus sp. NM D3676
Cirrospilus sp. NM D3677
Cirrospilus sp. HUN D6707
Cirrospilus petiole CRI D6709
Cirrospilus variegatus CA D3664
Cirrospilus variegatus BOL D3753
Cirrospilus variegatus NM D3669
Cirrospilus variegatus CA D3667
Cirrospilus sp. AUS D6722
Cirrospilus sp. UK D5963
Cirrospilus sp. UK D5970
Cirrospilus sp. NM D3673
Cirrospilus sp. NM D3672
Cirrospilus cinctithorax CA D3879
Cirrospilus sp. TUN D4995
Cirrospilus sp. ARG D3751
Cirrospilus nr. cinctithorax CA D3642
Cirrospilus nr. cinctithorax GTM D4989
Zagrammosoma latilineatum AUS D4672
Zagrammosoma latilineatum AUS D5328
Zagrammosoma latilineatum AUS D5332
Zagrammosoma velerii BHS D4685
Zagrammosoma talitzkii CHN D4739
Zagrammosoma talitzkii ISR D4545
Zagrammosoma talitzkii ISR D4546
Zagrammosoma calvini CHL D5884
Zagrammosoma calvini ARG D5939
Zagrammosoma villosum TX D3681
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Zagrammosoma villosum AZ D5935
Zagrammosoma buselus ECU D4692
Zagrammosoma buselus ECU GenBank
Zagrammosoma intermedium CA D4115
Zagrammosoma centrolineatum CA D4112
Zagrammosoma hobbesi CA D3703
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Zagrammosoma melinum CAN D5895
Zagrammosoma melinum AK D5896
Zagrammosoma melinum MT D5916
Zagrammosoma americanum CA D4116
Zagrammosoma americanum MEX D5909
Zagrammosoma americanum CA D4117
Zagrammosoma americanum CA D5937
Zagrammosoma americanum NM D3671
Zagrammosoma americanum CA D5938
Zagrammosoma americanum NM D3670
Zagrammosoma headricki MEX D4573
Zagrammosoma headricki TX D3861
Zagrammosoma lineaticeps DOM D5934
Zagrammosoma metallicum TX D4569
Zagrammosoma trifurcatum CA D4600
Zagrammosoma trifurcatum CA D4592
Zagrammosoma occidentale CA D0111
Zagrammosoma occidentale CA D3660
Zagrammosoma occidentale AZ D5932
Zagrammosoma occidentale CA D4576
Zagrammosoma occidentale CA D4578
Zagrammosoma flavolineatum CA D4111
Zagrammosoma flavolineatum CA D3840
Zagrammosoma flavolineatum CA D3668
Zagrammosoma multilineatum CRI D5329
Zagrammosoma multilineatum CA D4113
Zagrammosoma multilineatum BHS D5890
Zagrammosoma multilineatum MA D4601

Fig. 3.S2. cont.

