



Zootaxa 4792 (1): 001–155

<https://www.mapress.com/j/zt/>

Copyright © 2020 Magnolia Press

# Monograph

ISSN 1175-5326 (print edition)

**ZOOTAXA**

ISSN 1175-5334 (online edition)

<https://doi.org/10.11646/zootaxa.4792.1.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:326F6A15-216E-439A-AD59-3CDF7551D3F6>

# ZOOTAXA

4792

## A Taxonomic Revision of Nearctic *Conostigmus* (Hymenoptera: Ceraphronoidea: Megaspilidae)

CAROLYN TRIETSCH<sup>1\*</sup>, ISTVÁN MIKÓ<sup>2</sup>, BRIANA EZRAY<sup>3</sup> & ANDREW R. DEANS<sup>4</sup>

<sup>1</sup>*Frost Entomological Museum, Department of Entomology, 501 ASI Building,  
The Pennsylvania State University, University Park, PA, 16802 USA.*

[✉ carolyntrietsch@gmail.com](mailto:carolyntrietsch@gmail.com); <https://orcid.org/0000-0003-2781-6838>

<sup>2</sup>*University of New Hampshire Collection of Insects and Arthropods, Department of Biological Sciences,  
University of New Hampshire, Spaulding Hall, Durham, NH, 03824 USA.*

[✉ istvan.miko@gmail.com](mailto:istvan.miko@gmail.com); <https://orcid.org/0000-0003-2938-9075>

<sup>3</sup>*Department of Biology, The Pennsylvania State University, University Park, PA 16802, USA.*

[✉ brianaezray@gmail.com](mailto:brianaezray@gmail.com); <https://orcid.org/0000-0002-9240-8606>

<sup>4</sup>*Frost Entomological Museum, Department of Entomology, 501 ASI Building,  
The Pennsylvania State University, University Park, PA, 16802 USA.*

[✉ adeans@psu.edu](mailto:adeans@psu.edu); <https://orcid.org/0000-0002-2119-4663>

\*Corresponding author. E-mail: [carolyntrietsch@gmail.com](mailto:carolyntrietsch@gmail.com)



Magnolia Press  
Auckland, New Zealand

CAROLYN TRIETSCH, ISTVÁN MIKÓ, BRIANA EZRAY & ANDREW R. DEANS  
**A Taxonomic Revision of Nearctic *Conostigmus* (Hymenoptera: Ceraphronoidea: Megaspilidae)**  
(*Zootaxa* 4792)

155 pp.; 30 cm.

15 Jun. 2020

ISBN 978-1-77670-955-7 (paperback)

ISBN 978-1-77670-956-4 (Online edition)

FIRST PUBLISHED IN 2020 BY

Magnolia Press

P.O. Box 41-383

Auckland 1346

New Zealand

e-mail: [magnolia@mapress.com](mailto:magnolia@mapress.com)

<https://www.mapress.com/j/zt>

© 2020 Magnolia Press

All rights reserved.

No part of this publication may be reproduced, stored, transmitted or disseminated, in any form, or by any means, without prior written permission from the publisher, to whom all requests to reproduce copyright material should be directed in writing.

This authorization does not extend to any other kind of copying, by any means, in any form, and for any purpose other than private research use.

ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

## Table of Contents

Abstract	4
Introduction	4
Taxonomic History and Status	5
Hosts and Life History of <i>Conostigmus</i>	6
Methods	6
Results	8
Principal component analysis of <i>C. abdominalis</i> , <i>C. pulchellus</i> and <i>C. rosemaryae</i>	8
Morphological cladistic analysis of Megaspilinae	11
Taxonomic Treatment of Nearctic <i>Conostigmus</i>	11
Class Hexapoda Blainville, 1816	11
Order Hymenoptera Linnaeus, 1758	11
Suborder Apocrita Latreille, 1810	11
Superfamily Ceraphronoidea Haliday, 1833	11
Megaspilidae Ashmead, 1893	11
Megaspilinae Masner and Dessart, 1967	11
<i>Conostigmus</i> Dahlbom, 1858	11
Key to Male <i>Conostigmus</i> from the Nearctic Region	15
Redescribed species	18
<i>Conostigmus abdominalis</i> (Boheman, 1832)	18
<i>Conostigmus ambiguus</i> (Ashmead, 1893)	23
<i>Conostigmus bacilliger</i> (Kieffer, 1906)	24
<i>Conostigmus bakeri</i> Kieffer, 1908	25
<i>Conostigmus bipunctatus</i> Kieffer, 1907	25
<i>Conostigmus californicus</i> (Ashmead, 1893)	32
<i>Conostigmus canadensis</i> (Ashmead, 1888)	33
<i>Conostigmus crawfordi</i> (Mann, 1920)	35
<i>Conostigmus dimidiatus</i> (Thomson, 1858)	37
<i>Conostigmus erythrothorax</i> (Ashmead, 1893)	42
<i>Conostigmus harringtoni</i> (Ashmead, 1888)	48
<i>Conostigmus hyalinipennis</i> (Ashmead, 1887)	48
<i>Conostigmus inermis</i> (Kieffer, 1906)	48
<i>Conostigmus integriceps</i> (Kieffer, 1906)	49
<i>Conostigmus laeviceps</i> (Ashmead, 1893)	49
<i>Conostigmus marylandicus</i> (Ashmead, 1893)	54
<i>Conostigmus muesebecki</i> Dessart & Masner 1965	54
<i>Conostigmus nevadensis</i> (Kieffer, 1906)	58
<i>Conostigmus nigripes</i> (Kieffer, 1906)	58
<i>Conostigmus nigrorufus</i> Dessart 1997	58
<i>Conostigmus obscurus</i> (Thomson, 1858)	63
<i>Conostigmus orcasensis</i> (Brues, 1909)	67
<i>Conostigmus ottawensis</i> (Ashmead, 1888)	71
<i>Conostigmus pergandei</i> (Ashmead, 1893)	72
<i>Conostigmus popenoei</i> (Ashmead, 1893)	73
<i>Conostigmus pulchellus</i> Whittaker, 1930	74
<i>Conostigmus quadratogenalis</i> Dessart & Cooper, 1975	79
<i>Conostigmus rufoniger</i> (Provancher, 1888)	83
<i>Conostigmus schwarzi</i> (Ashmead, 1893)	85
<i>Conostigmus subinermis</i> (Kieffer, 1907)	86
<i>Conostigmus timberlakei</i> Kamal, 1926	86
<i>Conostigmus trapezoidus</i> Kieffer, 1908	87
<i>Conostigmus triangularis</i> (Thomson, 1858)	88
<i>Dendrocercus arietinus</i> (Provancher, 1887), new combination	92
New species	94
<i>Conostigmus dessarti</i> Trietsch & Mikó, sp. nov.	94
<i>Conostigmus duncani</i> Trietsch sp. nov.	99
<i>Conostigmus franzinii</i> Trietsch & Mikó sp. nov.	103
<i>Conostigmus johnsoni</i> Trietsch & Mikó sp. nov.	108
<i>Conostigmus lepus</i> Trietsch sp. nov.	112
<i>Conostigmus longiharpes</i> Trietsch sp. nov.	117
<i>Conostigmus michaeli</i> Trietsch sp. nov.	122
<i>Conostigmus minimus</i> Trietsch & Mikó sp. nov.	126
<i>Conostigmus muratorei</i> Trietsch sp. nov.	130

<i>Conostigmus musettiae</i> Trietsch & Mikó sp. nov. ....	134
<i>Conostigmus rosemaryae</i> Trietsch sp. nov. ....	138
<i>Conostigmus washburni</i> Trietsch sp. nov. ....	142
Other species. ....	146
<i>Conostigmus lucidus</i> Mikó and Trietsch 2016. ....	146
Discussion. ....	147
Acknowledgments. ....	150
References. ....	151

## Abstract

We revise the species of *Conostigmus* Dahlbom, 1858 (Hymenoptera: Ceraphronoidea: Megaspilidae) found in North America, north of Mexico. We describe the following 12 new species: *Conostigmus dessarti* Trietsch & Mikó **sp. nov.**; *C. duncani* Trietsch **sp. nov.**; *C. franzinii* Trietsch & Mikó **sp. nov.**; *C. johnsoni* Trietsch & Mikó **sp. nov.**; *C. lepus* Trietsch **sp. nov.**; *C. longiharpes* Trietsch **sp. nov.**; *C. michaeli* Trietsch **sp. nov.**; *C. minimus* Trietsch & Mikó **sp. nov.**; *C. muratorei* Trietsch **sp. nov.**; *C. musettiae* Trietsch & Mikó **sp. nov.**; *C. rosemaryae* Trietsch **sp. nov.**; and *C. washburni* Trietsch **sp. nov.** We also redescribe the following 12 species: *Conostigmus abdominalis* (Boheman, 1832); *C. bipunctatus* Kieffer, 1907; *C. dimidiatus* (Thomson, 1858); *C. erythrothorax* (Ashmead, 1893); *C. laeviceps* (Ashmead, 1893); *C. muesebecki* Dessart & Masner, 1965; *C. nigrorufus* Dessart, 1997; *C. obscurus* (Thomson, 1858); *C. orcasensis* (Brues, 1909); *C. pulchellus* Whittaker, 1930; *C. quadratogenalis* Dessart & Cooper, 1975; and *C. triangularis* (Thomson, 1858). We report specimens of *C. abdominalis* (Boheman, 1832) and *C. bipunctatus* Kieffer, 1907 from the Nearctic for the first time, expanding the range from Palearctic to Holarctic for both species. We regard the following 19 species as having uncertain status due to reasons such as missing type specimens: *Conostigmus ambiguus* (Ashmead, 1893); *C. bacilliger* (Kieffer, 1906); *C. bakeri* Kieffer, 1908; *C. californicus* (Ashmead, 1893); *C. canadensis* (Ashmead, 1888); *C. crawfordi* (Mann, 1920); *C. harringtoni* (Ashmead, 1888); *C. hyalinipennis* (Ashmead, 1887); *C. inermis* (Kieffer, 1906); *C. integriceps* (Kieffer, 1906); *C. marylandicus* (Ashmead, 1893); *C. nevadensis* (Kieffer, 1906); *C. nigripes* (Kieffer, 1906); *C. ottawensis* (Ashmead, 1888); *C. pergandei* (Ashmead, 1893); *C. popenoei* (Ashmead, 1893); *C. rufoniger* (Provancher, 1888); *C. schwarzi* (Ashmead, 1893); and *C. trapezoidus* Kieffer, 1908. We transfer *Conostigmus arietinus* (Provancher, 1887) to *Dendrocerus* Ratzeburg, 1852, and consider *Conostigmus subinermis* (Kieffer, 1907) to be absent from the Nearctic and limited to the Palearctic. The Nearctic species *C. timberlakei* Kamal, 1926 remains *incertae sedis*. We provide the name *Conostigmus fulgidus* Mikó and Trietsch to replace the junior homonym *Conostigmus lucidus* Mikó and Trietsch 2016. We provide a key for the identification of Nearctic *Conostigmus* species, and provide comments on their natural history. Finally, we infer evolutionary relationships within Megaspilinae using male genitalia and other morphological characters. This work represents the first in-depth study and revision of *Conostigmus* in North America, and contributes the first annotated identification key to Nearctic *Conostigmus* species.

**Key words:** Megaspilinae, morphology, museums, parasitoid wasps, systematics, taxonomy

## Introduction

Ceraphronoidea is a commonly-collected superfamily of parasitoid wasps that occurs on every continent except Antarctica (Johnson and Musetti, 2004; Martinez de Murgia *et al.*, 2001; Mikó *et al.*, 2013; Schmitt, 2004). The superfamily is relatively small, containing approximately 600 species classified in two families, Ceraphronidae and Megaspilidae (Johnson and Musetti, 2004). The superfamily includes species that are important to agriculture (Boenisch *et al.*, 1997; Chow and Mackauer, 1999a; Ferrière, 1933; Kamal, 1939; Kamarudin *et al.*, 1996; Ortiz-Martínez and Lavandero, 2017; Polaszek *et al.*, 1994), as well as species that have been used as models for studying parasitoid behavior and ecology (Chow and Mackauer, 1999a, 1999b; Mackauer, 2017; Mackauer and Chow, 2015, 2016; Nakashima *et al.*, 2016; Schwörer *et al.*, 1999). Ceraphronoidea also includes species with compelling morphological structures, such as the synsternal and syntergal translucent patches (Trietsch *et al.*, 2017) and a highly-articulated genitalia skeletomuscular system that is most similar to that found in non-apocritan wasps (Mikó *et al.*, 2013, 2018). With a dearth of taxonomic revision in the superfamily (Bennett *et al.*, 2019; Masner, 2006; Pezzini and Köhler, 2017), much remains to be discovered about the diversity, morphology, and life history of this compelling group of parasitoid Hymenoptera.

*Conostigmus* Dahlbom, 1858 is the most diverse genus in Megaspilidae, with over 170 species found worldwide (Bijoy *et al.*, 2014; Johnson and Musetti, 2004; Mikó *et al.* 2016, 2018). According to Johnson and Musetti

(2004), there are 32 species of *Conostigmus* known from the Nearctic, here considered as North America north of Mexico. However, the genus has never been revised for this region. The most recent paper addressing Nearctic *Conostigmus* was published over twenty years ago (Dessart, 1997a), and with *Conostigmus* being so widespread and potentially important, the genus needs attention. Here, we revise all *Conostigmus* species found in the Nearctic, discussing known species, describing new species and providing new species records. We also provide a key to Nearctic *Conostigmus* to aid identification efforts. Through this work, we hope to create a resource for those currently working with these hymenopterans, as well as creating a foundation for future taxonomic work.

## Taxonomic History and Status

*Conostigmus* was first described by Dahlbom (1858), who originally proposed it as a subgenus of *Megaspilus* Westwood. Kieffer (1909) was the first to recognize *Conostigmus* as a genus separate from *Megaspilus*, though he did not designate a type species for the genus at that time. Muesebeck and Walkley (1951) later designated *Megaspilus alutaceus* Thomson, 1858 as the type species of *Conostigmus*. However, as is the case with several other *Conostigmus* type specimens, the location of the female holotype (and only known specimen of this species) is currently unknown (Johnson and Musetti, 2004).

Dessart and Cancemi (1987) recognized five subgenera of *Conostigmus*, acknowledging that this division was provisional and would likely be changed as more was learned about the ceraphronoid taxa (Panis, 2008). The five subgenera of *Conostigmus* and the type specimens of each are as follows: *Conostigmus* s. str., type species: *C. alutaceus* Thomson, 1858; *Dolichoceraphron* Hellén, type species: *C. linearis* Hellén, 1966; *Ecnomothorax* Dessart and Masner, type species: *C. muesebecki* Dessart and Masner, 1965; *Eumegaspilus* Ashmead, type species: *C. canadensis* Ashmead, 1888; and *Szelenyides* Dessart, type species: *C. confluens* Dessart, 1974 (Dessart and Cancemi, 1987). Currently, the locations of the type material of *C. alutaceus* Thomson, 1858 and the male type specimen of *C. canadensis* Ashmead, 1888, are unknown (Johnson and Musetti, 2004). Diagnostic characters for these subgenera are provided in Table 1.

**TABLE 1.** The diagnostic characters and type specimens for the five subgenera of *Conostigmus*.

Subgenus	Type species	Diagnostic Characters
<i>Conostigmus</i> s. str.	<i>C. alutaceus</i> Thomson, 1858 (location of type material unknown)	Mesosoma not lengthened; pronotum not enlarged; mesonotum not reduced; transscutal articulation present, with mesoscutum and axilla as separate sclerites; sternaulus absent or present; wings absent or present; volsella not fused in males.
<i>Dolichoceraphron</i> Hellén	<i>C. linearis</i> Hellén, 1966	Mesosoma lengthened; pronotum not enlarged; mesonotum not reduced; transscutal articulation present, with mesoscutum and axilla as separate sclerites; sternaulus absent; wings present or absent; volsella not fused in males.
<i>Ecnomothorax</i> Dessart and Masner	<i>C. muesebecki</i> Dessart and Masner, 1965	Mesosoma not lengthened; pronotum enlarged; mesonotum reduced; transscutal articulation present, with mesoscutum and axilla as separate sclerites; sternaulus absent; wings absent; volsella fused in males.
<i>Eumegaspilus</i> Ashmead	<i>C. canadensis</i> Ashmead, 1888 (location of male type unknown)	Mesosoma not lengthened; pronotum not enlarged; mesonotum not reduced; transscutal articulation present, with mesoscutum and axilla as separate sclerites; sternaulus absent or present; wings absent or present; volsella fused in males.
<i>Szelenyides</i> Dessart	<i>C. confluens</i> Dessart, 1974	Mesosoma not lengthened; pronotum not enlarged; mesonotum not reduced; transscutal articulation absent, with mesoscutum and axilla forming a single sclerite; wings absent. Male unknown.

## Hosts and Life History of *Conostigmus*

Little is known about the life history of *Conostigmus* relative to their diversity, but some biologies are known. Kamal (1926) reared *C. triangularis* Thomson, 1858 from the puparia of multiple syrphid species (Diptera), and Laborius (1972) reared *C. rufescens* Kieffer from cocoons of the brassica pod midge, *Dasineura brassicae* Winnertz (Diptera: Cecidomyiidae), a pest of oil rapeseed (*Brassica napus* L.). Kieffer (1907) reported *C. syrphorum* Kieffer, 1907 (synonym of *C. obscurus* Thomson, 1858) reared from a syrphid puparium, although the single female type specimen is missing. Guppy (1961) reared an unknown *Conostigmus* species from the cocoons of *Dasyneura leguminicola* Lintner (Diptera: Cecidomyiidae), a pest of red clover, *Trifolium pratense* L.

Several *Conostigmus* species are also associated with ants (Hymenoptera: Formicidae) (Dessart, 1975; Panis, 2008). *Conostigmus formiceti* (Erichson) has been collected from the nests of several ant species, including *Formica pratensis* Retzius, *Formica rufa* L., *Lasius brunneus* Latreille, and *Lasius flavus* Fabricius (Dessart, 1975; Märkel, 1844; Panis, 2008). Other *Conostigmus* collected from ant nests include the following: *C. crawfordi* Mann, 1920; *C. dimorphus* (Kieffer, 1832); *C. dimidiatus* (Thomson, 1858), *C. frontalis* (Thomson, 1858); *C. halteratus* (Boheman, 1832); and *C. melanocephalus* (Boheman, 1832) (Dessart, 1975; Märkel, 1844; Panis, 2008).

Concerning other orders of insects, Alekseev (1978) reported *Conostigmus fasciatipennis* Kieffer, 1907 from the ladybird beetle species *Coccinella septempunctata* L. (Coleoptera: Coccinellidae), and Cooper and Dessart (1975) described *Conostigmus quadratogenalis* Dessart & Cooper, 1975 as an endoparasitoid of *Boreus notoperates* Cooper (Mecoptera: Boreidae), which is the first record of a ceraphronoid with a mecopteran host.

While *Conostigmus* are known to be associated with Hymenoptera, Coleoptera, Diptera and Mecoptera, other members of Ceraphronoidea have been reared from these and other orders of insects, including Lepidoptera, Hemiptera, Neuroptera, Trichoptera and Thysanoptera (Dessart, 1967, 1992; Evans *et al.*, 2005; Goulet and Huber, 1993; Graham, 1984; Hayat *et al.*, 2003; Kamal, 1926, 1939; Laborius, 1972; Matsuo *et al.*, 2016; Mikó and Deans, 2009; Schaffner, 1959; Ulina *et al.*, 2019). The sister genus to *Conostigmus*, *Dendrocerus*, includes both primary parasitoids and hyperparasitoids on the secondary, tertiary and even quaternary level (Burks *et al.*, 2016; Dessart, 1995a; Fergusson, 1980; Haviland, 1920). With ceraphronoids reared from such a wide variety of hosts and exhibiting such a wide variety of lifestyles, future work on the hosts and life histories of *Conostigmus* promises to be rich in new discoveries.

## Methods

Pinned, point-mounted, carded and ethanol-preserved specimens were borrowed from or observed in-house at the museums and collections listed below (museum codens following Arnett *et al.* (1993) and Evenhuis (2018)).

Collection Coden	Museum Name and Location
AMNH	American Museum of Natural History, New York, New York, USA
CAS	California Academy of Sciences, San Francisco, California, USA
CLEV	Cleveland Museum of Natural History, Cleveland, Ohio, USA
CNC	Canadian National Collection of Insects, Ottawa, Ontario, Canada
EDNC	North Carolina Department of Agriculture, Raleigh, North Carolina, USA
HIC	Hymenoptera Institute Collection, Department of Entomology, University of Kentucky, Lexington, Kentucky, USA
HNHM	Hungarian Natural History Museum, Budapest, Hungary
INHS	Illinois Natural History Survey, Champaign, Illinois, USA (Collection Identifier Namespace: INHS Insect Collection)
MCSN	Museu Civico di Storia Naturale “Giacomo Doria”, Genoa, Italy
MCZC	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA
MNHN	Museum National d’Histoire Naturelle, Paris, France
MSUC	Michigan State University, East Lansing, Michigan, USA
MZLU	Museum of Zoology, Lund University, Lund, Sweden
NCSU	North Carolina State University Insect Collection, Raleigh, North Carolina, USA

NHMUK	The Natural History Museum, London, UK (formerly BMNH)
NHRS	Naturhistoriska Riksmuseet, Stockholm, Sweden
NMKE	National Museum of Kenya, Nairobi, Kenya
OSUC	C. A. Triplehorn Insect Collection, Ohio State University, Columbus, Ohio, USA
PSUC	Frost Entomological Museum, Pennsylvania State University, State College, PA, USA
QM	Queensland Museum, South Brisbane, Queensland, Australia
ROME	Royal Ontario Museum, Toronto, Ontario, Canada
SAMC	Iziko Museum of Capetown (formerly South African Museum), Cape Town, South Africa
TAMU	Texas A&M University, College Station, Texas, USA
UAM	Entomology Collection, University of Alaska Museum, Fairbanks, Alaska, USA
UCFC	University of Central Florida, Orlando, Florida, USA
UCRC	Entomology Research Museum, Department of Entomology, University of California, Riverside, California, USA
ULQC	University of Laval, Quebec, Canada
UMSP	University of Minnesota Insect Collection, St. Paul, Minnesota, USA
UNHC	University of New Hampshire, Durham, New Hampshire, USA
UNSA	Natal Museum, Pietermaritzburg, Kwa-Zulu Natal, South Africa
USNM	Smithsonian Institution, National Museum of Natural History, Washington D.C., USA
WIRC	University of Wisconsin Insect Research Collection, Department of Entomology, University of Wisconsin, Madison, Wisconsin, USA

Specimens were also collected fresh by using sweep nets, Malaise traps, yellow pan traps, litter sifters and Winkler extractors (Masner, 2011; Trietsch and Mikó, 2018). All bycatch was donated to the Frost Entomological Museum at Penn State, University Park, PA. Any collected or loaned specimens in ethanol were either point mounted or moved to glycerin for subsequent observation or dissection.

Species were described and redescribed using 159 morphological characters, including both somatic and male genitalia characters. Male genitalia characters were first studied by ceraphronoid taxonomist Paul Dessart and have been found to be one of the best ways to distinguish ceraphronoid species (Dessart, 1997a, 1997b; Mikó *et al.*, 2013, 2016). To prepare male genitalia for study, metasomata were removed from specimens and placed in 35% H<sub>2</sub>O<sub>2</sub> (Alfa Aesar, Ward Hill, MA, USA) for 24 hours, 5% acetic acid (Distilled White Vinegar, Great Value, Bentonville, AR, USA) for 24 hours, distilled water for 1 hour and then transferred to a droplet of glycerin on a concavity slide (Sail Brand Ltd., West Yorkshire, UK). Dissections were performed in glycerin by using #5 forceps (Rubis 5A-SA, BioQuip, Rancho Dominguez, CA, USA) and #2 insect pins (BioQuip, Rancho Dominguez, CA, USA).

Morphological characters were scored based on observations of point-mounted and glycerin-stored specimens. Specimens were examined using an Olympus SZX16 stereomicroscope equipped with an Olympus SDF PLAPO 1X objective (115×) and an Olympus SDF PLAPO 2×PFC objective (230× magnification). Blue-Tac (Bostik, Inc., Wauwatosa, Wisconsin, USA) and molding clay (Sculpey, Polyform Products Company, Elk Grove Village, Illinois, USA) were used to stabilize specimens during imaging and observation. Brightfield images stacks were taken manually on an Olympus CX41 microscope with a Canon EOS 70D camera attached. All images were then aligned and stacked using Zerene Stacker Version 1.04 Build T201706041920 (Zerene Systems LLC, Richland, WA, USA). All specimens were imaged in this way, except for the lectotype specimen of *Conostigmus dimidiatus* (Thomson, 1858), which was imaged by Christoffer Fågerström at the MZLU. Figures were created in Adobe Photoshop Elements, Version 3.1 (Adobe Systems, San Jose, CA, USA).

Anatomical terms follow Harris (1979), Mikó and Deans (2009), Mikó *et al.* (2007, 2013, 2016), and the Hymenoptera Anatomy Ontology (Yoder *et al.*, 2010). Following the Phenotypic Quality Ontology (PATO; available at <http://obofoundry.org/>), the descriptions use the preferred label “count” instead of “presence” because character “presence” should logically not include the state “absence”. Concerning characters involving the dorsomedian conjunctiva, Mikó *et al.* (2013) hypothesized that the dorsomedian conjunctiva is always present, as conjunctiva is needed to hold the sclerite together (see dc; Fig. 43A in Mikó *et al.* (2016)). However, it can be difficult to see this, even with a microscope. We follow their hypothesis that the dorsomedian conjunctiva is present, even if it cannot be easily seen. One character in Mikó *et al.* (2016), “Distal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape”, has been changed to “Proximal end of dorsomedian conjunctiva of the gonostyle–volsella com-

plex shape” in this publication. The intention of this character is to describe the shape of the medial region of the gonostyle–volsella complex; sometimes the dorsomedian margin is acute, but it can be straight or blunt, regardless of whether the dorsomedian projection of the gonostyle–volsella complex is present. We created a second character, “Dorsomedial margin of gonostyle–volsella complex shape”, to further describe this shape and how it changes with the presence or absence of the dorsomedian projection.

Morphometric analysis following the methods of Ridenbaugh *et al.* (2018) was performed on three similar species of *Conostigmus* all characterized by the presence of a facial sulcus: *C. abdominalis* (Boheman, 1832); *C. pulchellus* Whittaker, 1930; and *C. rosemaryae* Trietsch **sp. nov.** Five male specimens of each species were chosen and measured based on availability of specimens and specimen condition. A series of shape principal component analyses (PCAs) was conducted for 19 measurements to determine if the specimens could be differentiated morphometrically and whether these differences could have an allometric component. All specimen data and measurements are presented in Supplementary File 1.

Georeferencing of specimens was done using a point-radius method for collecting event locality strings in the GEOLocate Web Application platform. Point maps depicting collection localities were created in R (Version 1.1.463) using the following packages: *rworldmap* (South, 2011), *ggthemes* (Arnold, 2017), *ggplot2* (Wickham, 2016), *RColorBrewer* (Neuwirth, 2014), and *data.table* (Dowle and Srinivasan, 2017). Overlapping localities were shifted slightly from central location for visual purposes.

Morphological cladistic analyses were performed for twenty-two *Conostigmus* spp.; twenty species of the megaspiline genera *Trichosteresis* Förster, *Megaspilus* and *Dendrocerus*; two species of Lagynodinae; and two outgroup species. Ceraphronoidea have a highly-articulated genitalia skeletomuscular system that is similar to that found in non-apocritan wasps (Mikó *et al.*, 2013, 2018). Male genitalia structures in Ceraphronoidea are so different than those of other apocritan wasps that it can be difficult to compare them morphologically. Due to the difficulty recognizing homology between Ceraphronoidea and other apocritan wasps, we used two non-megaspilid ceraphronoids, *Trassedia luapi* Cancemi and *Masner lubomirus* Mikó and Deans, as outgroup species.

Specimen data, species concepts, natural language phenotypes and images were compiled in the online database MX (<http://purl.oclc.org/NET/mx-database>), which was used to render the Description and Material Examined sections. All specimen data is present in Supplementary File 2. Specimen data was also entered into a Microsoft Excel spreadsheet template from GBIF to be published and made available on GBIF using the Integrated Publishing Toolkit (<https://www.gbif.org/news/82852/new-darwin-core-spreadsheet-templates-simplify-datapreparation-and-publishing>). All figures, tables, TNT files, protocols, and supplementary files are publicly available on figshare ([https://figshare.com/projects/A\\_Taxonomic\\_Revision\\_of\\_Nearctic\\_Conostigmus\\_Hymenoptera\\_Ceraphronoidea\\_Megaspilidae\\_/65075](https://figshare.com/projects/A_Taxonomic_Revision_of_Nearctic_Conostigmus_Hymenoptera_Ceraphronoidea_Megaspilidae_/65075)) and on Penn State’s ScholarSphere (<https://doi.org/10.26207/bmzg-3a23>).

Morphological data for 44 discrete binary or multistate characters, including 11 male genitalia characters and 33 somatic characters, were coded into a data matrix using mx. Cladistic analyses were done with TNT 1.1 (Goloboff *et al.* 2008). Space for 1,000 trees was reserved in memory and traditional searches were run in equal-weighting analyses. Analyses were run with collapsing rules set to maximum length = 0. One thousand replications with 1,000 trees saved per replication were run, and jackknife and bootstrap support values were calculated with 10,000 pseudo-replications. All specimen data, character codings and data matrices are present in Supplementary File 3, with TNT files available on figshare and ScholarSphere.

## Results

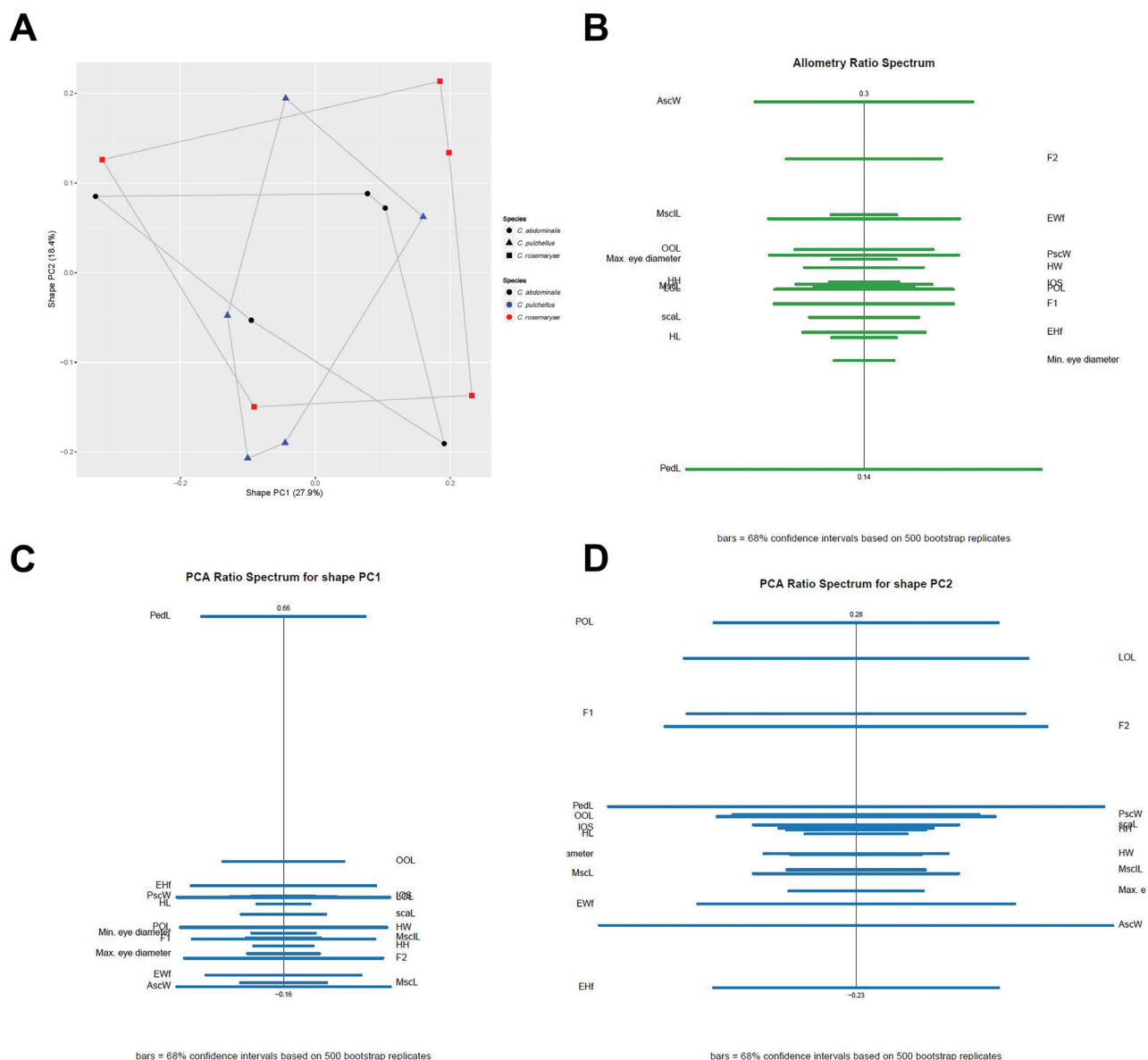
### Principal component analysis of *C. abdominalis*, *C. pulchellus* and *C. rosemaryae*

Fig. 1

*C. abdominalis* (Boheman, 1832); *C. pulchellus* Whittaker, 1930; and *C. rosemaryae* Trietsch **sp. nov.** are three similar species that share somatic morphological characters but differ in male genitalia characters. To test whether morphometric analysis could be used to differentiate these three species, a series of shape principal component analyses (PCAs) was done for 19 measurements, listed in Table 2. On the PCA ratio spectrum, the characters that are furthest apart show the most variation and are the most useful for distinguishing species, while the characters that are closest together have less variation and should not be used to distinguish species (Baur and Leuenberger



2011; László *et al.* 2013; Ridenbaugh *et al.* 2018). On the allometry ratio spectrum, characters that are the closest together are less allometric, whereas those furthest apart show the highest degrees of allometric variation (Baur and Leuenberger 2011; László *et al.* 2013; Ridenbaugh *et al.* 2018).



**FIGURE 1.** Principal component analysis of three species: *C. abdominalis* (Boheman, 1832); *C. pulchellus* Whittaker, 1930; and *C. rosemaryae* Trietsch **sp. nov.** The scatterplot of the first shape principal component plotted against the second shape principal component (A) does not show separation of the three species from the first principal component nor the second. On the allometry ratio spectrum (B), characters that are the closest together are less allometric, whereas those furthest apart show the highest degrees of allometric variation. On the ratio spectrums for the first principal component (C) and the second principal component (D), the characters that are furthest apart show the most variation and are the most useful for distinguishing species, while the characters that are closest together have less variation and should not be used to distinguish species. The horizontal bars in the allometry ratio spectrum and the ratio spectrums for both principal components represent 68% confidence based on 1000 bootstrap replicates.

For our measurements, the first and second shape principle component accounted for 46.3% of the variation observed, but separation of the species was not recovered from either the first principal component or the second (Fig. 1A). The most discerning ratios according to the first principal component were the median anatomical line of the pedicel (PedL):anterior mesoscutal width (AscW), PedL:mesoscutal length (MscL), and PedL:eye frontal width

(EWf). The most discerning ratios according to the second principal component were posterior ocellar line (POL): eye frontal height (EHf), POL:AscW, lateral ocellar line (LOL):EHf and LOL:AscW (Fig. 1B, C). According to the allometry ratio spectrum, the ratios showing the highest degrees of allometric differences were AscW:PedL, AscW: minimum eye diameter, Flagellomere 2 length (F2):PedL and F2:minimum eye diameter (Fig. 1D).

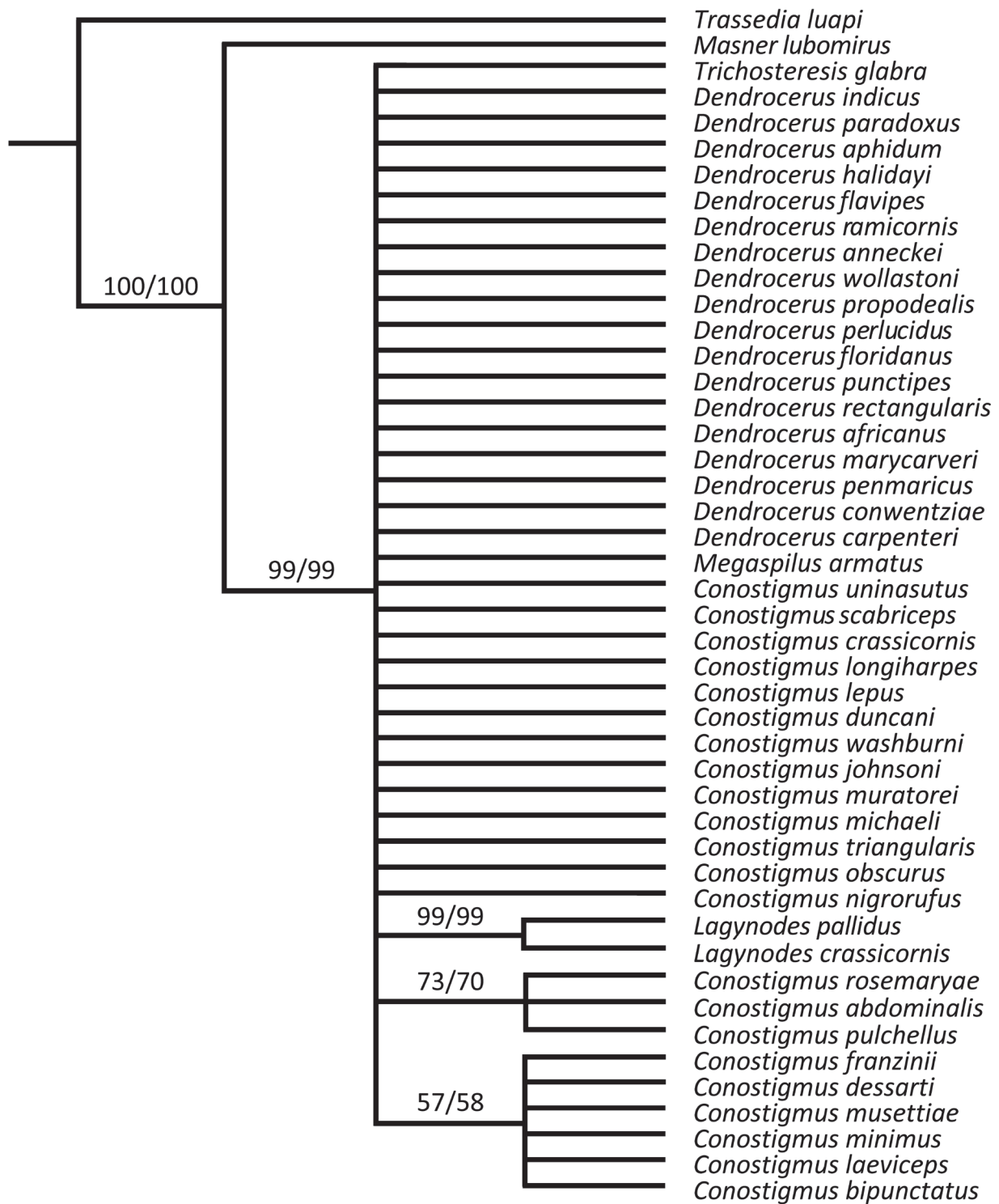
**TABLE 2.** A list of the measurements and abbreviations used for the morphometric analysis.

Abbreviation	Measurement
<b>AscW</b>	Anterior mesoscutal width. The anatomical line between the anterolateral edges of the mesoscutum dorsal view (measure one half if the specimen is poorly mounted and double).
<b>EHf</b>	Eye frontal height. Longest vertical line between the dorsal and ventral eye margins in frontal view.
<b>EWf</b>	Eye frontal width. Longest horizontal anatomical line between the medial and lateral eye margin in frontal view.
<b>HH</b>	Head height (vertical); Longest vertical line between the dorsal and ventral margin of cranium (not the mandible) in lateral view.
<b>HL</b>	Head length (horizontal line). The longest anatomical line of the cranium that is perpendicular to the ventrolateral portion of the occipital carina in lateral view and extends between the anterior and posterior cranial margins.
<b>HW</b>	Head width. The longest horizontal anatomical line between the lateral cranial margins in frontal view.
<b>IOS</b>	Interorbital space. The shortest anatomical line between the compound eyes in frontal view.
<b>LOL</b>	Lateral ocellar line. Shortest anatomical line between median and lateral ocelli.
<b>MscL</b>	Mesoscutal length. The longest median anatomical line of the mesoscutum.
<b>MscL</b>	Mesoscutellar length. The longest median anatomical line of the mesoscutellum.
<b>OCL</b>	Ocello-clypeal line. The longest distance between the median ocellus and the distal clypeal margin (the head has to be in a position with the maximum median anatomical line of the cranium).
<b>OOL</b>	Ocello-ocular line. Shortest anatomical line between eye and lateral ocellus.
<b>PcL</b>	Petiole neck length. The median length of petiole neck.
<b>PcW</b>	Shortest width of petiole neck.
<b>PedL</b>	Median anatomical line of the pedicel.
<b>POL</b>	Posterior ocellar line. Shortest anatomical line between lateral ocelli.
<b>PscW</b>	Posterior mesoscutal width. The longest transverse anatomical line of the mesoscutum.
<b>ScaL</b>	Median anatomical line of scape.

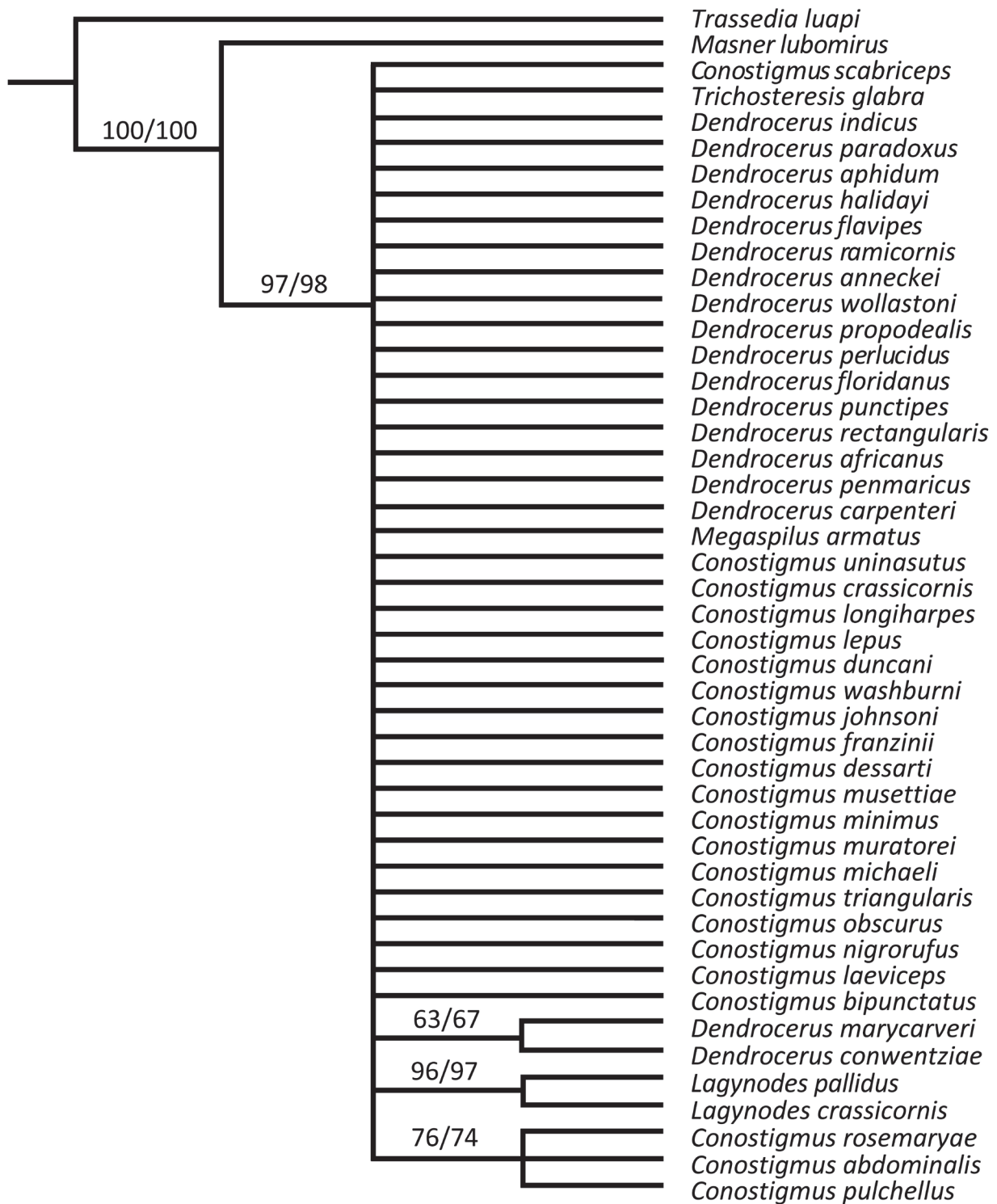
### Morphological cladistic analysis of Megaspilinae

Figs. 2, 3, 4

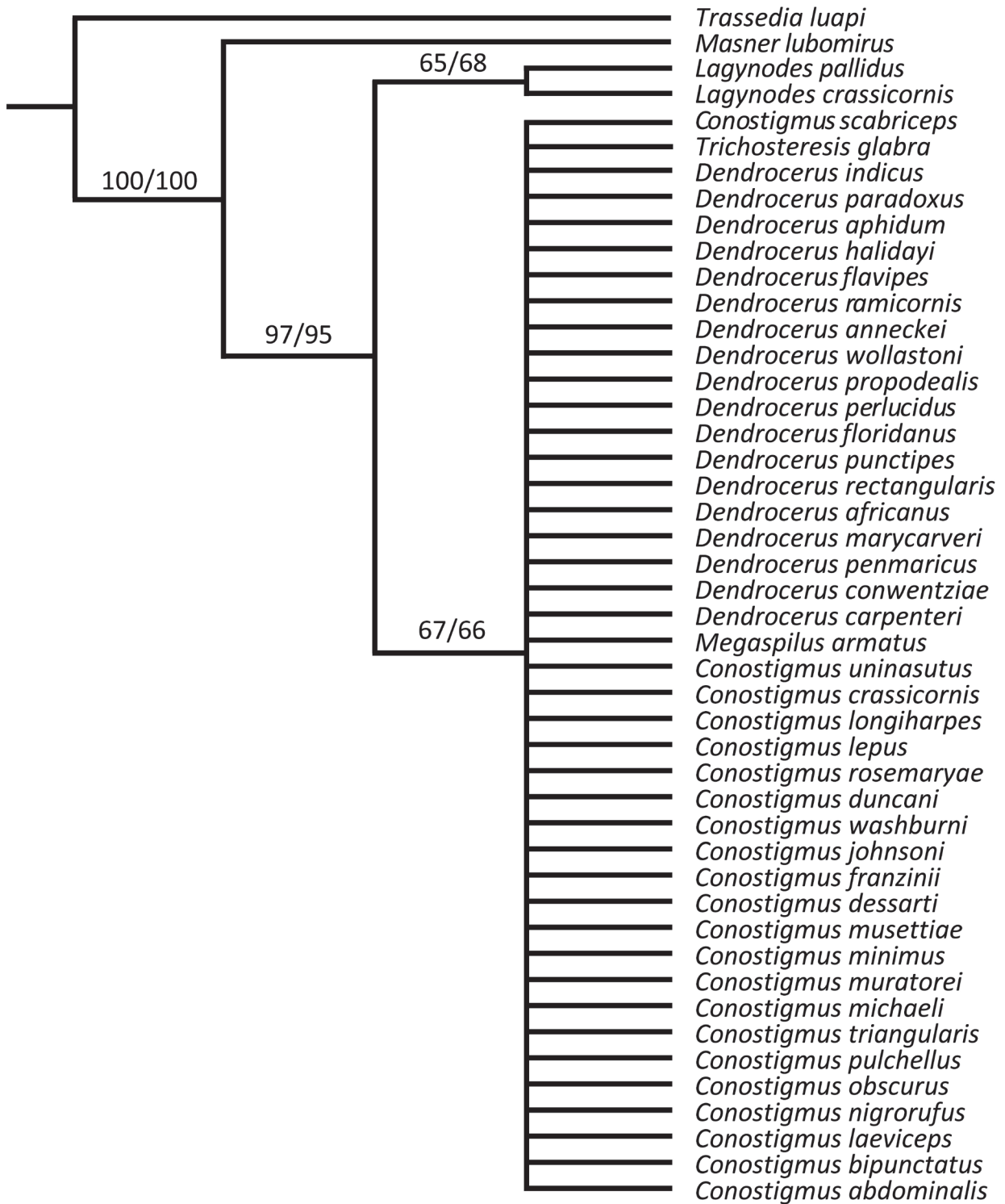
While somatic and male genitalia characters can be used as diagnostic characters for different species of *Conostigmus*, we wanted to test whether they could also be used to infer evolutionary relationships within Megaspilinae. For the combined dataset of male genitalia and somatic characters, there was a high degree of polytomy within Megaspilinae (Fig. 2). The two species of Lagynodinae formed a clade supported by bootstrap and jackknife values higher than 80. There was also a grouping of three *Conostigmus* species with a facial sulcus (*C. abdominalis*, *C. pulchellus* and *C. rosemaryae*) and six *Conostigmus* species (*C. franzinii*, *C. dessarti*, *C. bipunctatus*, *C. musettiae*, *C. minimus*, *C. laeviceps*) with the following synapomorphies: sternaulus present and elongate; medioventral conjunctiva of the gonostyle–volsella complex absent and parossiculi fused; and median process of the intertorular carina present. However, these two groupings of *Conostigmus* had jackknife and bootstrap values lower than 80, and this support level was considered to be insufficient.



**FIGURE 2.** Cladistic analysis using male genitalia and somatic characters to infer phylogenetic relationships within Ceraphronoidea, with a focus on Megaspilinae. Branch support values of the strict consensus tree have been calculated with jackknifing, on the right, and bootstrapping, on the left, using TNT.



**FIGURE 3.** Cladistic analysis using somatic characters to infer phylogenetic relationships within Ceraphronoidea, with a focus on Megaspilinae. Branch support values of the strict consensus tree have been calculated with jackknifing, on the right, and bootstrapping, on the left, using TNT.



**FIGURE 4.** Cladistic analysis using male genitalia characters to infer phylogenetic relationships within Ceraphronoidea, with a focus on Megaspilinae. Branch support values of the strict consensus tree have been calculated with jackknifing, on the right, and bootstrapping, on the left, using TNT.

When analyzing somatic characters separately, there was still a high degree of polytomy within Megaspilinae, but the clade of Lagynodinae remained with high bootstrap and jackknife support (Fig. 3). There was also a grouping of three *Conostigmus* species with a facial sulcus (*C. abdominalis*, *C. pulchellus* and *C. rosemaryae*) and two *Dendrocerus* species (*D. conwentziae* and *D. marycarveri*) with the following synapomorphies: notauli posterior

end anterior to the transverse midline of mesoscutum; speculum not extending ventrally of the pleural pit line; facial pit absent; and male flagellomeres asymmetrical or not cylindrical. However, the two groupings of *Conostigmus* species and *Dendrocerus* species both had jackknife and bootstrap values lower than 80 and were not sufficiently supported in our analysis.

Analyzing male genitalia characters independently produced similar results, with the clade of Lagynodinae supported by high bootstrap and jackknife values, and a high amount of polytomy observed in Megaspilinae (Fig. 4). However, there were no groupings of *Conostigmus* with jackknife and bootstrap values over 50, unlike in the dataset including only somatic characters and in the combined dataset including both somatic and male genitalia characters.

## Taxonomic Treatment of Nearctic *Conostigmus*

### Class Hexapoda Blainville, 1816

### Order Hymenoptera Linnaeus, 1758

### Suborder Apocrita Latreille, 1810

### Superfamily Ceraphronoidea Haliday, 1833

### Megaspilidae Ashmead, 1893

### Megaspilinae Masner and Dessart, 1967

### *Conostigmus* Dahlbom, 1858

**Diagnosis.** Antennae 11-merous in both sexes; male flagellomeres symmetrical (cylindrical) (also in *D. punctipes* species group, which has *Dendrocerus*-like ocellar ratios with POL greater than OOL and LOL, and *D. penmaricus* group, which has maximum scape width greater than pedicel length); ocelli present in both sexes; males usually with an acute or equilateral ocellar triangle (POL equal to or less than LOL), with posterior ocelli that are closer to each other than to the compound eyes (POL less than OOL); apex of calcar bifid (with two bristles, refer to Mikó and Deans (2009)); wings present and fully-formed (macropterous) or reduced (brachypterous); fore wing with pterostigma; posterior end of notauli always adjacent to transscutal articulation; propodeal spine sometimes present but never bifurcated; ventral metasoma with S1 present; proximal margin of S9 with medial projection; male parosiculi independent or fused—1. *Conostigmus* Dahlbom, 1858

## Key to Male *Conostigmus* from the Nearctic Region

Distribution Maps of Nearctic species: Figures 5, 6, 7, 8

1. Pronotum elongate, pronotum longer than mesoscutum along midline (prn; Figs. 31A, B) . . . . . *C. muesebecki* (*Ecnomothorax*) Dessart & Masner, 1965
- Pronotum not elongate, pronotum shorter than mesoscutum along midline (prn; Figs. 9A; 14A, C; 19B). . . . . 2.
2. Median mesoscutal sulcus absent or terminating anterior to the transscutal articulation (Fig. 21B). . . . . *C. dimidiatus* (Thomson, 1858)
- Median mesoscutal sulcus present and complete, terminating adjacent to the transscutal articulation (mms; Figs. 14A, C; 25A, B) . . . . . 3.
3. Ventral metapleural area with transverse striations (trs; Figs. 47B; 63B, C) . . . . . 4.
- Ventral metapleural area without transverse striations (Figs. 9C; 39A; 57). . . . . 5.
4. Ventral metapleural area with transverse striations only on dorsal half (trs; Fig. 47B); median process on intertorular carina present and blunt (mip; Fig. 60B); facial sulcus impression absent (Fig. 22); proximal margin of S9 without submedial projections (Fig. 10F); harpe bilobed (Fig. 48B); harpe with sparse lateral setae (Figs. 48A, C) . . . . . *C. triangularis* (Thomson, 1858)
- Ventral metapleural area with transverse striations on dorsal and ventral halves (trs; Figs. 63B, C); median process on intertoru-

- lar carina absent (Fig. 82B); facial sulcus impression sometimes present (for complete facial sulcus, see fs; Fig. 9B); proximal margin of S9 with submedial projections (sbm; Fig. 64D); harpe simple (Fig. 64B); harpe with dense lateral setae, evenly distributed across entire lateral surface (Figs. 64A, C) . . . . . *C. lepus* Trietsch **sp. nov.**
5. Head shape distinctly square in anterior view (on males and females) (Fig. 43D); F9 the longest male flagellomere (Fig. 43B) . . . . . *C. quadratogenalis* Dessart & Cooper, 1975
- Head shape circular or triangular in anterior view (Figs. 17B; 18B; 22; 49B; 66C); F9 not the longest male flagellomere (Figs. 16; 51; 78) . . . . . 6.
6. Facial sulcus present and complete, extending from intertorular carina to anterior ocellus (fs; Figs. 9B; 79B) . . . . . 7.
- Facial sulcus absent or incomplete, not connecting intertorular carina to anterior ocellus (absent in Figs. 17B; 18B; 22; 49B; 66C) . . . . . 9.
7. Harpe shorter than gonostipes in lateral view (Fig. 80B); harpe not spoon-shaped or spatulate (Figs. 80A, B, C); gonostyle–volsella complex with dorsomedian projection (dmp; Fig. 80C) . . . . . *C. rosemaryae* Trietsch **sp. nov.**
- Harpe longer than gonostipes in lateral view (Fig. 10C); harpe spoon-shaped or spatulate (Figs. 10A, B; 42A, B); gonostyle–volsella complex without dorsomedian projection (Fig. 42B) . . . . . 8.
8. Parossiculi with 1–3 apical setae (prs; Fig. 10B); harpe straight, oriented medially (Figs. 10A, B, D, E) . . . . . *C. abdominalis* (Boheman, 1832)
- Parossiculi with 4 or more apical setae (prs; Fig. 42A); harpe twisted, oriented dorsally or dorsomedially (Fig. 42AB; most visible when looking at base of right harpe in Fig. 42B) . . . . . *C. pulchellus* Whittaker, 1930
9. Mesopostscutellum present (mpm; Figs. 47B; 73A) . . . . . 10.
- Mesopostscutellum absent (Figs. 19A; 21A; 43A; 82A) . . . . . 12.
10. Dorsomedian projection of the gonostyle–volsella complex present and bilobed (dmp; Fig. 74C); head 1.3× wider than mesosoma ( $PscW \times 2$ ) (Fig. 73B); . . . . . *C. muratorei* Trietsch **sp. nov.**
- Dorsomedian projection of the gonostyle–volsella complex absent (Figs. 37C; 56C); head less than 1.3× as wide as mesosoma ( $PscW \times 2$ ) (Figs. 36A; 55B) . . . . . 11.
11. Proximodorsal notch of cupula present and U-shaped, longer than wide (pdn; Figs. 56A, C); parossiculi with one apical seta (prs; Fig. 56A); proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape acute (Fig. 56C) . . . . . *C. duncani* Trietsch **sp. nov.**
- Proximodorsal notch of cupula present and U-shaped, wider than long (pdn; Figs. 37A, C); parossiculi with 2–3 apical setae (Figs. 37A, C); proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape blunt (Fig. 37C) . . . . . *C. orcasensis* (Brues), 1909
12. Sternaulus present (ste; Figs. 9A; 34B; 70A) . . . . . 18.
- Sternaulus absent (Figs. 24; 32A; 60A; 66A) . . . . . 13.
13. Wings absent or reduced, never extending past the mesoscutellum (Figs. 24A, B; 25A, B); OOL:POL ratio less than 0.8 (Figs. 25A, B) . . . . . *C. erythrothorax* (Ashmead, 1893)
- Wings present and macropterous (Figs. 65; 78; 82); OOL:POL ratio greater than 0.8 (Figs. 60B; 66B; 68B) . . . . . 14.
14. Harpe equal to or longer than gonostipes in lateral view (Fig. 67B) . . . . . *C. longiharpes* Trietsch **sp. nov.**
- Harpe shorter than gonostipes in lateral view (Figs. 33D; 83B) . . . . . 15.
15. Occipital carina complete (see oc; Fig. 1B in Mikó and Deans (2009)); widest point of harpe between proximal 1/3rd and 2/3rds (Fig. 61B) . . . . . *C. johnsoni* Trietsch & Mikó **sp. nov.**
- Occipital carina incomplete; widest point of harpe at its articulation site with gonostyle–volsella complex (Figs. 33D; 69B; 83B) . . . . . 16.
16. Preoccipital lunula present (pou; Fig. 47c); preoccipital furrow present and crenulate (pof; Fig. 66B) . . . . . 17.
- Preoccipital lunula absent (Fig. 68B); preoccipital furrow present or absent, but if present, then appearing as a faint impression, never crenulate (Fig. 68B) . . . . . *C. michaeli* Trietsch **sp. nov.**
17. Median process on intertorular carina present and blunt (mip; Fig. 60B); head with rugose sculpture throughout (Fig. 32B); anterior half of mesosoma lighter in coloration than posterior half (Figs. 32A, B) . . . . . *C. nigrorufus* Dessart, 1997
- Median process on intertorular carina absent (Fig. 82B); head without rugose sculpture (Fig. 82B); anterior and posterior half of mesosoma concolorous (Figs. 81; 82A, B) . . . . . *C. washburni* Trietsch **sp. nov.**
18. Sternaulus not reaching 1/2 of mesopleuron length at level of sternaulus on winged specimens (no wingless specimens known) (ste; Fig. 34A); medioventral conjunctiva present (parossiculi independent or fused proximally) (Figs. 23A; 26A; 37A); cupula with proximodorsal notch present, arched (inverted U-shape), and longer than wide (pdn; Figs. 37A, C) . . . . . *C. obscurus* (Thomson, 1858)
- Sternaulus exceeding 3/4 of mesopleuron length at level of sternaulus in winged specimens (ste; Fig. 70A); medioventral conjunctiva absent (parossiculi fused) (Figs. 29A; 71A; 77A); cupula with proximodorsal notch present or absent, can be arched (inverted U-shape) if present, but never longer than wide (pdn; Fig. 37A) . . . . . 19.
19. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex acute (Fig. 53C; see Methods for explanation of this character); scape more than 5.5× as long as the pedicel in macropterous specimens (no wingless specimens known) (Fig. 52A) . . . . . *C. dessarti* Trietsch & Mikó **sp. nov.** (no wingless specimens known)
- Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex blunt or straight; scape less than 5.5× as long as pedicel in macropterous specimens (Fig. 28A) . . . . . 20.
20. Gonossiculi with one spine more than 2× as long as the others (gsn; Fig. 59B); gonostyle–volsella complex with medioventral ridge present (mgv; Figs. 29A; 59A) . . . . . 21.
- Gonossiculi not with one spine more than 2× as long as the others (spines of similar lengths) (gsn; Fig. 71B); gonostyle–volsella complex with medioventral ridge absent (Fig. 71A) . . . . . *C. minimus* Trietsch & Mikó **sp. nov.**

21. Distoventral edge of harpe with dense patch of setae (dps; Fig. 59A).....22.  
 - Distoventral edge of harpe without dense patch of setae (Figs. 29A, B)..... *C. laeviceps* (Ashmead, 1893)  
 22. Axillular carinae present (axc; Fig. 76B)..... *C. musettiae* Trietsch & Mikó **sp. nov.**  
 - Axillular carinae absent (Figs. 14A, C).....23.  
 23. Harpe curved and sickle-shaped in lateral view (distoventral margin of harpe concave in lateral view) (Figs. 15D, E, F); wings macropterous (Fig. 13A) or brachypterous (Figs. 13B; 14A, B, C); syntergite sometimes with paired blue iridescent ovals (Fig. 14C)..... *C. bipunctatus* Kieffer, 1907  
 - Harpe simple, not curved and sickle-shaped in lateral view (distoventral margin of harpe convex in lateral view) (Fig. 59B); wings always macropterous (Fig. 57); syntergite without paired blue iridescent ovals. . . *C. franzinii* Trietsch & Mikó **sp. nov.**

### Redescribed *Conostigmus* spp.

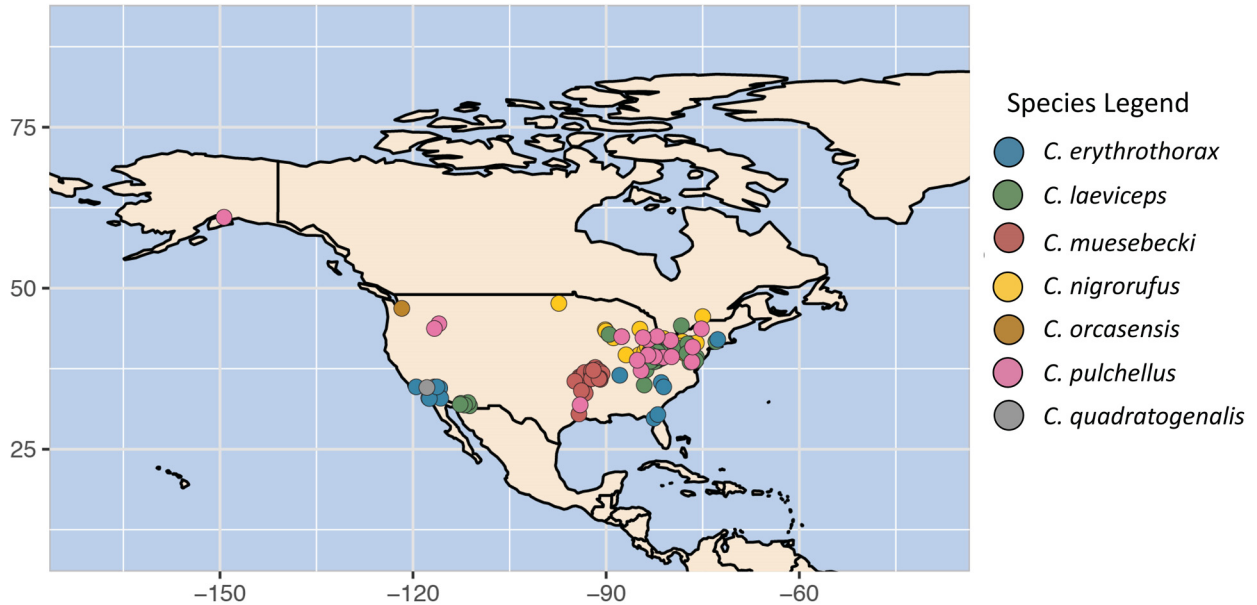


FIGURE 5. A map of redescribed Nearctic *Conostigmus* species.

### Holarctic *Conostigmus* spp.

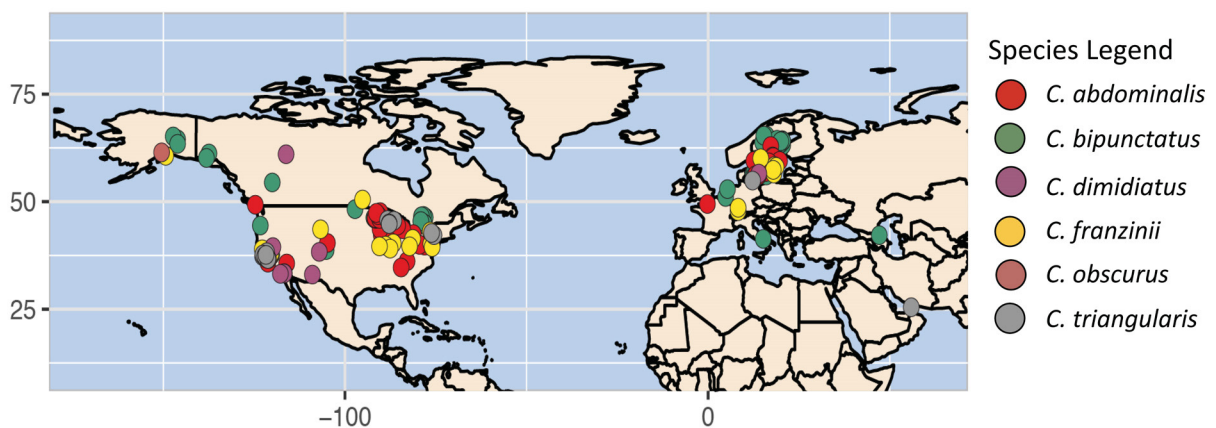


FIGURE 6. A map of Holarctic *Conostigmus* species.



## New Species of Nearctic *Conostigmus*

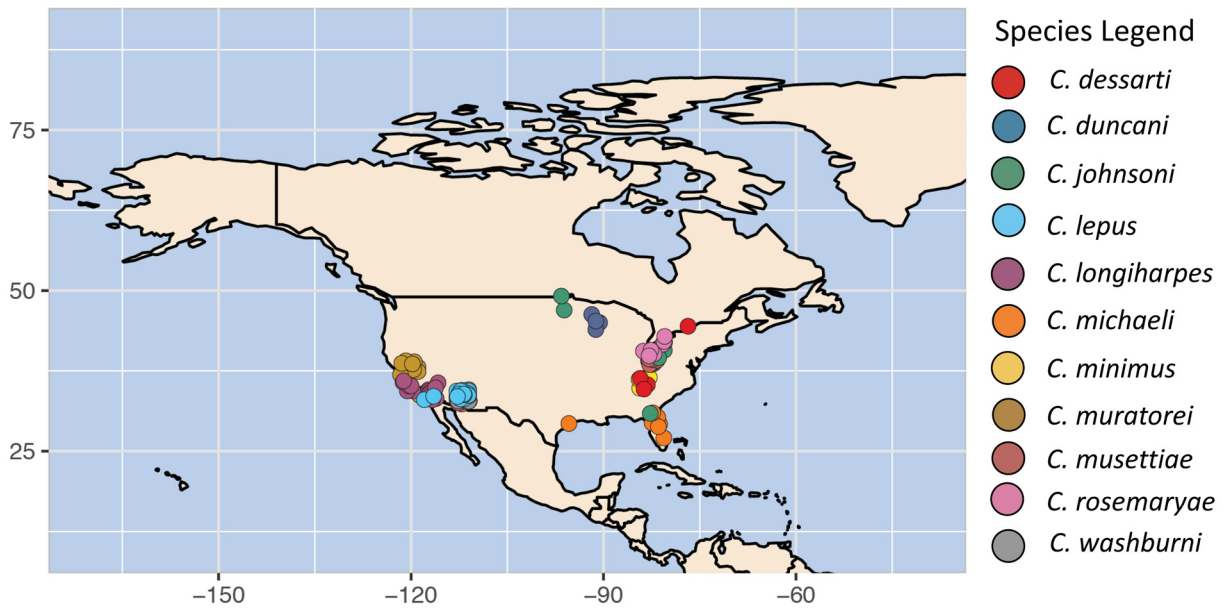


FIGURE 7. A map of newly described Nearctic *Conostigmus* species.

## Nearctic *Conostigmus*: *Species Inquirenda*

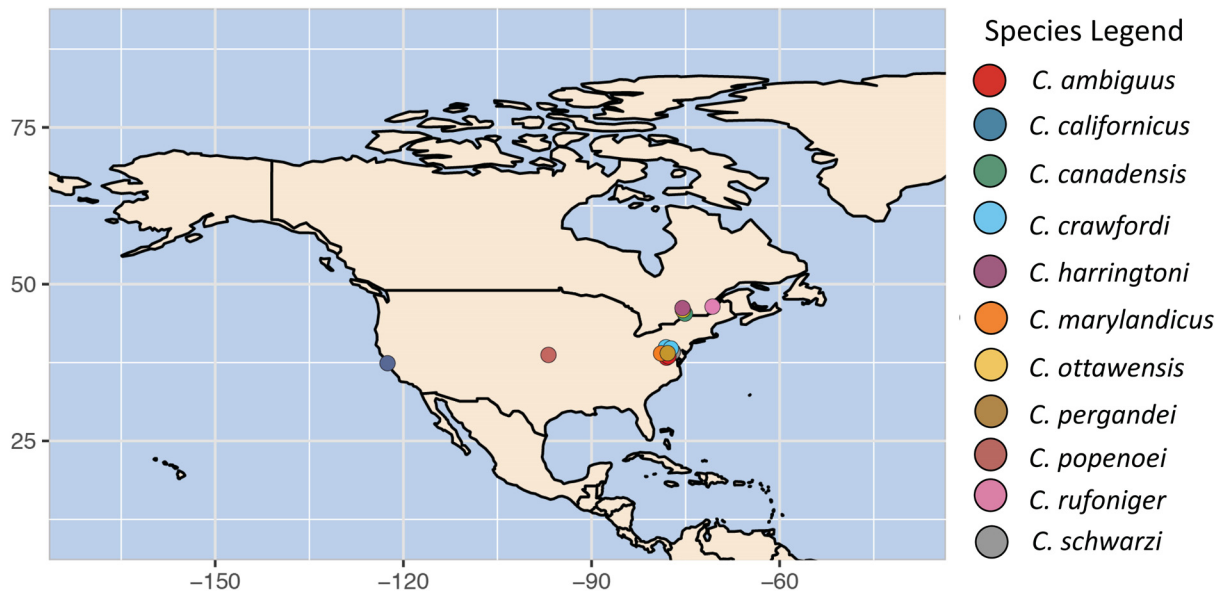


FIGURE 8. A map of Nearctic *Conostigmus* species considered *species inquirenda*.

### Redescribed species

#### *Conostigmus abdominalis* (Boheman, 1832)

Figs. 9, 10

**Species Comments and History.** Boheman (1832) originally described *Ceraphron abdominalis* from a female

specimen, noting that the species was abundant throughout “Smolandia et Vestrogothia” (pg. 330), now modern-day Sweden. Boheman (1832) also described the male of another species, *Ceraphron tenuicornis*, also found in “Smolandia”. Thomson (1858) synonymized the two species, noting the presence of the facial sulcus on both sexes, and transferred the species to *Megaspilus*. Both specimens are located at the NHRS.

Kieffer (1907) keyed, re-described and transferred the species to *Conostigmus*. He broadened the range of distribution and described a new variation, called *testacea*, from a female with lighter coloration collected in Scandinavia, now deposited in the MZLU. Kieffer (1907) described another new species, *C. divisifrons*, from a single female with a facial sulcus and lighter coloration, now deposited in the MNHN (Fig. 16 in Trietsch *et al.*, 2019). Kieffer (1907) also described a third species, *C. foveatifrons*, again from a single female specimen with different coloration, present at the MCSN.

Dessart (1972a) redescribed *C. abdominalis*, illustrated the male genitalia and male and female antennae for the first time, and treated *C. abdominalis* var. *testacea*, *C. divisifrons*, and *C. foveatifrons* as junior synonyms. Dessart (1983a) synonymized two more species with *Conostigmus abdominalis*: *C. pilosiceps* Szabo, 1979, and *C. curvilineaticeps* Szabo, 1979, both described from single female specimens present at the HNHM.

After encountering so many synonyms of *C. abdominalis*, Dessart turned to the Nearctic species *C. pulchellus*, expecting another synonym (1997a). He was surprised to find that although they shared many somatic characters, such as the presence of a facial sulcus and elongate sternaulus, *C. pulchellus* and *C. abdominalis* differed in male genitalia characters and Dessart concluded that they were separate species.

At the time of Dessart’s 1997a publication, *Conostigmus abdominalis* was only reported from the Palearctic. Here, we report male specimens from the Nearctic, overlapping in range with *Conostigmus pulchellus*.

One paratype of *C. pulchellus* present at the NHMUK (NHMUKENT010812165) bears a label from Dessart identifying it as a “*C. abdominalis*, (BOH 1832), syn. nov.”. However, Dessart did not mention this specimen in his 1997a publication. Presumably, Dessart thought the two species were synonymous when he left his label in 1975, as his 1997a paper expresses his surprise to find they are not synonymous. Dissection of the genitalia would be needed to confirm whether this specimen is indeed *C. abdominalis*, but if it were true, this would indicate that *C. abdominalis* has been present in the Nearctic since at least 1930.

**Variability.** The facial sulcus is always present and is usually well-defined with a crenulate carina (PSUC\_FEM 50242, PSUC\_FEM 34020, PSUC\_FEM 86279), but there are two specimens from Ohio where the facial sulcus is smooth instead of crenulate (CMNHENT0022737, CMNHENT0022804).

In the male genitalia, the number of apical setae on the parossiculi vary between 1 (PSUC\_FEM 148696, PSUC\_FEM 83702) and 3 (PSUC\_FEM 88175, NCSU 0055614), but there are never 4 or more (which only occurs in *C. pulchellus*). The male harpe are distinctly spatulate or spoon-shaped, with the widest part of the harpe occurring between the proximal 1/3<sup>rd</sup> (PSUC\_FEM 148540, PSUC\_FEM 148563) and proximal 2/3<sup>rd</sup>s (PSUC\_FEM 50143, PSUC\_FEM 86312). Three specimens (PSUC\_FEM 26786, PSUC\_FEM 50171 and UCRC\_ENT 00457086) have harpe that are barely spatulate, and the widest point of the harpe is at the articulation site with the gonostyle–volsella complex. In this way, the harpe of these three specimens resemble the harpe of *C. longiharpes*, although they otherwise match *C. abdominalis* and can be easily separated from *C. longiharpes* by the presence of the facial sulcus.

**Differences between Nearctic and Palearctic Populations.** No differences were found between Nearctic and Palearctic populations.

**Differences between males and females.** Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** This species is recognizable by the following combination of characters: facial sulcus present; sternaulus present and elongate, exceeding 1/2 of mesopleuron length at level of sternaulus; male genitalia with 1–3 apical parossicular setae (Fig. 10; prs); harpe longer than gonostipes in lateral view; harpe spatulate or spoon-shaped; and harpe oriented medially.

Similar species include *C. longiharpes*, which lacks the facial sulcus, and *C. rosemaryae*, which has the facial sulcus present but also has the dorsomedian projection of the gonostyle–volsella complex present (absent in *C. abdominalis*) and harpe that are not spatulate or spoon-shaped and are shorter than the gonostipes in lateral view. *Conostigmus pulchellus* is also very similar to *C. abdominalis* but differs in that it has 4 or more apical parossicular setae (1–3 in *C. abdominalis*). Also, the harpe are twisted and oriented either dorsally or dorsomedially (harpe are not twisted and are oriented medially in *C. abdominalis*).

Female *C. pulchellus* can be distinguished from *C. abdominalis* by lighter yellow or reddish coloration on the

anterior mesosoma, axilla and axillula (see diagnosis section of *C. pulchellus*). However, *C. abdominalis* and *C. rosemaryae* can only be distinguished by male genitalia characters. *Conostigmus rosemaryae* is only known from the Nearctic, whereas *C. abdominalis* is Holarctic in distribution, but at this time, it is not possible to distinguish Nearctic females of *C. abdominalis* from *C. rosemaryae*.

**Description.** Color hue pattern in male: cranium, mesosoma, metasoma reddish brown to dark brown; F1–F9 light brown to brown; scape, pedicel ochre to brown; legs ochre to light brown. Color intensity pattern in male: metasoma and mandible lighter than mesosoma; flagellomeres darker than scape and pedicel; mandible lighter than cranium. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: present on head and sometimes mesosoma. Rugose region on upper face count: present.

**Antennae:** Male scape length vs. pedicel length: 3.8–6.0. Male scape length vs. F1 length: 0.8–1.2. Male F1 length vs. pedicel length: 3.8–7.5. Male F1 length vs. male F2 length: 1.2–1.5. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma), except in smaller specimens (PSUC\_FEM 50086). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.5–1.8. Head height (HH) vs. head length (HL): HH:HL=1.2–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.7–1.9. Head width (HW) vs. head height (HH): HW:HH=1.3–1.5. Cephalic size (csb): Mean: 450–730 µm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.4. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base OR POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.6–2.2. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.8–1.3. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.6–2.2:1.7–2.2:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial sulcus present. Facial sulcus count: present. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: flat. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=390–1175 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.9. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.5–1.9. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.8–1.0. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 1/2 of mesopleuron length at level of sternaulus. Sternaulus sculpture:

smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discrimenal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 2.3–2.8. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.1–2.9. Syntergal translucent patch maximum width vs. minimum width: 1.1–1.7. Synsternal translucent patch maximum width vs. minimum width: 1.2–1.7. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin; synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

**Male Genitalia:** Distal margin of male S9 shape: straight; convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of setae, sometimes with fewer setae medially to form two separate patches. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: acute. Gonocondyle count: present. Gonocondyle shape: blunt. Distodorsal margin of cupula shape: straight. Distoventral submedian corner of the cupula count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: U-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one; two; three. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe longer than gonostipes in lateral view. Harpe shape: simple and not bilobed; spatulate or spoon-shaped. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is between proximal 1/3rd and 2/3rds. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: medially. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Holarctic.

**Material Examined.** Lectotype female: SWEDEN: NHRS-HEVA000006794 (NHRS).

Non-type material (34 males): CANADA: 1 male. PSUC\_FEM 50171 (CNC). SWEDEN: 10 males. IM 1585,

1741, 1718-1718; NCSU 0017731, 0017732, 0017745, 0055614, 0055635; PSUC\_FEM 28915, 148408 (NCSU). USA: California: 2 males. PSUC\_FEM 26786 (OSUC); UCRC\_ENT 00457086 (UCRC). USA: Colorado: 1 male. PSUC\_FEM 86279 (MSUC). USA: Michigan: 2 males. PSUC\_FEM 50143 (WIRC); PSUC\_FEM 86312 (MSUC). USA: North Carolina: 1 male. CMNHENT0022737 (CLEV). USA: Ohio: 1 male. CMNHENT0022804 (CLEV). USA: Pennsylvania: 1 male. PSUC\_FEM 58229 (PSUC). USA: Tennessee: 1 male. UCFC 243668 (UCFC). USA: West Virginia: 2 males. IM 1612; PSUC\_FEM 148575 (NCSU). USA: Wisconsin: 12 males. PSUC\_FEM 34020 (TAMU); PSUC\_FEM 50086, 50142, 50154, 50242, 50256, 83702, 84006, 84507, 88062, 88082, 98426 (WIRC).

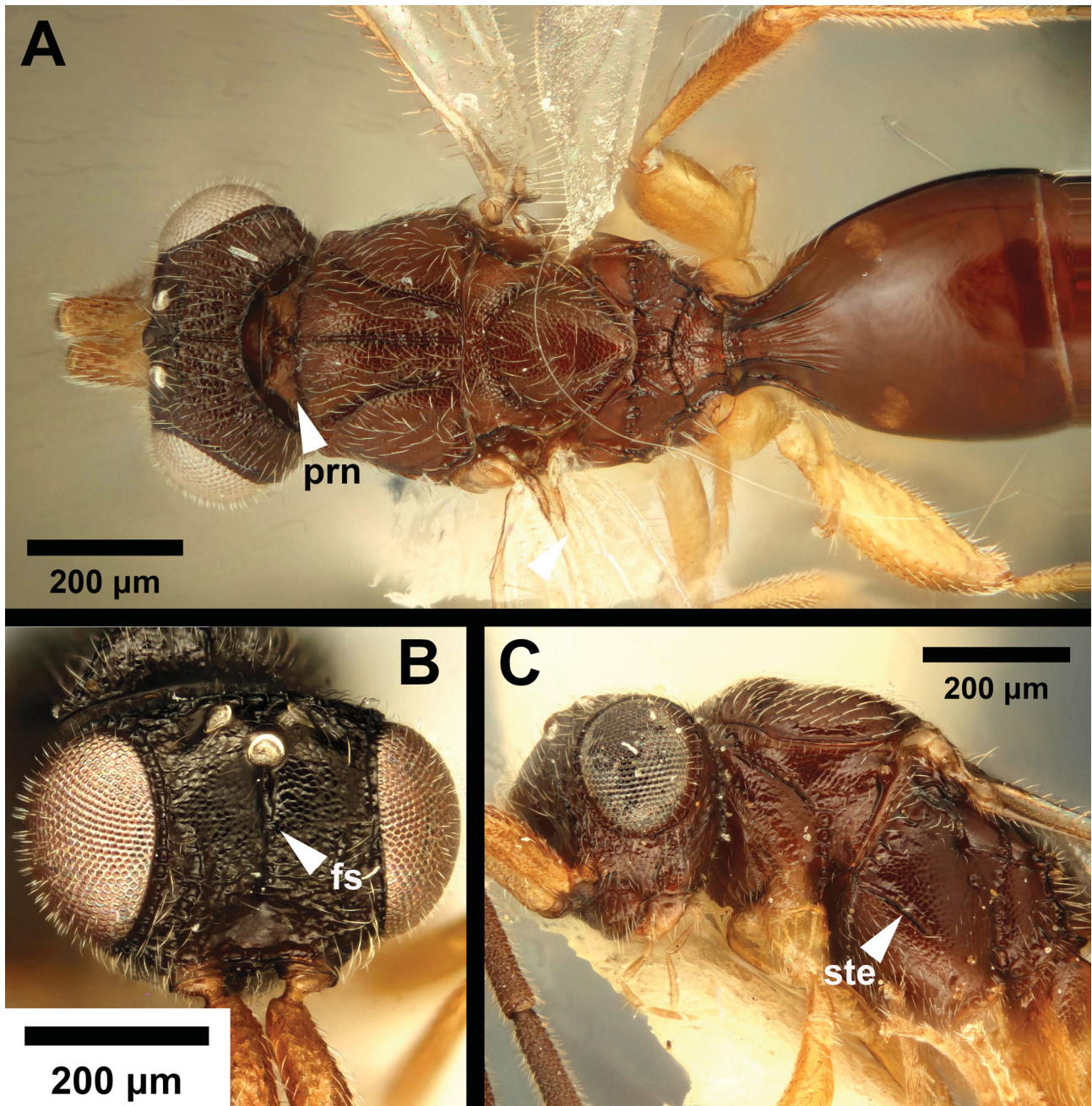
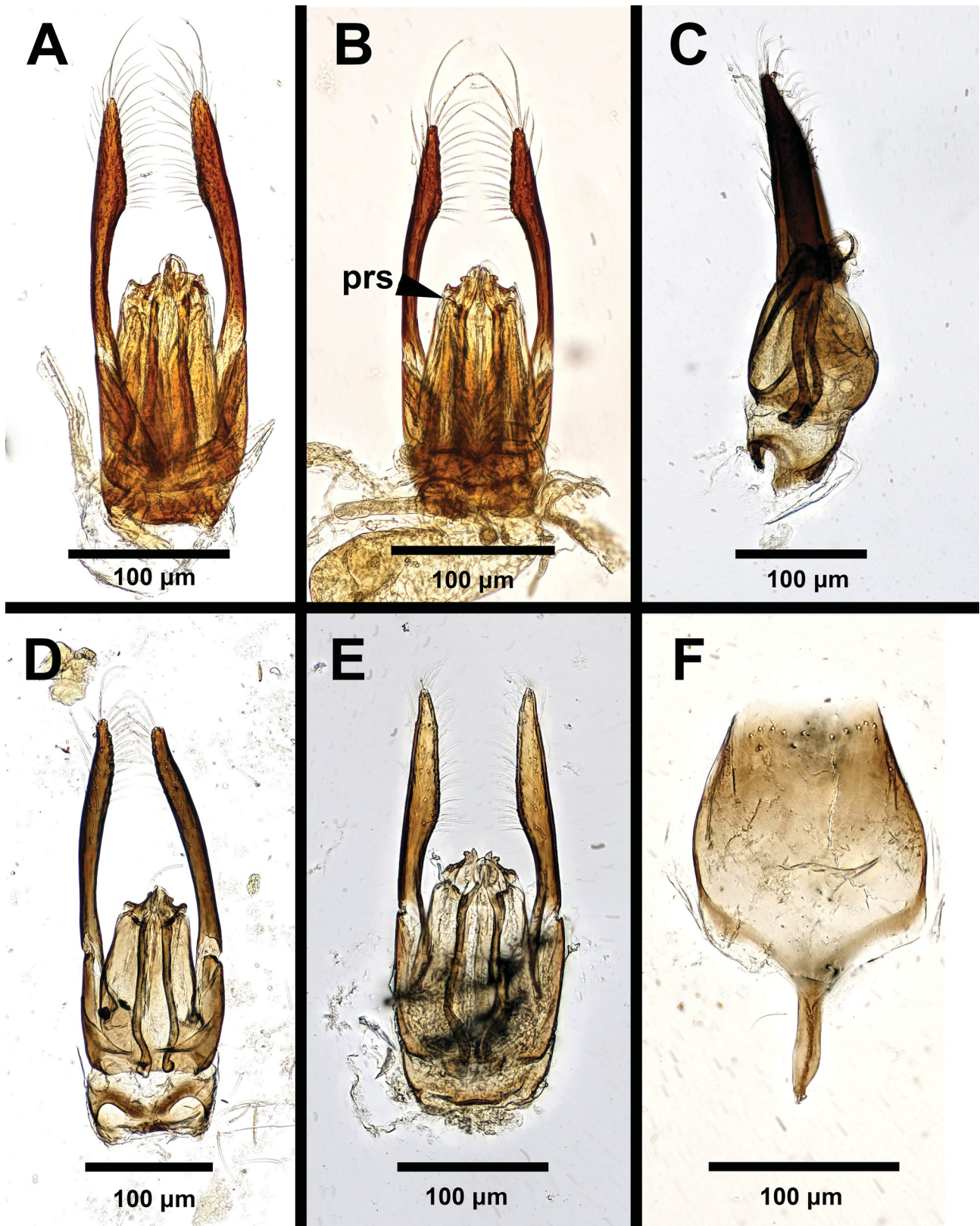


FIGURE 9. *Conostigmus abdominalis* (Boheman, 1832) males. A. Dorsal view. (PSUC\_FEM 88062). B. Frons (PSUC\_FEM 88082). C. Lateral (PSUC\_FEM 86279). Abbreviations: facial sulcus (fs), pronotum (prn), sternaulus (ste).



**FIGURE 10.** *Conostigmus abdominalis* (Boheman, 1832) male genitalia. A. Ventral (PSUC\_FEM 148450). B. Dorsal (PSUC\_FEM 148545). C. Lateral (PSUC\_FEM 88175). D. Odd specimen (PSUC\_FEM 50171) with harpe that are barely spatulate or spoon-shaped, resembling *C. longiharpes*. E. Odd specimen from Michigan (PSUC\_FEM 50143) with the widest part of the harpe varying occurring in the proximal 2/3rds. F. S9 (PSUC\_FEM 50154). Abbreviation: apical parossicular setae (prs).

*Conostigmus ambiguus* (Ashmead, 1893)

Figs. 11, 12

**Species Comments and History.** Ashmead (1893) described this species from a male and female specimen, stating that the male antennae are distinct because the pedicel and first flagellomere together are shorter than the scape. However, this is true in the majority of *Conostigmus* species (exceptions include *Conostigmus abdominalis* and related species). The female antennae are described as having the pedicel and first flagellomere of equal length (Ashmead, 1893), but this also occurs in females of *C. bipunctatus* and *C. lepus*, among others.



**FIGURE 11.** *Conostigmus ambiguus* (Ashmead, 1893) in dorsal view. A. Male allolectotype (USNMENT01212995). B. Female lectotype (USNMENT01339747).

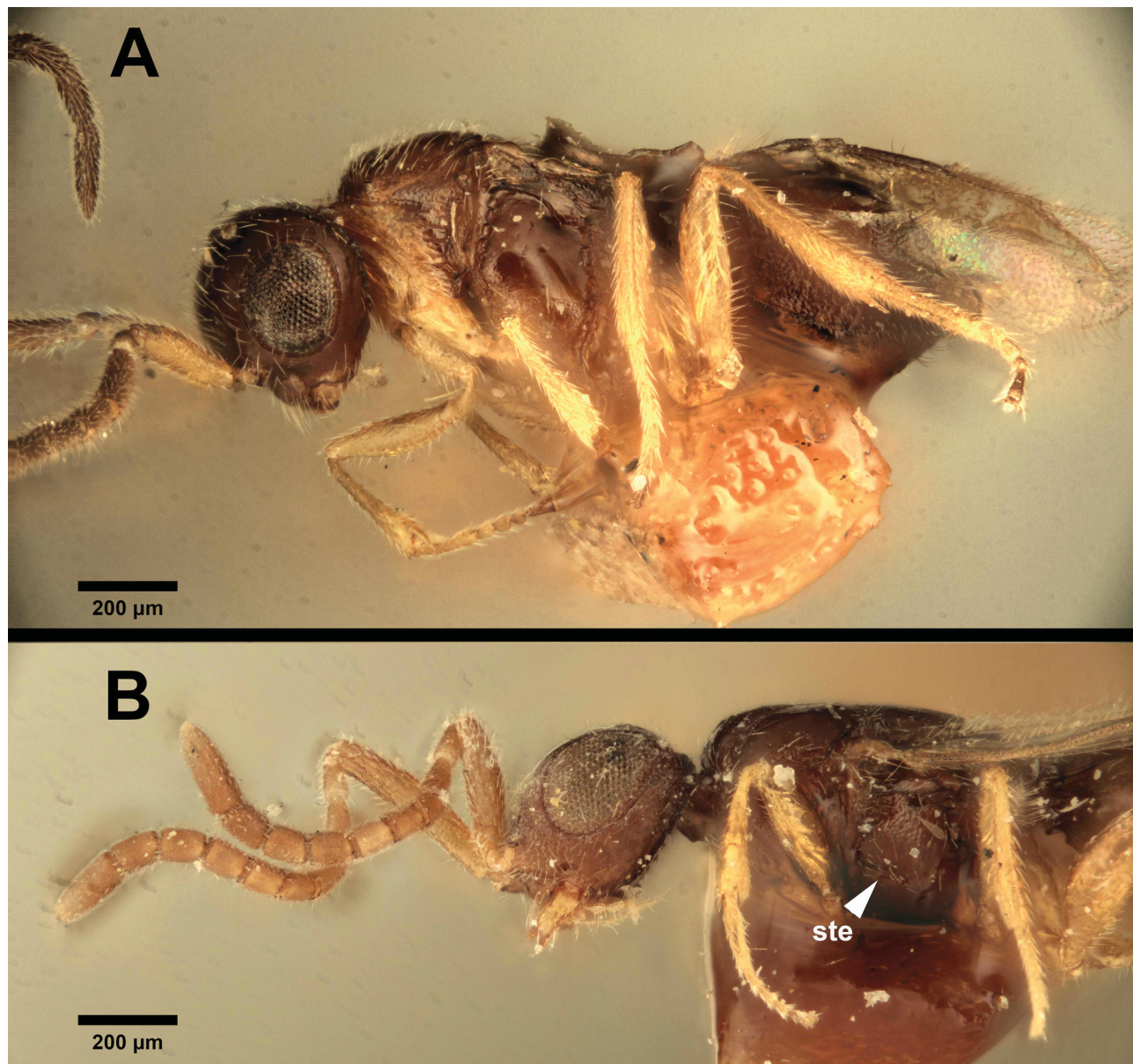
Masner and Muesebeck (1968) designated a female lectotype and male allolectotype at the USNM. Both specimens are complete but very poorly glued, and the excess glue obscures some characters. It is thus unclear whether the male and female belong to the same species. While both specimens have two mandibular points and a facial pit, the female appears to have a sternaulus while the male does not. The two specimens also have different collecting events, with the male collected in Arlington, Virginia, and the female collected in Washington, D.C., matching the original description given in Ashmead (1893).

Ashmead (1893) noted that this species closely resembles *C. laeviceps*, and differs in that *C. ambiguus* is larger and has differences in the sculpturing and lengths of the flagellomeres. *Conostigmus laeviceps* also has an elongate

sternaulus (exceeding 3/4 of mesopleuron length at level of sternaulus). The female lectotype of *C. ambiguus* does not have an elongate sternaulus, and the male allolectotype does not have a sternaulus, so neither of these specimens belong to *C. laeviceps*. The male allolectotype has a yellow propleuron similar to the males of *C. nigrorufus* or *C. rufoniger*, and male genitalia characters are needed to confirm whether these are the same species.

Unfortunately, this *Conostigmus* species lives up to its name. We consider this species as a *species inquirenda* until more specimens can be found, and the genitalia of a male matching the female can be dissected and compared.

**Material Examined.** Lectotype female: USA: USNMENT01339747 (USNM). Paralectotypes (1 male): USA: Virginia: 1 male. USNMENT01212995 (USNM).



**FIGURE 12.** *Conostigmus ambiguus* (Ashmead, 1893) in lateral view. A. Male allolectotype (USNMENT01212995). B. Female lectotype (USNMENT01339747). Abbreviation: sternaulus (ste).

### *Conostigmus bacilliger* (Kieffer, 1906)

**Species Comments and History.** Kieffer (1906) described this species from material collected from San Mateo, California, with the female unknown. According to Kieffer (1906), characteristics of this species include a black body with light brown legs, wings present and macropterous, notauli and median mesoscutal sulcus complete, and



“1. Glied kaum so lang wie die zwei folgenden mitsammen” (pg. 258), which we interpret as the scape being barely as long as the pedicel and F1 together (the redescription provided in Kieffer (1914) specifies “Scapus kaum so lang wie die 2 folgenden Glieder zusammen”, pg. 220). The key in Kieffer (1906) distinguishes this species from others by the “2. Fühlerglied nicht halb so lang wie das 3.” (pg. 258) and the “analsegment mit zwei langen stäbchenartigen Auhängseln” (pg. 258), which we interpret as the harpe protruding from the metasoma. This is hardly a species-specific characteristic, though it may hint that this species has long harpe, like *C. longiharpes*, *C. abdominalis* or *C. pulchellus*.

Kieffer (1914) repeats much of the original description, though the key adds that this species has “Scheitel ohne Mittellängefurche” (pg. 170), as opposed to “Scheitel mit einer Mittellängefurche hinter den ocellen” (pg. 170), which we interpret as the species lacking a preoccipital furrow. This would distinguish it from *C. longiharpes*, *C. abdominalis* and *C. pulchellus*, which all have a preoccipital furrow.

The location of Kieffer’s type material is unknown, and the characters given in the original description could apply to several different species of *Conostigmus*. We consider *Conostigmus bacilliger* as a *species inquirenda*.

### ***Conostigmus bakeri* Kieffer, 1908**

**Species Comments and History.** Kieffer (1908) described the species from specimens collected in Claremont and San Mateo, California. The description in Kieffer (1908) specifies that the “scape a peine egal aux articles 2 et 3 reunis; troisieme article trois fois aussi long que gros; quatrieme deux fois; dixieme a peine plus long que gros” (pg. 36). Other than these antennal characters, Kieffer describes the specimen as being black, smooth and shiny, with the wings slightly brownish in color and an indistinct facial pit present. Kieffer (1914) keys out the male and redescribes the species, adding that the preoccipital furrow is absent, as with *Conostigmus bacilliger*.

The location of Kieffer’s specimens is unknown, and the characters given in the original description could apply to several species. For now, we consider *Conostigmus bakeri* as a *species inquirenda*.

### ***Conostigmus bipunctatus* Kieffer, 1907**

Figs. 13, 14, 15

**Species Comments and History.** *Conostigmus bipunctatus* Kieffer is a widespread and highly variable species. Kieffer (1907) described this species from a type series of 89 wingless male and female specimens collected across Italy. Dessart (1980a) later described a winged female and reported additional specimens from Greece, Austria, Germany, Switzerland and Belgium. Here, we increase the range of this species to include the Nearctic as well as the Palearctic, adding specimens collected across the United States and Canada.

**Blue Ovoid Patches on the Syntergite.** The defining character that Kieffer used to identify this species is the presence of paired, blue-iridescent ovoid patches on the syntergite (Figure 14C; Kieffer, 1907). Though the type series at the MCSN all bear these distinctive blue iridescent ovals, the majority of specimens we examined from the Nearctic and Palearctic did not have these structures. We found three specimens, two males (PSUC\_FEM 88137, PSUC\_FEM 88167) and one female (PSUC\_FEM 88193) from the Palearctic with these patches. We found only one female specimen from the Nearctic (PSUC\_FEM 50192) that appeared to have the patches, but they were very faded and difficult to see.

Dessart (1980a) reported that while the blue patches were present on all of the specimens he observed from the Palearctic, the patches were variable between specimens and darker on some than others. Dessart (1980a) also reported one specimen of *C. rugiceps* that had paired blue iridescent ovoid patches present, though the patches were not present on any other *C. rugiceps* or other *Conostigmus* he observed. Likewise, we did not find any presence of these patches on any of the other Nearctic or Palearctic *Conostigmus* specimens we observed.

When we rubbed the patch on one specimen (PSUC\_FEM 88167) with a piece of Blue-Tac on a pin, we found that we were able to rub some of it off. While the purpose of these patches is unknown (Dessart, 1980a), we propose that these patches may be oil secretions produced by glands. It is possible that these patches are produced only under certain circumstances related to behavior (such as attracting mates, indicating mating status, etc.). Time of year does not appear to be a factor, as the specimens in Kieffer’s type series were collected from June to December (Kieffer, 1907), and Dessart (1980a) adds specimens with the patches collected in March, April and May.

It is also possible that these patches were present in more specimens but were removed due to how they were collected or preserved (i.e. oils washing off with ethanol, cyanide, soapy pan trap water; rubbing between specimens in a net; etc.). Of the four specimens with patches present, only one had a collection method specified (PSUC\_FEM 88167, “screen sweeping”). Collection methods are not provided for Kieffer’s syntype series (Kieffer 1907a), though Dessart (1980a) lists specimens collected from prairie, moss, and in dead leaves or old branches of trees (beech, pine and chestnut).

**Variability.** Dessart (1980a) recognized a large degree of variation in the coloration and the morphology across both wingless and winged specimens, and even comments that this species may have caused Kieffer to reconsider how he described species. We consider *Conostigmus bipunctatus* as one widespread and highly variable species, but further work (molecular, morphological, behavioral) may reveal this to be a complex of cryptic species.

This species includes macropterous and brachypterous specimens from the Holarctic, with other morphological differences occurring as a consequence of their macropterous or brachypterous state. The sternaulus is always present, but it is elongate (exceeding 3/4 of mesopleuron length at the level of sternaulus) on all macropterous and some brachypterous specimens, and shorter (reaching less than 3/4 of mesopleuron length at level of sternaulus) on other brachypterous specimens. Because the sternaulus functions as an attachment point for the wing muscles, the length of the sternaulus likely correlates with wing development.

Coloration in this species can vary from yellow (PSUC\_FEM 88137, PSUC\_FEM 88167, PSUC\_FEM 88193) to brown to black. Brachypterous specimens of *C. bipunctatus* tend to have yellow coloration and be lighter in color than macropterous specimens. All specimens have a median process on the intertorular carina, but it can be acute (PSUC\_FEM 50138, PSUC\_FEM 9733) or blunt (INHS Insect Collection 287559, PSUC\_FEM 50271), and can sometimes extend across the intertorular area towards the dorsal margin of clypeus (PSUC\_FEM 50271, PSUC\_FEM 34149). The species always has 2 mandibular points, though there is variation in the length of these mandibular points just as in other species of *Conostigmus* such as *C. madagascariensis* (see Mikó *et al.*, 2016, Fig. 37).

In males, the curved or sickle-shaped harpe (distoventral margin of the harpe in lateral view concave) is one of the defining features of this species, but the harpe can be longer and more pointed in some specimens (IM 1628 from the Palearctic; PSUC\_FEM 50060, PSUC\_FEM 34268, PSUC\_FEM 9733, INHS Insect Collection 287559 from the Nearctic) than in others. The gonocodyle is always acute, but it is more pointed in some specimens (PSUC\_FEM 88167, PSUC\_FEM 34065, IM 1799) than in others (IM 43397, PSUC\_FEM 16777, IM 1823). Other variations in male genitalia include the presence and shape of the distodorsal notch of the gonostyle–volsella complex, and the dorsomedian conjunctiva of the gonostyle–volsella complex length relative to the length of the gonostyle–volsella complex (see next section for more details).

**Differences between Nearctic and Palearctic Populations.** Most of the variation observed in the species occurs across both Nearctic and Palearctic populations. The only consistent differences between Nearctic and Palearctic populations occur in the male genitalia, specifically in the presence of the distodorsal notch of the gonostyle–volsella complex and the dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex. Nearctic specimens tend to have the dorsomedian conjunctiva extending between 1/3 to 1/2 the length of the gonostyle–volsella complex in dorsal view, and the distodorsal notch of the gonostyle–volsella complex present. Palearctic specimens, on the other hand, tend to have the dorsomedian conjunctiva extending equal to or less than 1/3 the length of the gonostyle–volsella complex in dorsal view, and because it is so short, the distodorsal notch of the gonostyle–volsella complex is usually absent.

There are also slight differences in the shape of the proximodorsal notch of the cupula between Nearctic and Palearctic specimens. Though most Palearctic specimens do not have a proximodorsal notch of the cupula, in specimens where it is present, the proximodorsal notch of the cupula has an inverted U-shape (PSUC\_FEM 148694, IM1568, IM1799). Most specimens from the Nearctic have a proximodorsal notch with an arched or inverted U-shape, though a few have a notch with an acute or inverted V-shape (PSUC\_FEM 50060, PSUC\_FEM 50278).

**Differences Between Males and Females.** Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** Males of this species can be distinguished from other *Conostigmus* by the curved, sickle-shaped harpe (distoventral margin of the harpe in lateral view concave), in combination with the fused parossiculi, the dense patch of setae on the distoventral edge of the harpe, and the distodorsal setae of the sensillar ring longer than the harpe width (sometimes 2× as long or greater). Males and females can be matched by the following characters: facial pit present, occipital carina complete, postocellar carina present, median process on the intertorular carina pres-

ent and extending from the intertorular carina towards the dorsal margin of the clypeus, axillular carinae absent, and sternaulus present and elongate in winged specimens. This is also the only species known from the Nearctic to have paired blue iridescent ovoid patches on the syntergite in both males and females. However, the majority of specimens do not have these patches, and it is possible that they could be present in other species of *Conostigmus* (the patches were also reported on one specimen of *Conostigmus rugiceps*, a Palearctic species, by Dessart (1980)).