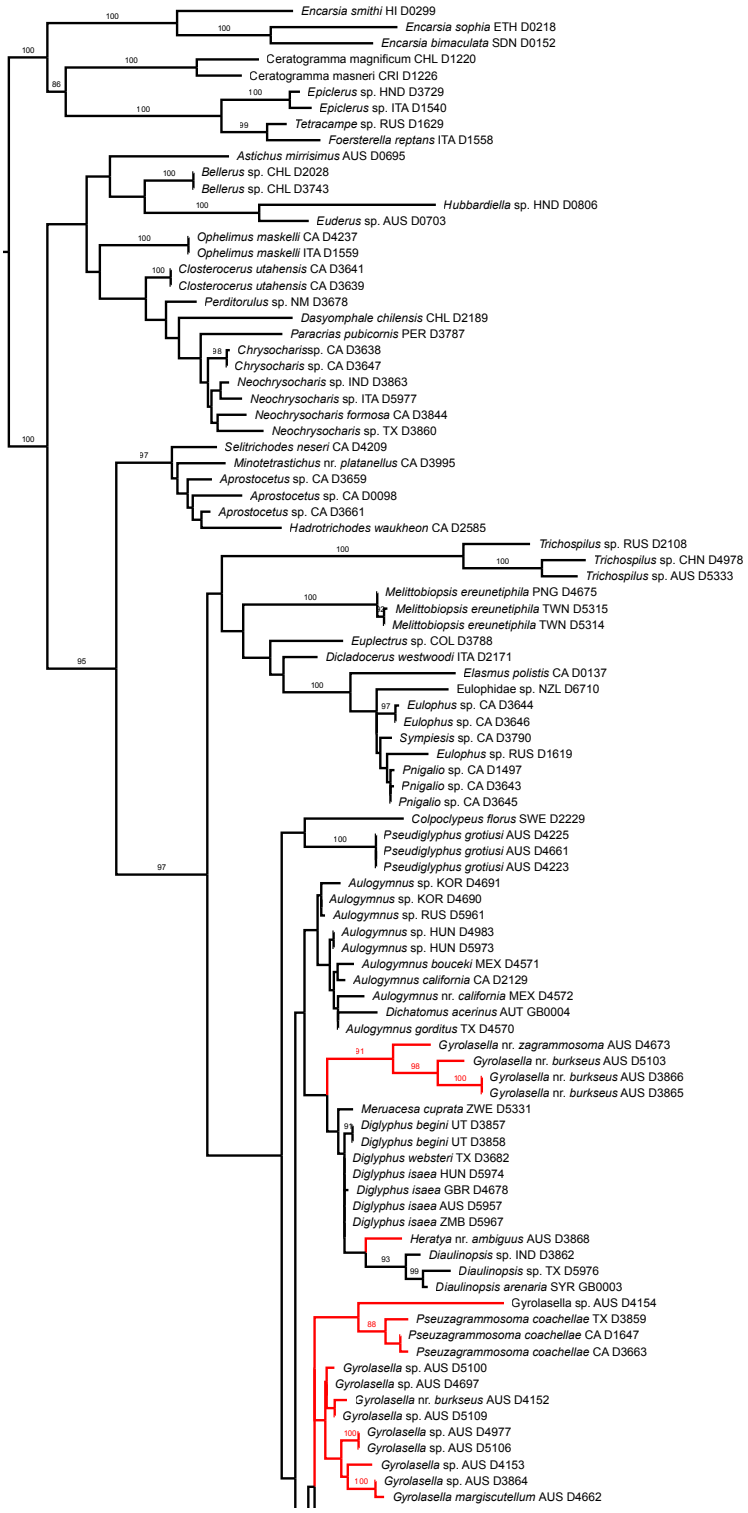

Fig. 3.S3. 28S D2 & D3–5 ML tree. Branches for specimens previously identified as *Cirrospilus* are indicated in red. Bootstrap values shown