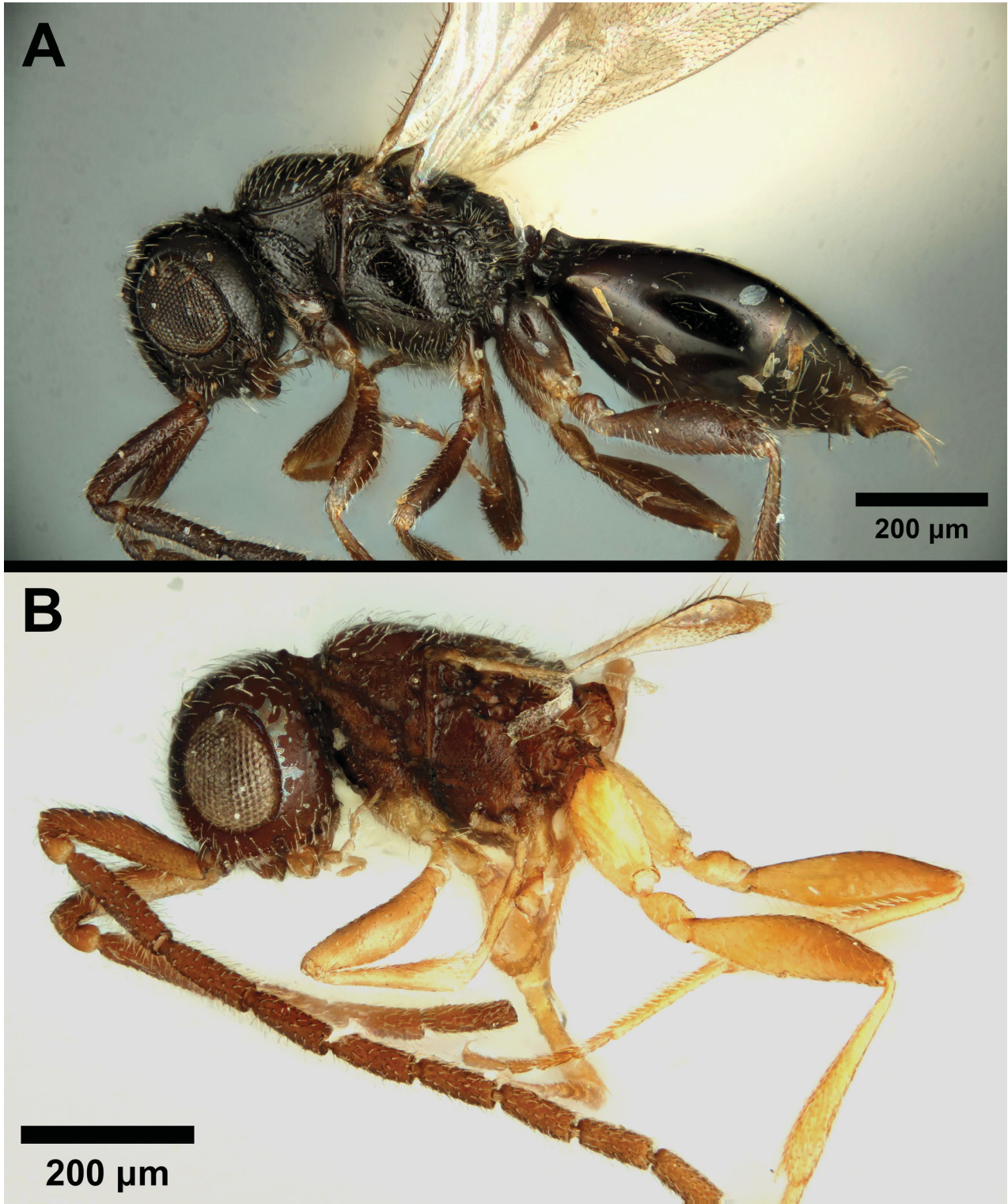
This species has similar male genitalia to the Palearctic species *C. grangeri*, which can easily be distinguished from *C. bipunctatus* by the lack of notauli and median mesonotal furrow. Other similar species from the Nearctic include *C. minimus*, *C. musettiae*, *C. laeviceps*, *C. dessarti* and *C. franzinii*, which all have elongated sternauli and the facial pit present, but *C. bipunctatus* can be distinguished by the curved or sickle-shaped harpe and the concave distoventral margin of the harpe in lateral view (convex or straight in others). These five species are also always macropterous and never have been reported with paired blue iridescent ovals on the syntergite.

**Description.** Body length: 1.275–2.475 mm. Color hue pattern in male: cranium, mesosoma, metasoma ochre to brown to black, with lighter coloration more common on brachypterous specimens; metasoma sometimes with paired ovoid iridescent patches. Color intensity pattern in male: flagellomeres and pedicel darker than scape; cranium darker than mesosoma, flagellomeres darker than legs; mandible lighter on cranium on darker specimens; lighter specimens sometimes with a darker patch around the ocellar triangle (PSUC\_FEM 88132, PSUC\_FEM 88167); anterior half of metasoma lighter than the posterior half on the lighter specimens (PSUC\_FEM 88132, PSUC\_FEM 88167). Color hue pattern female: cranium, mesosoma, metasoma ochre to brown to black; metasoma sometimes with paired ovoid iridescent patches. Color intensity pattern female: mandible lighter on cranium on darker specimens; lighter specimens sometimes with a darker patch around the ocellar triangle (PSUC\_FEM 88193); anterior half of metasoma lighter than the posterior half on the lighter specimens (PSUC\_FEM 88193); flagellomeres darker than scape and pedicel; scape and pedicel lighter than flagellomeres. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite; petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

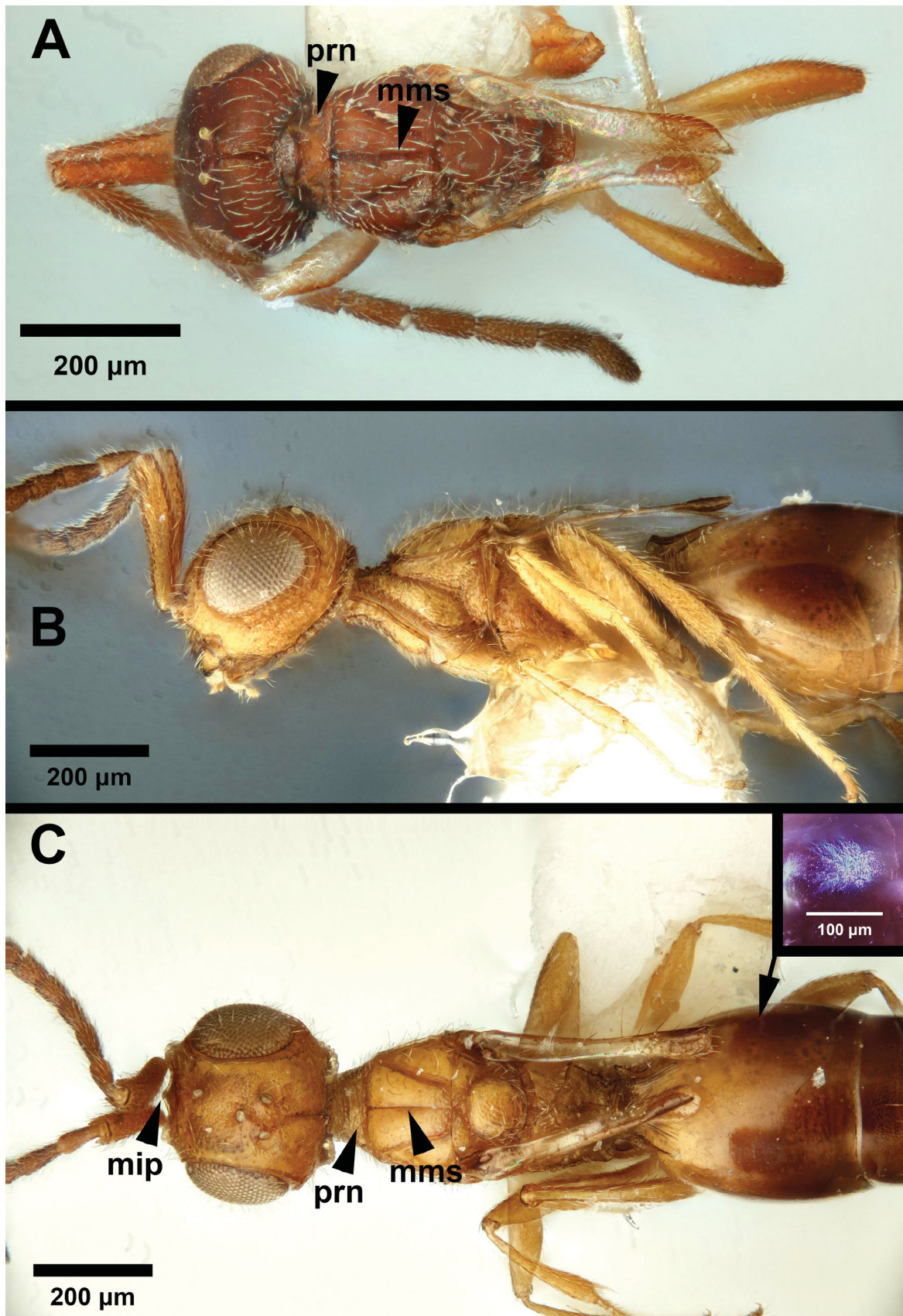
**Antennae:** Male scape length vs. pedicel length: 3.5–6.8. Male scape length vs. F1 length: 1.0–1.8. Male F1 length vs. pedicel length: 2.5–4.3. Male F1 length vs. male F2 length: 1.0–1.5. Longest male flagellomere: F1. Female scape length vs. pedicel length: 3.2–4.2. Female scape length vs. F1 length: 3.2–4.2. Female F1 length vs. F2 length: 1.1–1.6. Female F1 length vs. pedicel length: 0.9–1.2. Longest female flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma) in all macropterous and some brachypterous specimens; 1.3× wider than mesosoma in some brachypterous specimens. Head height (HH, lateral view) vs. eye height (EHf, anterior view): male HH:EHf=1.3–1.7; female HH:EHf=1.5–1.8. Head height (HH) vs. head length (HL): HH:HL=1.0–1.4. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.6–2.0. Head width (HW) vs. head height (HH): HW:HH=1.1–1.4. Cephalic size (csb): Mean: 335–535 μm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.4. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.4–3.4. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.1–2.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.4–3.4:1.0–2.0:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL 1.8–3.0× as long as LOL. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8–3.0:1.2–2.3:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count:

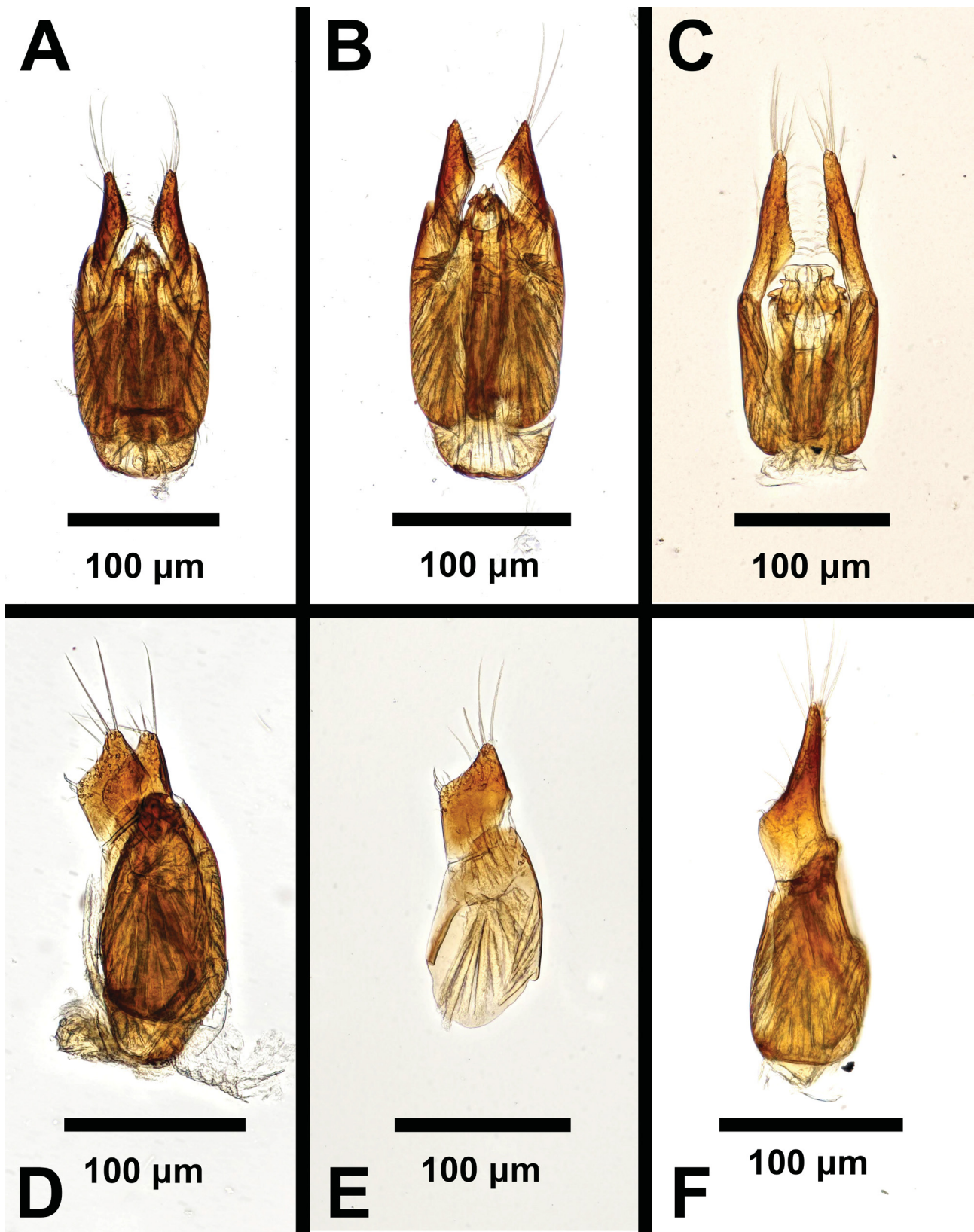
absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: absent or present. Median process on intertorular carina shape: blunt; acute. Median process of intertorular carina structure: process extends across intertorular area towards dorsal margin of clypeus; process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.



**FIGURE 13.** *Conostigmus bipunctatus* Kieffer, 1907 in lateral view. A. Macropterous male (PSUC\_FEM 34149). B. Brachypterous male (PSUC\_FEM 34065).



**FIGURE 14.** *Conostigmus bipunctatus* Kieffer, 1907. A. Reduced wing male, dorsal view (PSUC\_FEM 34065). B. Reduced wing female, lateral view (PSUC\_FEM 88193). C. Reduced wing female, dorsal view (PSUC\_FEM 88193), with insert showing a close-up of the blue iridescent ovoid patch (Insert: reduced wing male; PSUC\_FEM 88167). Abbreviations: median process on intertorular carina (mip); projection acute in this case); median mesoscutal sulcus (mms); pronotum (prn).



**FIGURE 15.** *Conostigmus bipunctatus* Kieffer, 1907 male genitalia. A. Ventral view (NCSU 0055671). B. Dorsal view (PSUC\_FEM 88193). C. Ventral view of a male with longer harpe (IM 1628). D. Lateral view (IM 1779). E. Lateral view (PSUC\_FEM 148461). F. Lateral view of a male with longer harpe (IM 1628).

**Mesosoma:** Weber length: WL=440–720 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.5–0.9. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/

AscW=1.2–2.2. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.6–1.3. Wing count: present; absent. Fore wing size: wings present and macropterous with apex extending past petiole; wings absent or reduced/brachypterous with apex never reaching past posterior margin of syntergite. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present; absent. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 3/4 of mesopleuron length at level of sternaulus on macropterous and some brachypterous specimens but reaching less than 3/4 of mesopleuron length at level of sternaulus on some brachypterous specimens. Sternaulus sculpture: scalloped. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discrimenal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present; absent. Ventral projection of the metapleural carina length: less than 2× as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”); straight (left and right lateral propodeal carinae compose a carina that is not broken medially). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: present; absent. Posterior margin of nucha in dorsal view shape: concave.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: present; absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.4–3.2. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.6–2.5. Syntergal translucent patch maximum width vs. minimum width: 1.0–2.3. Synsternal translucent patch maximum width vs. minimum width: 1.6–3.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

**Male Genitalia:** Distal margin of male S9 shape: straight; convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing setiferous patch or patches; distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single transverse row of distal setae occurring medially with less than 4 setae below it; patch of setae occurring medially; single transverse row of setae occurring medially with additional distal setae below it, sometimes organized in one or two additional transverse rows. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present; absent. Proximodorsal notch of cupula shape: arched (inverted U-shape); notched (inverted V-shape). Proximodorsal notch of cupula width vs length: wider than long; as long as wide. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent; present. Dorsomedian projection of the gonostyle–volsella complex shape: simple (not bilobed). Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending equal to or less than 1/3 of length of gonostyle–volsella complex in dorsal view; dorsomedian conjunctiva extending equal to or less than 1/2

of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight without a median projection; straight with a median projection. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva absent and parossiculi fused. Medioventral ridge of the gonostyle–volsella complex count (only applicable if medioventral conjunctiva of the gonostyle–volsella complex absent): present. Medioventral ridge of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: ridge extending 2/3 of length of gonostyle–volsella complex in ventral view; ridge not extending 2/3 of length of gonostyle–volsella complex in ventral view. Apical parossicular setae count: one. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2, sometimes with an additional dorsal apodeme below the second spine. Gonossiculus spine length: one spine more than 2× as long as the other(s). Harpe length: harpe equal to or shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed; curved or sickle-shaped. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its distal 1/3rd. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: present. Distal setae on harpe length: setae not of equal length, longer setae present on distodorsal point of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width; setae two times as long as harpe width or greater. Distodorsal setae of sensillar ring of harpe orientation: distoventrally. Sensillar ring area of harpe orientation: distoventrally. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: concave.

**Distribution.** Holarctic.

**Material Examined.** Non-type material (63 males, 9 females): CANADA: 1 male. PSUC\_FEM 50060 (PSUC). CANADA: British Columbia: 1 male. PSUC\_FEM 34234 (AMNH). CANADA: Ontario: 6 males. PSUC\_FEM 15317, 15677, 15846, 16258, 16317, 16777 (ROME). ITALY: 1 male. PSUC\_FEM 88167 (UCRC). NETHERLANDS: 1 male, 1 female. PSUC\_FEM 88137, 88193 (CNC). RUSSIA: 1 male. UCRC\_ENT 00264026 (UCRC). SWEDEN: 42 males. NCSU 0043327, 0043347, 0043390, 0043398 (NHRS); IM 1586, 1587 (NCSU); IM 1568, 1583, 1591, 1620, 1628, 1688, 1735–1740, 1747, 1751, 1752, 1754, 1756, 1762, 1779, 1798–1799, 1822–1824, 1762–1763, 1735–1740; NCSU 0043396, 0043397, 0055671; PSUC\_FEM 148439, 148461, 148604, 148607, 148652, 148664, 148694 (PSUC). USA: Alaska: 3 males, 2 females. PSUC\_FEM 34065, 50192, 50271, 50278, 56133 (AMNH). USA: California: 3 males. PSUC\_FEM 34149, 34268, 34270 (TAMU). USA: Colorado: 1 male. INHS Insect Collection 287559 (INHS). USA: Oregon: 1 male. PSUC\_FEM 9733 (ROME). USA: Wisconsin: 2 males, 6 females. PSUC\_FEM 50059, 50138, 50140, 50144, 50176, 50189, 50338, 91488 (INHS).

### ***Conostigmus californicus* (Ashmead, 1893)**

Figs. 16, 17

**Species Comments and History.** Ashmead (1893) described *Megaspilus californicus* from a single male specimen, relying mostly on characters related to color, microsculpture and antennal ratios. Kieffer transferred the species from *Megaspilus* to *Conostigmus* (1909), then redescribed the species and keyed it out with other males from the Nearctic, again relying mainly on coloration, microsculpture and antennal characters (1914).

The male lectotype present at the USNM is in good condition, and bears the following characteristics: wings present and macropterous, postocellar furrow present, preoccipital furrow present, anterior end of the preoccipital furrow ending at the postocellar furrow, facial pit present, median process on the intertorular carina present and acute, rugose region on upper face present, and sternaulus present and elongate (exceeding 3/4 of mesopleuron length at the level of the sternaulus).

This species has a similar habitus to *C. abdominalis* or *C. pulchellus*, and it shares the elongate sternaulus, but it lacks the facial sulcus found in both of these species. While *C. longiharpes* also resembles this species and lacks the facial sulcus, *C. longiharpes* also lacks an elongate sternaulus and postocellar carina, both of which are present in *C. californicus*.

Though *C. californicus* does not appear to be the same as any other Nearctic *Conostigmus* species that we are aware of, male genitalia characters would help to confirm whether this is a different species or just an odd specimen.



Unfortunately, we were unable to dissect out the male genitalia of the type specimen or locate any other specimens for dissection. We consider *Conostigmus californicus* as a *species inquirenda*.

**Material Examined.** Lectotype male: USA: California: USNMENT01339748 (USNM).



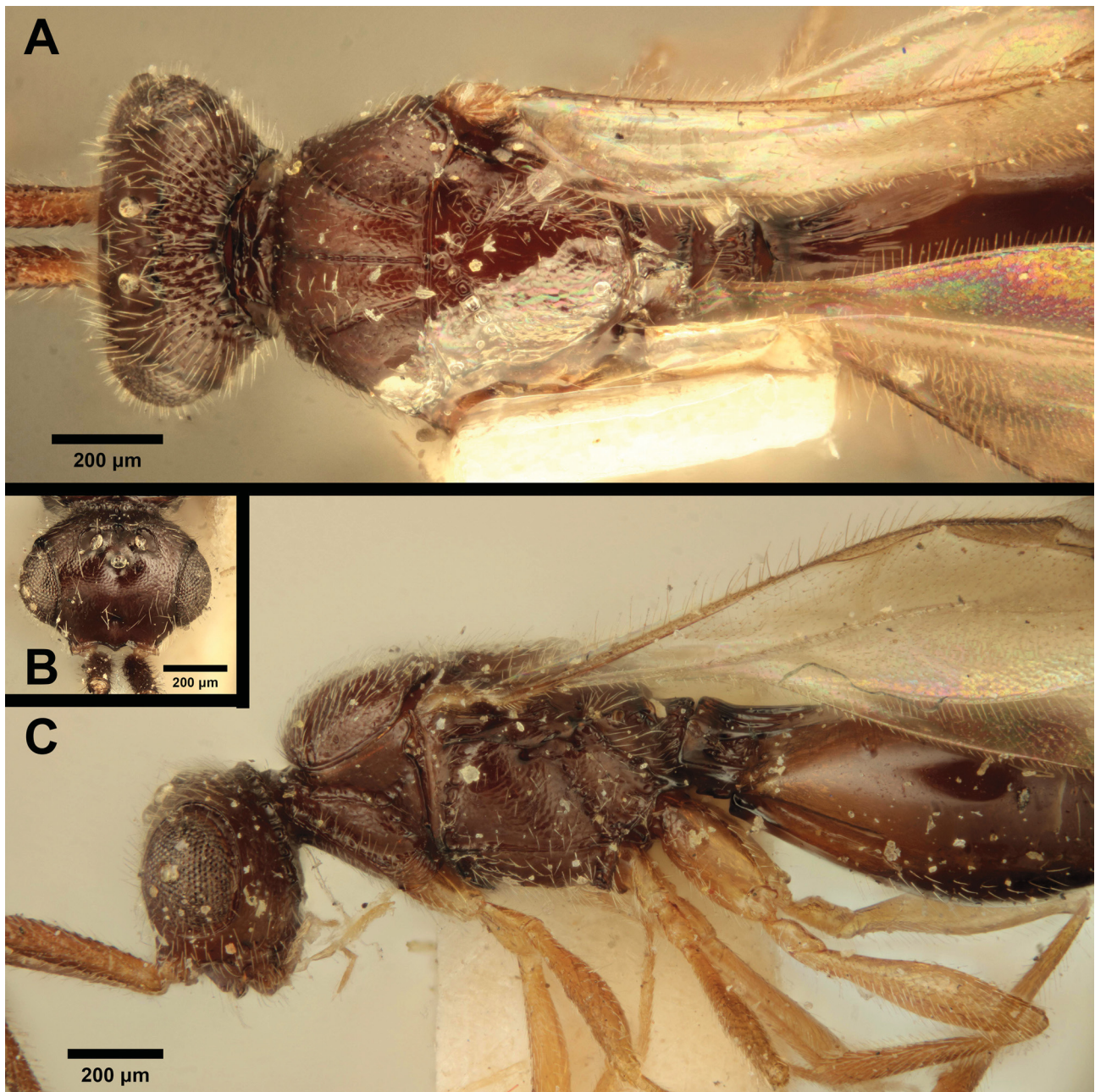
**FIGURE 16.** *Conostigmus californicus* (Ashmead, 1893) male lectotype (USNMENT01339748), lateral habitus.

### *Conostigmus canadensis* (Ashmead, 1888)

Figs. 18, 19

**Species Comments and History.** Ashmead (1888) described this species from a single female specimen as part of the genus *Eumegaspilus*, characterized by the females being wingless or having reduced wings. Ashmead (1893) redescribed the species, transferred it to *Megaspilus* and designated *C. erythrothorax* as the type species for *Eumegaspilus*. For *C. canadensis*, Ashmead keyed out the female, distinguishing it from other females based on its reduced wings, cuticular sculpture and color differences (1893).

Harrington (1900) recorded four more female specimens of *C. canadensis* collected with Harrington's *C. ottawensis* specimens, noting that these four specimens might be a variety of *C. ottawensis*. We found these four specimens at the CNC, all bearing labels reading "*Megaspilus canadensis* = *ottawensis* Ashm. || W. H. Harrington Collection". Harrington (1900) also recorded the existence of a fifth specimen, which we found at the CNC, bearing only a determination label reading "*Megaspilus canadensis*". All of these specimens are females in poor condition (damaged and badly glued, obscuring characters) and none were collected with the type. These specimens may not match each other, let alone the type of *C. canadensis*. One female had the preoccipital furrow not reaching the ocellar triangle (the type has the preoccipital furrow ending inside the ocellar triangle). Further work must be done to verify whether these specimens are the same species. These five specimens were not databased.



**FIGURE 17.** *Conostigmus californicus* (Ashmead, 1893) male lectotype (USNMENT01339748). A. Dorsal view. B. Dorsal view of the frons. C. Lateral view.

Kieffer (1909) transferred *C. canadensis* from *Megaspilus* to the genus *Conostigmus*. Kieffer (1914) then re-described and keyed out the female, distinguishing it from other female *Conostigmus* by its reduced wings and coloration. Muesebeck and Walkley (1951, 1956) reconsidered *C. canadensis* as the type of *Eumegaspilus* and consider *Eumegaspilus* as a synonym of *Conostigmus*. Muesebeck and Walkley (1956) justified this by noting that *C. erythrothorax* was not in the original description of the genus. Dessart and Cancemi (1987) consider *C. canadensis* to be the type species of the subgenus *Eumegaspilus*. They also note that *C. canadensis* is probably cosmopolitan (Dessart and Cancemi, 1987).

The female type is present at the USNM in the same condition as noted in Masner and Muesebeck (1968). Dessart and Cancemi (1987) suggested that this species could be synonymous with *C. lativentris*. While this specimen bears a strong resemblance to the female types of *C. lativentris* at the NHMUK and HNHM (wings reduced or absent, sternaulus present and elongate, facial pit present, postocellar carina present, preoccipital furrow present, median process on the intertorular carina present and acute, axillular carinae present), there are differences in the

sculpturing. The type at the NHMUK has foveolate sculpturing on the frons and mesosoma; the type at the HHNM does not have foveolae but has rugose sculpturing present on the frons and mesosoma; and the type at the USNM has smooth sculpturing on the frons and mesosoma. Though all three specimens have rugose sculpturing on the apex of the head around the ocelli, the types at the HHNM and NHMUK have crenulate sternauli, whereas the type at the USNM has a smooth sternaulus. It is possible that these differences could be attributed to size, nutrition and other factors, and that they could be the same species, but further evidence is needed to confirm this. *Conostigmus lativentris* is also only known from the Palearctic, whereas *C. canadensis* is only known from the Nearctic.

Both *C. canadensis* and *C. lativentris* are only known from female specimens. Until the discovery of males or more females, or until the five female specimens at the CNC can be further studied, we cannot confirm if *C. canadensis* and *C. lativentris* are the same species. We consider them separate species at this time, and we regard *C. canadensis* as a *species inquirenda*.

**Material Examined.** Lectotype female: CANADA: USNMENT01339753 (USNM).



**FIGURE 18.** *Conostigmus canadensis* (Ashmead, 1888) female lectotype (USNMENT01339753). A. Lateral habitus. B. Anterior view of the frons.

### *Conostigmus crawfordi* (Mann, 1920)

Fig. 20

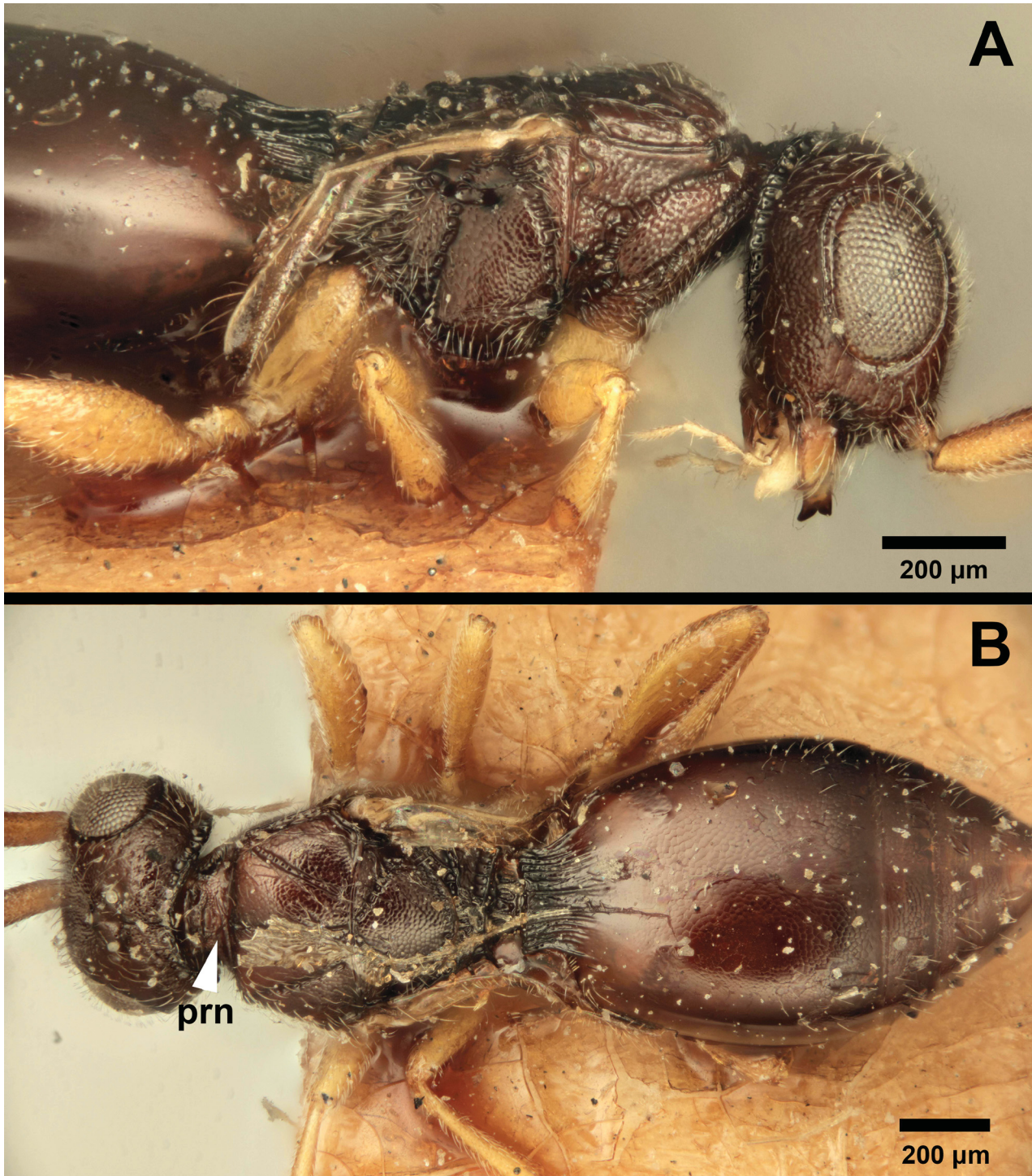
**Species Comments and History.** Mann (1920) described *Megaspilus crawfordi* from two female specimens collected from a nest of *Formica exsectoides* Forel, 1886 in Virginia. Muesebeck and Walkley (1951) later transferred the species to the genus *Conostigmus*. The male of the species is unknown, but the female holotype and paratype specimens are present at the USNM in good condition. Both are point mounted with the ants Mann collected them with.

The female holotype exhibits the following combination of characters: brachypterous; facial pit present; occipital carinae complete; postocellar carina present; preoccipital furrow present and crenulate, reaching the postocellar carina; axillular carinae absent; and sternaulus present and elongate, exceeding 3/4 of the mesopleuron length at the level of the sternaulus.

Mann (1920) noted that the most closely related species to *C. crawfordi* is *C. canadensis*. While they have several characters in common (brachypterous, sternaulus present and elongate, facial pit present, postocellar carina present, preoccipital furrow present), *C. canadensis* has axillular carinae, whereas *C. crawfordi* lacks this trait.

A more similar species is *C. bipunctatus*; in addition to the characters shared between *C. crawfordi* and *C. canadensis*, *C. bipunctatus* also lacks axillular carinae. It is possible that these are the same species. Unfortunately, the type is the only known specimen of *C. crawfordi*, and we were not able to make a full comparison of the two species during the limited time we had with the type. Because the male of *C. crawfordi* is unknown, male specimens cannot be compared either. More work is needed before a conclusion can be made. We consider *C. crawfordi* and *C. bipunctatus* separate species at this time, though future work could show otherwise. For now, we consider *Conostigmus crawfordi* as a *species inquirenda*.

**Material Examined.** Lectotype female: USA: Virginia: USNMENT01339781 (USNM). Paralectotypes (1 female): USA: Virginia: 1 female. USNMENT01339780 (USNM).



**FIGURE 19.** *Conostigmus canadensis* (Ashmead, 1888) female lectotype (USNMENT01339753). A. Lateral view. B. Dorsal view. Abbreviations: pronotum (prn).



**FIGURE 20.** *Conostigmus crawfordi* (Mann, 1920) female lectotype (USNMENT01339781). A. Lateral view. B. Dorsal view.

***Conostigmus dimidiatus* (Thomson, 1858)**

Figs. 21, 22, 23

**Species Comments and History.** Thomson (1858) described the genus *Dichogmus*, unique for its incomplete (or absent) median mesoscutal sulcus, and described *D. dimidiatus* as the only species in the genus. Thomson (1858) described the species from a holotype female specimen, but he also described the male antennae in the original description, indicating that he did have a male specimen as well as the female. The female type is present at the MZLU and is in good condition, but the location of the male specimen is unknown.

Dessart (1973) later synonymized the genus *Dichogmus* with *Conostigmus* and redescribed *C. dimidiatus*, reporting more specimens collected across Europe. Dessart (1973) designated a female lectotype and male allotype, providing illustrations of a dorsal habitus view of the female, as well as detailed illustrations of the male genitalia, male and female antennae and the pterostigma of the reduced wings.

Concerning the natural history of this species, Thomson (1858) described the species from specimens found in dry sand pits near Lund, Sweden. Dessart (1973) also reported having found a male specimen on a sandy path and notes that the female type specimen of the synonymous species *Dichogmus formicarius* Kieffer, 1917 was found with the ant species *Lasius flavus* Fabricius, 1781. Dessart (1973) reported an additional female specimen from Switzerland found with the ant species *Lasius fuliginosus* Latreille, 1798.

Although *Dichogmus* was only known from Palearctic specimens, Dessart (1973) noted that the genus was included in keys for Europe, the Americas and Australia. Ashmead (1893) also reported *Dichogmus* as “a European genus not yet recognized in America” (pg. 119). However, no specimens were known from the Nearctic until now. Here, we report the first Nearctic specimens from Arizona, California, and Colorado, USA, and British Columbia, Canada, expanding the species range from Palearctic to Holarctic.

**Variability.** The median mesoscutal sulcus is absent in some specimens (PSUC\_FEM 34209, INHS Insect Collection 14038) and present in others (PSUC\_FEM 50307, UCRC\_ENT 00103617, MZLU Type No. 5329: 1). However, when it is present, it is never adjacent to the transscutal articulation, and always ends anterior to the transscutal articulation. The preoccipital furrow is present in some specimens (INHS Insect Collection 14038, MZLU Type No. 5329: 1) and absent in others (UCRC\_ENT 00103617, PSUC\_FEM 50307). However, the preoccipital furrow always ends posterior to the ocellar triangle.

There are also slight differences in coloration between specimens. The petiole neck and anterior region of the syntergite can be lighter in coloration than the posterior region of the syntergite on some specimens (INHS Insect Collection 14038) but not on others (UCRC\_ENT 00457080).

**Differences between Nearctic and Palearctic Populations.** The only Palearctic specimen we observed was the lectotype from Lund, but we did not observe any remarkable differences between this specimen and Nearctic specimens.

**Differences Between Males and Females.** Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** This species is recognizable by the following combination of characters: head width in dorsal view at least 1.3× wider than the mesosoma, wings absent or brachypterous, pronotum not enlarged (pronotum shorter than mesoscutum along the midline), and median mesoscutal sulcus absent or terminating anterior to the transscutal articulation in males and females. The species also has unique coloration, with the anterior half of the mesosoma (yellow to light brown in color) lighter than the posterior half of the mesosoma (light brown to brown in color).

One similar species is *C. muesebecki*, which shares the absence of the median mesonotal furrow and absent or reduced wings. This species can also have similar coloration. However, the two species differ in that the pronotum is enlarged (pronotum longer than mesoscutum along the midline) in *C. muesebecki* and not in *C. dimidiatus* (pronotum shorter than the mesoscutum along the midline). Another similar species is *C. erythrothorax*, which also has absent or reduced wings and can have similar coloration. However, *C. erythrothorax* also has the median mesoscutal sulcus present and complete (median mesoscutal sulcus posterior end adjacent to the transscutal articulation), whereas *C. dimidiatus* does not.

**Description. Note:** Measurements are given for the two female specimens in the following order: UCRC\_ENT 00103617, INHS Insect Collection 14038.

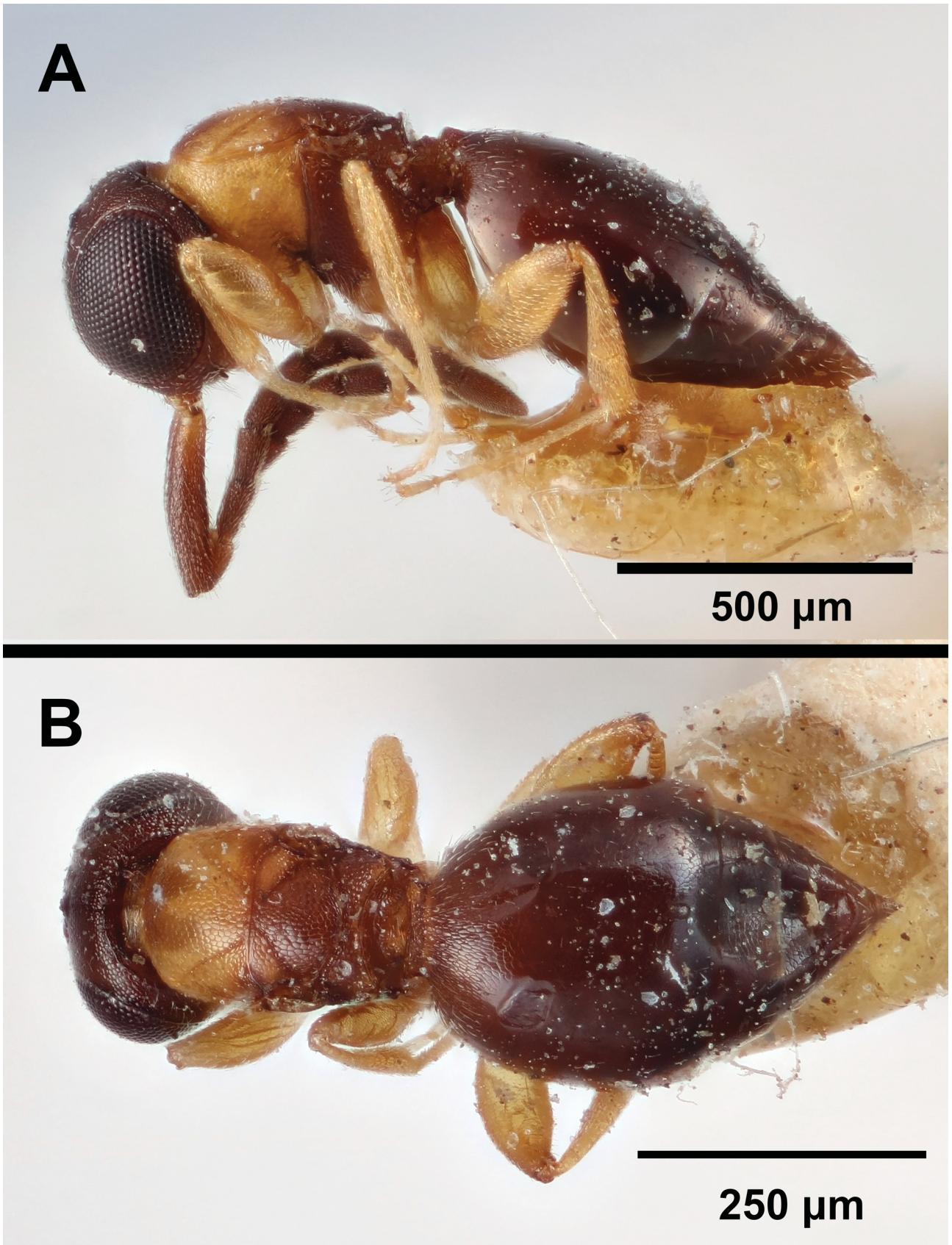
Body length: 1.175–1.775 mm. Color hue pattern in male: cranium, metasoma, flagellomeres brown to black; anterior half of mesosoma yellow to light brown; posterior half of mesosoma light brown to brown; legs, scape, pedicel ochre to light brown. Color intensity pattern in male: cranium darker than mesosoma, flagellomeres darker than legs; flagellomeres darker than scape and pedicel; mandible lighter than cranium; anterior half of mesosoma lighter than posterior half of mesosoma. Color hue pattern female: same as males; cranium, metasoma, flagellomeres brown to black; anterior half of mesosoma yellow to light brown; posterior half of mesosoma light brown to brown; legs, scape, pedicel ochre to light brown. Color intensity pattern female: legs lighter than the flagellomeres, scape and pedicel; cranium darker than mesosoma; distal portion of pedicel lighter than rest of pedicel; basal portion of scape lighter than rest of scape; anterior half of mesosoma lighter than posterior half of mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole

neck and anterior region of syntergite concolorous with the posterior region of the syntergite; petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 3.1–4.0. Male scape length vs. F1 length: 1.2–1.6. Male F1 length vs. pedicel length: 2.5–3.0. Male F1 length vs. male F2 length: 1.0–1.4. Longest male flagellomere: F1. Female scape length vs. pedicel length: 3.29, 3.6. Female scape length vs. F1 length: 3.29, 3.27. Female F1 length vs. F2 length: 1.17, 1.10. Female F1 length vs. pedicel length: 1.0, 1.1. Longest female flagellomere: F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F7–F9.

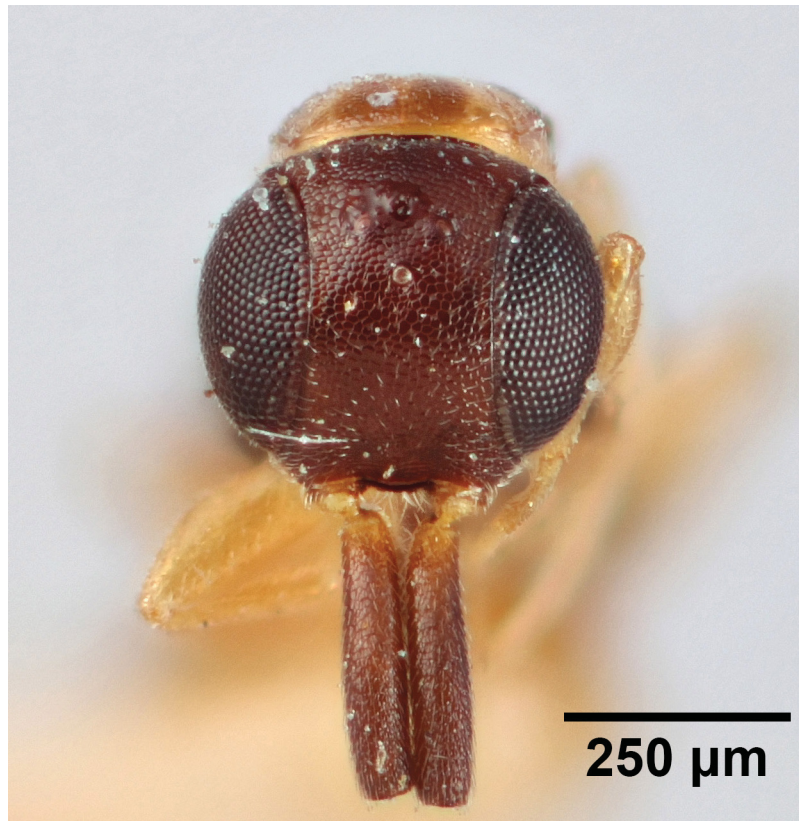
**Head:** Head width, dorsal view: at least 1.3× wider than mesosoma. Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.2–1.5. Head height (HH) vs. head length (HL): HH:HL=1.2–1.4. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.7–2.3. Head width (HW) vs. head height (HH): HW:HH=1.1–1.3. Cephalic size (csb): Mean: 285–445 µm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.4. POL: OOL: POL equal to or shorter than OOL and ocellar triangle with short base; POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.6–1.8. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.1–1.2. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.6–1.8:1.4–1.5:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.0, 1.33. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.33:1.33:1.0; 1.0:1.4:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: absent. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: absent; present. Preoccipital furrow anterior end: preoccipital furrow ends posterior to ocellar triangle. Postocellar carina count: absent. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: no external corresponding structure present. Facial pit count: absent. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: blunt. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=330–510 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.7–0.9. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.5–2.0. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 1.1–1.3. Wing count: present; absent. Fore wing size: wings reduced or brachypterous with apex never extending past scutellum. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus count: present; absent. Median mesoscutal sulcus posterior end: not adjacent to transscutal articulation (ends anterior to transscutal articulation). Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “U” (left and right lateral propodeal carina are adjacent to the antecostal sulcus of the first abdominal tergum submedially). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

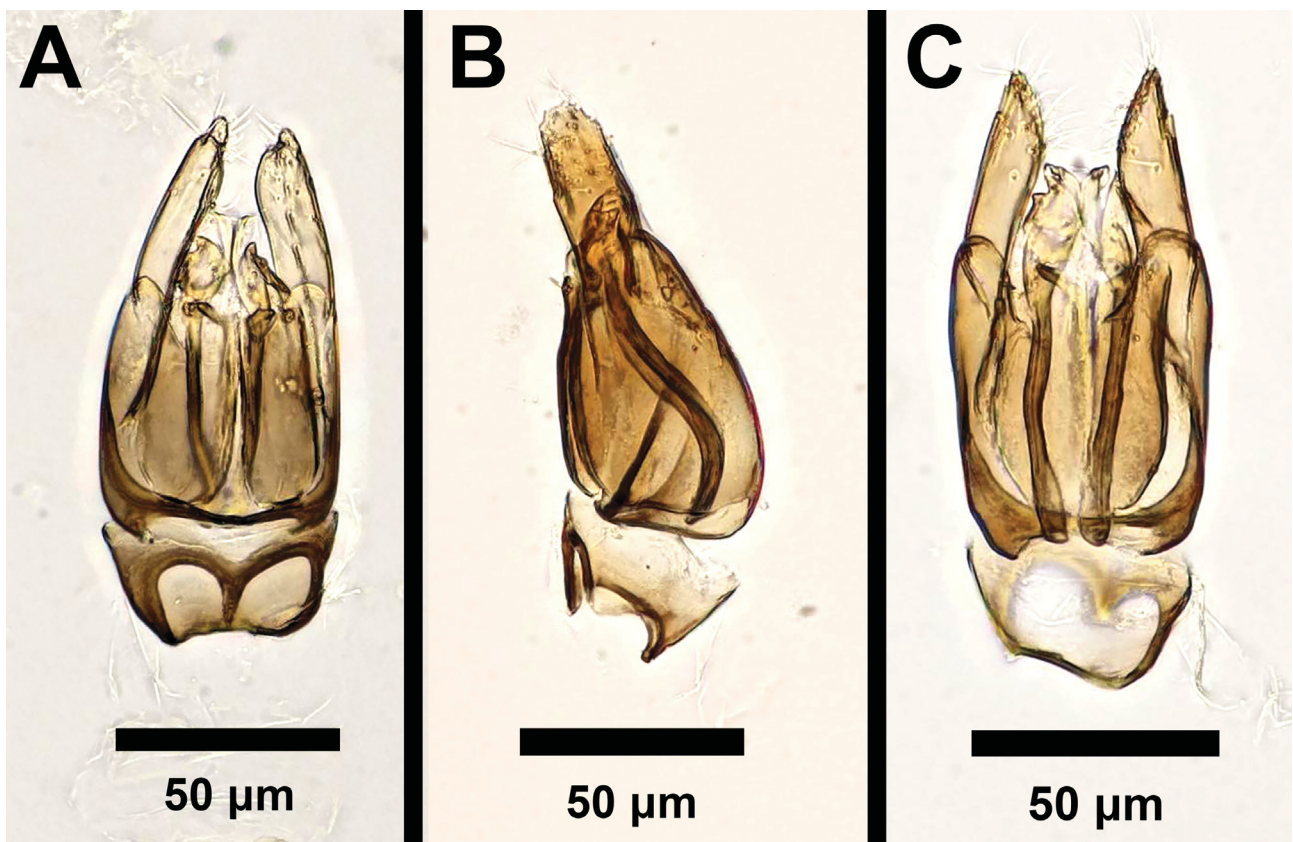


**FIGURE 21.** *Conostigmus dimidiatus* (Thomson, 1858) female lectotype (MZLU Type No. 5329). A. Lateral view. B. Dorsal view. Imaged by Christoffer Fägerström at the MZLU.





**FIGURE 22.** *Conostigmus dimidiatus* (Thomson, 1858) female lectotype (MZLU Type No. 5329) anterior view of the frons. Imaged by Christoffer Fägerström at the MZLU.



**FIGURE 23.** *Conostigmus dimidiatus* (Thomson, 1858) male genitalia. A. Ventral view (PSUC\_FEM 34290). B. Lateral view (UCRC\_ENT 00103613). C. Dorsal view (UCRC\_ENT 00103613).

**Metasoma:** Transverse carina on petiole shape: straight. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 2.0–2.2. Syntergal translucent patch maximum width vs. minimum width: 1.0–1.8. Syntergal translucent patch maximum width orientation: lateromedially. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear. Synsternal setiferous patch structure: comprised of a single or double row of setae. Synsternal setiferous patch anterior end: synsternal setiferous patch begins lateral or slightly anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral or just posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva not extending 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distally. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: straight.

**Distribution.** Holarctic.

**Material Examined.** Lectotype female: SWEDEN: MZLU Type No. 5329: 1 (MZLU).

Non-type material (4 males, 3 females): CANADA: 1 male. PSUC\_FEM 50307 (AMNH). USA: Arizona: 1 female. PSUC\_FEM 62155 (TAMU). USA: California: 3 males, 1 female. PSUC\_FEM 34290 (TAMU); PSUC\_FEM 457080; UCRC\_ENT 00103613, 00103617 (UCRC). USA: Colorado: 1 female. INHS Insect Collection 14038 (INHS).

### ***Conostigmus erythrothorax* (Ashmead, 1893)**

Figs. 24, 25, 26

**Species Comments and History.** Ashmead (1893) described this species from several male and female specimens collected in Jacksonville, FL, noting the distinctive coloration of both sexes and remarking that it is an “easily recognized species” (pg. 120). Most descriptions and redescriptions focus on its coloration and wings (or lack thereof) (Brues, 1916; Dodd, 1914; Kieffer, 1914), though Masner (1964) points out that while Ashmead (1893) described

the species as apterous, there are vestigial wing stumps present. Brues (1916) also reports specimens being collected from the nest of “*Lasius umbratus mixtus aphidicola*” (pg. 559) in “Colebrook” (possibly in New Hampshire) of August of 1900, making this another *Conostigmus* species associated with ants.

The species has a unique taxonomic history. Ashmead (1893) designated this species as the type species of the genus *Eumegaspilus* Ashmead, 1888 and the sole species in the genus, moving *canadensis* and *ottawensis* to the genus *Megaspilus*. Dodd (1914) transferred *erythrothorax* to another new genus, *Conostigmoides*, and declared it as the type species for the genus. Because Ashmead transferred the only two species in the genus, *canadensis* and *ottawensis*, to *Conostigmus* before describing *erythrothorax*, Dodd (1914) reasoned that the genus *Eumegaspilus* was effectively synonymized with *Conostigmus* before *erythrothorax* was included in it. Dodd (1914) erected the new genus *Conostigmoides* to resolve this taxonomic issue.

Masner (1964) revisited the genera *Eumegaspilus* Ashmead and *Conostigmoides* Dodd. Finding that there were no differences between either genera and *Conostigmus*, he synonymized *Conostigmoides*, moving *erythrothorax* to the genus *Conostigmus* (Masner, 1964). *Eumegaspilus* later became considered a subgenus of *Conostigmus* (Dessart and Cancemi, 1987). Although Ashmead (1893) had designated *C. erythrothorax* as the type species for *Eumegaspilus*, Muesebeck and Walkley (1951) emended this because *erythrothorax* was described in a publication after *Eumegaspilus*. Muesebeck and Walkley (1951) designated *C. canadensis* as the type of *Eumegaspilus*. This decision stands with others; Dessart and Cancemi (1987) consider *C. canadensis* to be the type species of the *Eumegaspilus* subgenus of *Conostigmus*.

**Variability.** The preoccipital furrow is usually absent, but it can appear as a faint impression (USNM-ENT01212999, PSUC\_FEM 34079). There is also color variation, especially with the age of the specimens. Fresher specimens tend to have a dark brown head, darker than the mesosoma (UCRC\_ENT 00103618, UCRC\_ENT 00103621), whereas in older specimens, the head tends to be light brown and can even appear of similar color to the mesosoma (MCZ-ENT711742, USNM-ENT01212999). This is likely a result of the specimen coloration fading over time (see Fig. 25).

**Differences Between Males and Females.** The median process on the intertorular carina is absent in females, but present and blunt in males. Other than this, as well as genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** This species can be identified from the following combination of characters: postocellar carina absent; rugose sculpturing absent on head; pronotum not enlarged (pronotum shorter than the mesoscutum along the midline); median mesoscutal sulcus present and complete (median mesoscutal sulcus posterior end adjacent to the transscutal articulation); and sternaulus absent. This species also has unique coloration, with the cranium being light brown to black in color and darker than the mesosoma, which is yellow to light brown. Females can be matched to males by the characters above, as well as by their unique coloration.

This species can have similar coloration to *C. nigrorufus*, and also lacks a sternaulus, but the two species can be easily distinguished by the wings, which are always macropterous in *C. nigrorufus* and brachypterous in *C. erythrothorax*. Other differences include the rugose sculpturing on the head (present in *C. nigrorufus*) and the male genitalia (gonocondyle blunt in *C. nigrorufus* and acute in *C. erythrothorax*; dorsomedian conjunctiva in dorsal view extending more than or equal to 2/3 of the length of the gonostyle–volsella complex in *C. erythrothorax*, extending between 1/3 to 1/2 the length in *C. nigrorufus*).

Another similar species is *C. michaeli*. These species share an incomplete occipital carina and lack the sternaulus, postocellar carina, preoccipital lunula and facial pit. The male genitalia are also similar, with the medioventral conjunctiva of the gonostyle–volsella complex present (parossiculi independent), proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape acute, one apical parossicular seta, gonocondyle acute, and the proximodorsal notch of cupula present, U-shaped and wider than long. However, these two species differ in that *C. erythrothorax* has reduced wings, whereas all known specimens of *C. michaeli* are macropterous. There are also differences in the male ocellar triangle ratios, with OOL:POL equal to 1 in *C. erythrothorax* males but less than 0.8 in *C. michaeli* males, and OOL:LOL over 1.6 in *C. erythrothorax* males but equal to or less than 1.3 in *C. michaeli* males.

Other similar species include *C. dimidiatus* and *C. muesebecki*, which both have reduced or absent wings and similar coloration. However, both species differ in that the median mesoscutal sulcus is absent or incomplete (when present, the median mesoscutal sulcus posterior end is not adjacent to the transscutal articulation), whereas *C. erythrothorax* has the median mesoscutal sulcus present and complete. In addition, *C. muesebecki* has an enlarged pronotum (pronotum longer than the mesoscutum along the midline), whereas *C. erythrothorax* does not.

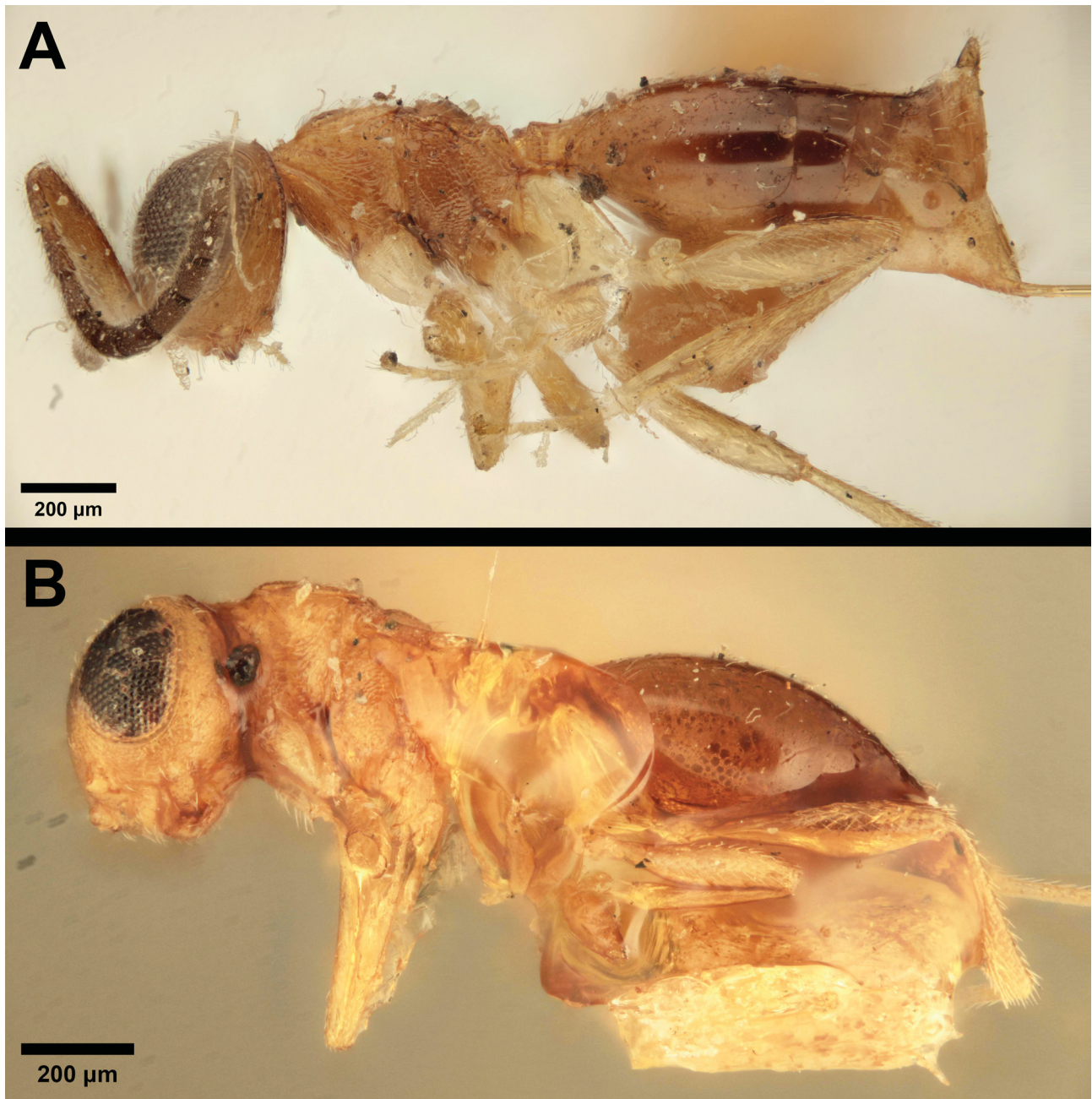
**Description.** Body length: 1.1–1.8 mm. Color hue pattern in male: cranium yellow to brown; mesosoma yellow to light brown; scape, pedicel and legs except hind coxae ochre; hind coxae white; petiole yellow; metasoma yellow to brown. Color intensity pattern in male: cranium darker than mesosoma, flagellomeres darker than legs; flagellomeres darker than scape and pedicel; petiole neck lighter than rest of metasoma; anterior half of mesosoma lighter than posterior half of mesosoma. Color hue pattern female: cranium light brown to black; scape, pedicel and flagellomeres ochre to brown; mesosoma yellow to light brown; legs light yellow to white; petiole yellow; metasoma light brown to dark brown. Color intensity pattern female: legs lighter than the flagellomeres, scape and pedicel; flagellomeres darker than scape and pedicel; cranium darker than mesosoma; petiole neck lighter than rest of metasoma; distal portion of pedicel lighter than rest of pedicel; basal portion of scape lighter than rest of scape; anterior half of mesosoma lighter than posterior half of mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 4.0. Male scape length vs. F1 length: 1.43. Male F1 length vs. pedicel length: 2.8. Male F1 length vs. male F2 length: 1.17. Longest male flagellomere: F1. Female scape length vs. pedicel length: 3.0–3.9. Female scape length vs. F1 length: 3.2–3.5. Female F1 length vs. F2 length: 1.1–1.3. Female F1 length vs. pedicel length: 0.8–1.2. Longest female flagellomere: F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

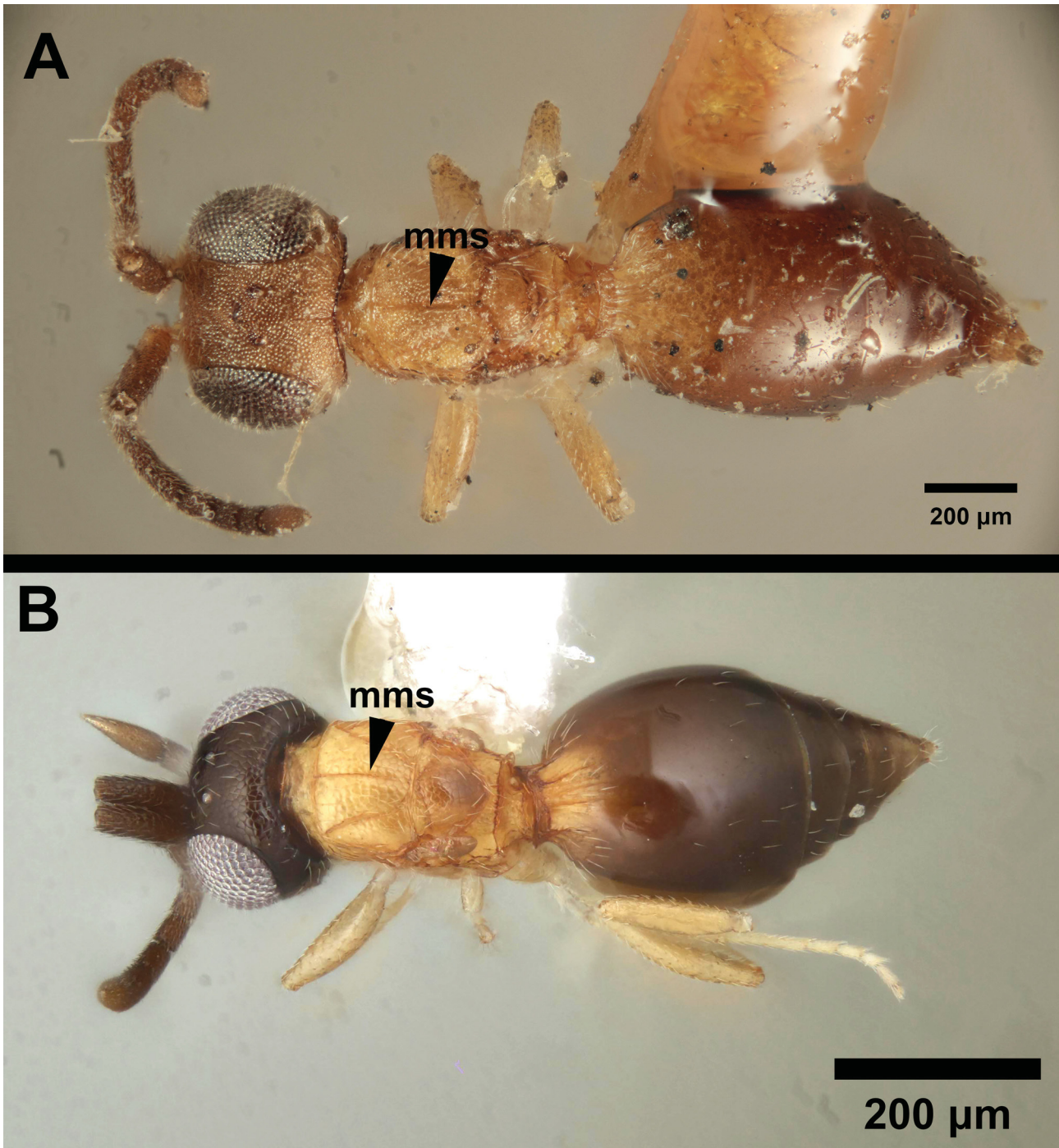
**Head:** Head width, dorsal view: at least  $1.3\times$  wider than mesosoma. Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.2–1.5. Head height (HH) vs. head length (HL): HH:HL=1.1–1.4. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.8–2.6. Head width (HW) vs. head height (HH): HW:HH=1.1–1.4. Cephalic size (csb): Mean: 250–400  $\mu\text{m}$ . Maximum eye diameter vs. minimum eye diameter: 1.3–1.7. POL: OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.67 (PSUC\_FEM 34079). Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.67:1.0:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL 1.2–1.4 $\times$  as long as LOL. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.2–1.4:1.2–1.7:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: absent. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: absent; present. Preoccipital furrow anterior end: preoccipital furrow ends posterior to ocellar triangle. Preoccipital furrow sculpture: appearing as a faint impression, smooth. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina dorsal to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: no external corresponding structure present. Facial pit count: absent. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present in males but not in females. Median process on intertorular carina shape: blunt on males, median process absent in females. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent, though very close together. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=300, 310  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.8–1.0. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.2–1.6. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 1.0–1.5. Wing count: absent. Fore wing size: wings reduced or brachypterous with apex never extending past scutellum. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than  $2\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median

mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “U” (left and right lateral propodeal carina are adjacent to the antecostal sulcus of the first abdominal tergum submedially). Meso-postscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.



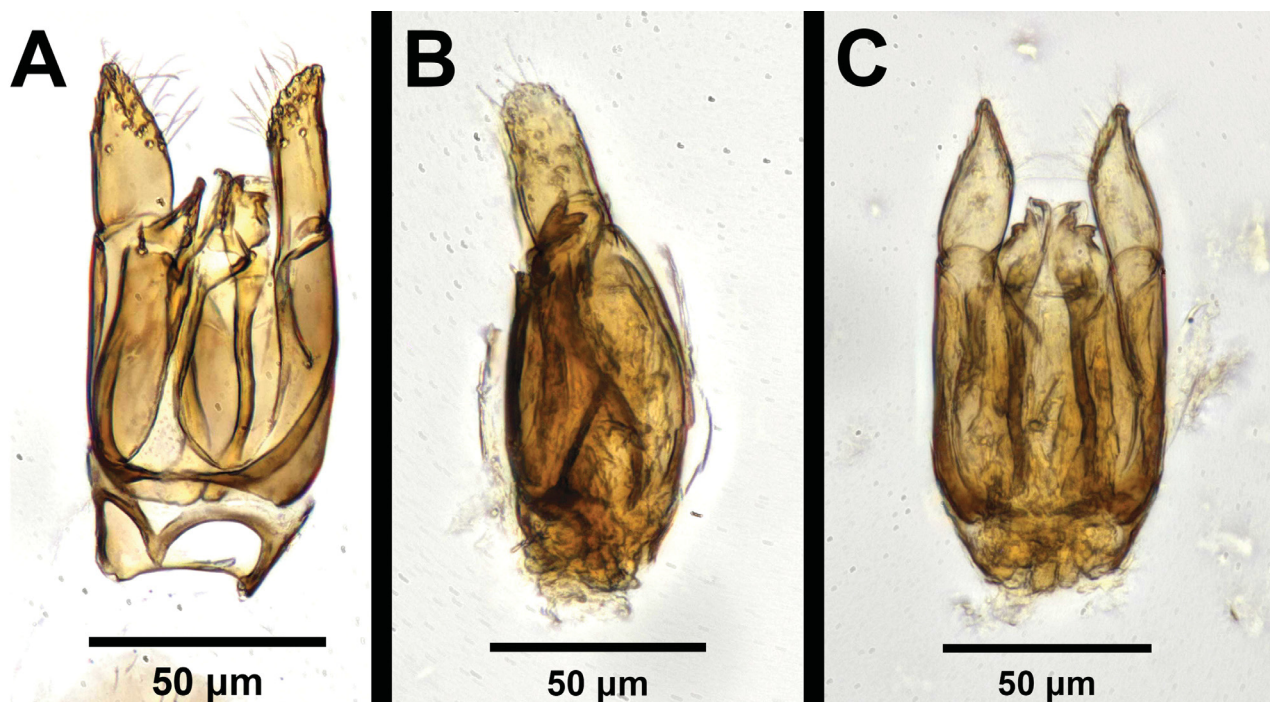
**FIGURE 24.** *Conostigmus erythrothorax* (Ashmead, 1893) type specimens in lateral view. A. Female lectotype (USNMMENT01339752). B. Male paralectotype (USNMMENT01212999).



**FIGURE 25.** *Conostigmus erythrothorax* (Ashmead, 1893) females in dorsal view. A. Female lectotype (USNMENT01339752). B. A female collected in 2004 (UCRC\_ENT 00103621). The differences in coloration between these two specimens is likely due to age. Abbreviation: median mesoscutal sulcus (mms).

**Metasoma:** Transverse carina on petiole shape: straight. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.6–2.6. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.6, 3.25. Syntergal translucent patch maximum width vs. minimum width: 1.2–1.3. Synsternal translucent patch maximum width vs. minimum width: 1.5, 2.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single row of setae. Synsternal setiferous patch anterior end: synsternal setiferous patch begins lateral to the synsternal translucent patch

anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



**FIGURE 26.** *Conostigmus erythrothorax* (Ashmead, 1893) male genitalia. A. Ventral view (PSUC\_FEM 1141). B. Lateral view (PSUC\_FEM 34079). C. Dorsal view (PSUC\_FEM 34079).

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: straight. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2, sometimes with an additional dorsal apodeme below the second spine. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar

ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Material Examined.** Lectotype female: USA: USNMENT01339752 (USNM). Paralectotypes (1 male): USA: Florida: 1 male. USNMENT01212999 (USNM).

Non-type material (6 females, 4 males): USA: California: 5 females, 1 male. UCRC\_ENT 00103616, 00103618, 00103619, 00103621, 00103622, 00457106 (UCRC). USA: Connecticut: 1 female. MCZ-ENT 711742 (MCZC). USA: North Carolina: 2 males. PSUC\_FEM 1141, 66352 (EDNC). USA: Tennessee: 1 male. PSUC\_FEM 34079 (TAMU).

### ***Conostigmus harringtoni* (Ashmead, 1888)**

Fig. 27

**Species Comments and History.** Ashmead (1888) described this species from one male and one female specimen, mostly relying on coloration and microsculpture. Harrington (1900) mentioned 6 more specimens in his personal collection, collected from the same area as the type. We located a series of 16 female specimens labeled as *C. harringtoni* at the CNC, including specimens from Harrington, but these specimens belonged to several different species, including several *Dendrocerus*, and none appeared to match the female type or share the same collecting information as the type (although both these specimens and the type have limited collection information).

The male and female types of *C. harringtoni* were both deposited in the USNM, but the male type has been missing for decades (Masner and Muesebeck, 1968). The female type is still present at the USNM, but it is in very poor condition. The head and antennae are missing, and the rest of the specimen is so poorly glued that it is not possible to determine if the specimen has a sternaulus.

We consider *C. harringtoni* as a *species inquirenda*.

**Material Examined.** Lectotype female: CANADA: USNMENT01339750 (USNM).

### ***Conostigmus hyalinipennis* (Ashmead, 1887)**

**Species Comments and History.** Ashmead (1887) described this species from a single female specimen collected in Florida. The specimen was described as having a black body, light brown legs, a large but pale stigma with a long radial vein, filiform antennae with “first two joints rather short, third and following joints much longer” (pg. 98), and hyaline wings (Ashmead, 1887). This is presumably the characteristic for which the specimen was named, but this feature is common among *Conostigmus*. Ashmead (1893) later redescribed the species and keyed it out with other *Conostigmus*, specifying that it was macropterous with the face “closely punctate or shagreened” (pg. 113).

The location and identity of Ashmead’s original specimen are unknown, and the characters given in the original description could apply to several different species. We consider *Conostigmus hyalinipennis* as a *species inquirenda* until Ashmead’s original specimen can be located and studied.

### ***Conostigmus inermis* (Kieffer, 1906)**

**Species Comments and History.** Kieffer (1906) described this species from a male specimen or specimens collected in San Mateo, California. The original description relies mostly on coloration, microsculpture and antennal characters, but specifies “kopf glänzend, fein chagriniert, ohne Längsfurche am Scheitel” (Kieffer, 1906, pg. 259), which we interpret as the absence of the preoccipital furrow. These characters are repeated for the most part in Kieffer’s later redescription of the species (1914).

The location of Kieffer’s type material is unknown, and the characters given in the original description could apply to many different species of *Conostigmus*. We consider *Conostigmus inermis* as a *species inquirenda*.





FIGURE 27. *Conostigmus harringtoni* (Ashmead, 1888) female lectotype (USNMENT01339750) in dorsal view.

### *Conostigmus integriceps* (Kieffer, 1906)

**Species Comments and History.** Kieffer (1906) described this species from a female specimen or specimens collected from San Mateo, California, with the male unknown. Kieffer later transferred the species to the genus *Conostigmus* (1909).

According to Kieffer (1906), the female of this species was macropterous and had a black body with dark brown antennae and yellowish legs. Kieffer (1906) distinguished this species from the female of *C. nevadensis* in that it has “Scheitel ohne Längsfurche” (pg. 258), which we interpret as the absence of the postocellar carina, and “Stirueindruck nicht bis zur Hälfte der Augen reichend” (pg. 258), which could indicate either a short preoccipital furrow (not reaching the ocellar triangle) or a short facial sulcus (not reaching half the length of the compound eye). Kieffer (1914) repeats these characters in the description, and in the key to species distinguishes it from the female of *C. schwarzi* by the “Das 2. Antennenglied gelraun, länger als das 3., scutellum fein lederartig” (pg. 178).

The characters given in Kieffer’s description could apply to several different species of *Conostigmus*, and the location of Kieffer’s type specimen or specimen series is unknown. We consider *Conostigmus integriceps* as a *species inquirenda*.

### *Conostigmus laeviceps* (Ashmead, 1893)

Figs. 28, 29

**Species Comments and History.** Ashmead (1893) described this species from an unknown number of male specimens. One specimen was collected by E. A. Schwarz in Bladensburg, Maryland; the others were collected by Ashmead along the bank of the Potomac River in Arlington, Virginia, and in the outskirts of Washington, D.C. (Ashmead, 1893). There are four male specimens present at the USNM representing these localities, with one from Maryland, one from Virginia, and two from Washington, D.C. We also found an additional male specimen present at the MCZC bearing an identification label from Ashmead, but this specimen does not have a locality label, so it is not possible to verify whether it was also part of the original type series.

At the USNM, the male lectotype from Maryland (USNMENT01339759) is in relatively good condition, though

the left antenna is missing flagellomeres 7, 8 and 9, and the right antenna is missing flagellomeres 8 and 9. This specimen damage was not mentioned in Masner and Muesebeck (1968) and must have occurred since then. The male paralectotype from Virginia (USNMENT01212998) is in better condition than the type and is not missing any pieces. Both of the paralectotypes from Washington, D.C., are in poor condition, with one (USNMENT01212996) missing the antennae and metasoma, and the other (USNMENT01212997) missing the head and metasoma.

We were not able to dissect the male genitalia from the type specimens, but we obtained permission to dissect the MZCU specimen and recognized the genitalia immediately by its fused parossiculi and the unique harpe. This species is widespread and common across the United States, with one specimen known from Canada. Though we were not able to dissect the type specimens, the lectotype and the paratype from Virginia have enough of the harpe protruding from the metasoma to see the unique harpe shape and confirm the species. The two additional paratypes from Washington, D.C., were too damaged to confirm the species, though we still include them below with the material examined.

**Variability.** The median process of the intertorular carina extends down across the intertorular area towards the dorsal margin of the clypeus, but in some specimens it reaches the clypeus (PSUC\_FEM 8993, PSUC\_FEM 50076), whereas in others it does not (CMNHENT0022709, PSUC\_FEM 16645). The distoventral margin of the harpe is usually straight, but can appear more convex in some specimens (PSUC\_FEM 8795) and more concave in others (PSUC\_FEM 50136).

**Diagnosis.** This species is distinguished by the following combination of characters: facial pit present; preoccipital furrow present; postocellar furrow present; median process on intertorular carina present and acute; sternaulus smooth (not crenulate), present and elongate, exceeding  $3/4$  of the mesopleuron length at the level of the sternaulus; ventral projection of the metapleural carina present; medioventral conjunctiva absent and parossiculi fused; medioventral ridge of the gonostyle–volsella complex present; gonossiculus with one spine more than  $2\times$  as long as the others; proximodorsal notch of cupula absent; gonocondyle present and acute; dorsomedian projection of the gonostyle–volsella complex present and simple (not bilobed); dorsomedian conjunctiva extending equal to or less than  $1/3$  of the length of the gonostyle–volsella complex in dorsal view; and proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex blunt or straight.

The female of this species is unknown.

The harpe of *C. laeviceps* and *C. dessarti* can appear very similar to each other in lateral view, in that they both have harpe with the distal margin pointed or acute, the distodorsal setae of sensillar ring longer than the harpe width (sometimes  $2\times$  as long or greater), and the distoventral margin of the harpe in lateral view straight, though it can appear more convex or concave in some specimens. These species can easily be distinguished by the proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex (acute in *C. dessarti*, blunt or straight in *C. laeviceps*) and the dorsomedian projection of the gonostyle–volsella complex (absent in *C. dessarti*, present in *C. laeviceps*). *C. dessarti* also differs from *C. laeviceps* in that the scape is more than  $5.5\times$  as long as the pedicel (less in *C. laeviceps*).

*C. laeviceps* also shares many somatic characters and even some genitalia characters in common with *C. bipunctatus*, *C. minimus*, *C. musettiae*, and *C. franzinii*. Male genitalia characters are almost always necessary to separate these species. *Conostigmus minimus* and *C. musettiae* differ from *C. laeviceps* in that they have a dense patch of setae on the distoventral edge of the harpe (absent in *C. laeviceps*) and lack the dorsomedian projection of the gonostyle–volsella complex (present in *C. laeviceps*). *Conostigmus franzinii* also has a dense patch of setae on the distoventral edge of the harpe as well as the proximodorsal notch of the cupula (absent in *C. laeviceps*). *Conostigmus bipunctatus* differs from *C. laeviceps* in that it has curved or sickle-shaped harpe in lateral view; it also has the dense patch of setae on the distoventral edge of the harpe.

**Description.** Body length: 1.625–1.825 mm. Color hue pattern in male: cranium and mesosoma reddish–brown to black; flagellomeres light brown; legs, scape, pedicel, neck of petiole and anterior portion of metasoma yellow; posterior portion of metasoma reddish–brown. Color intensity pattern in male: cranium darker than mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

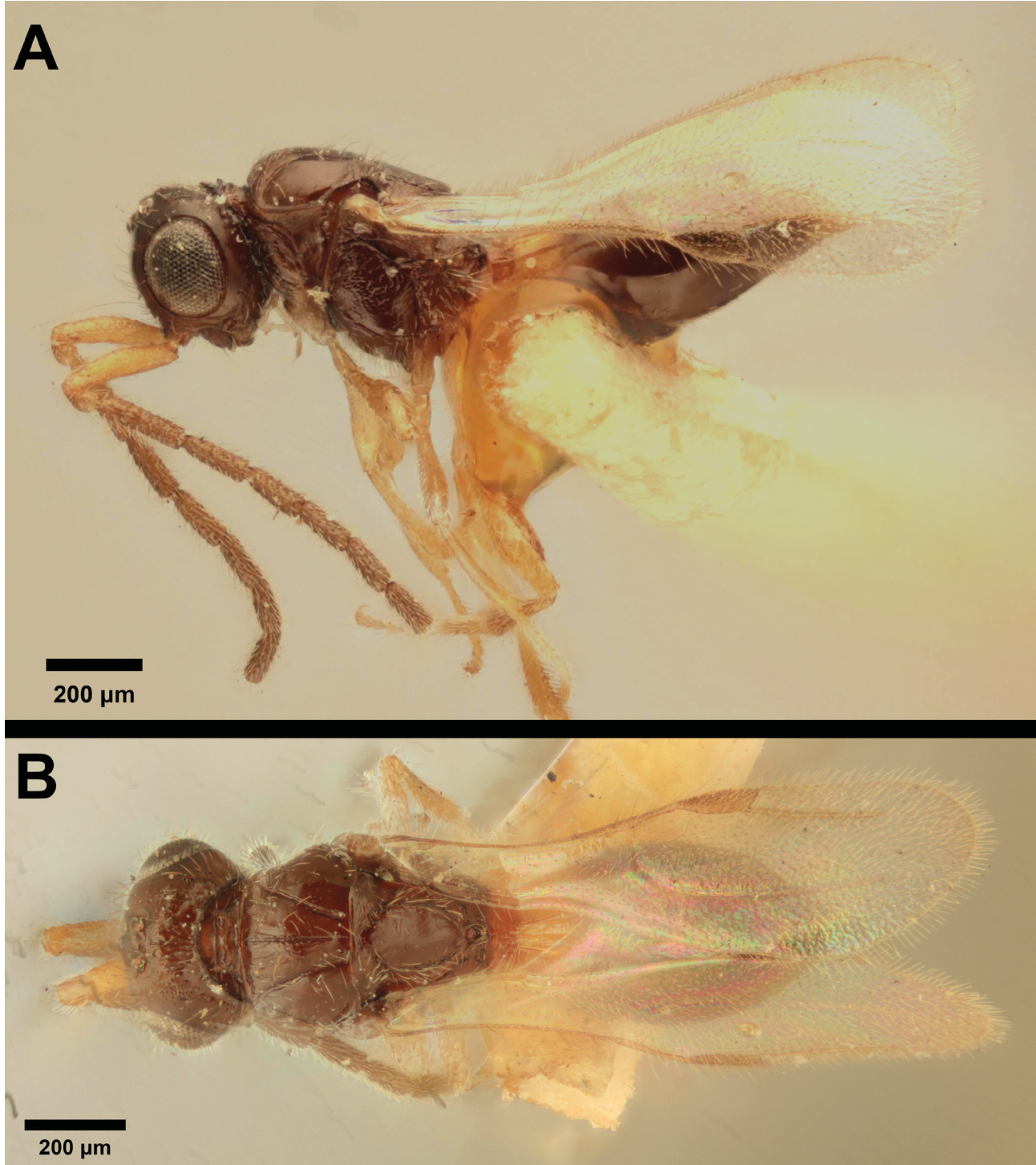
**Antennae:** Male scape length vs. pedicel length: 3.7–5.4. Male scape length vs. F1 length: 1.0–1.3. Male F1 length vs. pedicel length: 3.2–4.8. Male F1 length vs. male F2 length: 1.3–1.5. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.5–2.0. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.6–1.8. Head width (HW) vs. head height (HH): HW:HH=1.1–1.4. Cephalic size (csb): Mean: 335–480 µm. Maximum eye diameter vs. minimum eye diameter: 1.2–1.4. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.6–2.5. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.4–2.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.6–2.5:0.8–1.8:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process extends across intertorular area towards dorsal margin of clypeus; process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

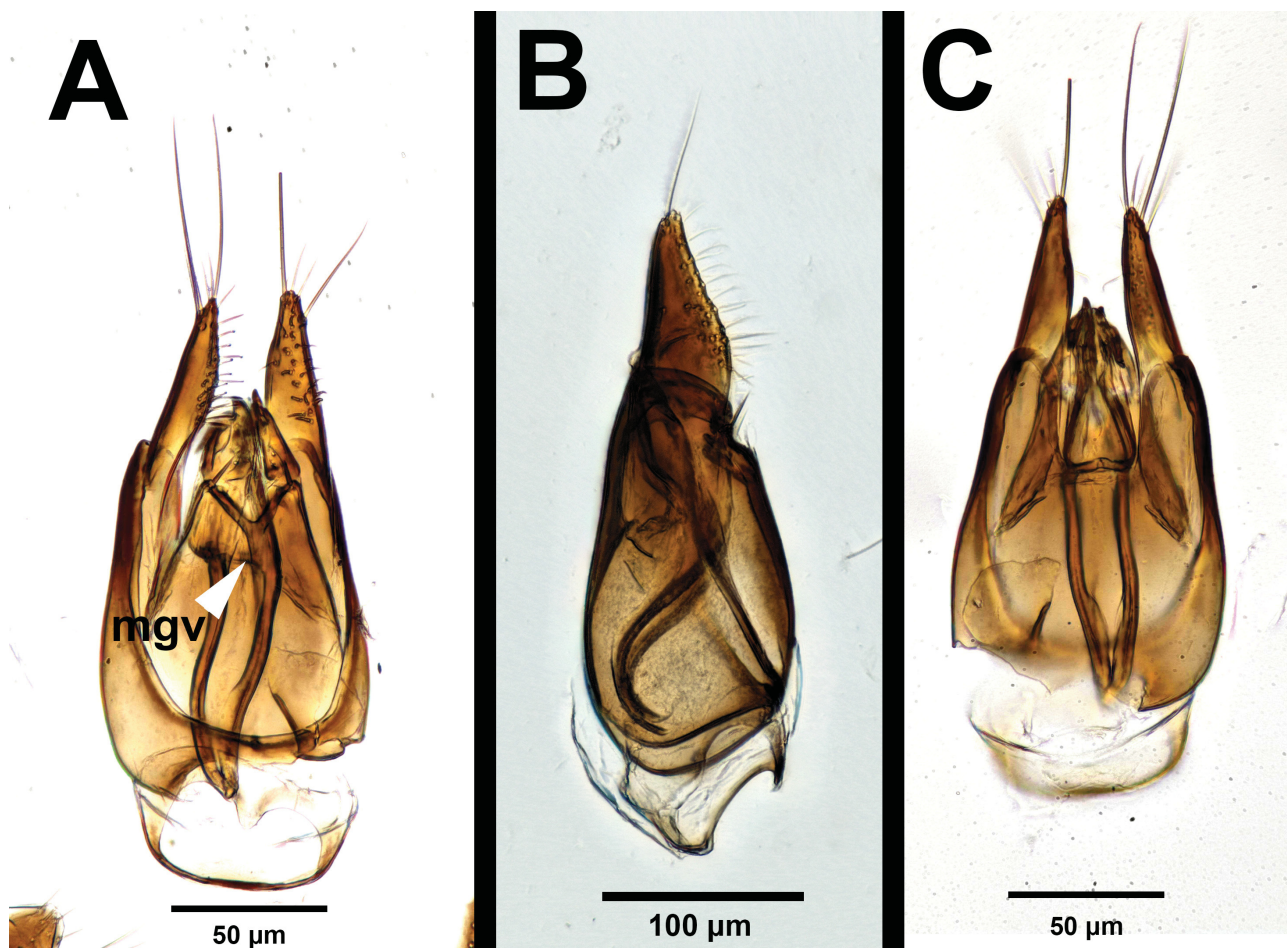
**Mesosoma:** Weber length: WL=480–690 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.2–1.7. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.8–1.0. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 3/4 of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: less than 2× as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.3–2.4. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.1–3.2. Syntergal translucent patch maximum width vs. minimum width: 1.7–3.0. Synsternal translucent patch maximum width vs. minimum width: 1.2–2.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior

to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single row of setae anterior to the synsternal translucent patch, with a patch of setae posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



**FIGURE 28.** *Conostigmus laeviceps* (Ashmead, 1893) male lectotype (USNMENT01339759). A. Lateral view. B. Dorsal view.



**FIGURE 29.** *Conostigmus laeviceps* (Ashmead, 1893) male genitalia. A. Ventral view (PSUC\_FEM 8795). B. Lateral view (PSUC\_FEM 50136). C. Dorsal view (PSUC\_FEM 8795). Abbreviation: medioventral ridge of the gonostyle–volsella complex (mgv).

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single transverse row of setae occurring medially with additional distal setae below it, sometimes organized in one or two additional transverse rows. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: absent. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: straight. Dorsomedian projection of the gonostyle–volsella complex count: present. Dorsomedian projection of the gonostyle–volsella complex shape: simple (not bilobed). Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending equal to or less than 1/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight with a median projection. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva absent and parossiculi fused. Medioventral ridge of the gonostyle–volsella complex count (only applicable if medioventral conjunctiva of the gonostyle–volsella complex absent): present. Apical parossicular setae count: one. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2. Gonossiculus spine length: one spine more than 2× as long as the other(s). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orienta-

tion: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: absent. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae not of equal length, longer setae present on distodorsal point of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distoventrally. Sensillar ring area of harpe orientation: medioventrally. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: straight but can be more convex or concave in some specimens.

**Distribution.** Nearctic.

**Material Examined.** Lectotype male: USA: USNMENT01339759 (USNM). Paralectotypes (3 males): USA: 2 males. USNMENT01212996, 01212997 (USNM). USA: Virginia: 1 male. USNMENT01212998 (USNM).

Non-type material (49 males): CANADA: Ontario: 1 male. PSUC\_FEM 16445 (ROME). USA: Arizona: 6 males. PSUC\_FEM 8795, 8799, 8826, 8905, 9077, 9549 (OSUC). USA: Connecticut: 1 male. PSUC\_FEM 15253 (PSUC). USA: Kentucky: 3 males. PSUC\_FEM 50136 (HIC); PSUC\_FEM 86114, 86309 (PSUC). USA: Ohio: 33 males. CMNHENT0022689, 0022709, 0022785, 0022790 (CLEV); PSUC\_FEM 6652, 8772, 8889, 8993, 9044, 9458, 9465, 9560, 9666, 26604, 26672, 26708, 26747, 26753, 26788, 26793, 26867, 26907, 26917, 26960, 27136, 27174, 27203, 27218, 27290, 28746, 28910, 50076, 68554 (OSUC). USA: Pennsylvania: 2 males. CMNHENT0022722 (CLEV); PSUC\_FEM 3016 (PSUC). USA: Tennessee: 1 male. CMNHENT0022745 (CLEV). USA: Wisconsin: 1 male. PSUC\_FEM 50071 (WIRC). Unknown country: 1 male. MCZ-ENT 711734 (MCZC).

### ***Conostigmus marylandicus* (Ashmead, 1893)**

Fig. 30

**Species Comments and History.** Ashmead (1893) described this species from female specimens collected in Oakland, Maryland. The original description relies mostly on general coloration, microsculpture and antennal characters that are common among *Conostigmus* and cannot be matched to one species (Ashmead, 1893). Although the original description indicates more than one specimen (Ashmead, 1893), there is only one female specimen present at the USNM. The specimen is point mounted, but the abdomen and right forewing were detached and loose in the unit tray. The detached pieces were glued back onto the point. This damage was not recorded in the catalog by Masner and Muesebeck (1968) and must have occurred since then.

The sole female specimen has foveolate sculpturing on the head and mesosoma, a preoccipital furrow that ends at the anterior ocellus, and an elongate sternaulus, as well as the facial pit, postocellar carina, and axillular carinae present. This combination of features is unique and is not found in any other Nearctic *Conostigmus* species. Similar species include *C. musettiae*, *C. franzinii*, and *C. bipunctatus*, which all differ in that they lack the foveolate sculpturing. All three species also have the preoccipital furrow ending inside the ocellar triangle but not at the anterior ocellus. It is possible that these differences could be due to intraspecific variation due to size, nutrition, temperature or other factors impacting development. Because the other specimens from the original type series is missing, it is not possible to see what variation occurs between specimens in this species, and because there are no known males, the species cannot be compared to the males of other species.

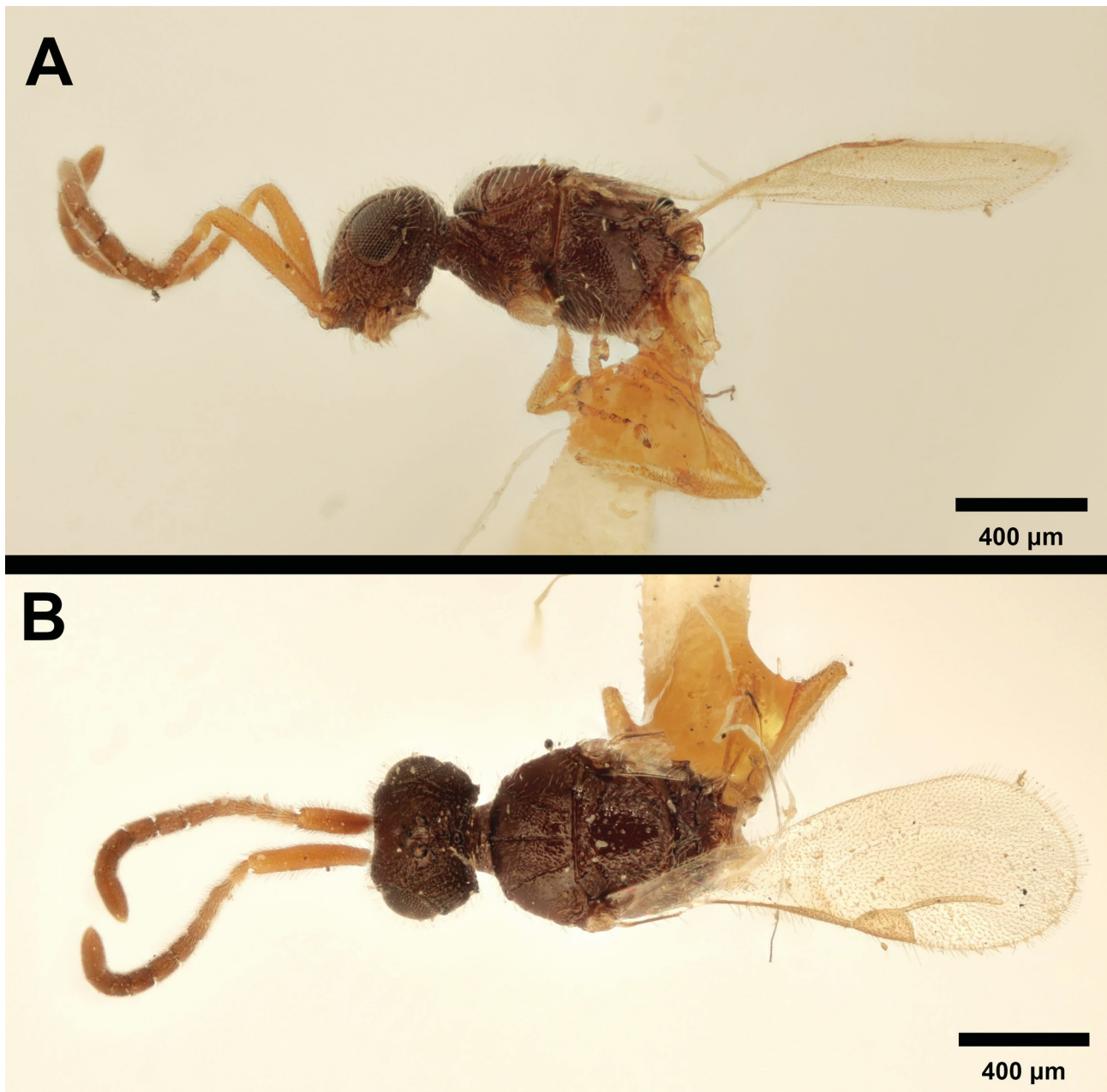
We consider *Conostigmus marylandicus* as a *species inquirenda*.

**Material Examined.** Lectotype female: USA: Maryland: USNMENT01339742 (USNM).

### ***Conostigmus muesebecki* Dessart & Masner 1965**

Fig. 31

**Species Comments and History.** Dessart and Masner (1965) described this species from a holotype female, allotype male, and multiple paratypes (6 males and 22 females from different collecting events), all present at the USNM. This species was originally described as the type species of a new genus, *Ecnomothorax* (Dessart and Masner, 1965), which was later synonymized with *Conostigmus* by Dessart and Cancemi (1987).



**FIGURE 30.** *Conostigmus marylandicus* (Ashmead, 1893) female lectotype (USNMENT01339742). A. Lateral view. B. Dorsal view.

Dessart dissected the allotype male and made a slide preparation of the male genitalia, deposited in the USNM. However, this male genitalia preparation is in such poor condition that it is not possible to verify any characters from it. We were not able to dissect any of the other paratype males present at the USNM or locate any other males to dissect for this revision. From illustrations of the male genitalia provided in Dessart and Masner (1965), this species appears to have the following characters: medioventral conjunctiva of the gonostyle–volsella complex absent (parossiculi independent, not fused); 1 apical parossicular seta; proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape blunt, without a dorsomedian projection; harpe shorter than the gonostipes in lateral view; 2 gonossicular spines, potentially with an additional dorsal apodeme below the second spine; and one gonossicular spine more than 2× as long as the other(s).

**Variability.** Other than slight intraspecific variations in color and size between specimens, we did not note any substantial variations.

**Differences Between Males and Females.** Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** This species is easily distinguished by the reduced wings (brachypterous), the absence of the median mesoscutal sulcus, and the presence of an enlarged pronotum (pronotum longer than the mesoscutum along the midline).

Similar Nearctic species include *C. dimidiatus*, which can have the median mesoscutal sulcus absent or present, but does not have an enlarged pronotum. There are no other species in the Nearctic with an enlarged pronotum beside *C. muesebecki*—the only other known *Conostigmus* species in the world with this character is *C. grangeri*, known only from Morocco. *Conostigmus grangeri* differs from *C. muesebecki* in size (*C. grangeri* is larger), coloration (*C. grangeri* has a two-toned body, whereas *C. muesebecki* has uniform body coloration), presence and length of the preoccipital furrow (preoccipital furrow ends at the site of the postocellar carina in *C. muesebecki*; preoccipital furrow absent or ending posterior to the ocellar triangle in *C. grangeri*) and male genitalia characters (compare Fig. 18 and 19 with Fig. 22 and 23 in Dessart and Masner, 1965).

**Description. Note:** Because we were unable to dissect any male specimens for observation, we have omitted scorings for male genitalia characters in the redescription below. The measurements given below were taken from two female specimens, PSUC\_FEM 66226 (TAMU) and CMNHENT0022724 (CLEV) respectively.

Body length: 1.2 mm, 1.2 mm. Color hue pattern in male: cranium, metasoma, flagellomeres brown to black; anterior half of mesosoma yellow to light brown; posterior half of mesosoma light brown to brown; legs, scape, pedicel ochre to light brown. Color intensity pattern in male: anterior half of mesosoma lighter than posterior half of mesosoma; flagellomeres darker than scape and pedicel. Color hue pattern female: cranium, mesosoma, metasoma, scape yellow to light brown; coxae and legs white to ochre; pedicel white to ochre; flagellomeres white to brown. Color intensity pattern female: pedicel, F1, F2 lighter than F6–F9; flagellomeres gradually darkening towards the apex; anterior half of metasoma lighter than posterior half of metasoma; anterior half of mesosoma lighter than posterior half of mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Longest male flagellomere: F9. Female scape length vs. pedicel length: 3.13, 3.25. Female scape length vs. F1 length: 3.57, 4.33. Female F1 length vs. F2 length: 1.75, 1.50. Female F1 length vs. pedicel length: 0.88, 0.75. Longest female flagellomere: F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres.

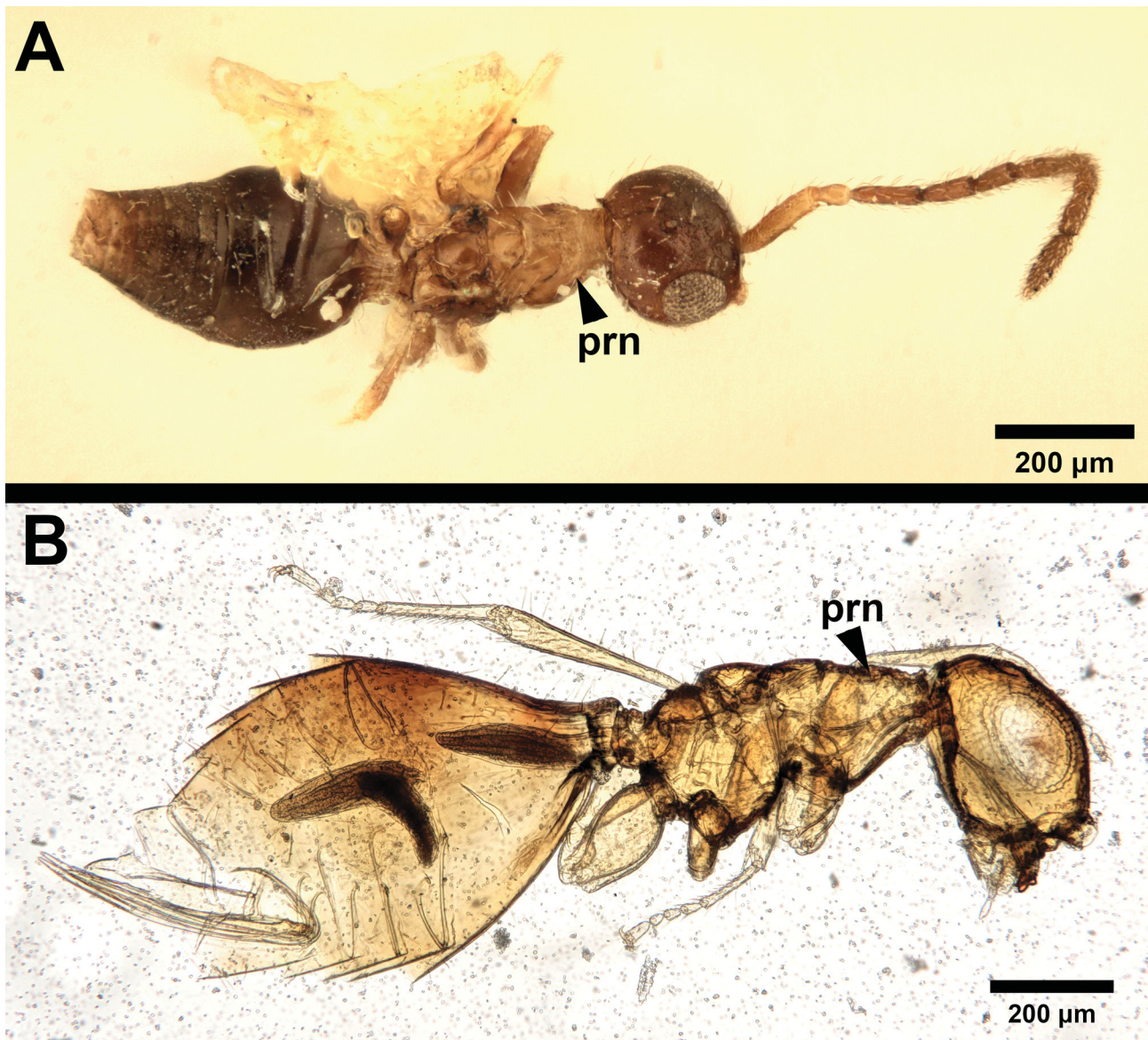
**Head:** Head width, dorsal view: at least 1.5× wider than mesosoma. Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.71, 1.81. Head height (HH) vs. head length (HL): HH:HL=1.26, 1.32. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.75, 1.68. Head width (HW) vs. head height (HH): HW:HH=1.17, 1.10. Cephalic size (csb): Mean: 260 μm, 305 μm. Maximum eye diameter vs. minimum eye diameter: 1.56, 1.55. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=3.0, 1.5. Head shape (anterior view): circular or triangular. Preoccipital lunula count: absent. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends at site of postocellar carina. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process extends across intertorular area towards dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.38, 0.40. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=2.0, 1.75. Mesoscutal length



(MscL) vs. mesoscutellar length (MscIL):  $MscL:MscIL = 0.67, 0.58$ . Wing count: absent. Fore wing size: wings reduced or brachypterous with apex never extending past scutellum. Pronotum median length: greater than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than  $2\times$  anteriorly. Median mesoscutal sulcus count: absent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “U” (left and right lateral propodeal carina are adjacent to the antecostal sulcus of the first abdominal tergum submedially). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Paired blue iridescent ovoid patches on the syntergite count: absent.

**Distribution.** Nearctic.



**FIGURE 31.** *Conostigmus muesebecki* Dessart & Masner, 1965 type specimens at the USNM. A. Male paratype (USNMMENT01212979) in dorsal view. B. Female holotype in lateral view (USNMMENT01339792). Abbreviation: pronotum (prn).

**Material Examined.** Holotype female: USA: Arkansas: USNMENT01339792 (USNM). Paratypes (22 females, 8 males): USA: Arkansas: 11 females, 2 males. USNMENT01212943, 01212976, 01212978-01212980, 01212982, 01212983, 01212986–01212990, 01212992 (USNM). USA: Missouri: 11 females, 6 males. USNMENT01212941, 01212945–01212947, 01212949, 01212951, 01212955, 01212957, 01212959, 01212975, 01212977, 01212981, 01212984, 01212985, 01212991, 01212993, 01212994 (USNM).

Non-type material (2 females): USA: South Carolina: 1 female. CMNHENT0022724 (CLEV). USA: Texas: 1 female. PSUC\_FEM 66226 (TAMU).