Burkseus nr. vittatus ZAF D6704
Burkseus nr. vittatus ZAF D6703
Burkseus robustus NM D3675
Burkseus robustus NM D3674
Burkseus robustus COL D4591
Burkseus robustus CHL D6705
Burkseus robustus CA D4740
Burkseus robustus AZ D4680
Burkseus robustus CA D5326
Burkseus robustus AZ D4580
Burkseus robustus AZ D4581
Burkseus flavoviridis CAN D4683
Burkseus flavoviridis UT D4682
Burkseus flavoviridis AZ D4679
Burkseus flavoviridis CA D4175
Burkseus flavoviridis CA D4176
Burkseus flavoviridis CA D4171
Burkseus flavoviridis CA D3791
Burkseus sigillatus CA D4738
Burkseus flavoviridis CA D4172
Burkseus flavoviridis CA D4169
Burkseus vittatus CA D4177
Burkseus vittatus CA D3993
Burkseus vittatus UK D4559
Burkseus vittatus CAN D5320
Burkseus vittatus CHE D4699
Burkseus vittatus CA D3666
Burkseus vittatus CA D3665
Burkseus vittatus CA D4173
Burkseus vittatus CA D3640
Burkseus vittatus HUN D5101
Burkseus vittatus UK D5113
Cirrospilus sp. AUS D4151
Cirrospilus sp. AUS D3867
Cirrospilus sp. AUS D3998
Cirrospilus silvicola AUS D6715
Cirrospilus petiolatus GRC D6717
Cirrospilus petiolatus JOR genbank
Cirrospilus sp. NM D3673
Cirrospilus sp. NM D3672
Cirrospilus cinctithorax CA D3879
Cirrospilus sp. ARG D3751
Cirrospilus sp. TUN D4995
Cirrospilus nr. cinctithorax GTM D4989
Cirrospilus nr. cinctithorax CA D3642
Atoposoma variegatum CA D3753
Atoposoma variegatum CA D3664
Atoposoma variegatum NM D3669
Atoposoma variegatum CA D3667
Cirrospilus sp. CA D3996
Cirrospilus sp. NM D3677
Cirrospilus sp. NM D3676
Cirrospilus sp. UK D5964
Cirrospilus sp.UK D5966
Cirrospilus sp. UK D5965
Cirrospilus sp. AUS D6722
Cirrospilus sp. UK D5970
Cirrospilus sp.UK D5963
Cirrospilus sp. NZL D4987
Cirrospilus sp.HUN D6707
Cirrospilus 'petiole' CRI D6709
Ascotolinx reticoxa AUS D6720
Ascotolinx reticoxa AUS D6719
Gattonia nigra AUS D4674
Gattonia basifura AUS D6718
Gallowayia picta AUS D6708
Naumanniola varians AUS D4671
Naumanniola sp. AUS D3994
Naumanniola sp. AUS D5956
Naumanniola sp. AUS D4174
Zagrammosoma flavolineatum CA D4111
Zagrammosoma flavolineatum CA D3840
Zagrammosoma flavolineatum CA D3668
Zagrammosoma americanum MEX D5909
Zagrammosoma americanum CA D4116
Zagrammosoma americanum CA D5937
Zagrammosoma americanum CA D5938
Zagrammosoma americanum NM D3671
Zagrammosoma americanum NM D3670
Zagrammosoma americanum CA D4117
Zagrammosoma hobbesi CA D3703
Zagrammosoma hobbesi CA D4000
Zagrammosoma villosum TX D3681
Zagrammosoma villosum TX D3679
Zagrammosoma villosum AZ D5935
Zagrammosoma buselus ECU GB0005
Zagrammosoma buselus ECU D4692
Zagrammosoma headricki TX D3861
Zagrammosoma headricki MEX D4573
Zagrammosoma velerii BHS D4685
Zagrammosoma latilineatum AUS D4672
Zagrammosoma latilineatum AUS D5332
Zagrammosoma latilineatum AUS D5328
Zagrammosoma melinum CAN D5895
Zagrammosoma melinum AK D5896
Zagrammosoma melinum MT D5916
Zagrammosoma multilineatum BHS D5890
Zagrammosoma multilineatum CRI D5329
Zagrammosoma multilineatum CA D4113
Zagrammosoma intermedium CA D4115
Zagrammosoma centrolineatum CA D4112
Zagrammosoma calvini CHL D5884
Zagrammosoma calvini ARG D5939
Zagrammosoma multilineatum MA D4601
Zagrammosoma lineaticeps DOM D5934
Zagrammosoma metallicum TX D4569
Zagrammosoma trifurcatum CA D4592
Zagrammosoma trifurcatum CA D4600
Zagrammosoma talitzkii ISR D4545
Zagrammosoma talitzkii ISR D4546
Zagrammosoma talitzkii CHN D4739
Zagrammosoma occidentale CA D0111
Zagrammosoma occidentale AZ D5932 2
Zagrammosoma occidentale CA D4578
Zagrammosoma occidentale CA D3660
Zagrammosoma occidentale CA D4576

Fig. 3.S3. cont.