### ***Conostigmus nevadensis* (Kieffer, 1906)**

**Species Comments and History.** As with *C. integriceps*, Kieffer (1906) described this species from a female specimen or specimens collected from San Mateo, California, with the male unknown. Kieffer (1906) described the species as being macropterous with a black body and “Grund und Unterseite des Schaftes, Hüften und Beine lehmgelb” (pg. 259). Kieffer (1906) distinguished this species from the female of *C. integriceps* by the character “Scheitel mit Längsfurche” (pg. 258), which we interpret as the presence of the postocellar carina, and the character “Stirneindruck bis zur Mitte der Augen reichend” (pg. 258), which could indicate either a long preoccipital furrow, ending inside the ocellar triangle or at the anterior ocellus, or a facial sulcus reaching half the length of the compound eye.

Kieffer later transferred the species to the genus *Conostigmus* (1909), then published another description and key (1914). In the key, *C. nevadensis* is distinguished from other Nearctic female *Conostigmus* by the character “Scheitel mit einer Längsfurche vom Hinterrande bis zur vorderen ocelli” (Kieffer, 1914, pg. 178), which appears to confirm that the preoccipital furrow ends at the anterior ocellus.

The location of Kieffer’s type material is unknown, and the characters given in the original description could apply to several different *Conostigmus* species (Kieffer, 1906). Hoebeke (1980) recorded a paratype specimen present in the Cornell University Insect Collection (CUIC) in Ithaca, NY, USA, but we were unable to confirm this. Until the female can be studied and more specimens located and examined, including males, we consider *Conostigmus nevadensis* as a *species inquirenda*.

### ***Conostigmus nigripes* (Kieffer, 1906)**

**Species Comments and History.** Kieffer (1906) described this species from a male specimen or specimens collected in Santa Clara, California. The female of the species is unknown. Kieffer (1906) includes this species in a key to male species that are closely related to *C. schwarzi* Ashmead, 1893 apart from the antennae (which is logical because the type of *C. schwarzi* is female and there is sexual dimorphism in the antennae). Kieffer (1906) differentiates this species from others in the key by the following characters: “Beine schwarz; 2. Fühlerglied die Hälfte des 3. Erreichend” (pg. 258). The description further adds, “Wangen ohne Furche”, which we interpret as the absence of the facial sulcus (Kieffer, 1906). The rest of the description and later redescription relies on antennal characters, microsculpture and coloration (Kieffer, 1906; 1914).

The location of the type material is unknown, and the characters given in the description are common across *Conostigmus*. We consider *Conostigmus nigripes* as a *species inquirenda*.

### ***Conostigmus nigrorufus* Dessart 1997**

Figs. 32, 33

**Species Comments and History.** Dessart (1997a) described this species from male and female specimens collected in Ontario, Canada, as well as New York and Maryland, USA. The holotype male, allotype and one female paratype are deposited in the CNC, with additional paratypes deposited in the USNM and the Royal Belgian Institute of Natural Sciences in Belgium (RBINS), Brussels. We found the specimens at the CNC in good condition, but we did not find any paratype specimens at the USNM. As Dessart’s 1997a study was published near the end of his lifetime, it is unclear if the specimens were ever deposited in the USNM. The presence or status of specimens at the RBINS remains unconfirmed.

**Variability.** This species has a large size variation, with some larger specimens having more rugose sculpturing on the frons and head. The gonocondyle is also blunt in some male specimens (PSUC\_FEM 45241, PSUC\_FEM 88173) and acute in others (PSUC\_FEM 64076, PSUC\_FEM 15380). This character being blunted or pointed could be a function of this extreme size difference.

There is also variation in coloration. This species is easily recognizable by the yellow-to-orange coloration on the anterior half of the mesosoma, lighter than the posterior half of the mesosoma, which is brown to dark brown. However, some specimens have the entire pronotum and mesoscutum the same lighter color, whereas others have darker brown patches across the mesoscutum. Sometimes the pronotum will be yellow to orange in color, but the mesoscutum will be brown. On one female (CMNHENT0022708), not only is the lighter coloration present on the pronotum and mesoscutum, but also on the axilla. This color variation could be attributed to geographical range, nutrition, temperature, or other factors.

**Differences Between Males and Females.** The median process on the intertorular carina is absent in females but present and blunt in males. Other than this, as well as genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** This species is distinguished from other Nearctic *Conostigmus* by the following combination of characters: facial pit present; median process on intertorular carina and blunt; occipital carina not complete; preoccipital lunula present; preoccipital furrow present and crenulate; wings present and macropterous; sternaulus absent; and the harpe shorter than the gonostipes in lateral view. This species also has unique coloration, with the anterior half of the mesosoma yellow to orange in color and lighter than the posterior half of the mesosoma, which is brown to dark brown. This unique coloration and the somatic characters listed above are found in both males and females and can be used to match them.

The most similar Nearctic species is *C. erythrothorax*, which also lacks a sternaulus and can have similar coloration in both males and females. However, a major difference between these two species is that *C. erythrothorax* is always brachypterous, whereas *C. nigrorufus* is always macropterous. Other differences include the preoccipital furrow, which is present and crenulate in *C. nigrorufus* and is either absent or appears as a smooth impression in *C. erythrothorax*.

**Description.** Body length: 1.65–2.50 mm. Color hue pattern in male: cranium, axillula, posterior half of mesosoma light brown to dark brown; anterior half of mesosoma yellow to orange; supraclypeal depression yellow to dark brown; F1–F9 light brown to dark brown; hind coxa and petiole neck light yellow to white. Color intensity pattern in male: flagellomeres and their branches darker than scape and pedicel. Scape and pedicel same as legs; anterior half of mesosoma lighter than posterior half of mesosoma. Color hue pattern female: cranium, axillula, posterior half of mesosoma light brown to dark brown; anterior half of mesosoma yellow to orange; supraclypeal depression yellow to dark brown; F1–F9 light brown to dark brown; hind coxa and petiole neck light yellow to white. Color intensity pattern female: flagellomeres and their branches darker than scape and pedicel. Scape and pedicel same as legs; anterior half of mesosoma lighter than posterior half of mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent; present.

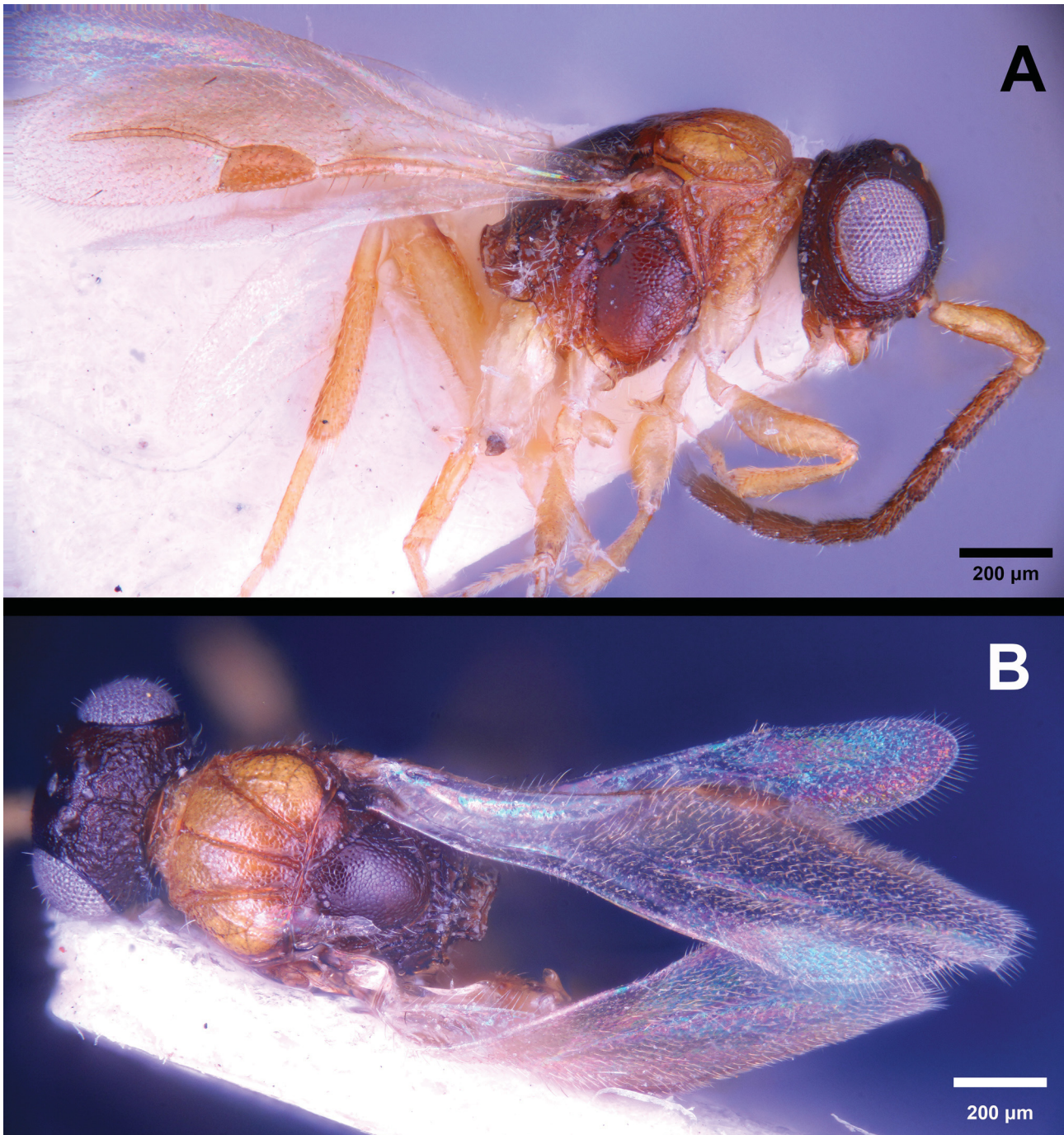
**Antennae:** Male scape length vs. pedicel length: 3.6–4.5. Male scape length vs. F1 length: 1.3–1.5. Male F1 length vs. pedicel length: 2.6–3.4. Male F1 length vs. male F2 length: 1.1–1.4. Longest male flagellomere: F1. Female scape length vs. pedicel length: 4.0–4.3. Female scape length vs. F1 length: 2.7–3.4. Female F1 length vs. F2 length: 1.4–1.8. Female F1 length vs. pedicel length: 1.2–1.6. Longest female flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): male HH:EHf=1.2–1.7; female HH:EHf=1.5–2.0. Head height (HH) vs. head length (HL): HH:HL=1.1–1.4. Head width (HW) vs. interorbital space (IOS): male HW:IOS=1.7–2.0; female HW:IOS=1.9–2.2. Head width (HW) vs. head height (HH): male HW:HH=1.2–1.4; female HW:HH=0.9–1.3. Cephalic size (csb): Mean: 375–555 µm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.5. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base OR POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.2–2.0. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.8–1.3.

Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.2–2.0:1.3–1.5:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL 1.2–1.8× as long as LOL. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.2–1.8:1.3–1.8:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends posterior to ocellar triangle. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: present. Region on upper face width transverse scutes lateral limit: restricted to lateral branches of supraclypeal depression. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: no external corresponding structure present. Facial pit count: absent. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present in males but not in females. Median process on intertorular carina shape: blunt on males, median process absent in females. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

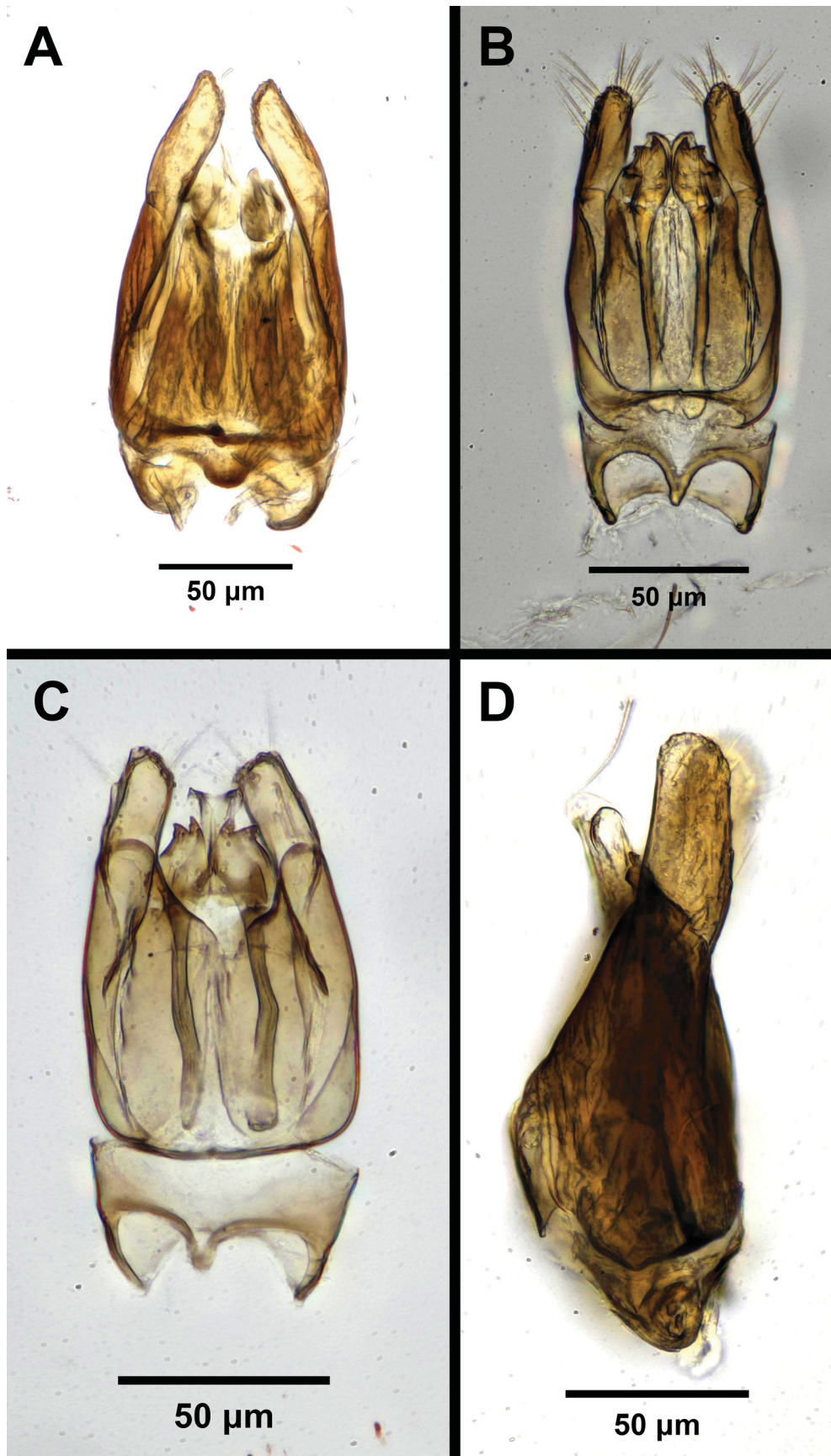
**Mesosoma:** Weber length: WL=550–780 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.2–1.8. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.1. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: sternaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discrimenal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: less than 2× as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: straight (left and right lateral propodeal carinae compose a carina that is not broken medially). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 2.0–2.3. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.9–2.4. Syntergal translucent patch maximum width vs. minimum width: 1.4–2.0. Synsternal translucent patch maximum width vs. minimum width: 1.4–1.9. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least as long as the maximum width of the synsternal translucent patch but not 2× as long. S1 length vs. shortest width: S1 wider than long.



**FIGURE 32.** *Conostigmus nigrorufus* Dessart, 1997 holotype male (PSUC\_FEM 31468). A. Lateral view. B. Dorsal view.

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single transverse row of distal setae occurring medially with less than 4 setae below it. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: blunt; acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorso



**FIGURE 33.** *Conostigmus nigrorufus* Dessart, 1997 A. Ventral view, with blunt gonocondyle (PSUC\_FEM 45241). B. Ventral view, with acute gonocondyle (PSUC\_FEM 15380). C. Dorsal view (INHS Insect Collection 287550). D. Lateral view (PSUC\_FEM 45241).

median conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending between 1/3 to 1/2 the length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: blunt or straight. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distolaterally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Material Examined.** Holotype male: CANADA: PSUC\_FEM 31468 (CNC). Paratypes (1 female): USA: New York: 1 female. PSUC\_FEM 31472 (CNC).

Non-type material (14 females, 12 males): CANADA: Ontario: 1 female. PSUC\_FEM 56130 (CNC). USA: Illinois: 1 female, 1 male. INHS Insect Collection 14055, 287550 (INHS). USA: Michigan: 1 female. PSUC\_FEM 86365 (PSUC). USA: Minnesota: 1 female. PSUC\_FEM 66203 (UMSP). USA: Ohio: 2 females, 8 males. PSUC\_FEM 64076, 86140, 86149, 86265, 86324, 86397, 86407 (OSUC); PSUC\_FEM 50276 (WIRC); CMN-HENT0022708, 0022712 (CLEV). USA: Pennsylvania: 7 females, 1 male. PSUC\_FEM 15380, 50113, 50114, 83801, 84010, 91435, 98074, 148618 (PSUC). USA: Wisconsin: 1 female, 2 males. PSUC\_FEM 45241, 88173, 92614 (WIRC).

### ***Conostigmus obscurus* (Thomson, 1858)**

Figs. 34, 35

**Species Comments and History.** Thomson (1858) first described *Megaspilus obscurus* from a male and female collected in Sweden. Kieffer (1907) later transferred the species to *Conostigmus*. Dessart (1974) redescribed the species, synonymizing *Megaspilus arcticus* Thomson, 1858 (single female holotype) and *Conostigmus syrphorum* Kieffer, 1907 (female type missing), as well as redescribing the male and illustrating the male genitalia for the first time. Due to the limited number of specimens, our description is based on a single male specimen (UAM100257610) collected in Alaska and identified as *C. obscurus* by Paul Dessart.

**Variability.** We did not observe enough specimens to describe variations, but Dessart (1974) notes that there are slight variations in color, and that females are lighter in color than males.

**Differences between Nearctic and Palearctic Populations.** We did not observe enough specimens to note variations between Nearctic and Palearctic specimens.

**Differences Between Males and Females.** Dessart (1974) notes that the males are very similar to the females, with the females lighter in coloration. We did not observe enough specimens to note variations.

**Diagnosis.** Males of this species can be distinguished from all other *Conostigmus* in that: the sternaulus is present and short, not reaching 1/2 of the mesopleuron length; the width of the crenulae of the notauli increases more than 2× anteriorly; the medioventral conjunctiva is present (parossiculi independent or fused proximally); and the proximodorsal notch of the cupula is present, arched (inverted U-shape), and longer than wide. Females can be matched to males by the presence of the sternaulus and the width of the crenulae of the notauli increasing more than 2× anteriorly, as this is the only Nearctic species with these two characters.

*Conostigmus obscurus* has the proximodorsal notch of the cupula present, U-shaped, and longer than wide, which only occurs in *C. lepus*, *C. bipunctatus*, and *C. triangularis*. This species differs from *C. lepus* in that it lacks the submedial corners of S9 and has sparse lateral setae on the harpe (*C. lepus* with submedial corners on S9 and

dense lateral setae sparse on harpe), and from *C. triangularis* in that it does not have bilobed harpe (present in *C. triangularis*). *Conostigmus bipunctatus* is easily distinguished from this species by the absence of the medioventral conjunctiva and the fused parossiculi (*C. obscurus* with conjunctiva present and independent parossiculi).

**Description.** Body length: 1.325 mm. Color hue pattern in male: cranium, mesosoma, metasoma brown; legs, scape, pedicel, flagellomeres ochre to light brown. Color intensity pattern in male: flagellomeres darker than scape and pedicel; mandible lighter than cranium; metasoma lighter than mesosoma and cranium. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

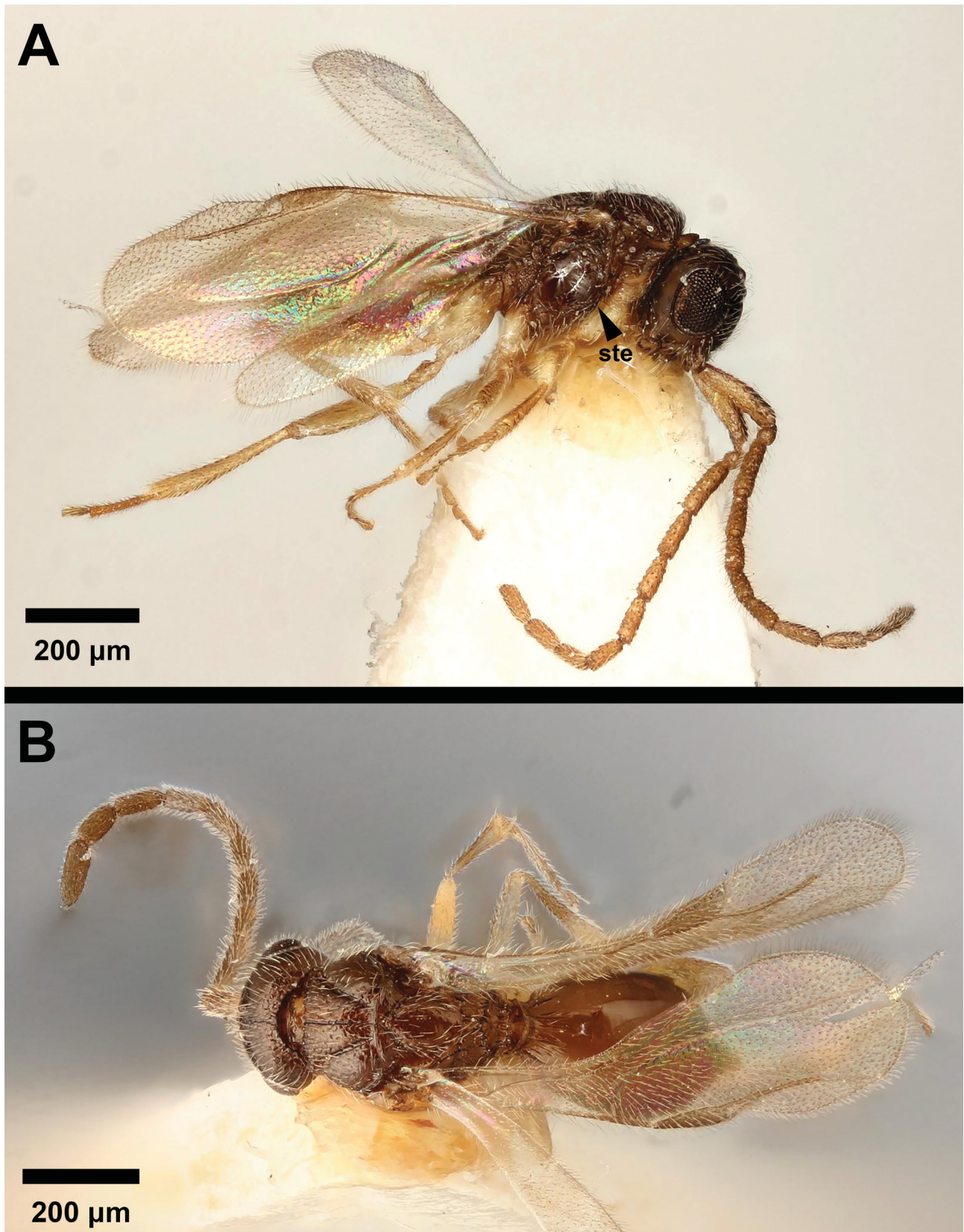
**Antennae:** Male scape length vs. pedicel length: 4.0. Male scape length vs. F1 length: 1.2. Male F1 length vs. pedicel length: 3.33. Male F1 length vs. male F2 length: 1.25. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.57. Head height (HH) vs. head length (HL): HH:HL=1.38. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.52. Head width (HW) vs. head height (HH): HW:HH=1.14. Cephalic size (csb): Mean: 385 μm. Maximum eye diameter vs. minimum eye diameter: 1.13. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=2.5. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=2.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.5:1.25:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends at site of postocellar carina. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=550 μm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.5. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.82. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: short and not reaching 1/2 of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are



adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.



**FIGURE 34.** *Conostigmus obscurus* (Thomson, 1858) male (UAM100257610). A. Lateral view. B. Dorsal view. Abbreviation: sternaulus (ste).

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.86. Syntergal translucent patch maximum width vs. minimum width: 1.4. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior and lateral to the synsternal translucent patch, with a patch of setae posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least as long as the maximum width of the synsternal translucent patch but not 2× as long. S1 length vs. shortest width: S1 wider than long.

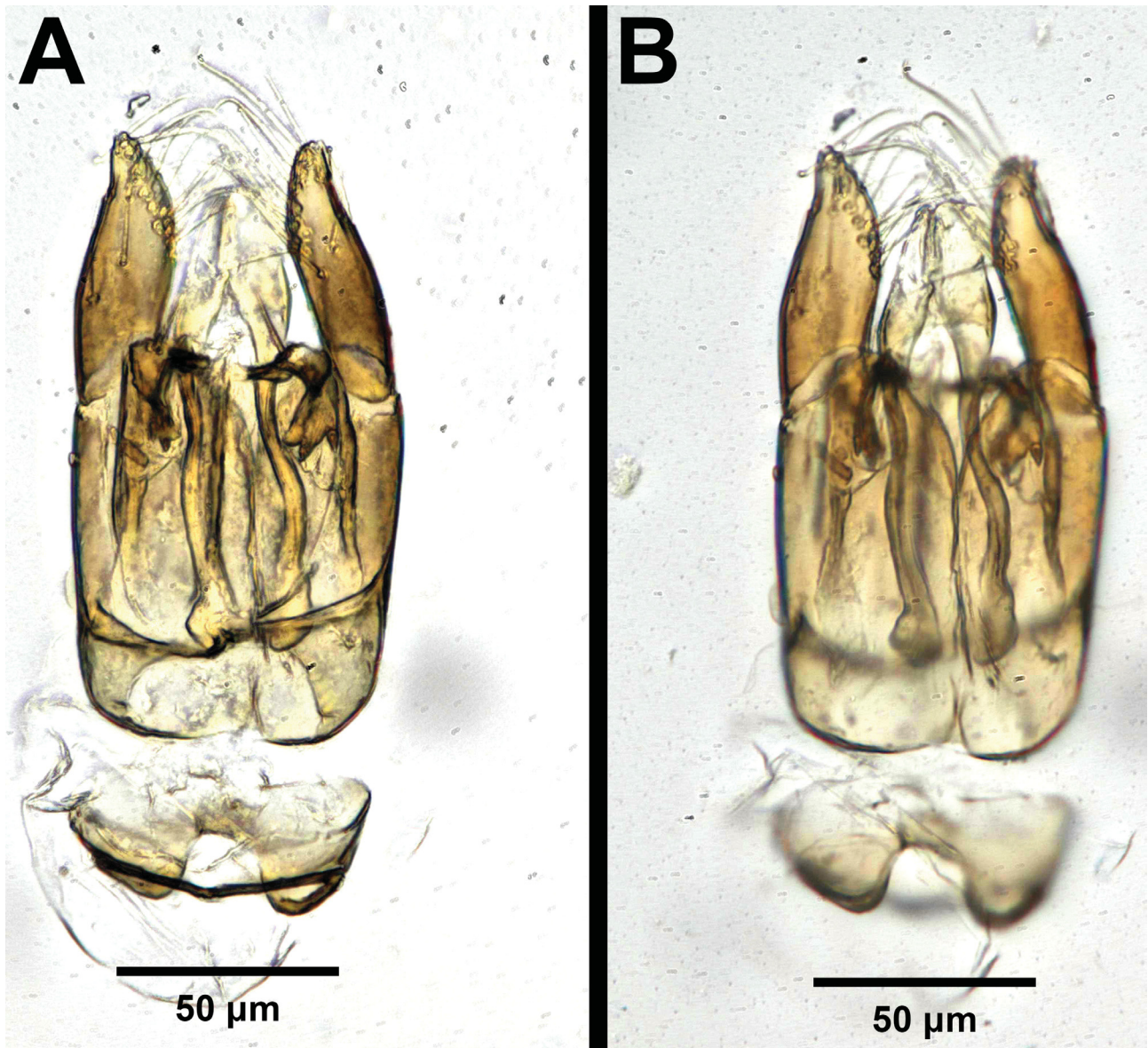


FIGURE 35. *Conostigmus obscurus* (Thomson, 1858) male genitalia (UAM100257610). A. Ventral view. B. Dorsal view.

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of setae, sometimes with fewer setae medially to form two separate patches. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proxi-

modorsal notch of cupula width vs length: longer than wide. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Holarctic.

**Material Examined.** Non-type material (1 male): USA: Alaska: UAM100257610 (UAM).

### ***Conostigmus orcasensis* (Brues, 1909)**

Figs. 36, 37

**Species Comments and History.** Brues (1909) described this species from a single male specimen collected in Puget Sound, Washington. The type specimen is deposited in the MCZC. This specimen remains the only known specimen of this species. We were unable to capture or locate any other specimens, but we were allowed to dissect out the male genitalia, and we are thankful to the MCZC for allowing us to properly study this specimen. The female of this species is unknown.

**Variability.** The holotype specimen has two mandibular teeth, though one tooth is much smaller than the other. This resembles the intraspecific variability seen in other *Conostigmus* species, including *C. bipunctatus*, *C. muratorei* and *C. madagascariensis* (see Mikó *et al.*, 2016, Fig. 37). The holotype specimen also has 2 apical setae on one parossiculus and 3 on the other. This rarely occurs in *Conostigmus* specimens and is not a species-specific character but a teratology.

**Diagnosis.** This species can be distinguished from other Nearctic *Conostigmus* species by the following combination of characters: head width less than 1.3× wider than the mesosoma; mesopostscutellum present; dorsomedian projection of the gonostyle–volsella complex absent; proximodorsal notch of the cupula present and U-shaped, wider than long; and proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape blunt.

The female of this species remains unknown.

One similar species is *C. muratorei*, in that both species have the mesopostscutellum present and the width of the crenulae of the notauli increasing more than 2× anteriorly. These species differ in that *C. muratorei* has a head width at least 1.3× wider than the mesosoma, whereas the head width in *C. orcasensis* is equal to or only slightly wider than the mesosoma (less than 1.3× wider than the mesosoma). Also, *C. orcasensis* lacks the dorsomedian projection of the gonostyle–volsella complex, whereas *C. muratorei* has the dorsomedian projection of the gonostyle–volsella complex present and is also the only known *Conostigmus* species where it is bilobed.

Another similar species to *C. orcasensis* is *C. duncani*, which shares the presence of the mesopostscutellum, the width of the crenulae of the notauli increasing more than 2× anteriorly, and the absence of the dorsomedian projection of the gonostyle–volsella complex. These two species differ in the male genitalia. *Conostigmus orcasensis* has the proximodorsal notch of the cupula present and U-shaped, but wider than long (longer than wide in *C. duncani*); 2–3 apical parossicular seta (1 in *C. duncani*); and the proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape blunt (acute in *C. duncani*).

**Description.** Body length: 2.05 mm. Color hue pattern in male: antenna, cranium, mesosoma, metasoma reddish-brown; legs ochre. Color intensity pattern in male: mandible lighter than cranium. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

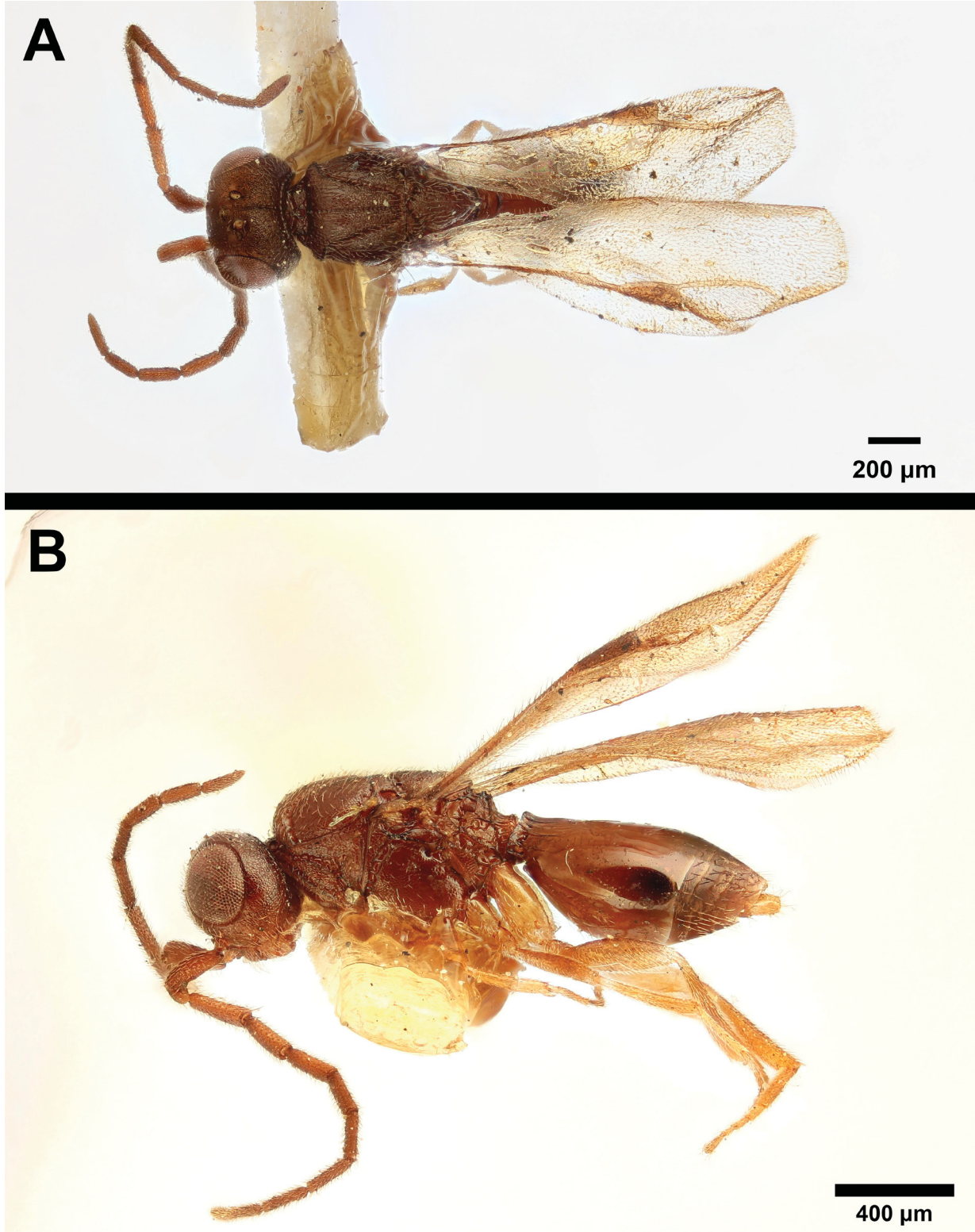
**Antennae:** Male scape length vs. pedicel length: 2.88. Male scape length vs. F1 length: 1.0. Male F1 length vs. pedicel length: 2.88. Male F1 length vs. male F2 length: 1.1. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.48. Head height (HH) vs. head length (HL): HH:HL=1.1. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.76. Head width (HW) vs. head height (HH): HW:HH=1.35. Cephalic size (csb): Mean: 505 μm. Maximum eye diameter vs. minimum eye diameter: 1.17. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.67. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.25. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.67:1.33:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: absent. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=820 μm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.87. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.95. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 1.22. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae increases more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscuteellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: less than 2× as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: present (posterior margin of scutellum appears raised). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

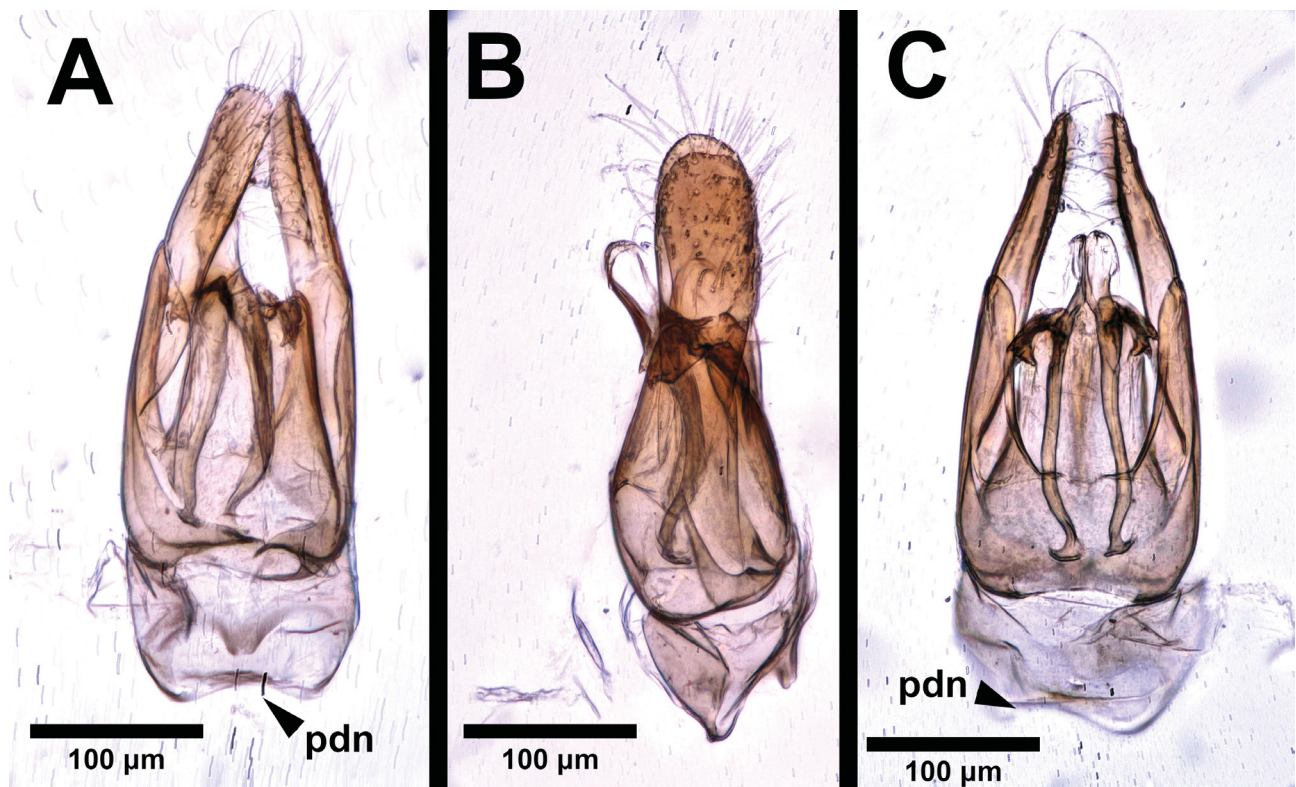
**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 3.33. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 4.0. Syntergal translucent patch maximum width vs. minimum width: 1.2. Synsternal translucent patch maximum width vs. minimum width: 1.25. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal

translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior and lateral to the synsternal translucent patch, with a patch of setae posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



**FIGURE 36.** *Conostigmus orcasensis* (Brues, 1909) male holotype (UAM100257610). A. Dorsal view. B. Lateral view.

**Male Genitalia:** Distal margin of male S9 shape: straight. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: blunt. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva not extending 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight, though there is a slight depression medially that could be the natural state or could be the result of specimen damage. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: two; three. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe as long as gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its distal 1/3rd. Distal margin of harpe in lateral view: blunt. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distally. Sensillar ring area of harpe orientation: medially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.



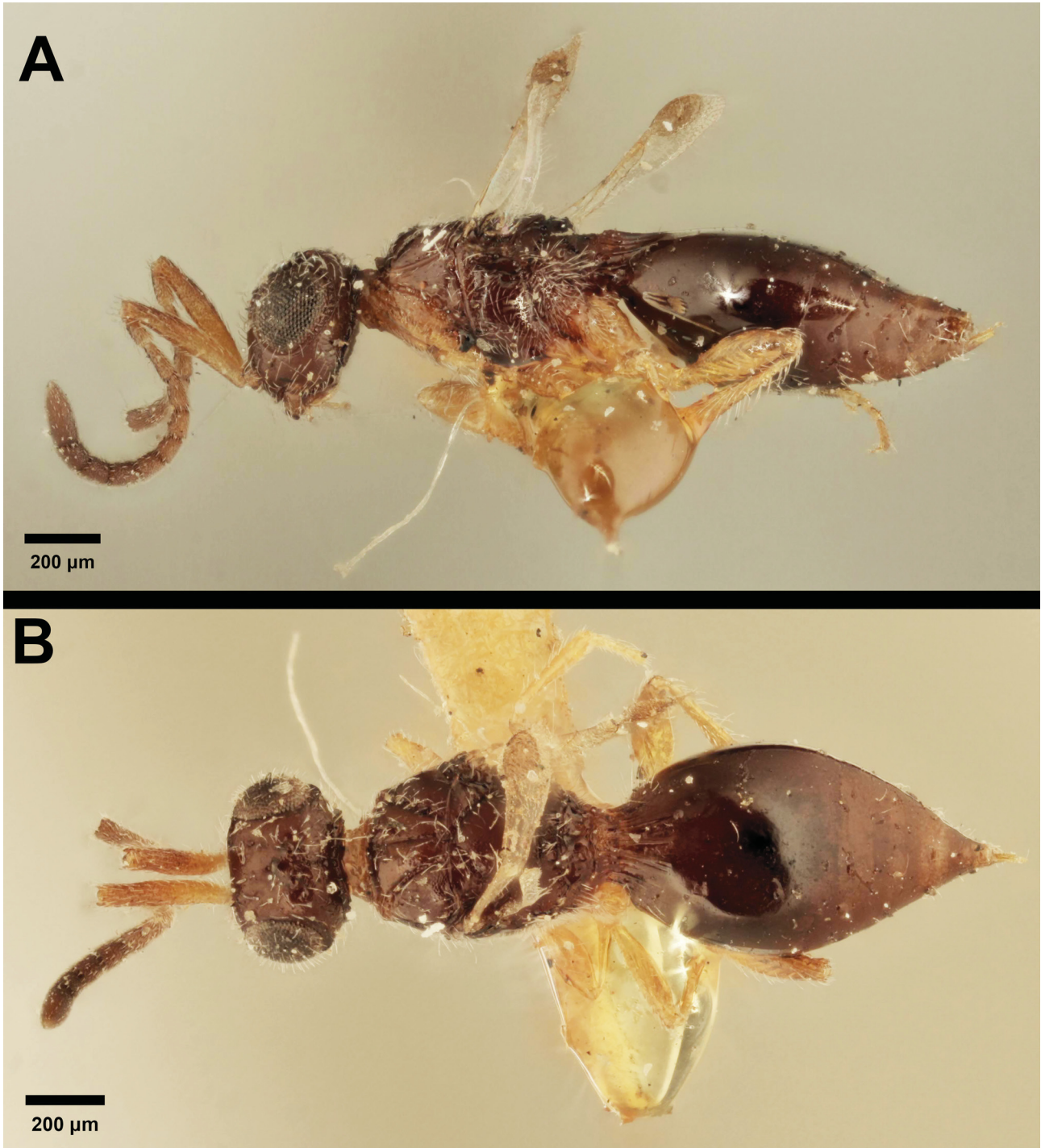
**FIGURE 37.** *Conostigmus orcasensis* (Brues, 1909) male holotype genitalia (UAM100257610). A. Ventral view. B. Lateral view. C. Dorsal view. Abbreviation: proximodorsal notch of cupula (pdn).

**Distribution.** Nearctic.

**Material Examined.** Holotype male: USA: MCZ-ENT 30985 (MCZC).

*Conostigmus ottawensis* (Ashmead, 1888)

Fig. 38



**FIGURE 38.** *Conostigmus ottawensis* (Ashmead, 1888) female lectotype (USNMENT01339741). A. Dorsal view. B. Lateral view.

**Species Comments and History.** As with *C. canadensis*, Ashmead (1888) described this species from a single female specimen as part of the genus *Eumegaspilus*, characterized by the females being wingless or having reduced wings. *Conostigmus ottawensis* is distinguished from *C. canadensis* by being “more slender and more highly pol-

ished” (pg. 49), as well as having differences in coloration and microsculpture. Harrington (1900) later described *C. ottawensis* as a common species, with both males and females having macropterous and brachypterous forms, despite the fact that the male was never described.

We located ten specimens labeled as *C. ottawensis* at the CNC (notes left inside the tray read “*C. ottawensis* = *C. canadensis*”), including brachypterous and macropterous males and females. However, all of the specimens are in poor condition (damaged and badly glued, obscuring characters), and due to the limited collecting information on both these specimens and the type, it is not possible to determine if any were collected with the type specimen (it seems unlikely). There were three males among these specimens: one brachypterous, with the metasoma glued in such a way that it was not possible to remove it without damaging the specimen (PSUC\_FEM 56001); one macropterous, but missing the metasoma (PSUC\_FEM 56019); and one macropterous, from which we did not dissect the metasoma (PSUC\_FEM 56016). The ten specimens may not be the same species based on their morphology, but it is not possible to tell from the poor condition of the specimens. Further work, and perhaps new technology and techniques, is required to determine if these specimens are *C. ottawensis*. The CNC specimens are listed in the material examined section to aid in future research efforts.

The female type specimen of *C. ottawensis* is present at the USNM, and is in relatively good condition other than the fact that it is missing the last four flagellomeres of the right antenna, which is consistent with Masner and Muesebeck’s description (1968). We compared this type with the type of *C. canadensis*, and found that both specimens have a postocellar carina, facial pit, preoccipital furrow extending into the ocellar triangle, and reduced wings. The sternaulus appears to be present in *C. ottawensis* and may also be elongate, as in *C. canadensis*, but it is difficult to tell with glue partially obscuring this part of the specimen. As Ashmead noted, there are differences in the coloration and microsculpture; *C. ottawensis* has lighter coloration on the propleural area, whereas *C. canadensis* has uniform coloration. *Conostigmus ottawensis* also has less longitudinal carinae on the petiole than *C. canadensis*. These two female specimens could be the same species, but it is not possible to tell at this time. We consider *C. ottawensis* as a *species inquirenda* until more (preferably freshly collected) specimens are located or until the type specimens can be studied more in depth and compared with the CNC specimens.

**Material Examined.** Lectotype female: CANADA: USNMENT01339741 (USNM).

Non-type material (1 sex unknown, 3 males, 6 females): Canada: 1 sex unknown, 3 males, 6 females. PSUC\_FEM 56001, 56010, 56011, 56014, 56016, 56018, 56019, 56042, 56063, 56069 (CNC).

### ***Conostigmus pergandei* (Ashmead, 1893)**

Fig. 39

**Species Comments and History.** Ashmead (1893) described this species from a single male specimen collected in Washington, D.C. The specimen is deposited in the USNM, and is point-mounted and in good condition except that the left antenna is missing the last two flagellomeres and the right antenna is missing last four flagellomeres. Masner and Muesebeck (1968) report the damages to the right antenna but not the left antenna, which must have happened since they examined the specimens.

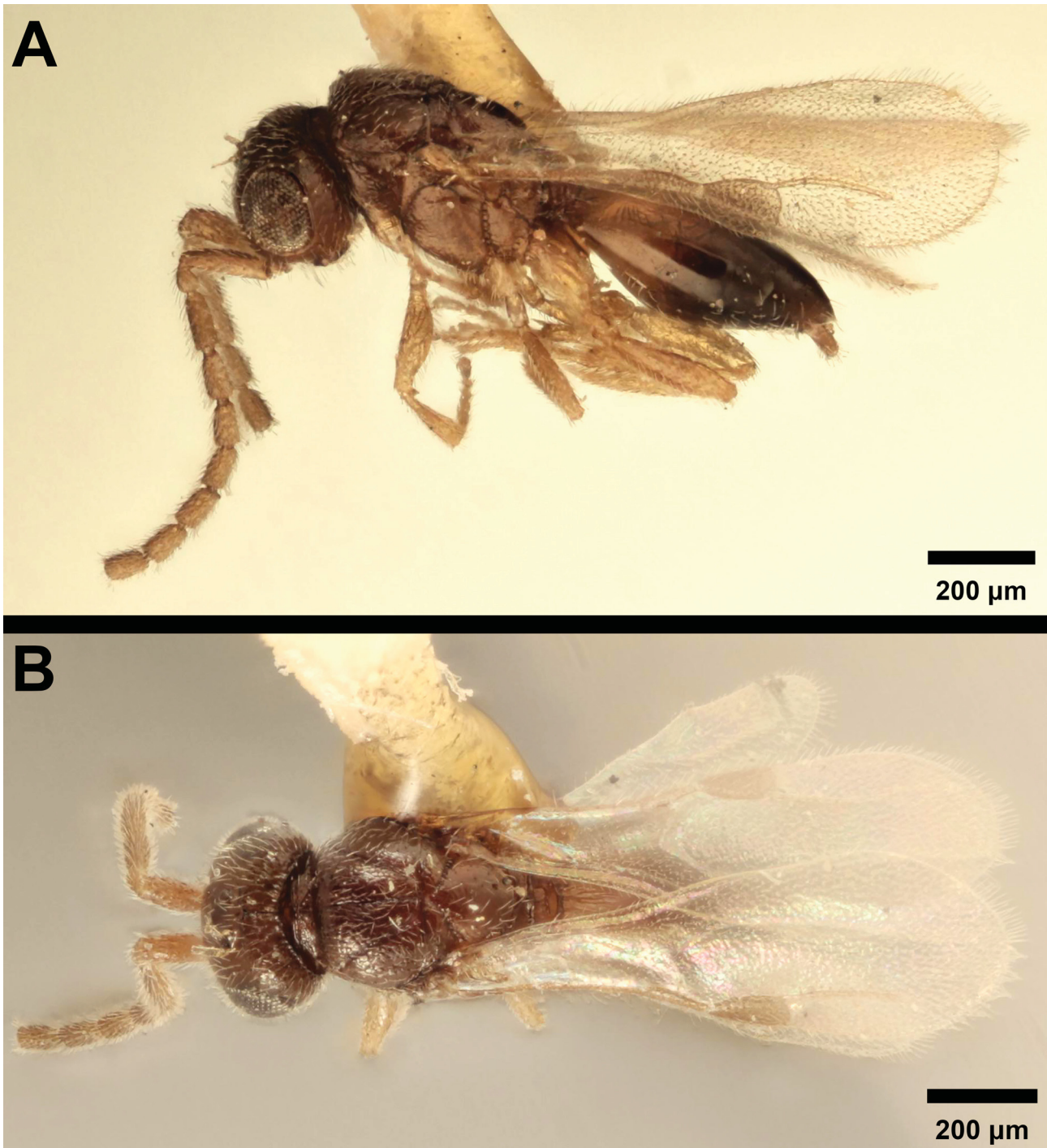
The specimen has the sternaulus absent and the facial pit, preoccipital furrow, and mesopostscutellum present. The specimen is *Dendrocerus*-like in that the metapleural sulcus appears arched. The tip of the harpe is protruding and looks simple and blunt in shape, but we were not able to confirm any other male genitalia characters.

The two Nearctic species that most resemble this species are *C. duncani* and *C. orcasensis*, which both also have the facial pit, preoccipital furrow, and mesopostscutellum present and the sternaulus absent. Both species also have the harpe simple and blunt in shape. The metapleural sulcus can be straight or arched among specimens of *C. duncani*; because *C. pergandei* (arched) and *C. orcasensis* (straight) are only known by single specimens, it is uncertain whether this intraspecific variation occurs in these species as well.

There appear to be differences in flagellomere length and antennal ratios between the three species, with *C. pergandei* having much shorter flagellomeres than the other two species, but we were not able to measure the type specimen of *C. pergandei* to compare. *Conostigmus duncani* and *C. orcasensis* can only be differentiated by male genitalia characters, and we were not able to dissect out the male genitalia of *C. pergandei* or locate any other specimens. We consider *Conostigmus pergandei* as a *species inquirenda*.

**Material Examined.** Lectotype male: USA: USNMENT01339755 (USNM).





**FIGURE 39.** *Conostigmus pergandei* (Ashmead, 1893) female lectotype (USNMENT01339755). A. Lateral view. B. Dorsal view.

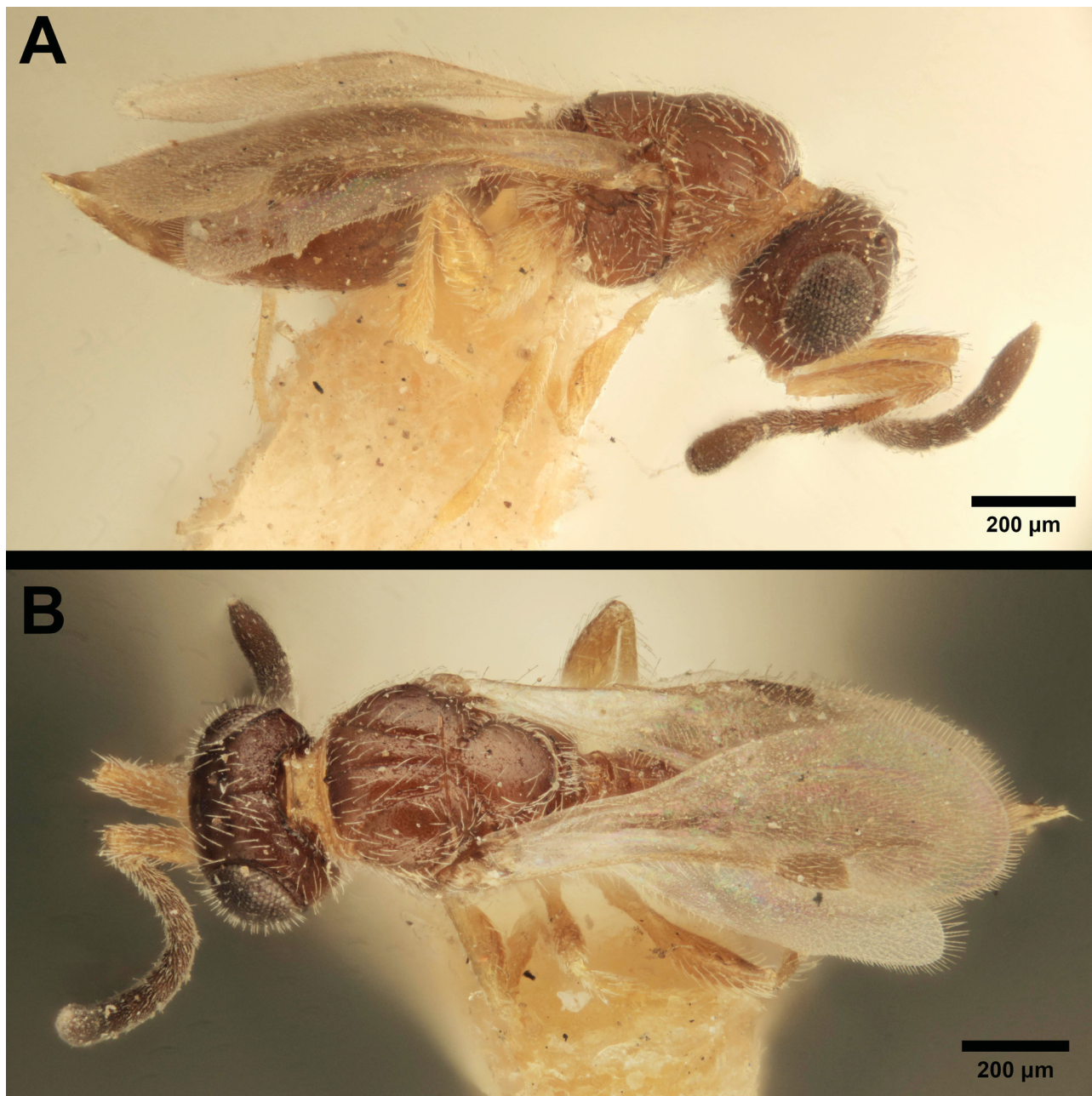
***Conostigmus popenoei* (Ashmead, 1893)**

Fig. 40

**Species Comments and History.** Ashmead (1893) described this species from a single female specimen collected in Manhattan, Kansas. The specimen is deposited in the USNM, and is point-mounted and in relatively good condition, although there is dirt and dust on the specimen, which can obscure characters. The female has the preoccipital furrow present and the sternaulus absent. The female type specimen bears a close resemblance to *C. duncani*, *C. orcasensis* and *C. pergandei*, which are all known only by male specimens, and it could be the female matching one

of these species. Unfortunately, the female type specimen of *C. popenoei* remains the only known specimen of its species; we were unable to locate any additional females or male specimens that match this species. For now, we consider *Conostigmus popenoei* as a *species inquirenda*.

**Material Examined.** Lectotype female: USA: USNMENT01339764 (USNM).



**FIGURE 40.** *Conostigmus popenoei* (Ashmead, 1893) female lectotype (USNMENT01339764). A. Lateral view. B. Dorsal view.

### ***Conostigmus pulchellus* Whittaker, 1930**

Figs. 41, 42

**Species Comments and History.** Whittaker (1930) described this species from three male specimens collected in Hollyburn, British Columbia, Canada, deposited in the NHMUK. Dessart (1997a) expected to synonymize this species with *C. abdominalis*, but after examining the types and comparing them with additional male and female specimens collected in the United States and Canada, he was surprised to find that *C. pulchellus* and *C. abdominalis* did constitute different species. Dessart (1997a) noted that while *C. pulchellus* and *C. abdominalis* were nearly

indistinguishable in somatic characters, there were differences in the male genitalia. Dessart (1997a) also described the females of *C. pulchellus* for the first time.

Whittaker's holotype and two paratype specimens are present at the NHMUK, as well as a third specimen from Whittaker that Dessart identified as *C. pulchellus*. This third specimen does not have type status but was also collected by Whittaker in "Hn.", which matches the type locality, Hollyburn. One paratype (NHMUKENT010812165) bears a label from Dessart identifying it as "*C. abdominalis*, (BOH 1832), syn. nov.", but Dessart presumably thought the species were synonymous when he left his label on the specimen in 1975, as he expresses surprise in his 1997a publication that they were not synonymous species. Dessart does not mention this particular paratype specimen in his 1997a publication. The genitalia would need to be dissected to confirm the species identification, but we consider it *C. pulchellus* and include it in the material examined below.

**Variability.** The main variation observed in this species is in the coloration. Females have lighter reddish or yellow coloration along the notauli and median mesoscutal sulcus, as well as on the axilla, axillula and the anterior mesosoma, though some specimens have lighter coloration (PSUC\_FEM 34271, PSUC\_FEM 34085) than others (PSUC\_FEM 50386, PSUC\_FEM 84526). Males are brown to black in color and typically lack the lighter yellow or reddish coloration observed in females, but there is one male specimen (PSUC\_FEM 64329) that exhibits the female coloration pattern.

**Differences between males and females.** The most striking difference between male and female specimens is in the coloration of the mesosoma, viewed dorsally. Females have lighter reddish or yellow coloration on the axilla, axillula and the anterior mesosoma along the notauli and the median mesoscutal sulcus. There is one male specimen (PSUC\_FEM 64329) that has the same coloration pattern found in females, but the majority of male specimens have uniform mesosomal coloration. Other than coloration, genitalia differences and sexual dimorphism in the antennae, there are no differences in the morphology of the males and females.

**Diagnosis.** This species can be distinguished from other *Conostigmus* species by the following combination of characters: facial sulcus present; sternaulus present and elongate, exceeding 1/2 of the mesopleuron length at the level of the sternaulus; harpe longer than the gonostipes in lateral view; harpe shape spatulate; harpe twisted and oriented dorsally or dorsomedially; and 4 apical parossicular setae. This species is similar to *C. longiharpes* but can be distinguished by the facial sulcus, which is present in *C. pulchellus* and absent in *C. longiharpes*. This species is also similar to *C. rosemaryae*, but differs in that *C. rosemaryae* has the dorsomedian projection of the gonostyle–volsella complex present (absent in *C. pulchellus*), and has harpe that are not spatulate or spoon-shaped and are shorter than the gonostipes in lateral view.

The most similar species to *C. pulchellus* is *C. abdominalis* in that they share the presence of a facial sulcus, elongate sternauli and elongated spatulate harpe. The major differences between the males of these two species are in the genitalia. *Conostigmus pulchellus* has 4 or more apical parossicular setae (1–3 in *C. abdominalis*), and the harpe are twisted and oriented dorsally or dorsomedially (harpe are not twisted and are oriented medially in *C. abdominalis*). The main difference between females of *C. abdominalis* and *C. pulchellus* is in the coloration; whereas the females of *C. abdominalis* have similar coloration to the males, the females of *C. pulchellus* have lighter reddish or yellow coloration on the axilla, axillula and the anterior mesosoma along the notauli and median mesoscutal sulcus.

Dessart (1997a) compared the females of *C. pulchellus* and *C. abdominalis* and noticed minor differences in pubescence (European *C. abdominalis* more densely pubescent), the shape of the head (head of *C. pulchellus* less triangular, more domed and rounded) and body (mesopleuron more rounded in *C. abdominalis*), the sculpturing of the mesosoma (mesopleuro-metapleural furrow more strongly foveolate in *C. abdominalis*, pleural characters less defined in *C. pulchellus*), and antennal ratios. Dessart (1997a) pointed out that all of these characters could be due to intraspecific variation, and expressed doubt whether the colored females associated with *C. pulchellus* belonged to that species.

However, we found one male specimen of *C. pulchellus* (PSUC\_FEM 64329) that bears the same lighter yellow or reddish coloration on the anterior mesosoma, axilla and axillula that is present in the females associated with the species. The presence of this male exhibiting the female coloration pattern, coupled with the fact that no male or female specimens with this unique coloration have been found in the Palearctic, suggests that these females do belong to *C. pulchellus* and not another species.

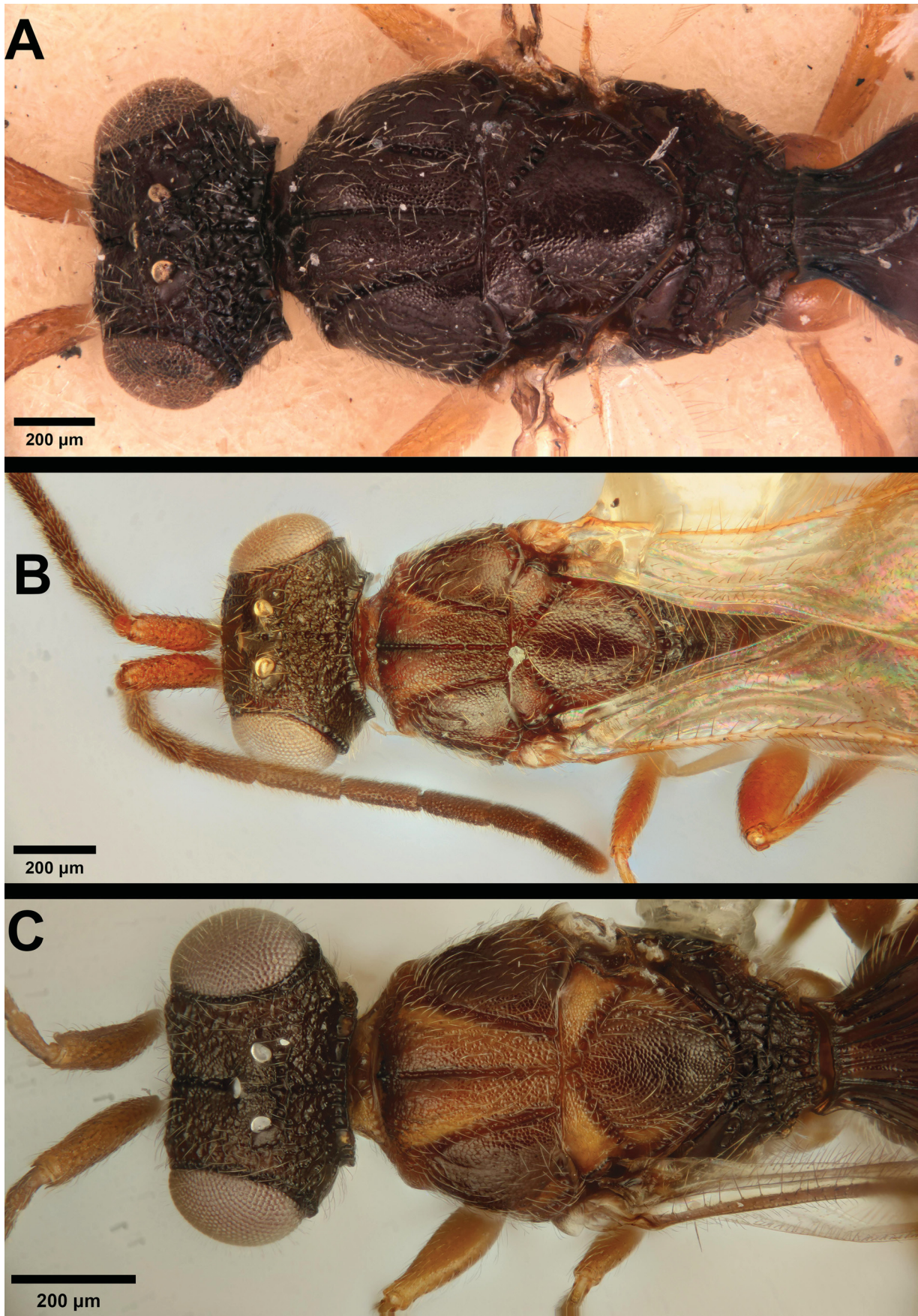
**Description.** Body length: 2.5–3.4 mm. Color hue pattern in male: cranium, mesosoma, metasoma brown to black; F1–F9 brown to dark brown; scape, pedicel ochre to brown; legs ochre to brown; cranium, metasoma brown

to black; mesosoma brown to black except propleuron, anterior mesosoma between the notauli and median mesoscutal sulcus, axilla, axillula; F1–F9 brown to dark brown; propleuron, anterior mesosoma between the notauli and median mesoscutal sulcus, axilla, axillula reddish to yellow on one specimen (PSUC\_FEM 64329). Color intensity pattern in male: flagellomeres and pedicel darker than scape; mandible lighter than cranium; anterior mesosoma between the notauli and median mesoscutal sulcus, axilla, axillula lighter than rest of mesosoma on one specimen (PSUC\_FEM 64329). Color hue pattern female: cranium, mesosoma, metasoma brown to black; F1–F9 brown to dark brown; scape, pedicel ochre to brown; legs ochre to brown; propleuron, anterior mesosoma between the notauli and median mesoscutal sulcus, axilla, axillula reddish to yellow. Color intensity pattern female: scape and pedicel lighter than flagellomeres; anterior mesosoma between the notauli and median mesoscutal sulcus, axilla, axillula lighter than rest of mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: present on head. Rugose region on upper face count: present.

**Antennae:** Male scape length vs. pedicel length: 4.1–5.5. Male scape length vs. F1 length: 0.8–1.2. Male F1 length vs. pedicel length: 4.7–5.3. Male F1 length vs. male F2 length: 1.2–1.5. Longest male flagellomere: F1. Female scape length vs. pedicel length: 3.4–4.0. Female scape length vs. F1 length: 2.0–2.2. Female F1 length vs. F2 length: 1.6–2.0. Female F1 length vs. pedicel length: 1.6–1.9. Longest female flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than  $1.3\times$  wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.4–2.1. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.6–2.0. Head width (HW) vs. head height (HH): HW:HH=1.2–1.5. Cephalic size (csb): Mean: 450–760  $\mu\text{m}$ . Maximum eye diameter vs. minimum eye diameter: 1.1–1.3. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base OR POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.8–2.0. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.8–1.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8–2.0:1.8–2.3:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL 1.8–2.0 $\times$  as long as LOL. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8–2.0:1.8–2.3:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus; Preoccipital furrow ends at anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial sulcus present. Facial sulcus count: present. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=750–1200  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.7–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.3–1.9. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.8–1.2. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than  $2\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not



**FIGURE 41.** *Conostigmus pulchellus* Whittaker, 1930 in dorsal view. A. Holotype male (NHMUKENT010812088). B. Male with female coloration (PSUC\_FEM 64329). C. Female (CMNHENT0022766).

adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 1/2 of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.9–2.7. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.1–2.7. Syntergal translucent patch maximum width vs. minimum width: 1.4–2.0. Synsternal translucent patch maximum width vs. minimum width: 1.1–2.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin; synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

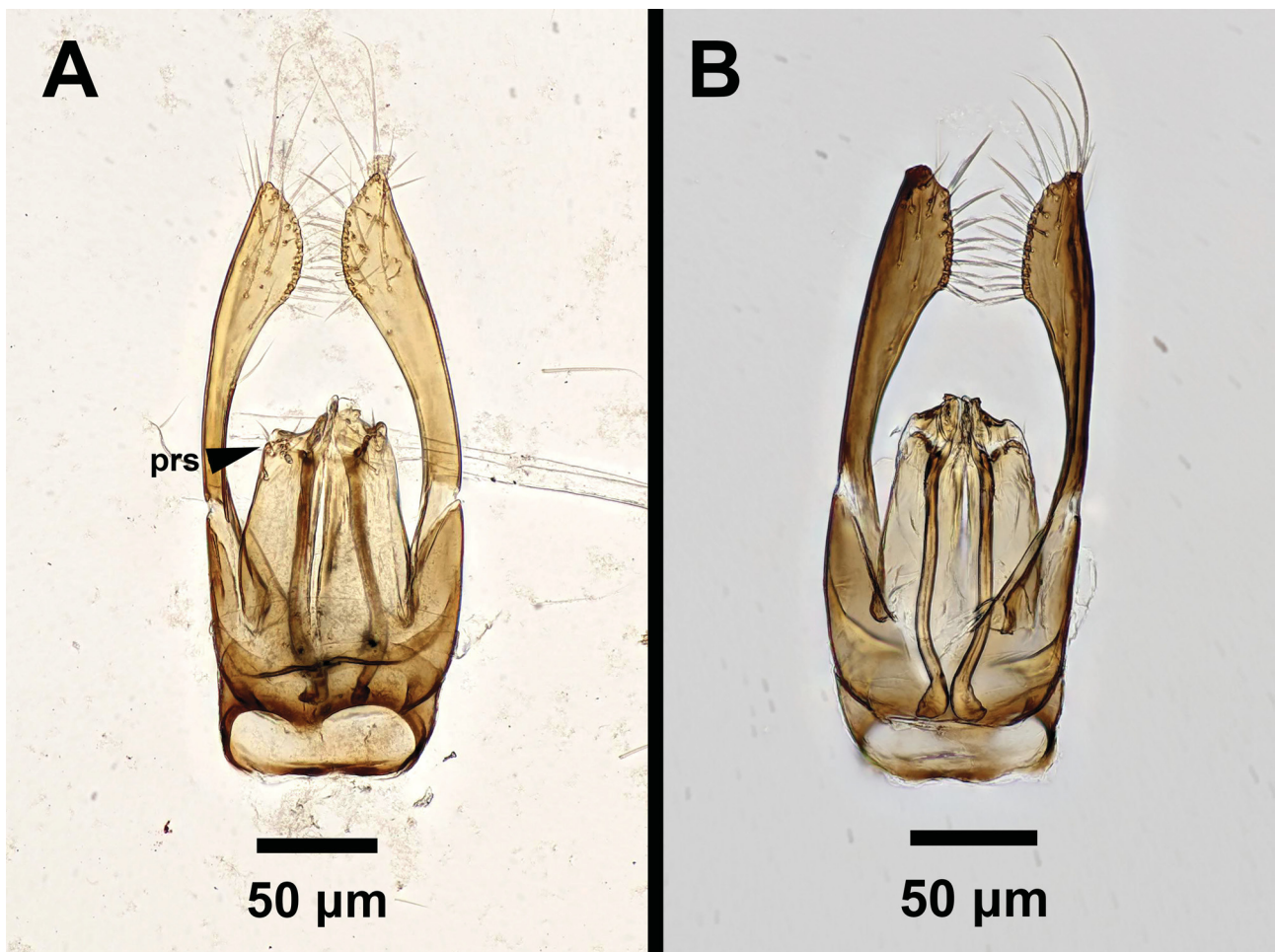
**Male Genitalia:** Distal margin of male S9 shape: straight; convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: acute. Gonocondyle count: present. Gonocondyle shape: blunt. Distodorsal margin of cupula shape: straight. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: U-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: 4 or more. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe longer than gonostipes in lateral view. Harpe shape: simple and not bilobed; spatulate or spoon-shaped. Harpe orientation: dorsomedial. Lateral margin of harpe shape: widest point of harpe is in its distal 1/3rd. Distal margin of harpe in lateral view: blunt or rounded. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distolaterally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across

distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distodorsally. Sensillar ring area of harpe orientation: distodorsally. Sensillar ring shape: circular; elongate. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Material Examined.** Holotype male: CANADA: NHMUKENT010812088 (NHMUK). Paratypes (2 males): CANADA: 2 males. NHMUKENT10812165, 10812175 (NHMUK).

Non-type material (10 females, 9 males): CANADA: 1 male. NHMUKENT10812160 (NHMUK). USA: Alaska: 1 male. PSUC\_FEM 50073 (PSUC). USA: Idaho: 2 males. PSUC\_FEM 34075, 34140 (TAMU). USA: Kentucky: 2 males. PSUC\_FEM 148623 (NCSU); PSUC\_FEM 76971 (PSUC). USA: Maryland: 1 female. PSUC\_FEM 34085 (TAMU). USA: Michigan: 1 female. PSUC\_FEM 34095 (TAMU). USA: New York: 1 female. PSUC\_FEM 50386 (WIRC). USA: Ohio: 1 male, 5 females. CMNHENT0022692, 0022698, 0022766, 0022769 (CLEV); PSUC\_FEM 7369, 27264 (OSUC). USA: Pennsylvania: 1 male. PSUC\_FEM 64329 (PSUC). USA: Texas: 1 female. PSUC\_FEM 34271 (TAMU). USA: West Virginia: 1 male. PSUC\_FEM 148451 (PSUC). USA: Wisconsin: 1 female. PSUC\_FEM 84526 (WIRC).



**FIGURE 42.** *Conostigmus pulchellus* Whittaker, 1930 male genitalia. A. Ventral view (PSUC\_FEM 7369). B. Dorsal view (PSUC\_FEM 76971). Abbreviation: apical parossicular setae (prs).

***Conostigmus quadratogenalis* Dessart & Cooper, 1975**

Figs. 43, 44

**Species Comments and History.** Dessart and Cooper (1975) described this species from male and female specimens reared as endoparasitoids from the host *Boreus notoperates* Cooper (Mecoptera), collected from Riverside County, California. This species is remarkable not only because of its unique appearance, but because it is one of

the few *Conostigmus* species with known host information and descriptions of larvae. This is also the only known ceraphronoid reared from a mecopteran host.

**Variability.** The facial pit is always present, but sometimes there is the impression of a facial sulcus between the facial pit and the anterior ocellus. The female holotype (USNMENT01339796) and male allotype (USNMENT01212953) at the USNM both lack the impression of a facial sulcus, but the male and female paratypes at the MCZC both have the impression of a facial sulcus, which is more faint on the female paratype (MCZ-ENT 711739) and more apparent on the male paratype (MCZ-ENT 711738).

**Differences Between Males and Females.** Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** This species is easily distinguished from all other species of *Conostigmus* by the square shape of the head in anterior view, the feature for which this species is named. This species also has the ventral margin of the antennal rim adjacent to the dorsal margin of the clypeus; the occipital carina dorsal to the lateral ocellus in lateral view; the postocellar carina absent; the intertorular carina absent; and the sternaulus absent. Females can be matched to the males by using the somatic characters listed above.

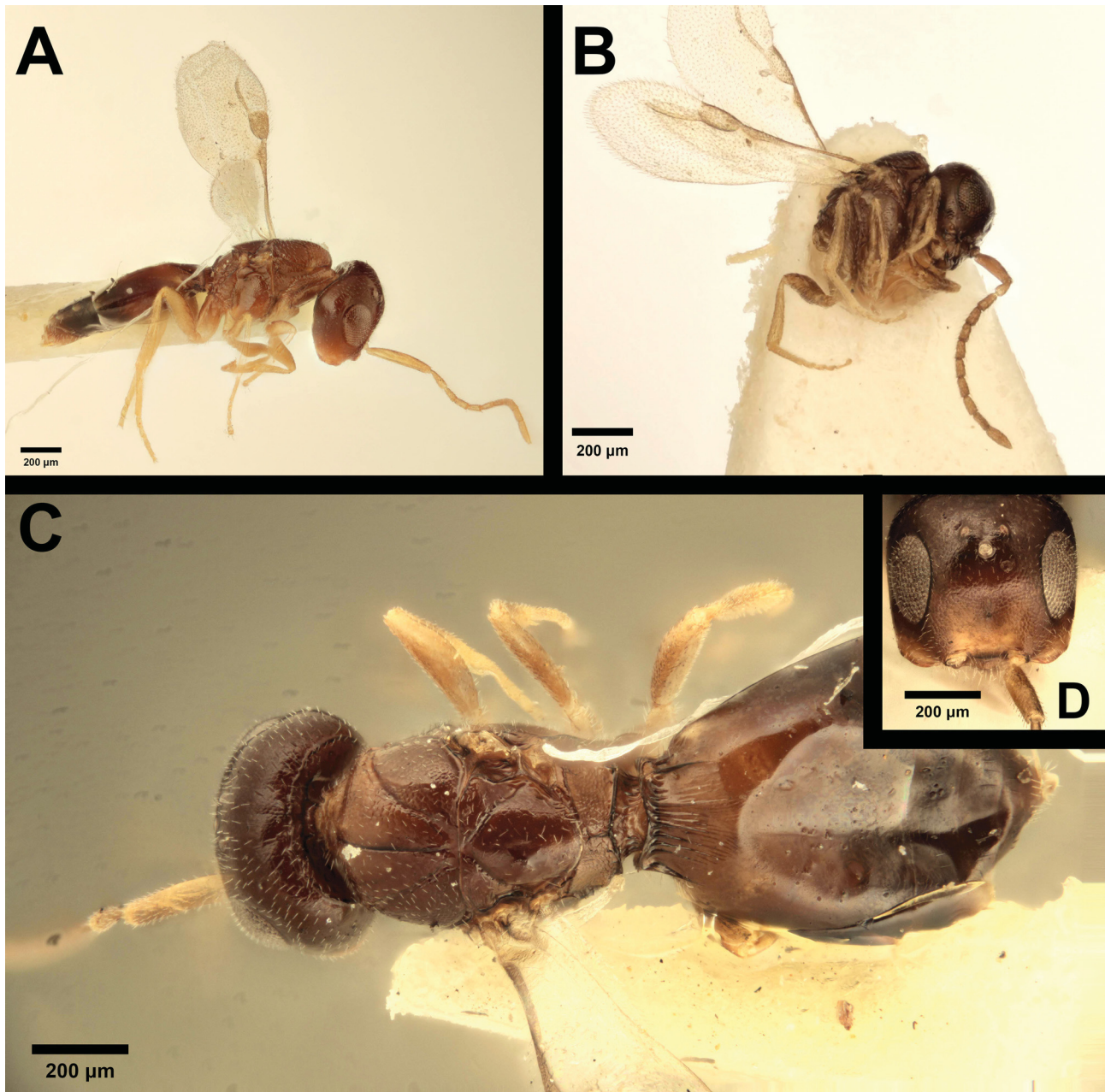
**Description.** Body length: 1.15 mm (MCZ-ENT 711738, male paratype); 2.0 mm (MCZ-ENT 711739, female paratype). Color hue pattern in male: cranium brown; mesosoma and antennae light brown to brown; legs ochre; anterior half of metasoma ochre to brown; posterior half of metasoma brown to dark brown. Color intensity pattern in male: cranium darker than mesosoma, flagellomeres darker than legs; anterior half of metasoma lighter than posterior half of metasoma. Color hue pattern female: cranium ochre to dark brown; mesosoma brown to dark brown; anterior metasoma brown; posterior metasoma black; legs and antennae ochre to light brown. Color intensity pattern female: ventral region of cranium is lighter than dorsal region of cranium; anterior half of metasoma lighter than posterior half of metasoma. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 2.29. Male scape length vs. F1 length: 1.78. Male F1 length vs. pedicel length: 1.29. Male F1 length vs. male F2 length: 1.29. Longest male flagellomere: F9. Female scape length vs. pedicel length: 2.86. Female scape length vs. F1 length: 4.0. Female F1 length vs. F2 length: 1.11. Female F1 length vs. pedicel length: 0.71. Longest female flagellomere: F9. Length of setae on male flagellomere vs. male flagellomere width: setae as long as or shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F7–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.67 (MCZ-ENT 711738, male paratype); 1.96 (MCZ-ENT 711739, female paratype). Head height (HH) vs. head length (HL): HH:HL=1.14 (MCZ-ENT 711738, male paratype); 1.55 (MCZ-ENT 711739, female paratype). Head width (HW) vs. interorbital space (IOS): HW:IOS=1.7–1.8. Head width (HW) vs. head height (HH): HW:HH=1.36 (MCZ-ENT 711738, male paratype); 1.04 (MCZ-ENT 711739, female paratype). Cephalic size (csb): Mean: 295 μm (MCZ-ENT 711738, male paratype); 520 μm (MCZ-ENT 711739, female paratype). Maximum eye diameter vs. minimum eye diameter: 1.25 (MCZ-ENT 711738, male paratype); 1.41 (MCZ-ENT 711739, female paratype). POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=2.0. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.6. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.0:1.25:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL 1.8× as long as LOL. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8:1.6:1.0. Head shape (anterior view): quadrangular, square-shaped. Preoccipital lunula count: absent. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: appearing as a faint impression, smooth. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina dorsal to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present, sometimes with the impression of a facial sulcus between



the facial pit and the anterior ocellus. Facial pit count: present. Facial sulcus count: absent but some specimens with the impression of a facial sulcus between the facial pit and the anterior ocellus. Median facial keel count: absent. Intertorular area count: present. Intertorular carina count: present. Median region of intertorular area shape: flat. Ventral margin of antennal rim vs. dorsal margin of clypeus: adjacent. Torulo–clypeal carina count: absent. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

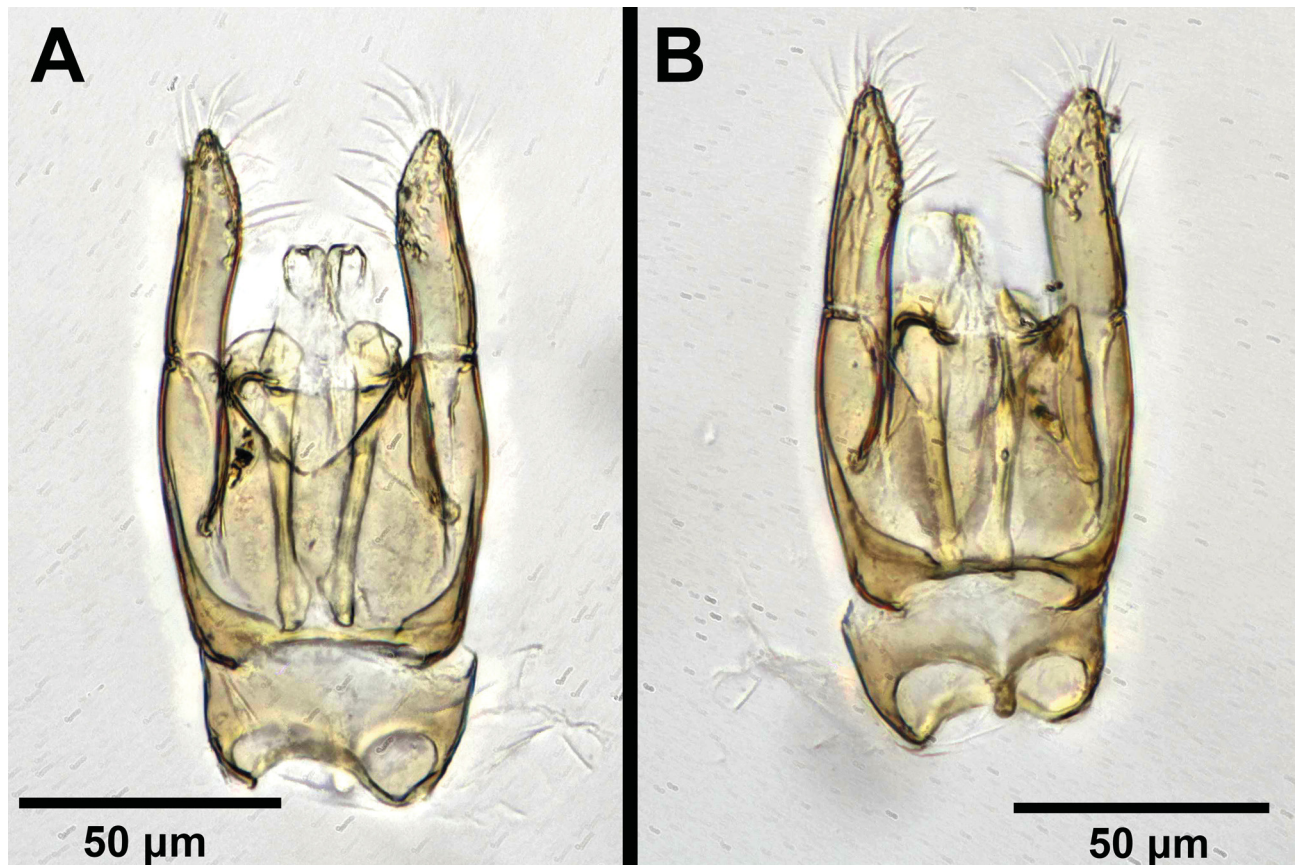


**FIGURE 43.** *Conostigmus quadratogenalis* Dessart & Cooper, 1975. A. Lateral habitus of holotype female (USNMENT01339796). B. Lateral habitus of allotype male (USNMENT01212953). C. Dorsal view of holotype female (USNMENT01339796). D. Frons of holotype female (USNMENT01339796).

**Mesosoma:** Weber length: WL=295 µm (MCZ-ENT 711738, male paratype); 680 µm (MCZ-ENT 711739, female paratype). Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.79 (MCZ-ENT 711738, male paratype); 0.80 (MCZ-ENT 711739, female paratype). Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.45. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.0. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus

posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto-propodeo–metapecto–mesopectal complex count: absent.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear. Synsternal setiferous patch anterior end: synsternal setiferous patch begins lateral to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least as long as the maximum width of the synsternal translucent patch but not 2× as long. S1 length vs. shortest width: S1 wider than long.



**FIGURE 44.** *Conostigmus quadratogenalis* Dessart & Cooper, 1975 allotype male genitalia (USNMENT01212953). A. Dorsal view. B. Ventral view.

**Male Genitalia:** Distal margin of male S9 shape: straight. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing setiferous patch or patches. Male S9 distal setal line / setal patch structure: single transverse row of setae, interrupted medially to form two separate patches. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: present with distal setiferous patch/line separated medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–

volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending between 1/3 to 1/2 the length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: blunt. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally; oriented distolaterally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distally. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: straight.

**Distribution.** Nearctic.

**Material Examined.** Holotype female: USA: USNMENT01339796 (USNM). Paratypes (2 males, 1 female): USA: California: 2 males, 1 female. USNMENT01212953 (USNM); MCZ-ENT 711738, 711739 (MCZC).

### ***Conostigmus rufoniger* (Provancher, 1888)**

Fig. 45

**Species Comments and History.** Provancher (1888) described this species from a single male specimen collected in Cap-Rouge, Quebec, Canada. The type is present at the ULQC, but is in poor condition. The female remains unknown.

Dessart (1997a) examined the type specimen and compared it to *C. pulchellus* and *C. nigrorufus*. This species is not synonymous with *C. pulchellus* because it lacks the facial sulcus (present in *C. pulchellus*), and it is not synonymous with *C. nigrorufus* because it has a sternaulus (absent in *C. nigrorufus*).

We examined the type specimen and found that it had the following combination of characters: preoccipital furrow present and ending inside the ocellar triangle, but ending posterior to the anterior ocellus; facial pit present; sternaulus present; and axillular carinae absent. The specimen also has unique coloration, with the propleuron and other portions of the mesosoma lighter in coloration than the rest of the mesosoma, though the specimen is in such poor condition it is difficult to say whether this is due to specimen age and damage over the years.

Dessart (1997a) did not receive permission to dissect the male genitalia of the specimen. We did not receive permission either, but we were able to measure and score the specimen, and we include these characters in a partial redescription below. Until the male genitalia can be dissected and studied, or more specimens can be found, we follow Dessart (1997a) and conclude that this is an uncertain species in need of more study. We regard *Conostigmus rufoniger* as a *species inquirenda*.

**Description.** Body length: 1.725 mm. Color hue pattern in male: cranium brown; propleuron yellow; mesosoma except propleuron yellow to brown; antennae ochre to light brown; metasoma ochre to brown. Color intensity pattern in male: cranium darker than mesosoma, flagellomeres darker than legs; cranium darker than mesosoma; propleuron lighter than the rest of the mesosoma; flagellomeres and pedicel darker than scape; mandible lighter than cranium. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 4.14. Male scape length vs. F1 length: 1.53. Male F1 length vs. pedicel length: 2.71. Male F1 length vs. male F2 length: 1.12. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than  $1.3\times$  wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.36. Head height (HH) vs. head length (HL): HH:HL=1.17. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.68. Head width (HW) vs. head height (HH): HW:HH=1.38. Cephalic size (csb): Mean: 405  $\mu\text{m}$ . Maximum eye diameter vs. minimum eye diameter: 1.3. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=2.0. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.14. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.0:1.75:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: blunt. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=550  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.7. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.44. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.96. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than  $2\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: short and not reaching  $3/4$  of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “V” (left and right lateral propodeal carinae are adjacent medially at their intersection with antecostal sulcus of the first abdominal tergum). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 0.67. Syntergal translucent patch maximum width vs. minimum width: 2.25. Syntergal translucent patch maximum width orientation: anterolaterally.

**Distribution.** Nearctic.

**Material Examined.** Lectotype male: CANADA: PSUC\_FEM 148467 (ULQC).



**FIGURE 45.** *Conostigmus rufoniger* (Provancher, 1888) male holotype (PSUC\_FEM 148467). A. Lateral view. B. Dorsal view.

***Conostigmus schwarzi* (Ashmead, 1893)**

Fig. 46

**Species Comments and History.** Ashmead (1893) described this species from a single female specimen collected in the Washington, D.C., area by E. A. Schwarz, for whom the species is named. Dessart (1996) gives an overview of the troubled naming of the species: Ashmead (1893) refers to the species as *schwarzi* in a key to female species on pg. 113, but then uses the spelling *schwarzii* in the actual species description on pg. 115. Kieffer (1909, 1914) adopts

the spelling *schwarzii*, then Brues (1916) introduces the new spelling *schwartzii*. Muesebeck and Walkley (1951) go back to Ashmead's first spelling, *schwarzi*, but then Masner and Muesebeck (1968) use Ashmead's second spelling, *schwarzii*, in their catalog of specimens at the USNM. Dessart (1996) resolved this naming controversy by selecting *schwarzi* as the correct spelling, citing that it is the simplest spelling, the first spelling used by Ashmead, and the spelling used in American catalogs at the time.

The lectotype female specimen is present at the USNM in good condition. We found a second female specimen at the CNC (PSUC\_FEM 56057), bearing a label with Ashmead's handwriting. This specimen is labeled as a paratype, though further work is needed to determine whether this specimen is a valid type specimen because Ashmead never labeled specimens as holotypes or paratypes. It is unclear who labeled this specimen as a paratype. The specimen is included in the material examined section below for further reference.

The female lectotype at the USNM bears the following characteristics: facial pit present; postocellar carina present; median process on the intertorular carina present and acute, extending towards the dorsal margin of the clypeus; and the sternaulus present and elongate, exceeding 3/4 of the mesopleuron length at the level of the sternaulus. However, there are several species that share these characters (including *C. laeviceps*, *C. bipunctatus*, *C. minimus*, and *C. musettiae*), and neither individual characters nor the combination of characters is distinct enough to match this female to any of them at this time. We consider *C. schwarzi* as a *species inquirenda*.

It is worth noting that the female specimen has a mite attached to the metasoma. A similar mite was found on the metasoma of the female type specimen of *Ceraphron carinatus*. Dr. Michael Skvarla and Dr. Barry O'Connor identified the mites as phoretic deutonymphs belonging to the family Acaridae (Astigmata). Depending on the species, deutonymphs can be generalists, found on many different types of insects, or specialists, which rely on certain insects to transport them to certain areas or hosts (Skvarla and O'Connor, pers. comm). It is unknown what hosts *Ceraphron carinatus* or *Conostigmus schwarzi* parasitize, or what the natural histories of these species are, so it is not possible to know where they acquired the mites. This illustrates the need for more work on the life histories of Ceraphronoidea species.

**Material Examined.** Lectotype female: USA: USNMENT01339767 (USNM).

Non-type material (1 female): USA: 1 female. PSUC\_FEM 56057 (CNC).

### ***Conostigmus subinermis* (Kieffer, 1907)**

**Species Comments and History.** Johnson and Musetti (2004) listed this species as having a Holarctic distribution, but this appears to be a mistake. Kieffer (1907) described two species, *subinermis* and *nigriceps*, from female specimens collected in Italy. Dessart (1972a) later synonymized *nigriceps* with *subinermis*, but again, there is no mention of North American specimens. Dessart (1972a) notes the unique shape of the mesosoma, and mentions, "elle sera redécrite en détail dans une autre note" (pg. 28), but it appears that he never did publish another note on the species. His writing indicates that he viewed Kieffer's type specimens, but does not mention where he viewed them (Dessart, 1972a). The location of the specimens is currently unknown, and we were not able to verify the identity of the species or confirm its presence in the Nearctic. We consider *Conostigmus subinermis* as only a Palearctic species at this time.

### ***Conostigmus timberlakei* Kamal, 1926**

**Species Comments and History.** Kamal (1926) described this species from 3 female specimens reared from syrphid puparia collected in California near San Diego. Kamal (1926) described 3 other new species in the same publication, but while Kamal specifies that the types of the other 3 species are deposited in the USNM, no repository is given for the specimens of *C. timberlakei*. Dessart (1974) commented that the types were probably in Kamal's personal collection ("Est inconnu-- probablement dans la collection personnelle du descripteur", pg. 444). We confirmed that the specimens were not at the USNM during an October 2017 visit. Because Kamal did his PhD at the University of California, Riverside, we contacted their department and other insect collections in California, as well as collections in Egypt (where Kamal returned after his PhD) but were unable to track down the specimens.

Based on illustrations published of the specimens in Kamal (1939), Dessart (1974) believes this species is a

member of the genus *Dendrocerus*. However, without any specimens to examine and confirm this, Dessart (1974) declared the species *incertae sedis*. With our attempts to track down the type specimens unsuccessful, this species must remain *incertae sedis* for now.



**FIGURE 46.** *Conostigmus schwarzi* (Ashmead, 1893) female lectotype (USNMENT01339767). A. Lateral view, with a mite attached to the metasoma. B. Dorsal view.

### *Conostigmus trapezoidus* Kieffer, 1908

**Species Comments and History.** Kieffer (1908) described this species from a single male specimen collected in Jeannette, PA. The species is named for the trapezoidal appearance of the vertex of the head: “tête rétrécie graduellement en arrière des yeux, le vertex par suite trapezoidal” (Kieffer, 1908, pg. 35). However, this is a feature of many megaspilid species. The original description offers other characters related to antennae ratios, coloration and

microsculpture that could apply to several different species as well. The location of the original type specimen is unknown, so it is not possible to verify this species at the time. We consider *Conostigmus trapezoidus* as a *species inquirenda*.

### ***Conostigmus triangularis* (Thomson, 1858)**

Figs. 47, 48

**Species Comments and History.** Thomson (1858) described the species from material in Lund, Sweden, deposited in the NHRS. Kieffer (1907) described another species, *Trichosteresis armata* Kieffer, from male and female specimens deposited in the HNHM that Dessart (1974) later synonymized with *triangularis*. Other species that Dessart synonymized with *triangularis* include *Conostigmus ater* Fouts 1926 and *Conostigmus zaglouli* Kamal 1926 (Dessart, 1980b, 1981); the specimens of both synonymous species are deposited in the USNM.

The female holotype of *C. ater* Fouts is point mounted and missing its metasoma; this damage is not mentioned in Masner and Muesebeck (1968) and must have occurred since then. There is also one female paralectotype in good condition. The female holotype specimen of *C. zaglouli* Kamal 1926 is point mounted and missing the last three flagellomeres on the right antenna. There is also one male allotype and 5 female paratypes, which are all damaged to various degrees and missing pieces as Masner and Muesebeck (1968) noted. Two female paratypes (USNMMENT01212973; USNMMENT01212971) even have extra antennae glued on the point mounts that may have come from other specimens in the type series.

Thomson (1858) originally named this species *triangularis* after the triangle-shaped pterostigma, though this character is found in many Megaspilidae and is not particularly useful as a defining character for the species. Rather, the most unique defining character of this species is the male harpe, which are bilobed. This character state is not known in any other *Conostigmus* species worldwide, though it does occur in some *Dendrocerus* species, including *D. penmaricus* (illustrations in Dessart, 1995a) and *D. rodhaini* (illustrations in Dessart, 1978).

*Conostigmus triangularis* is a very *Dendrocerus*-like species in that it lacks a sternaulus, the ocellar triangle can appear obtuse (POL longer than LOL, ocellar triangle with a wide base), and the metapleural sulcus can appear arched in some specimens (including USNMMENT01339809 and USNMMENT01339808, the types from Fouts and Kamal). However, *C. triangularis* is not a *Dendrocerus* species in that it has the facial pit present, the parossiculi present (parossiculi and gonostipes not fused) and the medioventral conjunctiva of the gonostyle–volsella complex present (parossiculi independent). While the facial pit occurs in some *Dendrocerus* species, such as *D. carpenteri* and *D. rectangularis*, there are no *Dendrocerus* species with independent parossiculi.

**Variability.** The metapleural sulcus is arched in some specimens (USNMMENT01339809, USNMMENT01339808) and straight in others (PSUC\_FEM 9773).

**Differences between Nearctic, Palearctic and Afrotropical Populations.** We did not note any differences between Palearctic and Nearctic specimens. We did not examine any Afrotropical specimens.

**Differences Between Males and Females.** Other than genitalia differences and sexual dimorphism in the antennae, there are no obvious differences between males and females.

**Diagnosis.** Males of this species are easily recognizable by the bilobed male harpe, which does not occur in any other known *Conostigmus* species. Another unique character is the transverse striation present and limited to the dorsal half of the ventral metapleural area. This character can be used to match males and females. Other characters that can be used to recognize the species and match males to females include the absence of the sternaulus and presence of the facial pit.

The most similar species to *C. triangularis* is *C. lepus*, another *Dendrocerus*-like species that also has the sternaulus absent and facial pit present. *Conostigmus triangularis* and *C. lepus* can easily be distinguished by the male genitalia. *Conostigmus lepus* has simple harpe (not bilobed), submedial projections on the proximal margin of S9 present (absent in *C. triangularis*) and dense lateral setae on the harpe that are evenly distributed across the entire lateral surface of the harpe (lateral setae sparse in *C. triangularis*). Females of both species can be distinguished by the extent of the transverse striations on the ventral metapleural area; the transverse striations occur across the entire ventral metapleural area in *C. lepus*, whereas they are limited to the dorsal half of the ventral metapleural area in *C. triangularis*.

**Description.** Body length: 2.1–2.8 mm. Color hue pattern in male: cranium, mesosoma, scape brown to dark



brown; pedicel, mandible, flagellomeres and legs light brown; metasoma reddish-brown. Color intensity pattern in male: pedicel lighter than scape. Color hue pattern female: cranium and mesosoma reddish-brown to dark brown; metasoma reddish-brown; scape, pedicel, flagellomeres light brown to dark brown; legs ochre to brown. Color intensity pattern female: legs lighter than the flagellomeres, scape and pedicel. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 3.2–3.4. Male scape length vs. F1 length: 1.6–1.7. Male F1 length vs. pedicel length: 2.0. Male F1 length vs. male F2 length: 1.3–1.5. Longest male flagellomere: F1. Female scape length vs. pedicel length: 3.4–5.0. Female scape length vs. F1 length: 2.5–3.0. Female F1 length vs. F2 length: 1.3–1.7. Female F1 length vs. pedicel length: 1.3–2.0. Longest female flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): male HH:EHf=1.5–1.7; female HH:EHf=1.2–1.5. Head height (HH) vs. head length (HL): HH:HL=1.1–1.5. Head width (HW) vs. interorbital space (IOS): male HW:IOS=1.7–1.9; female HW:IOS=2.0–2.2. Head width (HW) vs. head height (HH): HW:HH=1.3–1.5. Cephalic size (csb): Mean: 430–710 μm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.4. POL:OOL: POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=2.0–2.5. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.8–1.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.0–2.5:2.2–2.5:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL 1.8–2.0× as long as LOL. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8–2.0:1.8–2.3:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends at anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: blunt. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: adjacent. Torulo–clypeal carina count: absent. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=670–950 μm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.7–0.9. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.4–1.9. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.1. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight or arched. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: sternaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit absent; epicnemial carina curved. Transverse striations on the ventral metapleural area count: present. Transverse striations on the ventral metapleural area ventral limit: transverse striations

limited to dorsal half of ventral metapleural area. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex count: present. Posterior margin of nucha in dorsal view shape: concave.

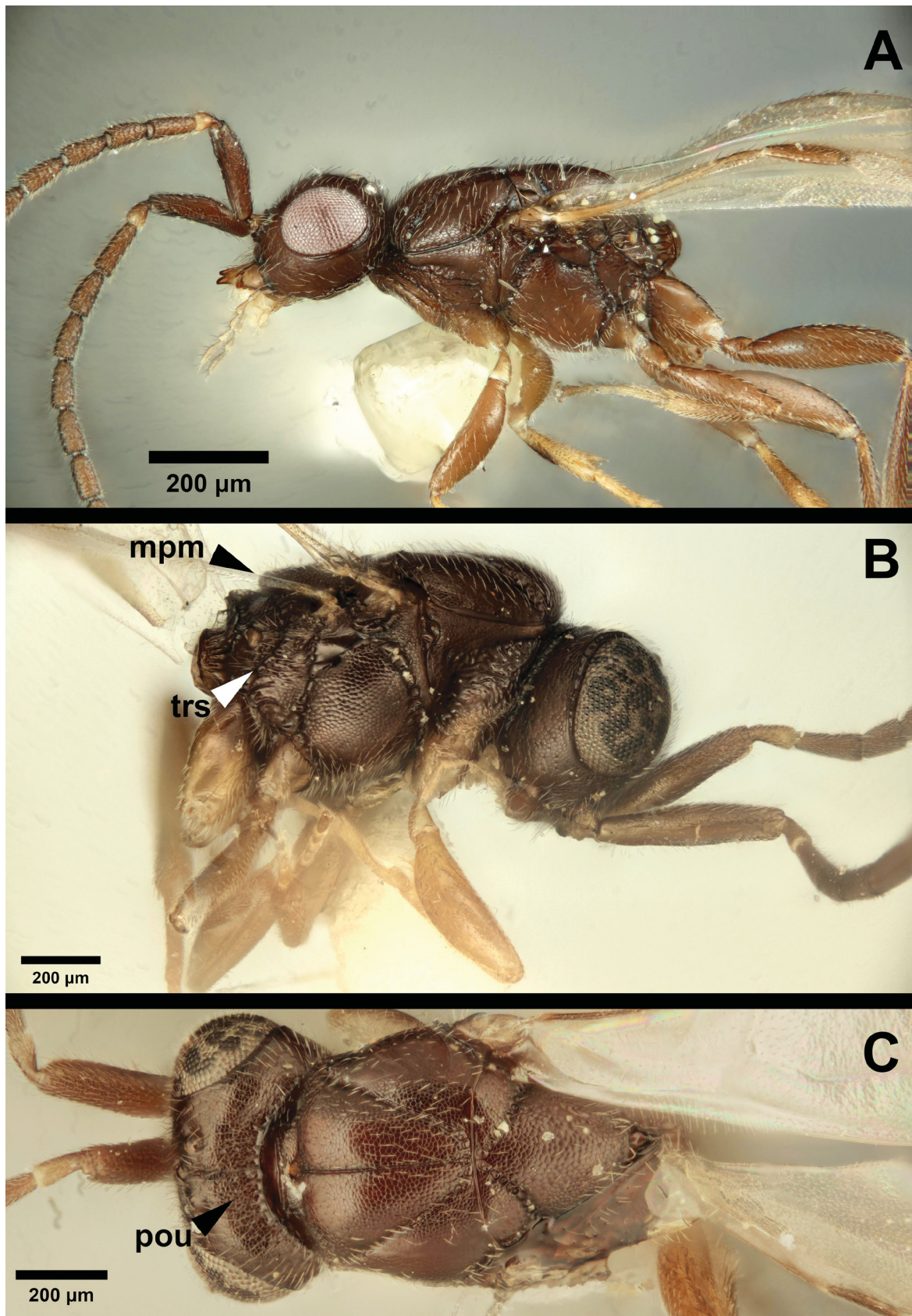
**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 2.2–2.8. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.57 (PSUC\_FEM 9773). Syntergal translucent patch maximum width vs. minimum width: 1.4–2.3. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterior–posteriorly. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

**Male Genitalia:** Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: present with distal setiferous patch/line separated medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: at least two times as long as wide. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: blunt. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending equal to or less than 1/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: bilobed. Lateral margin of harpe shape: widest point of harpe is in its distal 1/3rd. Distal margin of harpe in lateral view: two acute or pointed lobes of harpe. Lateral setae of harpe count: absent. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distoventrally. Sensillar ring area of harpe orientation: distoventrally. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: harpe bilobed and distoventral margin concave between lobes.