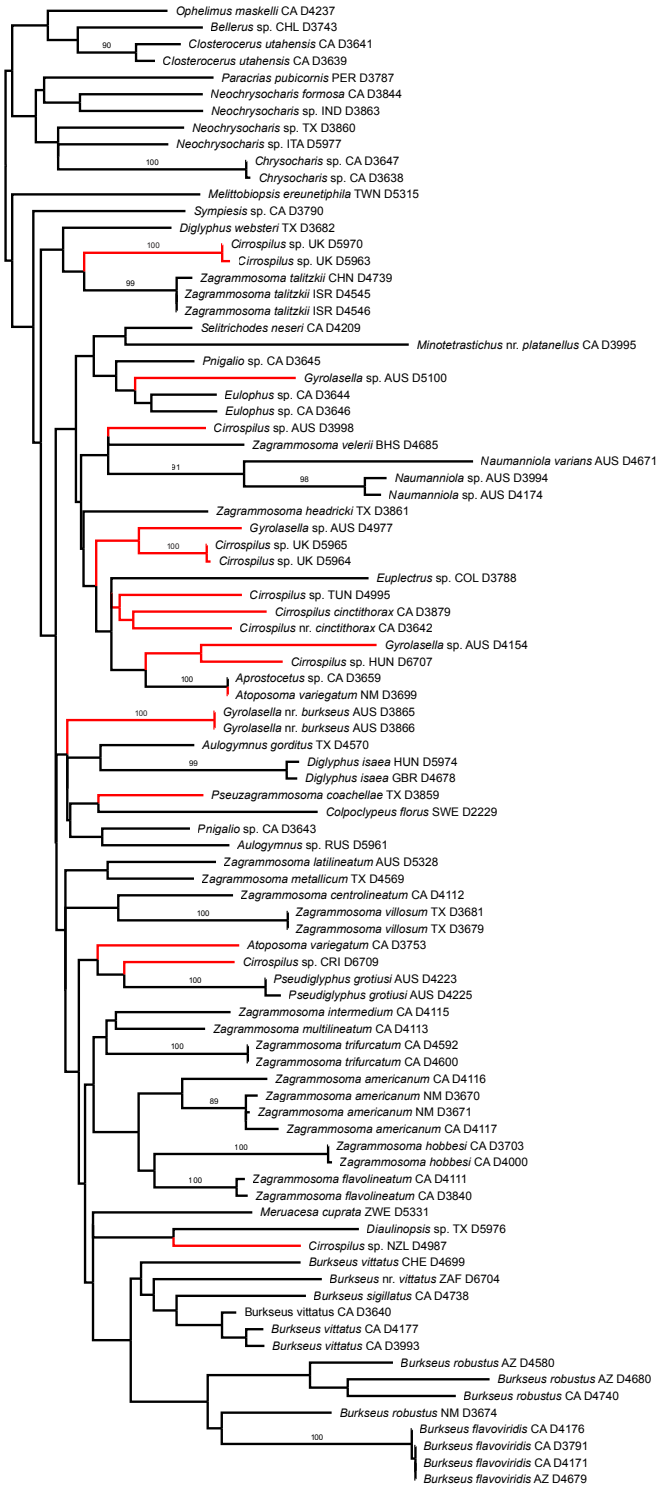

Fig. 3.S4. COI ML tree. Branches for specimens previously identified as *Cirrospilus* are indicated in red. Bootstrap values shown.

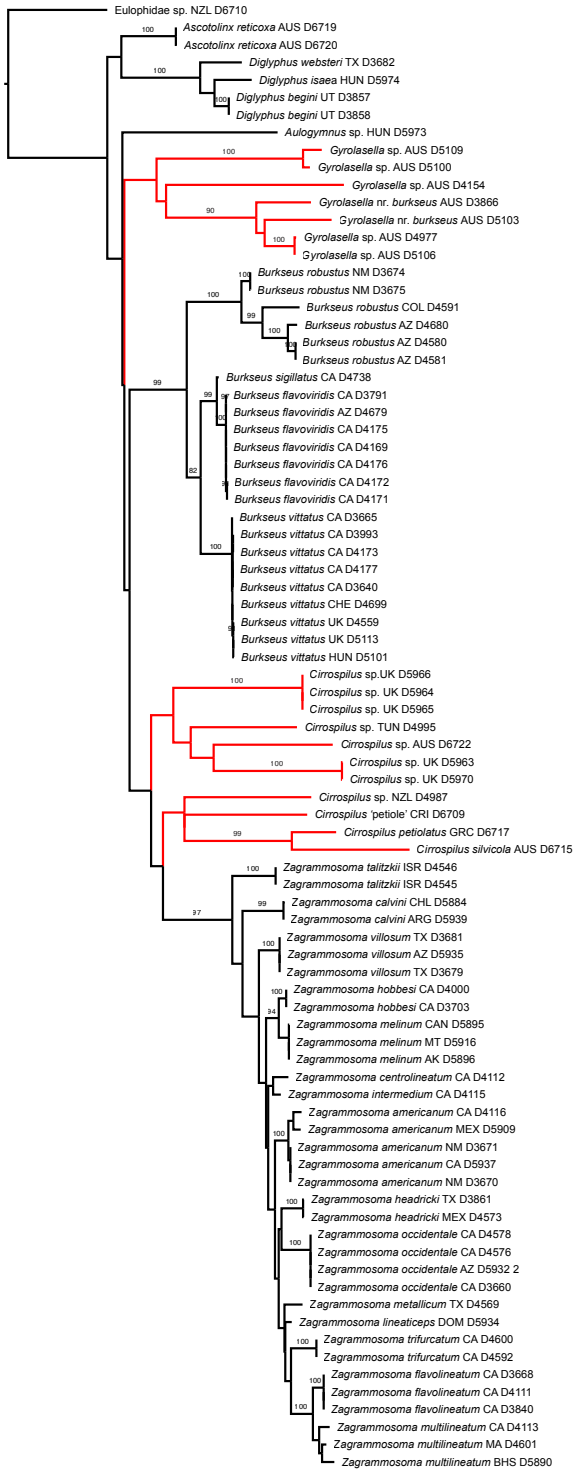

Fig. 3.S5. ITS2 ML tree. Branches for specimens previously identified as *Cirrospilus* are indicated in red. Bootstrap values shown.