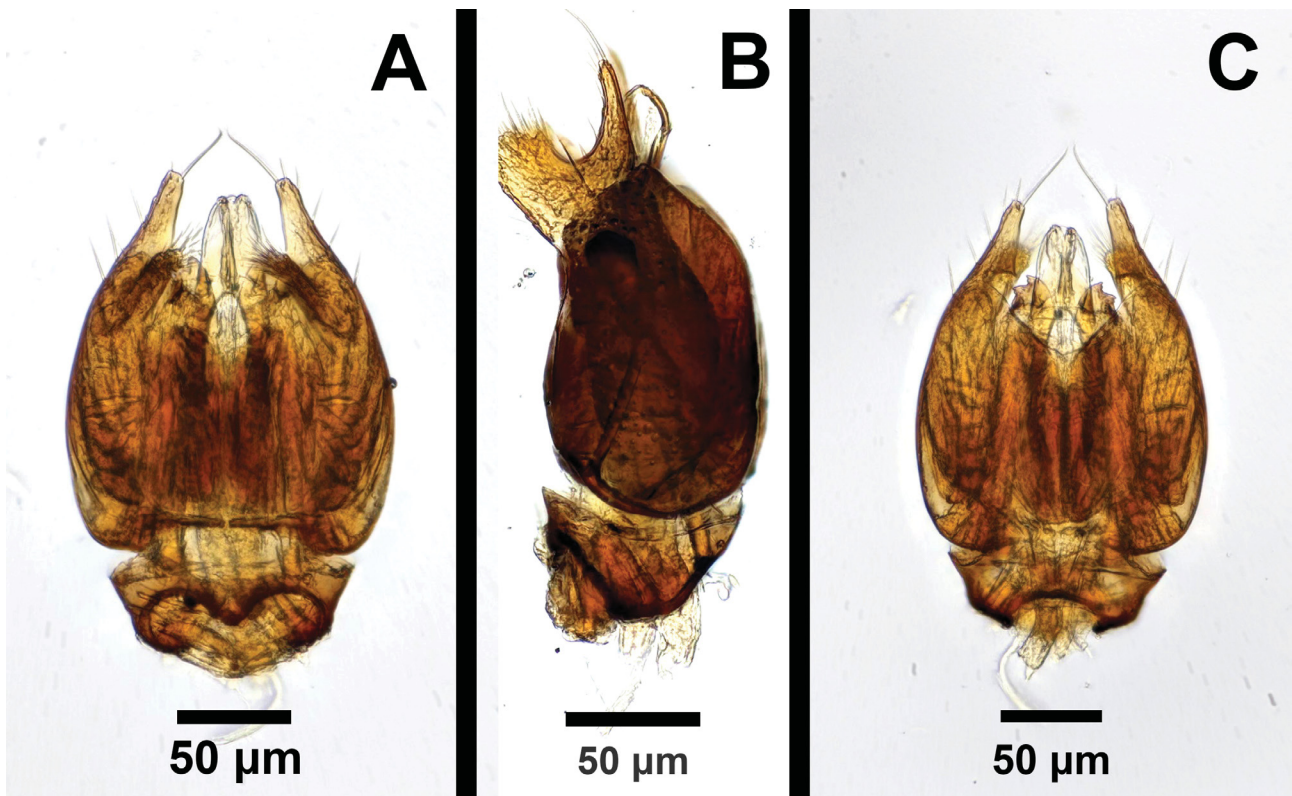
**Distribution.** Holarctic and Afrotropical.

**Material Examined.** Holotype female: SWEDEN: NHRS-HEVA000006796 (NHRS). Synonymized types: USA: California: USNMMENT01339809, 01212968, 01339808, 01212961, 01212971, 01212970, 01212974, 01212973 (USNM).

Non-type material (3 males, 5 females): UNITED ARAB EMIRATES: 1 male. IM 1836 (NCSU). USA: California: 1 female. UCRC\_ENT 00457054 (UCRC). USA: New York: 1 male, 1 female. PSUC\_FEM 8810, 9773 (ROME). USA: Wisconsin: 1 male, 3 females. PSUC\_FEM 50074, 50186, 50297, 84299 (WIRC).



**FIGURE 47.** *Conostigmus triangularis* (Thomson, 1858). A. Lateral view of the male (PSUC\_FEM 9773). B. Lateral view of the female former type specimen of *C. ater* Fouts, synonym of *C. triangularis*. (USNMENT01339809). C. Dorsal view of the female former type specimen of *C. ater* Fouts, synonym of *C. triangularis*. (USNMENT01339809). Abbreviations: mesopost-scutellum (mpm); preoccipital lunula (pou); transverse striations on ventral metapleural area (trs).



**FIGURE 48.** *Conostigmus triangularis* (Thomson, 1858) male genitalia (PSUC\_FEM 148624). A. Ventral view. B. Lateral view, showing the bilobed harpe. C. Dorsal view.

***Dendrocerus arietinus* (Provancher, 1887), new combination**

Figs. 49, 50

**Species Comments and History.** *Isostasis arietinus* Provancher, 1887 was described from a single female specimen. Provancher named the species *arietinus* or “tête de belier” after the curve of the antennae, which he believed resembled the horns of a ram. Provancher (1888) transferred the species from *Isostasis* to the genus *Baeoneura*, another genus described by Förster (1856). Harrington (1900) transferred the species from Platygastroidea to Ceraphronoidea, remarking that the description “answers very well to *Megaspilus Harringtoni*, Ashm.”, and Kieffer (1914) subsequently redescribed the species and transferred it to *Conostigmus*. Gahan and Rohwer (1917) designated a *Baeoneura arietina* specimen as a lectotype at the ULQC, and noted that the specimen was badly glued. Masner (1969) echoed this statement on the condition of the specimen and reported that the specimen was a *Conostigmus* species.

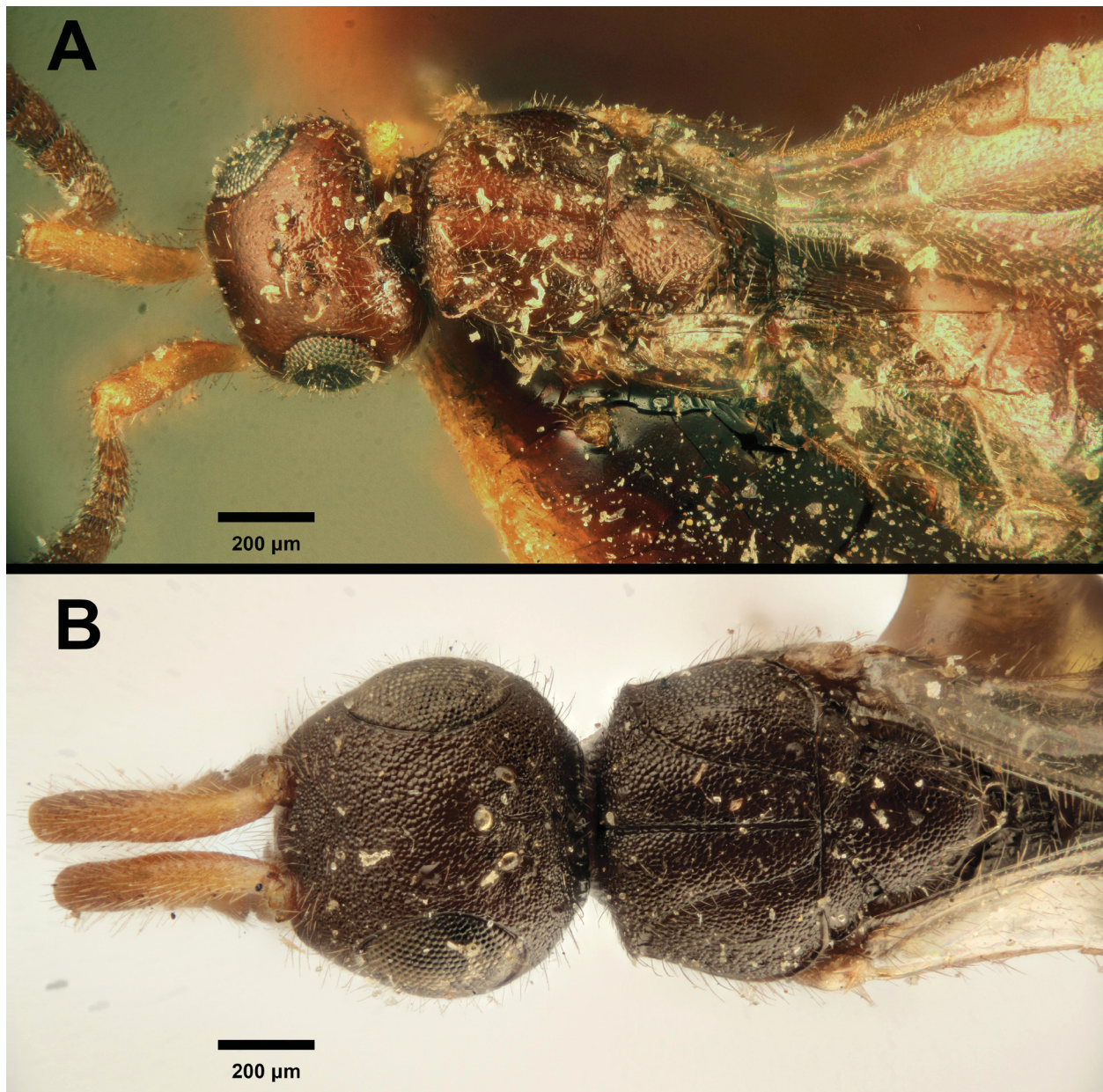
Provancher (1887) originally described the species *arietinus* as a member of the genus “*Isostasis*”, which Provancher attributed to Förster; however, Förster never described a genus “*Isostasis*”. Instead, Förster had described the platygastriid genus *Isostasius* (Hymenoptera, Platygastriidae) (Förster, 1856). Dessart (1996) later designated *Isostasis* Provancher, 1888 not as an incorrect spelling but as a valid genus that was synonymous with *Conostigmus* Dahlbom, 1858. Johnson and Musetti (2004) do not accept Dessart’s action and instead consider *Isostasis* as a misspelling of Förster’s *Isostasius*, pointing out that such an action would set a precedent leading “to the adoption of untold numbers of junior homonyms!” (pg. 6).

We mention the troubled history of this species to comment that Dessart did not directly observe the holotype, but considered the species a *Conostigmus* based on the assertions of Kieffer (1914) and Masner (1969). Upon examining the female lectotype specimen of *Conostigmus arietinus* (Provancher), 1887 at the ULQC, however, we realized that this specimen was a *Dendrocerus* based on its close resemblance to the female holotype of *D. penmaricus* (see Figs. 49, 50 for comparison with the female holotype of *Dendrocerus penmaricus* (Ashmead), 1893 deposited in the USNM). The species also has the following combination of *Dendrocerus*-like characters: ocelli in an obtuse triangle (POL greater than LOL), where the two posterior ocelli are closer to the compound eyes than to each other (POL greater than OOL); mesometapleural sulcus arched; and facial pit absent.

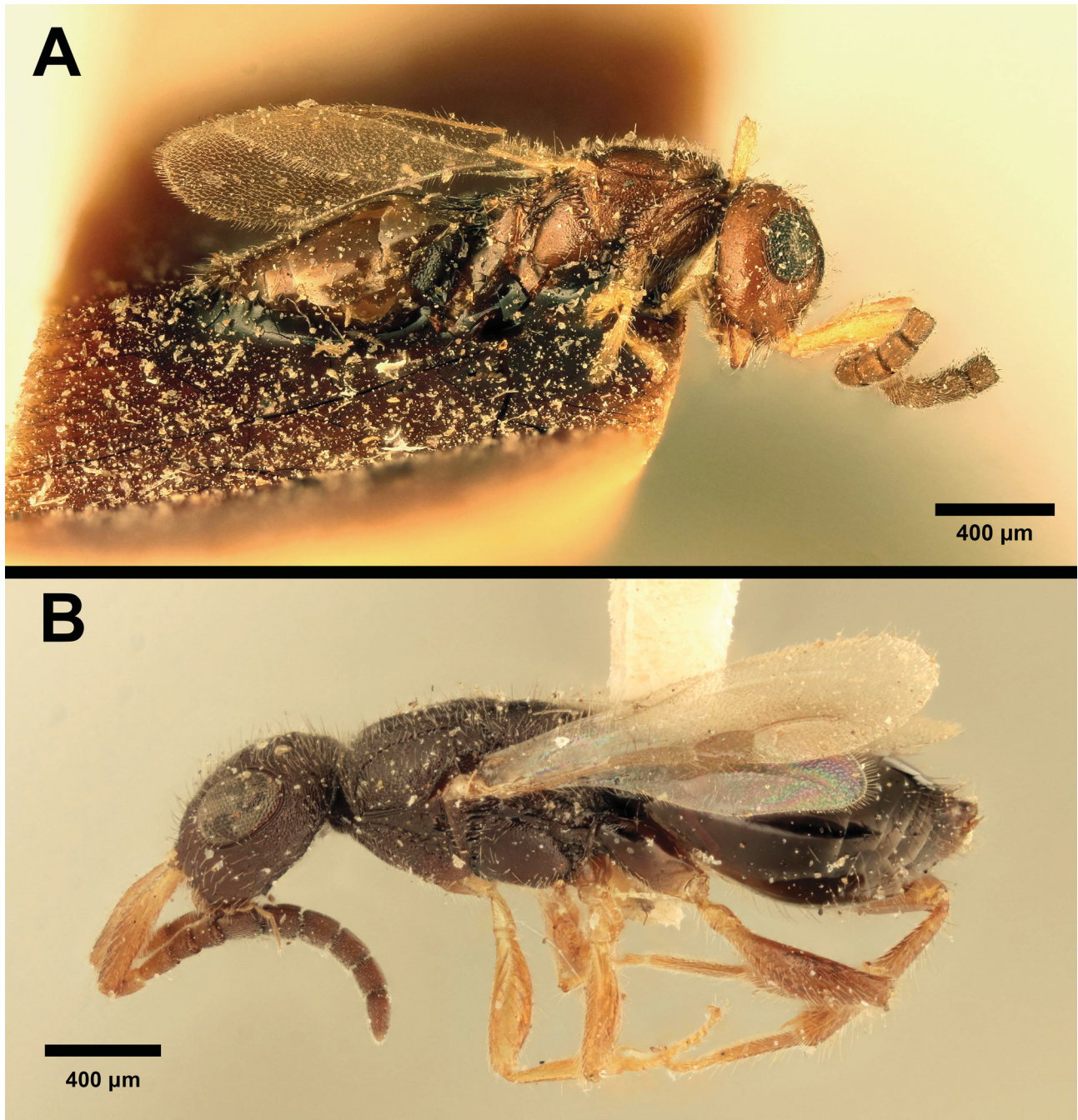
This species likely belongs to the *D. penmaricus* species group, and may even be the same species as *D. penmaricus*, as the female type of *arietinus* shares the following characters with the female holotype of *D. penmaricus*: ocelli in an obtuse triangle; facial pit absent; median process on the intertorular carina present and blunt; preoccipital furrow present and the anterior end reaching the anterior ocellus; postocellar furrow absent; mandibles with two teeth; posterior end of the notaulus not adjacent to the median mesoscutal sulcus; and the general habitus (in particular, the shape of the head and the size of the eyes in relation to the head in lateral view are unique). The type specimen of *arietinus* is so poorly glued that it is not possible to confirm the absence of a sternaulus, which would be another indicator that this species is indeed a *Dendrocerus*.

Because the female type is in such poor condition and the male of the species is unknown, it is not possible to confirm whether *D. arietinus* is synonymous with *D. penmaricus*. For now, we consider *D. arietinus* and *D. penmaricus* as separate species, but we move *D. arietinus* from *Conostigmus* to *Dendrocerus* and consider *D. arietinus* as a member of the *D. penmaricus* species group.

**Material Examined.** Lectotype female: CANADA: PSUC\_FEM 148706 (ULQC).



**FIGURE 49.** A. The female type specimen of *Conostigmus arietinus* Provancher, 1887 from the ULQC in dorsal view (PSUC\_FEM 148706), now *Dendrocerus arietinus* (Provancher, 1887). B. The female holotype specimen of *Dendrocerus penmaricus* (Ashmead, 1893) at the USNM in dorsal view (USNM Type no. 58969) for comparison.



**FIGURE 50.** A. The female type specimen of *Conostigmus arietinus* Provancher, 1887 from the ULQC in lateral view (PSUC\_FEM 148706), now *Dendrocerus arietinus* (Provancher, 1887). B. The female holotype specimen of *Dendrocerus penmaricus* (Ashmead, 1893) at the USNM in lateral view (USNM Type no. 58969) for comparison.

### New species

#### *Conostigmus dessarti* Trietsch & Mikó, sp. nov.

Figs. 51, 52, 53

**Diagnosis.** This species can be recognized by the following combination of characters: scape more than 5.5× as long as the pedicel; sternaulus present and elongate, exceeding 3/4 of the mesopleuron length at the level of the sternaulus; medioventral conjunctiva absent and parossiculi fused; medioventral ridge of the gonostyle–volsella complex present; dense patch of setae on the distoventral edge of the harpe absent; and the proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape acute.

The female of this species is unknown.

This species shares several characters in common with *C. franzinii*, *C. bipunctatus*, *C. minimus* and *C. musettiae*, including the following: facial pit present; preoccipital furrow present; median process on the intertorular carina present and acute; sternaulus present and elongate, exceeding 3/4 of the mesopleuron length at the level of the sternaulus; ventral projection of the metapleural carina present; medioventral conjunctiva absent and parossiculi fused; and gonocondyle present and acute. *Conostigmus dessarti* can be differentiated by the acute proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape (blunt or straight in all others) and the scape being more than 5.5× as long as the pedicel.

The harpe of *C. dessarti* can appear very similar to the harpe of *C. laeviceps* in lateral view; both species have harpe with the distal margin pointed or acute, the distodorsal setae of sensillar ring longer than the width of the harpe (sometimes 2× as long or greater), and the distoventral margin of the harpe in lateral view straight, though it can appear more convex or concave in some specimens. However, these two species can easily be distinguished by the dorsomedian projection of the gonostyle–volsella complex (absent in *C. dessarti*, present in *C. laeviceps*), the shape of the proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex (acute in *C. dessarti*, blunt or straight in *C. laeviceps*) and the scape to pedicel length (scape more than 5.5× as long as the pedicel in *C. dessarti*, less in *C. laeviceps*).

**Variability.** The distoventral margin of the harpe is usually straight, but can appear more convex in some specimens (PSUC\_FEM 8795) and more concave in others (PSUC\_FEM 50136).

**Description.** Body length: 1.875 mm (CMNHENT0022751). Color hue pattern in male: cranium, mesosoma and metasoma brown to dark brown; mandible, legs, pedicel and scape ochre; F1–F9 ochre to light brown. Color intensity pattern in male: metasoma lighter than mesosoma and cranium. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 5.5–7.2. Male scape length vs. F1 length: 1.6–1.8. Male F1 length vs. pedicel length: 3.1–4.3. Male F1 length vs. male F2 length: 1.2–1.5. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F3–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=2.1–2.3. Head height (HH) vs. head length (HL): HH:HL=1.2–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.4–1.6. Head width (HW) vs. head height (HH): HW:HH=1.1–1.3. Cephalic size (csb): Mean: 380–435 µm. Maximum eye diameter vs. minimum eye diameter: 1.2–1.5. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.3–2.0. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.1–1.7. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.3–2.0:1.1–1.6:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process extends across intertorular area towards dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=600–740 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal

width (PscW): AscW/PscW=0.6–0.7. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.6–1.8. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.1. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 3/4 of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: more than or equal to 2× as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.

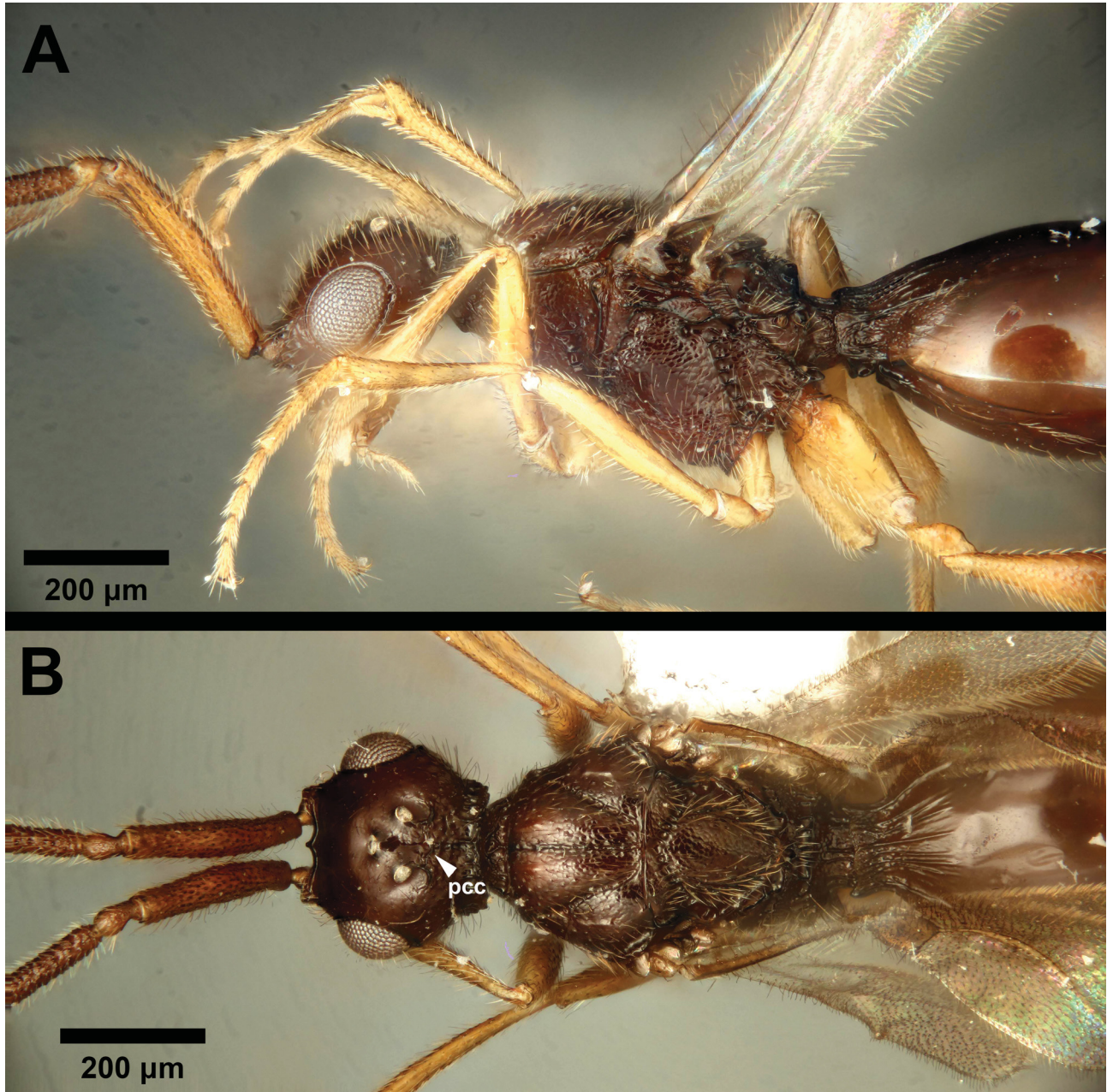


**FIGURE 51.** *Conostigmus dessarti* Trietsch and Mikó **sp. nov.**, habitus of holotype male (CMNHENT0022751).

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.4–1.7. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.7–1.9. Syntergal translucent patch maximum width vs. minimum width: 1.5–2.8. Synsternal translucent patch maximum width vs. minimum width: 1.3–1.8. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single row of setae anterior



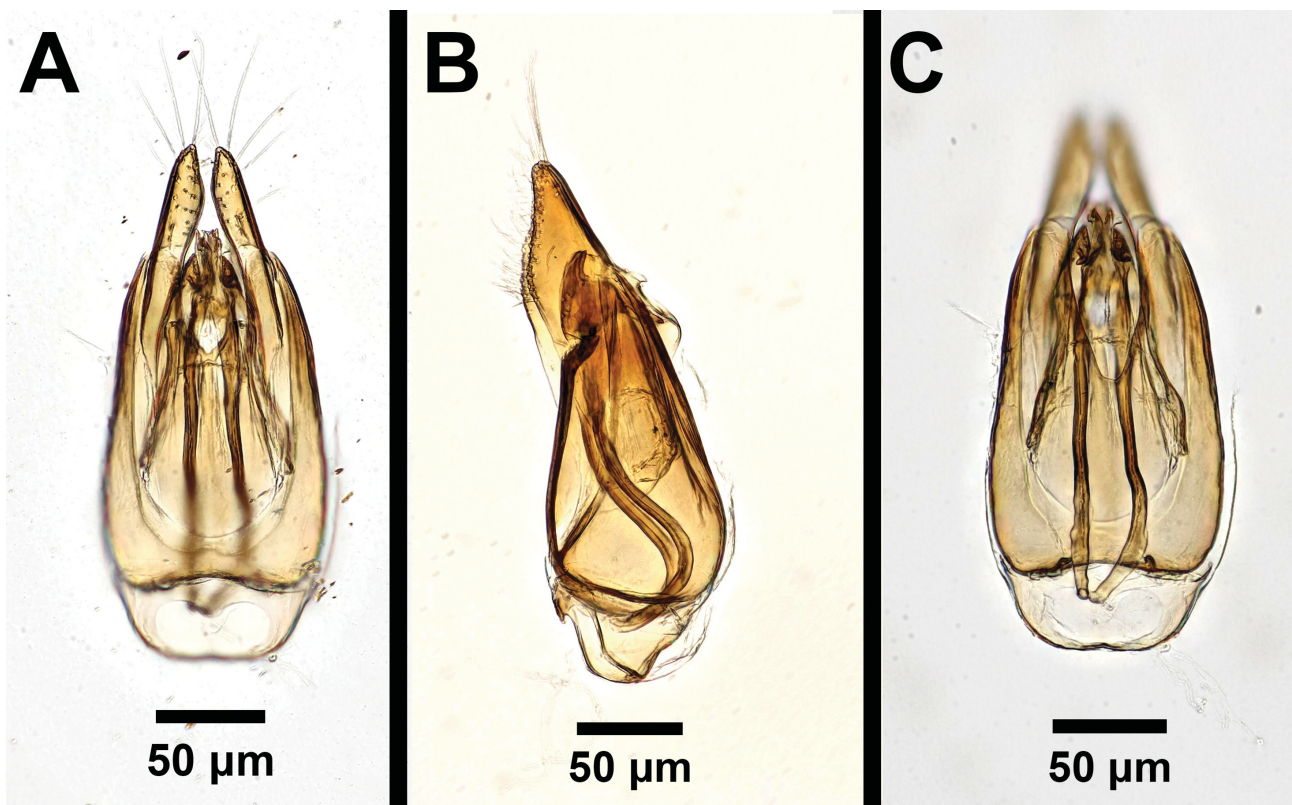
to the synsternal translucent patch, with a patch of setae posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



**FIGURE 52.** *Conostigmus dessarti* Trietsch and Mikó **sp. nov.**, habitus of holotype male (CMNHENT0022751). A. Lateral view. B. Dorsal view. Abbreviation: postocellar carina (pcc).

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single transverse row of distal setae occurring medially with less than 4 setae below it. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: absent. Proximolateral projection of the cupula shape: blunt. Gonocondyle

count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: straight. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending equal to or less than 1/2 of length of gonostyle–volsella complex in dorsal view; dorsomedian conjunctiva extending between 1/3 to 1/2 the length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva absent and parossiculi fused. Medioventral ridge of the gonostyle–volsella complex count (only applicable if medioventral conjunctiva of the gonostyle–volsella complex absent): present. Medioventral ridge of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: ridge extending 2/3 of length of gonostyle–volsella complex in ventral view. Apical parossicular setae count: one. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2. Gonossiculus spine length: one spine more than 2× as long as the other(s). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its proximal 1/3rd. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: absent. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae not of equal length, longer setae present on distodorsal point of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distoventrally. Sensillar ring area of harpe orientation: distoventrally. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: straight but can be more convex or concave in some specimens.



**FIGURE 53.** *Conostigmus dessarti* Trietsch and Mikó **sp. nov.**, paratype male genitalia (PSUC\_FEM 34126). A. Ventral view. B. Lateral view. C. Dorsal view.

**Distribution.** Nearctic.

**Etymology.** This species is named *dessarti* in honor of the great taxonomist Paul Dessart, who worked on Ceraphronoidea from 1962 to 2001.

**Material Examined.** Holotype male: USA: Tennessee: CMNHENT0022751 (CLEV). Paratypes (3 males):

CANADA: 1 male. PSUC\_FEM 33358 (TAMU). USA: North Carolina: 1 male. PSUC\_FEM 34126 (TAMU). USA: Tennessee: 1 male. CMNHENT0022735 (CLEV).

***Conostigmus duncani* Trietsch sp. nov.**

Figs. 54, 55, 56

**Diagnosis.** This Nearctic species is distinguished by the following combination of characters: head width less than  $1.3\times$  wider than the mesosoma; facial pit present; sternaulus absent; mesopostscutellum present; transverse striations on the ventral metapleural area absent; proximodorsal notch of the cupula present and U-shaped, longer than wide; proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape acute; and dorsomedian projection of the gonostyle–volsella complex absent.

The female of this species is unknown.

This species can appear *Dendrocerus*-like in that it lacks a sternaulus, the ocellar triangle can appear obtuse (POL longer than LOL, ocellar triangle with a wide base), and the metapleural sulcus can appear arched in some specimens (including PSUC\_FEM 50388). However, it is not a *Dendrocerus* species because of the presence of the facial pit, independent parossiculi (parossiculi and gonostipes not fused), medioventral conjunctiva of the gonostyle–volsella complex, and cylindrical male antennae. This species differs from *C. lepus* and *C. triangularis*, two other *Dendrocerus*-like species, in that it lacks the transverse striations on the ventral metapleural area (present in both *C. lepus* and *C. triangularis*).

Another similar species is *C. orcasensis*, which also possesses the mesopostscutellum and lacks a sternaulus. However, these species can be distinguished by the male genitalia. The proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape is acute in *C. duncani* and blunt in *C. orcasensis*. The proximodorsal notch of the cupula is present and U-shaped in both species, but it is longer than wide in *C. duncani* and wider than long in *C. orcasensis*. *Conostigmus duncani* also has 1 apical parossicular seta, whereas *C. orcasensis* has 2–3.

**Variability.** The metapleural sulcus can appear straight (PSUC\_FEM 50384) or arched (PSUC\_FEM 50388). Though some specimens have an ocellar triangle with a short base and POL equal to or shorter than OOL (PSUC\_FEM 50259), other specimens have an ocellar triangle with a wide base and POL longer than OOL (PSUC\_FEM 50388, PSUC\_FEM 50380). Both the arched metapleural sulcus and the ocellar triangle with a wide base can give some specimens a *Dendrocerus*-like appearance.

**Description.** Body length: 1.7 mm, 1.925 mm. Color hue pattern in male: cranium, mesosoma except propleuron, metasoma reddish brown to dark brown; propleuron yellow to light brown; legs, basal half of scape and apical half of pedicel ochre to light brown; apical half of scape, flagellomeres and basal half of pedicel brown. Color intensity pattern in male: anterior half of metasoma lighter than posterior half of metasoma; propleuron lighter than the rest of the mesosoma. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 4.0–4.7. Male scape length vs. F1 length: 1.1–1.2. Male F1 length vs. pedicel length: 3.3–4.2. Male F1 length vs. male F2 length: 1.1–1.3. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than  $1.3\times$  wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.3–1.6. Head height (HH) vs. head length (HL): HH:HL=1.2–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.5–1.8. Head width (HW) vs. head height (HH): HW:HH=1.2–1.5. Cephalic size (csb): Mean: 480–550  $\mu\text{m}$ . Maximum eye diameter vs. minimum eye diameter: 1.2–1.4. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base OR POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.2–1.8. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.9–1.5. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.2–1.8:1.1–1.4:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital

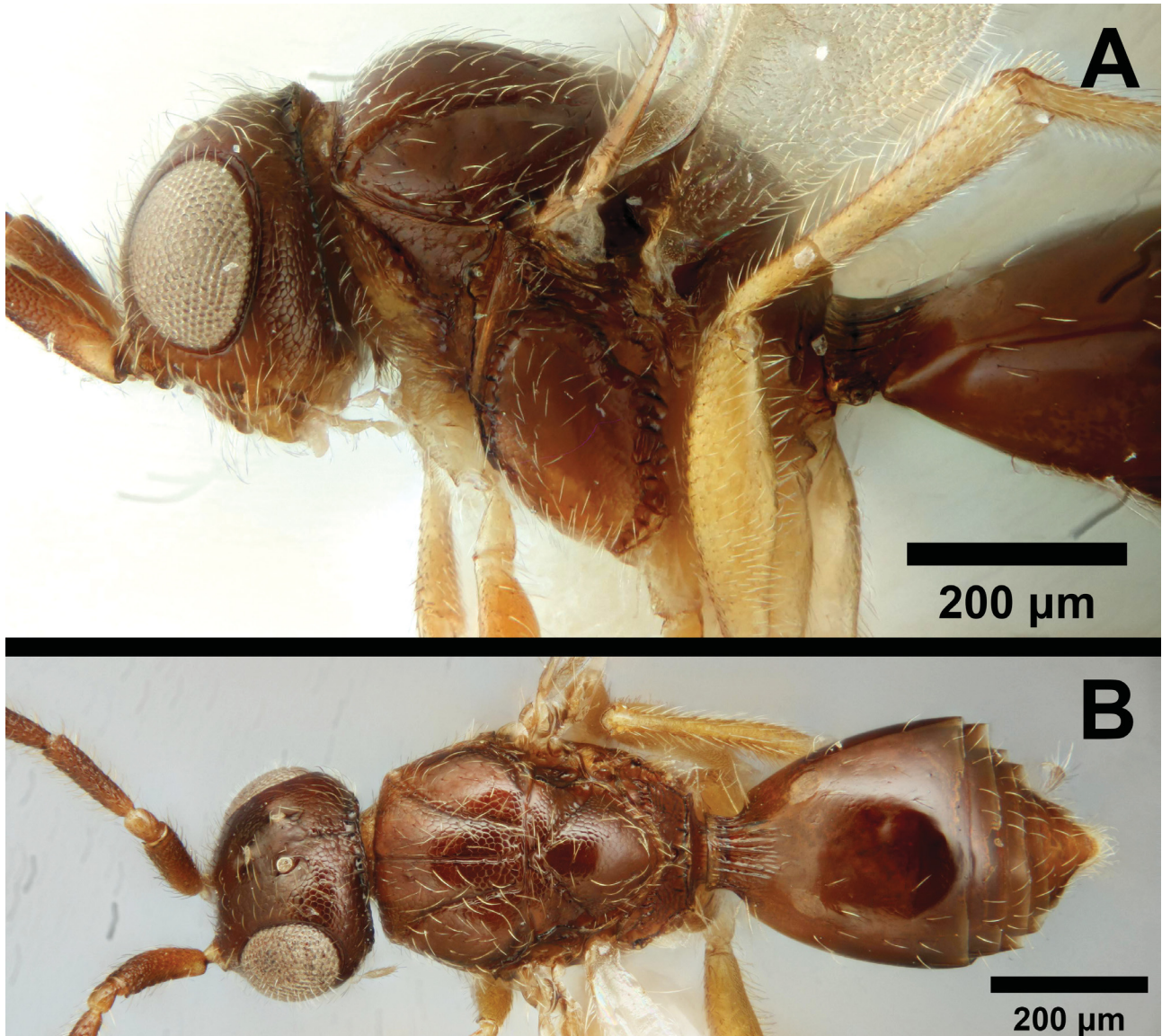
furrow sculpture: crenulate. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: absent. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.



**FIGURE 54.** *Conostigmus duncani* Trietsch **sp. nov.**, male holotype (PSUC\_FEM 50384).

**Mesosoma:** Weber length: WL=800  $\mu$ m, 850  $\mu$ m. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.5–1.9. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.1. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae increases more than 2 $\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adja-

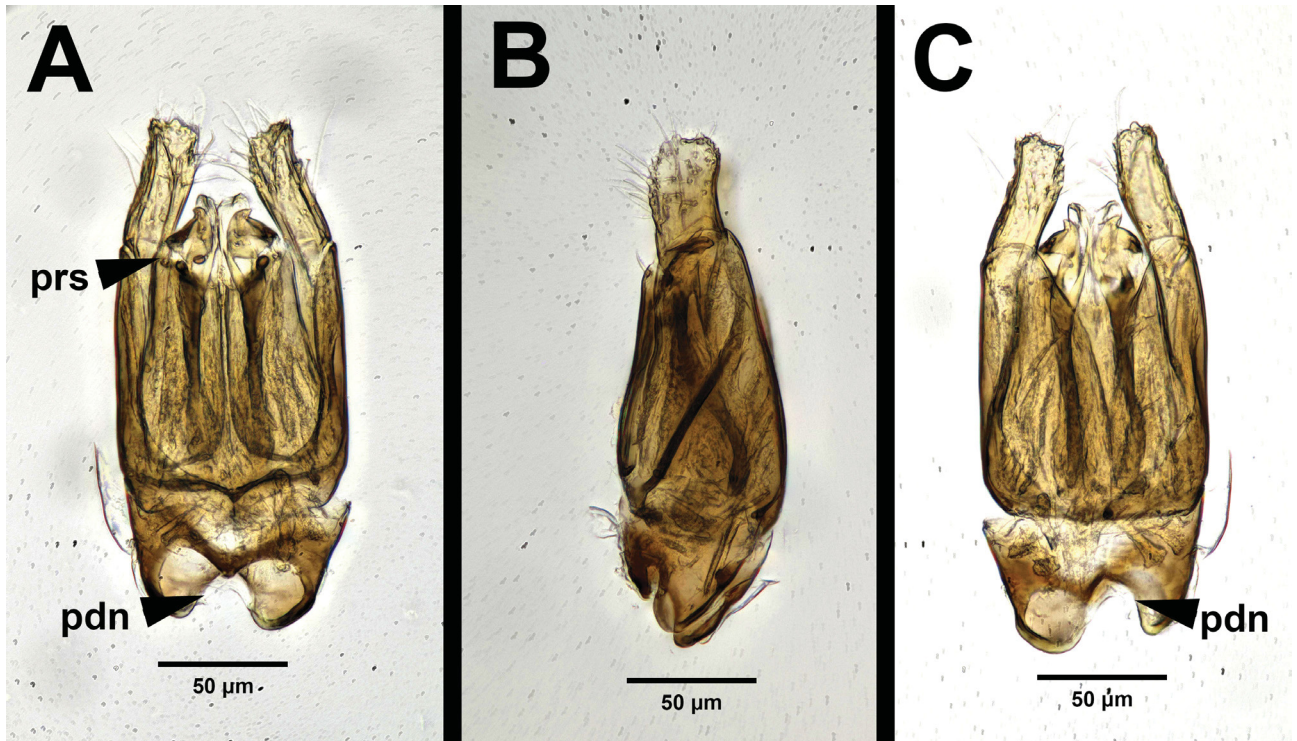
cent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight or arched. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: stermaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Mesopostscutellum count: present (posterior margin of scutellum appears raised). Anteromedian projection of the metanoto-propodeo-metapecto-mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.



**FIGURE 55.** *Conostigmus duncani* Trietsch **sp. nov.** A. Lateral view of paratype (PSUC\_FEM 50388). B. Dorsal view of holotype (PSUC\_FEM 50384).

**Metasoma:** Transverse carina on petiole shape: straight. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.7–2.5. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.5–2.3. Syntergal translucent patch maximum width vs. minimum width: 1.1–2.0. Synsternal translucent patch maximum width vs. minimum width: 1.5–2.3. Syntergal translucent patch maximum width orientation: anteromedially. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae

anterior and lateral to the synsternal translucent patch, with a patch of setae posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least  $2\times$  as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



**FIGURE 56.** *Conostigmus duncani* Trietsch **sp. nov.**, paratype male genitalia (PSUC\_FEM 50380) A. Ventral view. B. Lateral view. C. Dorsal view. Abbreviations: apical parossicular setae (prs); proximodorsal notch of cupula (pdn; in this case, longer than wide).

**Male Genitalia:** Distal margin of male S9 shape: straight. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than  $1/2$  the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: longer than wide. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to  $2/3$  of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine more than  $2\times$  as long as the other(s). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: dorsomedial. Distal margin of harpe in lateral view: blunt or straight. Lateral setae of harpe count: present. Lateral setae of harpe

orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Etymology.** This species is named *duncani* in honor of the first author's partner, Stephen D. Duncan, for his love and support during the course of this research.

**Material Examined.** Holotype male: USA: Wisconsin: PSUC\_FEM 50384 (WIRC). Paratypes (3 males): USA: Wisconsin: 3 males. PSUC\_FEM 50388 (PSUC); PSUC\_FEM 50259, 50380 (WIRC).

### ***Conostigmus franzinii* Trietsch & Mikó sp. nov.**

Figs. 57, 58, 59

**Diagnosis.** This is a widespread and variable species. *Conostigmus franzinii* can be differentiated from all other species by the combination of the following characters: absence of the axillular carinae; presence of an elongate sternaulus (exceeding 3/4 of the mesopleuron length at the level of the sternaulus); absence of the medioventral conjunctiva of the gonostyle–volsella complex (parossiculi fused); presence of the medioventral ridge of the gonostyle–volsella complex; presence of a dense patch of setae on the distoventral edge of the harpe; and presence of distal setae composing a setiferous patch on S9.

Two similar species are *C. musettiae* and *C. bipunctatus*, which share the elongated sternaulus, fused parossiculi and the dense patch of setae on the distoventral edge of the harpe. *Conostigmus franzinii* can be distinguished from *C. musettiae* by the absence of the axillular carinae (present in *C. musettiae*) and the presence of the thick medial patch of setae on S9 (whereas *C. musettiae* has a single transverse row of distal setae occurring medially with less than 4 setae below it). While *C. bipunctatus* is similar to *C. franzinii* in that it is a variable species with a wide Holarctic distribution, *C. franzinii* can be easily distinguished from *C. bipunctatus* by male genitalia characters. In *C. bipunctatus*, the harpe are curved and sickle-shaped and the distoventral margin of harpe is concave in lateral view, whereas in *C. franzinii*, the harpe are simple, not curved or sickle-shaped, and the distoventral margin of harpe is convex in lateral view. Other differences include that *C. franzinii* is always macropterous and lacks the paired blue iridescent ovals on the syntergite, whereas *C. bipunctatus* can be brachypterous and have the paired iridescent ovals present.

*C. franzinii* bears a strong resemblance to *C. minimus* in the shape of the harpe, and shares the elongated sternaulus, fused parossiculi and the dense patch of setae on the distoventral edge of the harpe. *Conostigmus minimus* differs from *C. franzinii* in gonossiculus spine length (spines of equal length in *C. minimus*; one spine more than 2× as long as the others in *C. franzinii*), and in the absence of the medioventral ridge of the gonostyle–volsella complex (present in *C. franzinii*), as well as the ventral projection of the metapleural carina more than or equal to 2× as long as wide (less than 2× as long as wide in *C. franzinii*). The four specimens of *C. minimus* are much smaller than most *C. franzinii* specimens, but these differences can still be seen in smaller *C. franzinii* specimens of the same size as *C. minimus* specimens (UCRC\_ENT 00457072, INHS Insect Collection 287574, INHS Insect Collection 287580), so these differences in male genitalia do not appear to be a function of body size.

**Variability.** Specimens vary in color from brown to black. The proximodorsal notch of the cupula is always present and V-shaped (acute), though the V-shape is more pronounced in some specimens (PSUC\_FEM 50399, INHS Insect Collection 287574) than in others (INHS Insect Collection 287564, UCRC\_ENT 00457072). The dorsomedian projection of the gonostyle–volsella complex is present in most specimens, but reduced or seemingly absent in others (PSUC\_FEM 50399, UCRC\_ENT 00457072). There are also slight variations in coloration, with the neck of the petiole being lighter than the rest of the metasoma in a few specimens (UCRC\_ENT 00457072, INHS Insect Collection 287574).

These variations occur across both Nearctic and Palearctic populations. The only consistent difference between Nearctic and Palearctic populations is that in Palearctic specimens, the dorsomedian conjunctiva of the gonostyle–volsella complex usually extends about 1/2 of the length relative to the length of the gonostyle–volsella complex, whereas in Nearctic specimens, it usually extends about 1/3 of the length relative to the length of the gonostyle–volsella complex.

**Description.** Color hue pattern in male: cranium and mesosoma except for propleuron dark brown to black; F1–F9 brown; legs, coxae ochre; scape, pedicel, mandibles ochre to brown; propleuron light brown to black. Color intensity pattern in male: propleuron lighter than the rest of the mesosoma on a few specimens (CMNHENT0022719, UCRC\_ENT 00457072); flagellomeres darker than scape and pedicel. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 3.7–4.8. Male scape length vs. F1 length: 1.3–1.7. Male F1 length vs. pedicel length: 2.2–3.3. Male F1 length vs. male F2 length: 1.0–1.3. Longest male flagellomere: F1, F2. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

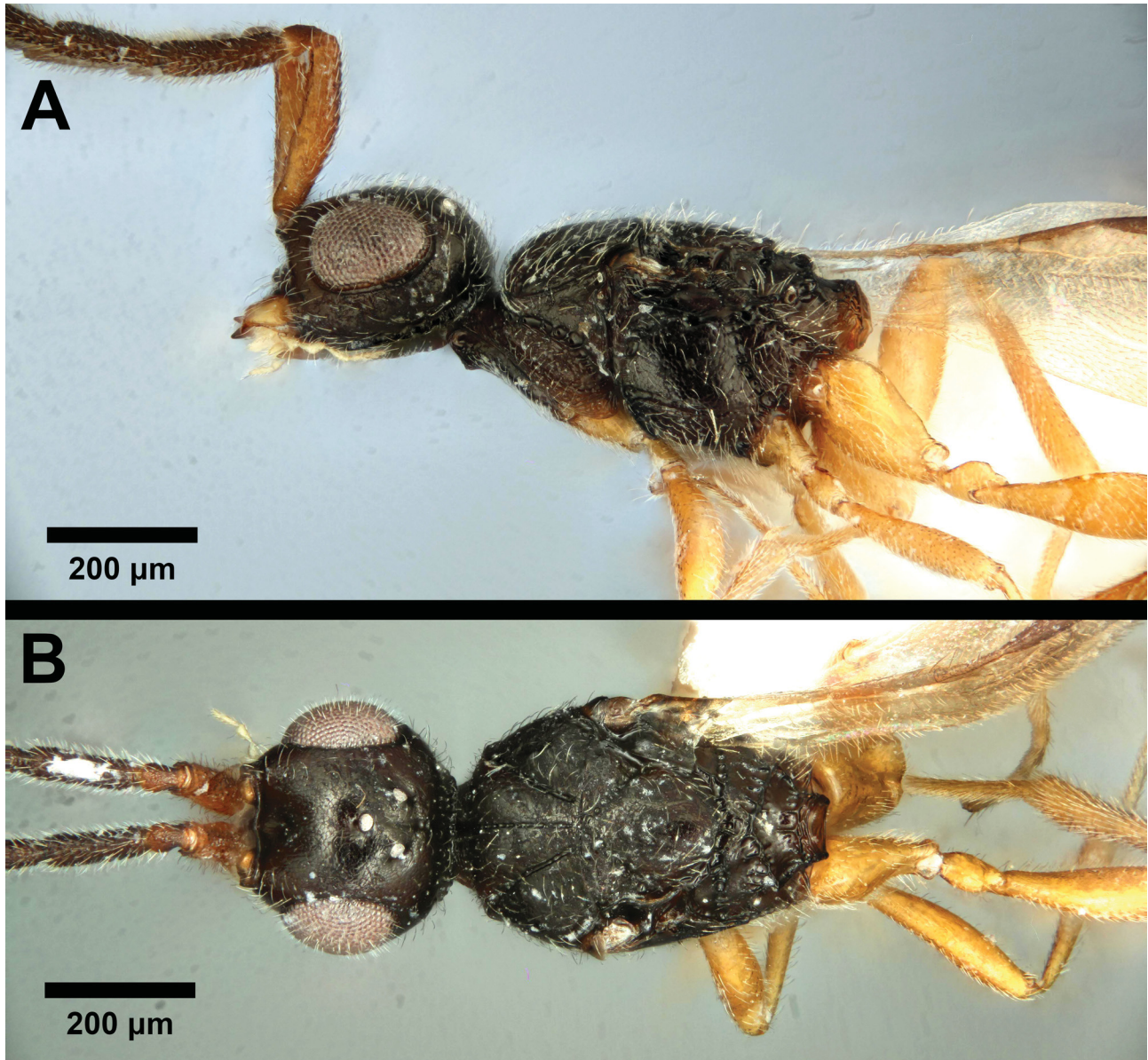


**FIGURE 57.** *Conostigmus franzinii* Trietsch and Mikó **sp. nov.**, habitus of holotype male (PSUC\_FEM 287553).

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.61–1.71. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.6–1.8. Head width (HW) vs. head height (HH): HW:HH=1.2–1.4. Cephalic size (csb): Mean: 340–465 µm. Maximum eye diameter vs. minimum eye diameter: 1.3–1.5. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.7–2.7. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.1–1.5. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.7–2.7:1.5–2.0:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal



pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: blunt. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.



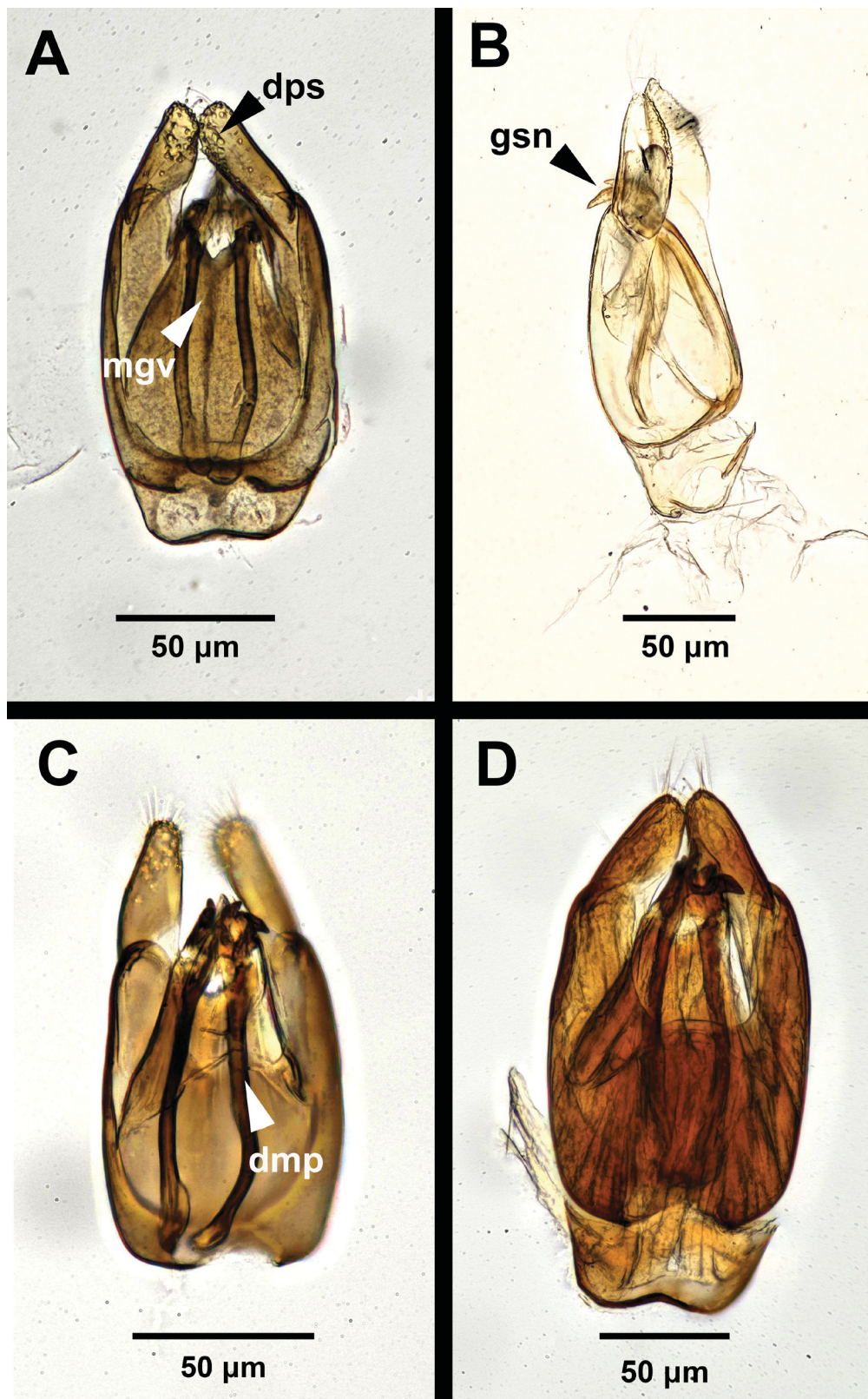
**FIGURE 58.** *Conostigmus franzinii* Trietsch and Mikó **sp. nov.**, paratype male (PSUC\_FEM 15835). A. Lateral view. B. Dorsal view.

**Mesosoma:** Weber length: WL=500–700  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.3–1.7. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.0. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2 $\times$  anteriorly. Notaulus posterior end location: adjacent to trans-

cutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 3/4 of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: less than 2× as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.5–2.2. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.1–2.3. Syntergal translucent patch maximum width vs. minimum width: 1.5–3.0. Synsternal translucent patch maximum width vs. minimum width: 2.2–3.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin; synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing setiferous patch or patches. Male S9 distal setal line / setal patch structure: patch of setae occurring medially. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: notched (inverted V-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: straight. Dorsomedian projection of the gonostyle–volsella complex count: absent; present. Dorsomedian projection of the gonostyle–volsella complex shape: simple (not bilobed). Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending between 1/3 to 1/2 the length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight with a median projection. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva absent and parossiculi fused. Medioventral ridge of the gonostyle–volsella complex count (only applicable if medioventral conjunctiva of the gonostyle–volsella complex absent): present. Medioventral ridge of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: ridge extending 2/3 of length of gonostyle–volsella complex in ventral view. Apical parossicular setae count: one. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent.



**FIGURE 59.** *Conostigmus franzinii* Trietsch and Mikó **sp. nov.**, paratype male genitalia A. Ventral view (INHS Insect Collection 287580). B. Lateral view (PSUC\_FEM 50399). C. Dorsal view of Paelearctic male from Sweden without a pronounced dorsomedian projection of the gonostyle–volsella complex (PSUC\_FEM 43326). D. Dorsal view of male with a pronounced dorsomedian projection of the gonostyle–volsella complex (PSUC\_FEM 86113). Abbreviations: dorsomedian projection of the gonostyle–volsella complex (dmp); dense patch of setae on the distoventral edge of the harpe (dps); gonosticulus spine (gsn); medioventral ridge of the gonostyle–volsella complex (mgv).

Gonossiculus spine count: 2. Gonossiculus spine length: one spine more than 2× as long as the other(s). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its proximal 1/3rd. Distal margin of harpe in lateral view: blunt or straight. Lateral setae of harpe count: absent. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: present. Distal setae on harpe length: setae not of equal length, longer setae present on distodorsal and distoventral edges of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distally. Sensillar ring area of harpe orientation: medioventrally. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Holarctic.

**Etymology.** This species is named *franzinii* in memory of Luca Franzini, a bumble bee researcher and fellow PhD student in the Department of Entomology at Penn State who passed away suddenly during the course of this research.

**Material Examined.** Holotype male: USA: Illinois: INHS Insect Collection 287553 (INHS). Paratypes (24 males): CANADA: 1 male. PSUC\_FEM 15835 (PSUC). GERMANY: 2 males. PSUC\_FEM 26761, 28771 (PSUC). SWEDEN: 5 males. IM 1592; NCSU 0043326, 0052296, 0055652, 0055674 (NCSU). USA: Alaska: 1 male. PSUC\_FEM 50399 (PSUC). USA: California: 4 males. IM 1524 (PSUC); PSUC\_FEM 33990, 34228, 34231 (UCFC). USA: Illinois: 3 males. INHS Insect Collection 287564, 287574, 287580 (INHS). USA: New York: 1 male. PSUC\_FEM 9734 (ROME). USA: Ohio: 2 males. CMNHENT0022719 (CLEV); PSUC\_FEM 86113 (OSUC). USA: Pennsylvania: 2 males. PSUC\_FEM 60374, 68186 (PSUC). USA: Wyoming: 1 male. UCRC\_ENT 00457072 (UCRC). Unknown country: 1 male. INHS Insect Collection 287560 (INHS).

### ***Conostigmus johnsoni* Trietsch & Mikó sp. nov.**

Figs. 60, 61

**Diagnosis.** This species can be distinguished from all other Nearctic *Conostigmus* species by the following combination of characters: occipital carina complete, postocellar carina present, wings present and macropterous, width of the crenulae of the notauli increasing more than 2× anteriorly, sternaulus absent, and proximal end of the dorso-median conjunctiva of the gonostyle–volsella complex shape acute.

The female for this species is unknown.

One similar species is *C. obscurus*, which also has the width of the crenulae of the notauli increasing more than 2× anteriorly, in combination with the presence of the postocellar carina, preoccipital furrow and facial pit. *Conostigmus obscurus* differs in that it has a short sternaulus, whereas *C. johnsoni* does not have a sternaulus. There are also differences in the male genitalia; *C. obscurus* has the proximodorsal notch of the cupula present, U-shaped, and longer than wide, and while *C. johnsoni* has a U-shaped proximodorsal notch present, it is never longer than wide.

This species also has unique coloration; most specimens have different coloration above and below the site of the sternaulus (the sternaulus is absent), with the area ventral to the site of the sternaulus lighter than the area dorsal to the site of the sternaulus. This coloration also occurs in *C. michaeli* and *C. washburni*, which both differ from this species in that the occipital carina is not complete (complete in *C. johnsoni*), and that the widest point of the harpe is at the articulation site with the gonostyle–volsella complex (widest point of harpe between the proximal 1/3rd and 2/3rds in *C. johnsoni*).

**Variability.** The gonocondyle is blunt in some specimens (PSUC\_FEM 68976, PSUC\_FEM 16076) and acute in others (PSUC\_FEM 110/UCFC384702, PSUC\_FEM 8705). The dorsal gonostipes are comprised of two separate pieces that overlap in some specimens and do not in others; there is variation in the character “Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex” based on this. Though most specimens have different coloration above and below the site of the sternaulus, with the area ventral to the site of the sternaulus lighter than the area dorsal to the site of the sternaulus, there is one specimen from Florida that lacks this unique coloration (PSUC\_FEM 110/UCFC384702).

There is also one specimen (CMNHENT0022819) with a teratology in the male genitalia; when viewed laterally, one harpa is wider than the other. This specimen matches the rest in all other characters.

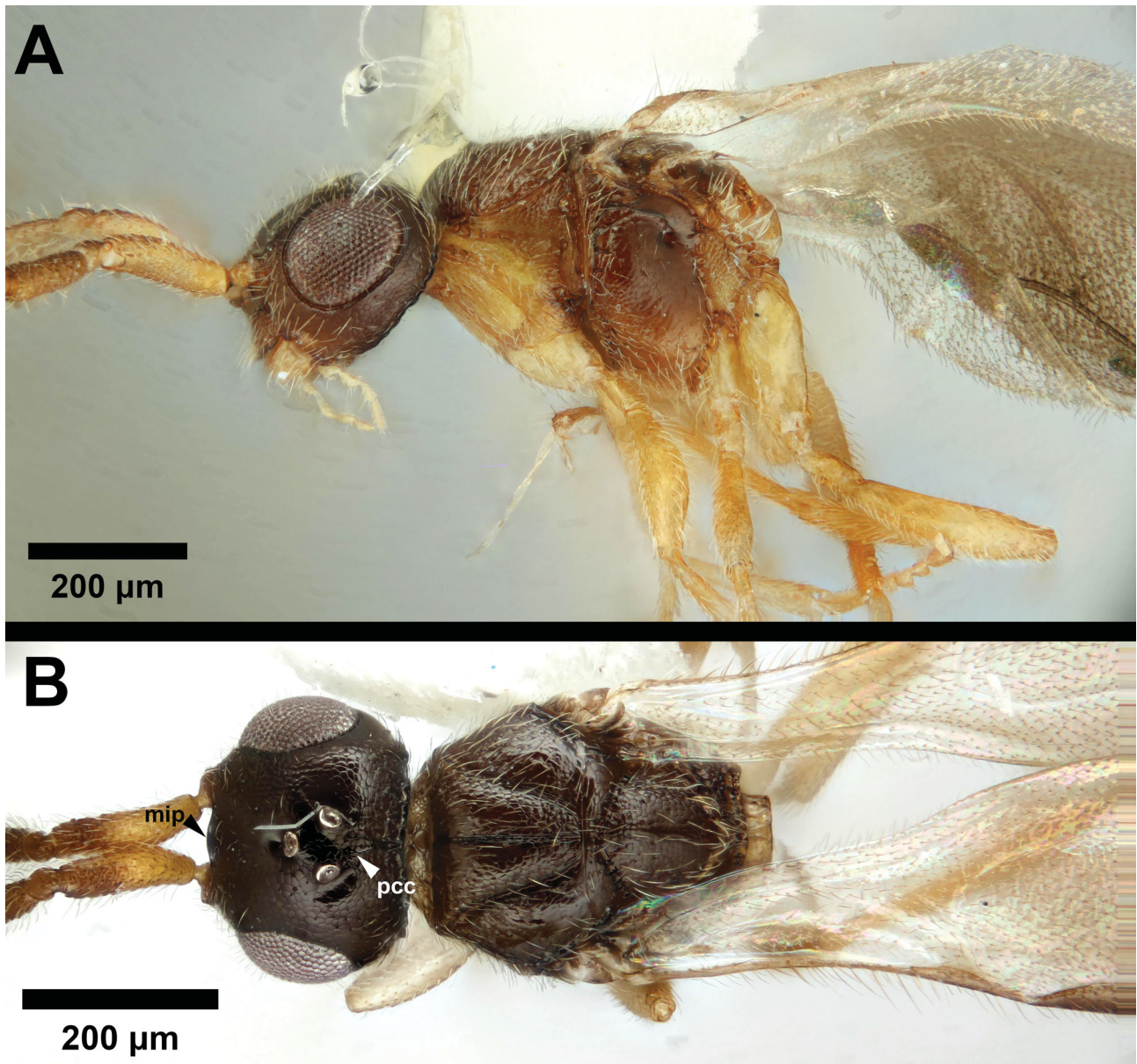
**Description.** Color hue pattern in male: cranium dark brown to black; propleuron yellow; coxae white to yellow; scape ochre to yellow; pedicel and flagellomeres brown; mesosoma brown dorsally and yellow to ochre ventrally. Color intensity pattern in male: cranium darker than mesosoma; area ventral to the site of the sternaulus lighter than the area dorsal to the site of the sternaulus. Color intensity dorsal and ventral to the site of the sternaulus: area ventral to the site of the sternaulus lighter than the area dorsal to the site of the sternaulus. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite; petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 2.7–4.2. Male scape length vs. F1 length: 1.1–1.5. Male F1 length vs. pedicel length: 2.4–3.3. Male F1 length vs. male F2 length: 1.3–1.5. Longest male flagellomere: F1. Longest female flagellomere: F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.2–2.0. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.4–1.7. Head width (HW) vs. head height (HH): HW:HH=1.1–1.5. Cephalic size (csb): Mean: 335–445 µm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.4. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.7–2.5. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.4–1.8. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.7–2.5:1.2–1.8:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus; Preoccipital furrow ends at site of postocellar carina. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: blunt. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: flat; convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=450–700 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.3–1.7. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.8–1.1. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae increases more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: sternaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminial pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: less than 2×

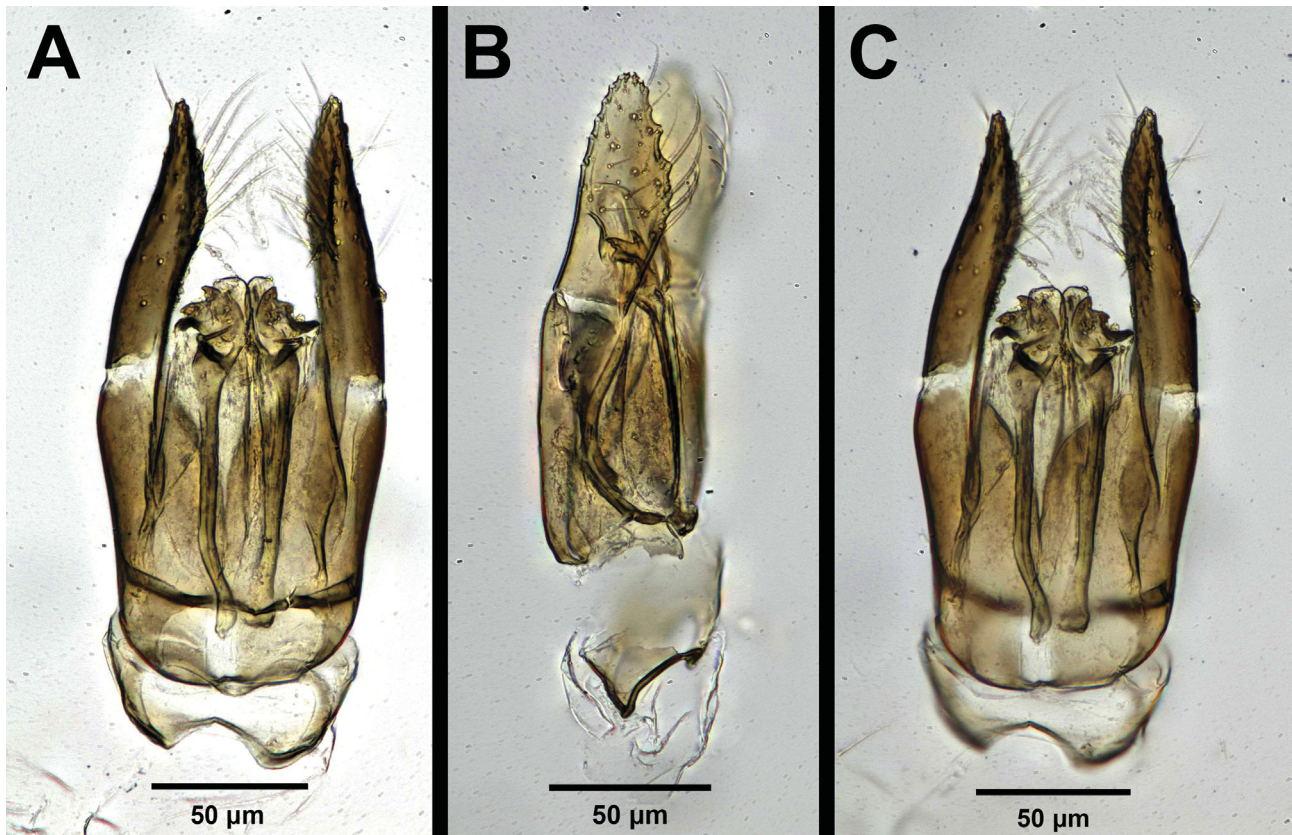
as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight; concave.



**FIGURE 60.** *Conostigmus johnsoni* Trietsch and Mikó sp. nov., paratype males. A. Lateral view (PSUC\_FEM 22819). B. Dorsal view (PSUC\_FEM 16076). Abbreviations: median process on intertorular carina (mip; projection blunt in this case); postocellar carina (pcc).

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.8–2.4. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.0–2.4. Syntergal translucent patch maximum width vs. minimum width: 1.0–1.8. Synsternal translucent patch maximum width vs. minimum width: 1.6–2.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translu-

cent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least as long as the maximum width of the synsternal translucent patch but not  $2\times$  as long. S1 length vs. shortest width: S1 wider than long.



**FIGURE 61.** *Conostigmus johnsoni* Trietsch and Mikó **sp. nov.**, male genitalia. A. Ventral view of holotype (PSUC\_FEM 68976). B. Lateral view of paratype (PSUC\_FEM 110). C. Dorsal view of holotype (PSUC\_FEM 68976).

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing setiferous patch or patches. Male S9 distal setal line / setal patch structure: single or double transverse row of setae, interrupted medially to form two separate patches. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: present with distal setiferous patch/line separated medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than  $1/2$  the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: blunt; acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to  $2/3$  of length of gonostyle–volsella complex in dorsal view; dorsomedian conjunctiva extending equal to or less than  $1/2$  of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than  $2\times$  as long as the other(s) (spines of similar lengths). Harpe length: harpe equal to or shorter than gonostipes in lateral

view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is between proximal 1/3rd and 2/3rds. Distal margin of harpe in lateral view: blunt. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: medially. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Etymology.** This species is named *johnsoni* in honor of Norman F. Johnson for his valuable contributions to the taxonomy and systematics of Ceraphronoidea.

**Material Examined.** Holotype male: USA: Minnesota: PSUC\_FEM 68976 (UMSP). Paratypes (4 males): CANADA: 1 male. PSUC\_FEM 16076 (PSUC). USA: Florida: 1 male. PSUC\_FEM 110 (UCFC). USA: Ohio: 2 males. CMNHENT0022819 (CLEV); PSUC\_FEM 8705 (OSUC).

### *Conostigmus lepus* Trietsch sp. nov.

Figs. 62, 63, 64

**Diagnosis.** *Conostigmus lepus* is the only known *Conostigmus* with transverse striations present and extending across the entire ventral metapleural area, a character that can be used to match males and females. Male *Conostigmus lepus* can also be distinguished from all other species by the presence of submedial projections on the proximal margin of S9 and dense setae evenly distributed across the entire lateral surface of the harpe.

This species is *Dendrocerus*-like in that it has a transverse/triangular head shape, ocelli in an obtuse triangle on males and females, and no sternaulus. It is also *Dendrocerus*-like in that the male flagellomeres can appear asymmetrical or trapezoidal, and some specimens have an arched metapleural sulcus. However, this species is a *Conostigmus* and not a *Dendrocerus* because the male genitalia have independent parossiculi, a character state that is never present in *Dendrocerus*.

This species is similar to *C. triangularis*, another *Dendrocerus*-like *Conostigmus* species, in that they both have the occipital carina not complete, ventral margin of the antennal rim adjacent to the dorsal margin of the clypeus, preoccipital furrow ending at the anterior ocellus, postocellar furrow absent, anteromedian projection present, and sternaulus absent. *Conostigmus lepus* and *C. triangularis* also share the presence of transverse striations on the ventral metapleural area, though in *C. triangularis* these striations only occur on the distal half of the ventral metapleural area, whereas on *C. lepus* they occur across the entire surface of the ventral metapleural area. *Conostigmus triangularis* also has a blunt median projection on the intertorular area, whereas *C. lepus* lacks the median process on the intertorular carina.

In addition to the characters mentioned above, *C. lepus* females can be distinguished from *C. triangularis* females in that the longest female flagellomere is F9 in *C. lepus* and F1 in *C. triangularis*. *Conostigmus triangularis* and *C. lepus* males can easily be distinguished from each other by the vast differences in genitalia morphology, as well as the differences in the male flagellomere ratios.

**Variability.** Some specimens have the metapleural sulcus straight (PSUC\_FEM 32888, PSUC\_FEM 34292), whereas others have it arched (PSUC\_FEM 34295, PSUC\_FEM 32971). Other than slight intraspecific variations in color and size between specimens, we did not note any substantial variations between specimens or between males and females.

**Description.** Body length: 1.70–2.15 mm. Color hue pattern in male: legs light brown to brown; antennae brown to dark brown; cranium, mesosoma dark brown to black. Color intensity pattern in male: metasoma and mandible lighter than mesosoma; metasoma lighter than mesosoma and cranium; scape darker than pedicel and flagellomeres. Color hue pattern female: legs, mandibles ochre to brown; cranium and mesosoma dark brown to black; flagellomeres brown to dark brown; scape and pedicel ochre to dark brown. Color intensity pattern female: metasoma lighter than mesosoma and cranium; scape and pedicel lighter than flagellomeres. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.



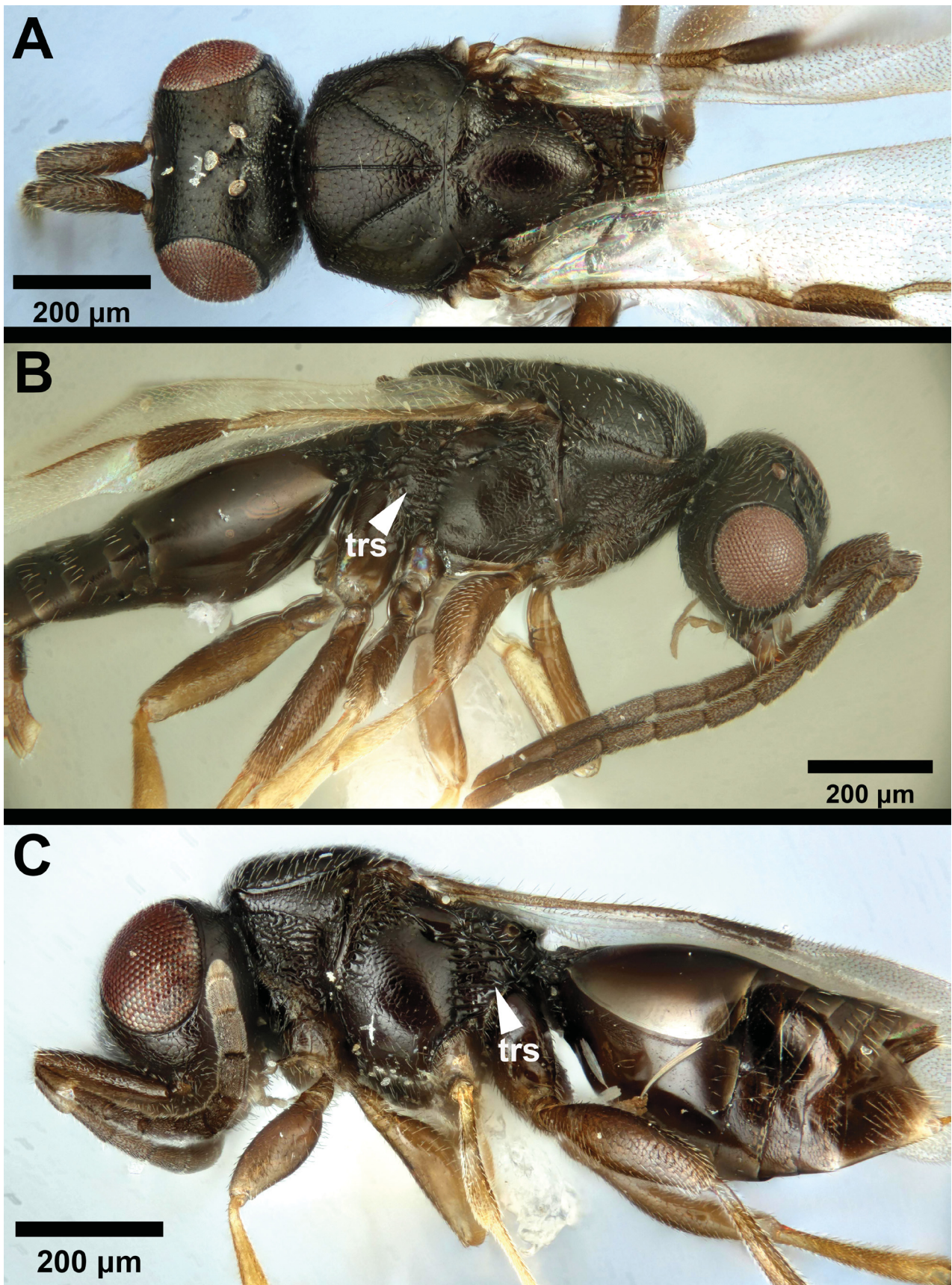
**Antennae:** Male scape length vs. pedicel length: 2.7–3.8. Male scape length vs. F1 length: 1.6–1.9. Male F1 length vs. pedicel length: 1.5–2.0. Male F1 length vs. male F2 length: 1.0–1.2. Longest male flagellomere: F9, though all flagellomeres similar in length. Female scape length vs. pedicel length: 2.6–3.4. Female scape length vs. F1 length: 2.4–3.3. Female F1 length vs. F2 length: 1.2–1.6. Female F1 length vs. pedicel length: 0.9–1.4. Longest female flagellomere: F9. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): male HH:EHf=1.3–1.9; female HH:EHf=1.3–1.4. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): male HW:IOS=1.7–1.9; female HW:IOS=1.8–2.2. Head width (HW) vs. head height (HH): male HW:HH=1.3–1.6; female HW:IOS=1.1–1.6. Cephalic size (csb): Mean: 375–565 µm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.6. POL:OOL: POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.8–3.7. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.9–1.4. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8–3.7:2.0–2.7:1.0. Female ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL 1.7–2.5× as long as LOL. Female ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.7–2.5:2.0–2.3:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends at anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present, sometimes with the impression of a facial sulcus between the facial pit and the anterior ocellus. Facial pit count: present. Facial sulcus count: absent but some specimens with the impression of a facial sulcus between the facial pit and the anterior ocellus. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: absent. Median region of intertorular area shape: flat; convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: adjacent. Torulo–clypeal carina count: absent. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

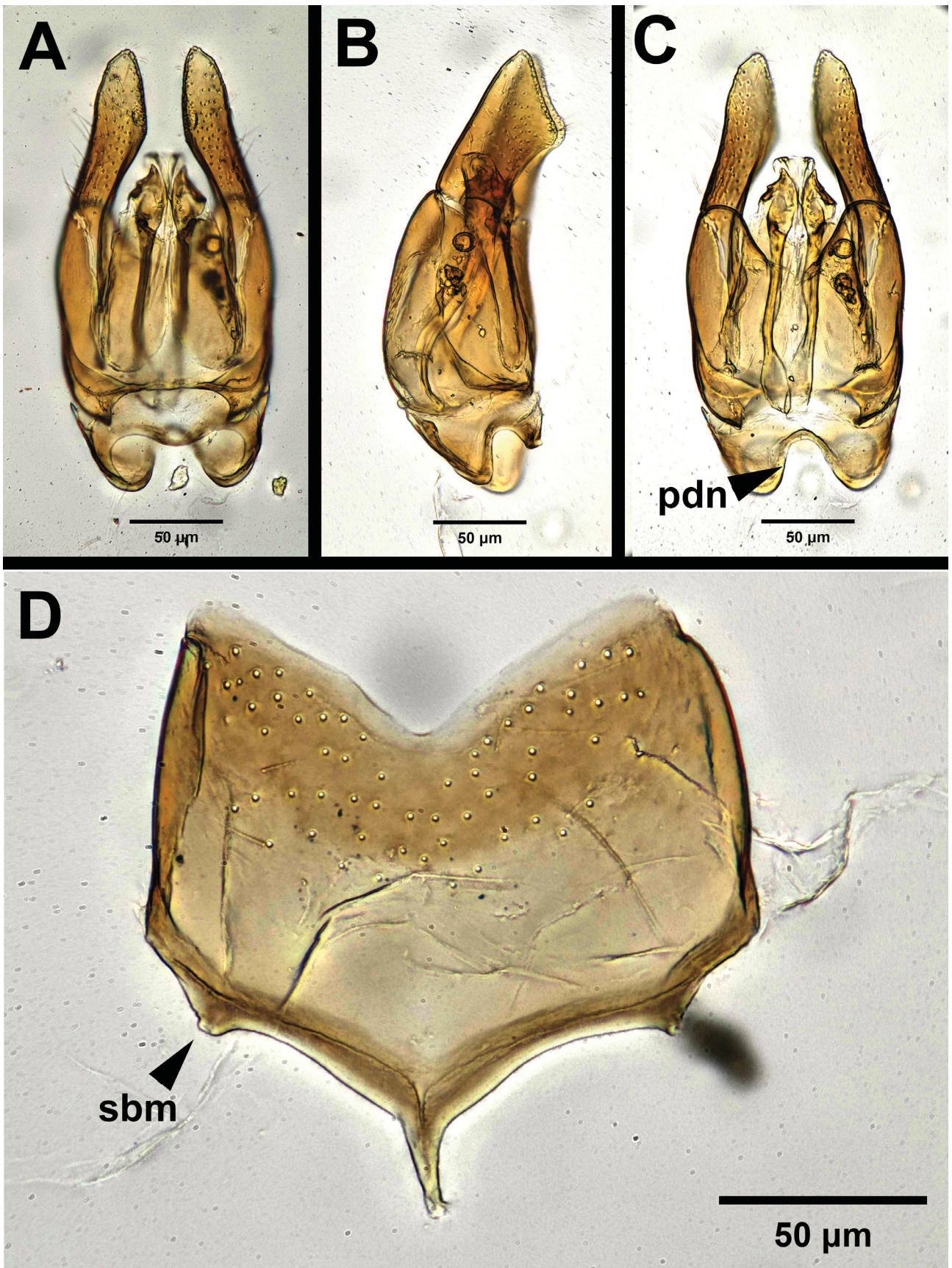
**Mesosoma:** Weber length: WL=550–850 µm. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.7–0.9. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.4–2.0. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 1.0–1.1. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2× anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight or arched. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: sternaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit absent; epicnemial carina curved. Transverse striations on the ventral metapleural area count: present. Transverse striations on the ventral metapleural area ventral limit: transverse striations occurring across entire ventral metapleural area. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: present. Posterior margin of nucha in dorsal view shape: concave.



**FIGURE 62.** *Conostigmus lepus* Trietsch **sp. nov.**, lateral view. A. Holotype male (PSUC\_FEM 32888). B. Paratype female (PSUC\_FEM 34292).



**FIGURE 63.** *Conostigmus lepus* Trietsch **sp. nov.** A. Paratype male, dorsal view (PSUC\_FEM 33132). B. Holotype male, lateral view (PSUC\_FEM 32888). C. Paratype female, lateral view (PSUC\_FEM 34292). Abbreviation: transverse striations on ventral metapleural area (trs).



**FIGURE 64.** *Conostigmus lepus* Trietsch **sp. nov.**, paratype male genitalia. A. Ventral view (PSUC\_FEM 34295). B. Lateral view (PSUC\_FEM 34295). C. Dorsal view (PSUC\_FEM 34295). D. S9 (UCRC\_ENT 00227058). Abbreviations: proximodorsal notch of cupula (pdn; in this case, longer than wide); submedial projections on proximal margin of S9 (sbm).

**Metasoma:** Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 3.0 (UCRC\_ENT 00227058). Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.5 (UCRC\_ENT 00227058). Syntergal translucent patch maximum width vs. minimum width: 1.6–1.8. Synsternal translucent patch maximum width vs. minimum width: 2.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear. Synsternal setiferous patch structure: patch of equal width anterior and posterior to the synsternal translucent patch, comprised of 2 or more rows of setae. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

**Male Genitalia:** Distal margin of male S9 shape: concave. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: 3 or more transverse rows of setae with additional setae scattered between them. Disto-median hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: present. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long; longer than wide. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: blunt. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending equal to or less than 1/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its distal 1/3rd. Distal margin of harpe in lateral view: blunt or straight. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae dense, evenly distributed across entire lateral surface of harpe. Dense patch of setae on the distoventral edge of the harpe count: present. Distal setae on harpe length: setae not of equal length, longer setae present on distoventral edge of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distoventrally. Sensillar ring area of harpe orientation: distoventrally. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Etymology.** The name *lepus* refers to the setaceous harpe, which resemble rabbit ears.

**Material Examined.** Holotype male: USA: Arizona: PSUC\_FEM 32888, UCFC 0208171 (UCFC). Paratypes (3 males, 18 females): USA: Arizona: 2 males, 18 females. PSUC\_FEM 32603, 32912, 32971, 33132, 33146, 33985, 33986, 33988, 34033, 34061, 34080, 34104, 34115, 34242, 34248, 34283, 34285, 34292, 34295, 34297 (UCFC). USA: California: 1 male. UCRC\_ENT 00227058 (UCRC).

### ***Conostigmus longiharpes* Trietsch sp. nov.**

Figs. 65, 66, 67

**Diagnosis.** Males of this species are distinguished by the following combination of characters: facial sulcus absent;

preoccipital furrow absent; sternaulus absent; shortest width of petiole neck vs. syntergal translucent patch maximum width: 3.0–4.0; shortest width of petiole neck vs. synsternal translucent patch maximum width: 3.0–4.5; parosiculi not fused; and length of the harpe equal to or longer than the length of the gonostipes in lateral view.

The female of this species is unknown.

This species is unique in that it has very small syntergal and synsternal translucent patches; the ratios of the shortest width of the petiole neck vs. the syntergal and the synsternal translucent patch maximum widths are both greater than 3.0. The only other species with these two ratios greater than 3.0 is *C. orcasensis*, which differs from *C. longiharpes* in that the mesopostscutellum is present and the width of the crenulae of the notauli increases more than 2× anteriorly.

This species is also one of the few *Conostigmus* with the length of the harpe equal to or longer than the length of the gonostipes in lateral view. The male genitalia are very similar to a Palearctic species, *C. difformis* (Boheman), 1832, which Dessart (1993) redescribed and illustrated after viewing the types in Lund (this information missing from Johnson and Musetti, 2004). However, these are not the same species because *C. difformis* has a facial suture, whereas *C. longiharpes* does not. *Conostigmus difformis* is also only known from the Palearctic, whereas *C. longiharpes* is only known from the Nearctic. The only other two species that occur in the Nearctic and have long harpe are *C. abdominalis* and *C. pulchellus*, but both of these species also have a facial suture, postocellar carina, and elongate sternaulus, which are all absent in *C. longiharpes*.

The Nearctic species most similar to *C. longiharpes* is *C. nigrorufus*, which shares the absence of the sternaulus. However, the syntergal and synsternal translucent patches are much smaller in *C. longiharpes* than in *C. nigrorufus*. There are also similarities in the male genitalia of both species, including the following characters: one apical parosicular seta; proximodorsal notch of the cupula present and arched (inverted U-shape); medioventral conjunctiva of the gonostyle–volsella complex present (parosiculi not fused); harpe simple (not bilobed); and the dorsomedial margin of gonostyle–volsella complex V-shaped. However, upon looking laterally, it is easy to distinguish the male genitalia by the length of the harpe, which are shorter than the length of the gonostipes in *C. nigrorufus* but equal to or longer than the length of the gonostipes in *C. longiharpes*.

**Variability.** There is variability in the preoccipital lunula based on specimen size. The preoccipital lunula is present on larger specimens (PSUC\_FEM 36108, PSUC\_FEM 36092) and small or absent on smaller specimens (PSUC\_FEM 88192, PSUC\_FEM 36051, UCRC\_ENT 00457092). There are also slight variations in color between specimens, with some specimens having lighter brown or yellow coloration on the petiole or pronotum.

**Description.** Body length: 1.275–1.550 mm. Color hue pattern in male: cranium, mesosoma and metasoma brown to dark brown; mandible, legs, pedicel and scape ochre to light brown; F1–F9 light brown to brown. Color intensity pattern in male: cranium darker than mesosoma, flagellomeres darker than legs; mandible lighter than cranium; pronotum sometimes lighter than rest of mesosoma; petiole neck sometimes lighter than rest of metasoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite; petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 3.2–5.0. Male scape length vs. F1 length: 1.4–1.9. Male F1 length vs. pedicel length: 2.2–3.0. Male F1 length vs. male F2 length: 1.2–1.4. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.3–1.7. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.8–2.0. Head width (HW) vs. head height (HH): HW:HH=1.2–1.4. Cephalic size (csb): Mean: 300–450 µm. Maximum eye diameter vs. minimum eye diameter: 1.2–1.5. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=2.0–2.7. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.1–1.4. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.0–2.7:1.6–2.4:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: absent; present. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends posterior to ocellar triangle. Preoccipital furrow sculpture: crenulate. Postocellar carina count:

absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: blunt. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

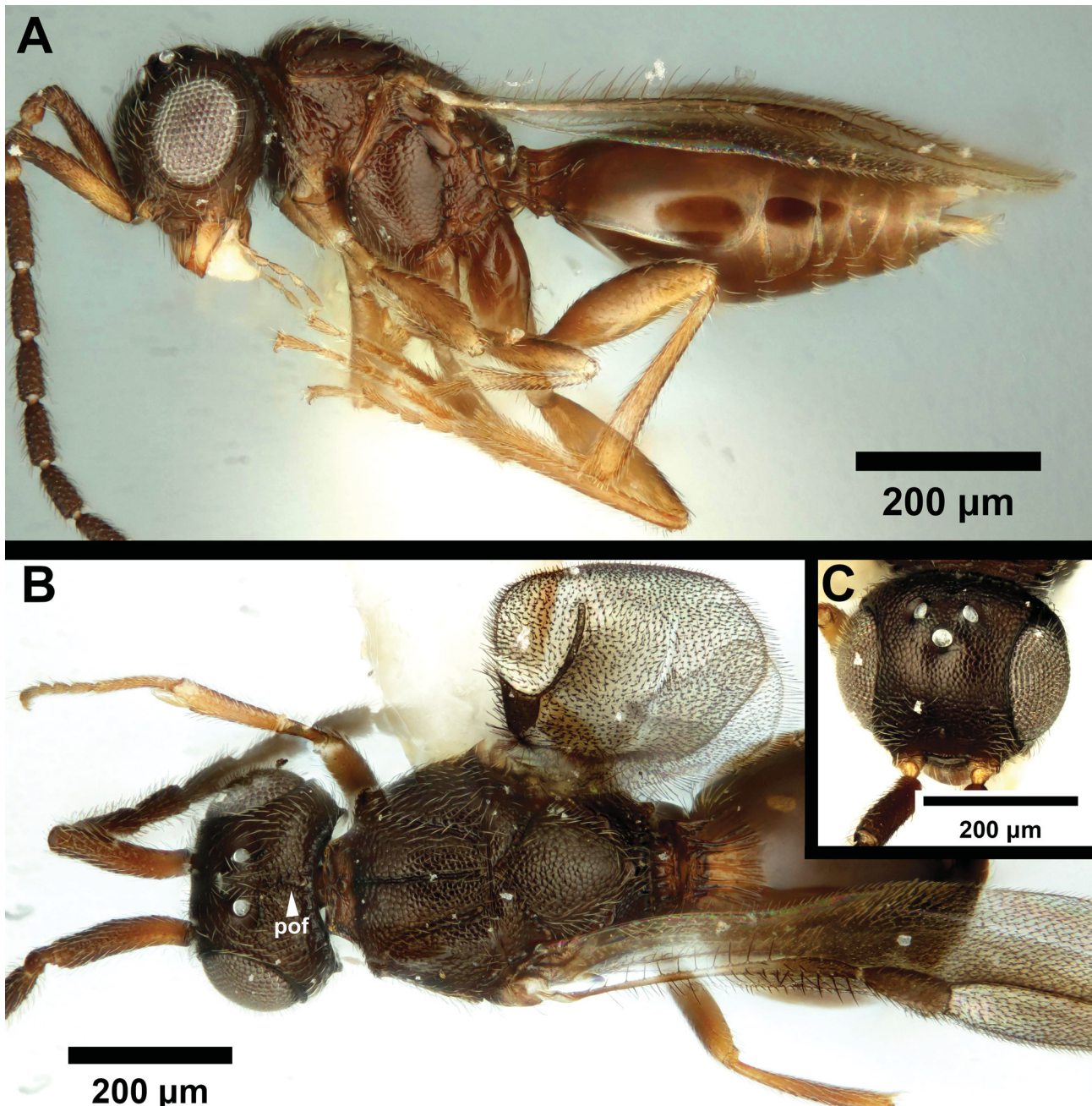


**FIGURE 65.** *Conostigmus longiharpes* Trietsch **sp. nov.**, habitus of male holotype (PSUC\_FEM 88145).

**Mesosoma:** Weber length:  $WL=400\text{--}650\ \mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW):  $AscW/PscW=0.7\text{--}0.8$ . Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW):  $MscL/AscW=1.2\text{--}1.6$ . Mesoscutal length (MscL) vs. mesoscutellar length (MscIL):  $MscL:MscIL=0.8\text{--}1.0$ . Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than  $2\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Meso-metapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: sternaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “V” (left and right lateral propodeal carinae are adjacent medially at their intersection with antecostal sulcus of the first abdominal tergum). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

**Metasoma:** Transverse carina on petiole shape: straight. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 3.0–4.0. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 3.0–4.5. Syntergal translucent patch

maximum width vs. minimum width: 1.1–1.7. Synsternal translucent patch maximum width vs. minimum width: 1.3–2.5. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterior–posteriorly. Synsternal setiferous patch shape: linear. Synsternal setiferous patch structure: comprised of a single row of setae anterior and posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin; synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

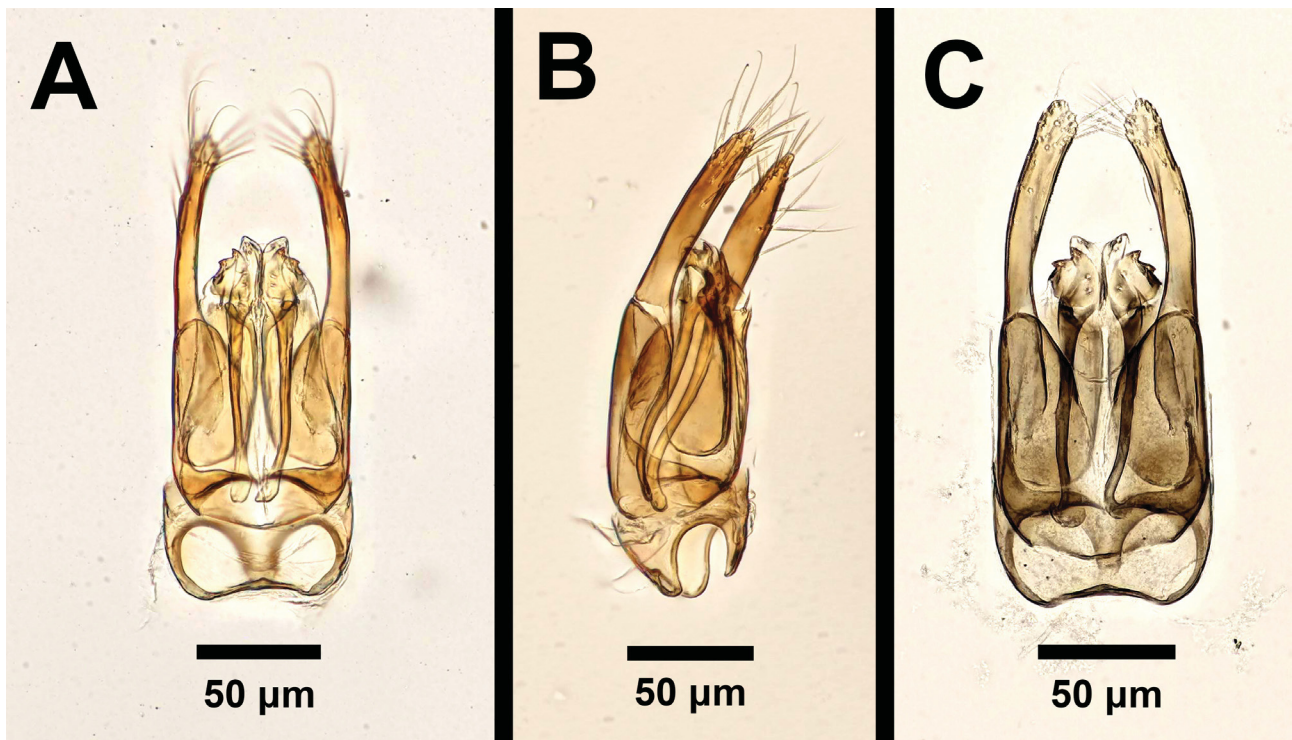


**FIGURE 66.** *Conostigmus longiharpes* Trietsch **sp. nov.** A. Lateral view of holotype (PSUC\_FEM 88145). B. Dorsal view of paratype (PSUC\_FEM 34295). C. Anterior view of frons in paratype. (PSUC\_FEM 34295). Abbreviation: preoccipital furrow (pof).



**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: 2 or more transverse rows of setae with additional setae scattered between them. Disto-median hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: blunt. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe equal to or longer than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: medially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.



**FIGURE 67.** *Conostigmus longiharpes* Trietsch sp. nov., paratype male genitalia. A. Ventral view (PSUC\_FEM 26707). B. Lateral view (PSUC\_FEM 27056). C. Dorsal view (PSUC\_FEM 88192).

**Etymology.** This species is named *longiharpes* after the harpe, which are longer than the gonostipes in lateral view. This is a character that is only shared by three other species, *C. abdominalis*, *C. difformis* and *C. pulchellus*, which are all easily differentiated from this species by the presence of the facial sulcus (absent in *C. longiharpes*).

**Material Examined.** Holotype male: USA: California: PSUC\_FEM 88145, UCRC\_ENT 00103685 (UCRC). Paratypes (15 males): USA: California: 15 males. PSUC\_FEM 26681, 26707, 26709, 26848, 27056, 27198 (OSUC); PSUC\_FEM 36051, 36092, 36108, 36113, 88187, 88188, 88192, 92182; UCRC\_ENT 00457092 (UCRC).

### ***Conostigmus michaeli* Trietsch sp. nov.**

Figs. 68, 69

**Diagnosis.** This species can be differentiated from all other Nearctic *Conostigmus* by the following combination of characters: median process on the intertorular carina present and blunt; facial pit absent; occipital carina not complete; postocellar carina absent; preoccipital furrow present or absent, but if present, then appearing as a faint impression, never crenulate; sternaulus absent; wings present and macropterous; medioventral conjunctiva of the gonostyle–volsella complex present (parossiculi independent); and proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape acute. This species also has unique coloration, with the head and mesosoma lighter than the metasoma, the posterior half of the metasoma darker than the anterior half, and the flagellomeres darker than the head, mesosoma, scape, and pedicel. The anterior half of the metasoma is yellow to brown, whereas the posterior half of the metasoma is dark brown to black.

The female is unknown for this species.

Similar species include *C. erythrothorax*, which also has an incomplete occipital carina and lacks a facial pit, postocellar carina, and sternaulus. The two species also have similar male genitalia, with the medioventral conjunctiva of the gonostyle–volsella complex present (parossiculi independent), proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape acute, one apical parossicular seta, gonocondyle acute, and the proximodorsal notch of cupula present, U-shaped and wider than long. However, these two species differ in that all known specimens of *C. erythrothorax* are brachypterous, whereas all known specimens of *C. michaeli* are macropterous. There are also differences in the ocellar triangle ratios, with OOL:POL equal to 1.0 in *C. erythrothorax* males but less than 0.8 in *C. michaeli* males, and OOL:LOL over 1.6 in *C. erythrothorax* males but equal to or less than 1.3 in *C. michaeli* males.

It is possible that these differences could be intraspecific based on nutrition, locality, and the presence or absence of the wings; however, the smallest specimens of *C. michaeli* are the same size as the largest specimens of *C. erythrothorax*. There are no macropterous *C. erythrothorax* and no brachypterous *C. michaeli* known, but even such a variable species as *C. bipunctatus* that has macropterous and brachypterous forms still does not have differences in ocellar ratios as great as those observed between *C. erythrothorax* and *C. michaeli*. Future work could show these two species to represent different populations of macropterous and brachypterous forms of the same species, but until such work proves otherwise, it is our hypothesis that these are two different species.

**Variability.** As in *C. erythrothorax*, the preoccipital furrow can be present in some specimens (PSUC\_FEM 34214, PSUC\_FEM 34055, PSUC\_FEM 33153) and absent in others (PSUC\_FEM 5345, PSUC\_FEM 34151, PSUC\_FEM 34078). When present, it appears as a faint impression, never as a crenulate carina, and it can appear to reach the ocellar triangle (PSUC\_FEM 34214, PSUC\_FEM 34055) or end posterior to it (PSUC\_FEM 33153).

There is also variation in color within this species. Some specimens have lighter coloration (PSUC\_FEM 34055, PSUC\_FEM 34078) than others (PSUC\_FEM 34214, PSUC\_FEM 34232), though all have darker coloration on the posterior half of the metasoma and the dorsal half of the cranium. Some specimens even have coloration reminiscent of *C. nigrorufus*, with the anterior half of the mesosoma yellow (PSUC\_FEM 34078, PSUC\_FEM 34156).

Concerning the color intensity dorsal and ventral to the site of the sternaulus: on some specimens the area ventral to the site of the sternaulus is lighter than the area dorsal to the site of the sternaulus (PSUC\_FEM 34055/UCFC 381232, PSUC\_FEM 5345), whereas on other specimens these two regions are concolorous (PSUC\_FEM 34078, PSUC\_FEM 34214).

**Description.** Body length: 1.275–1.425 mm. Color hue pattern in male: cranium, mesosoma yellow to brown; legs except coxae, scape, pedicel ochre to brown; anterior half of metasoma yellow to brown; posterior half of metasoma dark brown to black; coxae white to ochre; flagellomeres brown to dark brown. Color intensity pattern

in male: flagellomeres darker than scape and pedicel; anterior half of metasoma lighter than posterior half of metasoma; propleuron lighter than the rest of the mesosoma; petiole neck lighter than rest of metasoma; ventral region of cranium is lighter than dorsal region of cranium; anterior half of mesosoma lighter than posterior half of mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous; area ventral to the site of the sternaulus lighter than the area dorsal to the site of the sternaulus. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

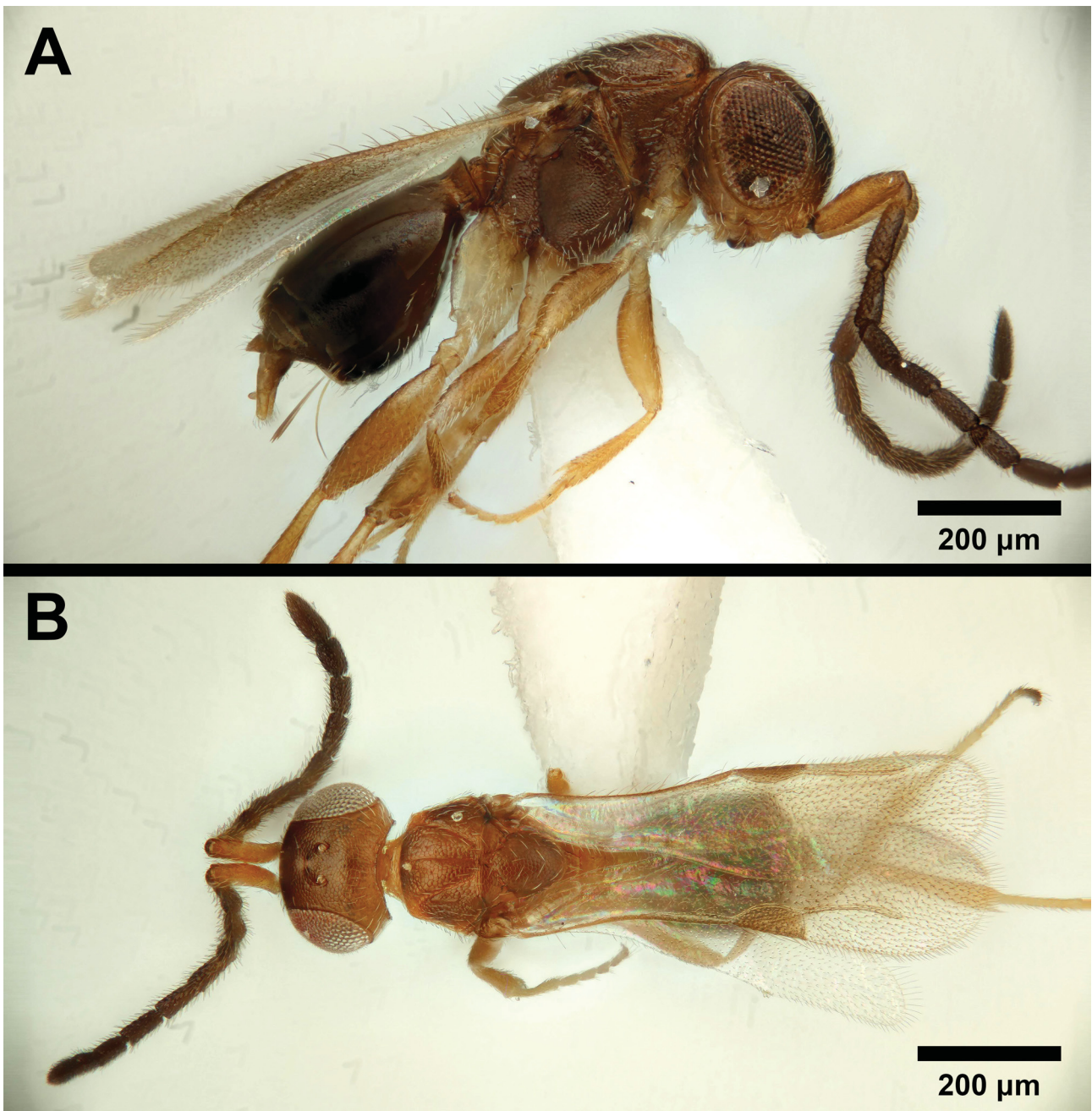
**Antennae:** Male scape length vs. pedicel length: 3.2–3.7. Male scape length vs. F1 length: 1.2–1.4. Male F1 length vs. pedicel length: 2.4–2.9. Male F1 length vs. male F2 length: 1.0–1.2. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than  $1.3\times$  wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.2–1.8. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.9–2.2. Head width (HW) vs. head height (HH): HW:HH=1.2–1.5. Cephalic size (csb): Mean: 300–450  $\mu\text{m}$ . Maximum eye diameter vs. minimum eye diameter: 1.3–1.5. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base OR POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.1–1.3. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.6–0.8. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.1–1.3:1.2–2.0:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: absent. Preoccipital carina count: present. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: absent; present. Preoccipital furrow anterior end: preoccipital furrow ends posterior to ocellar triangle; preoccipital furrow ends at site of postocellar carina. Preoccipital furrow sculpture: appearing as a faint impression, smooth. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina dorsal to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: blunt. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

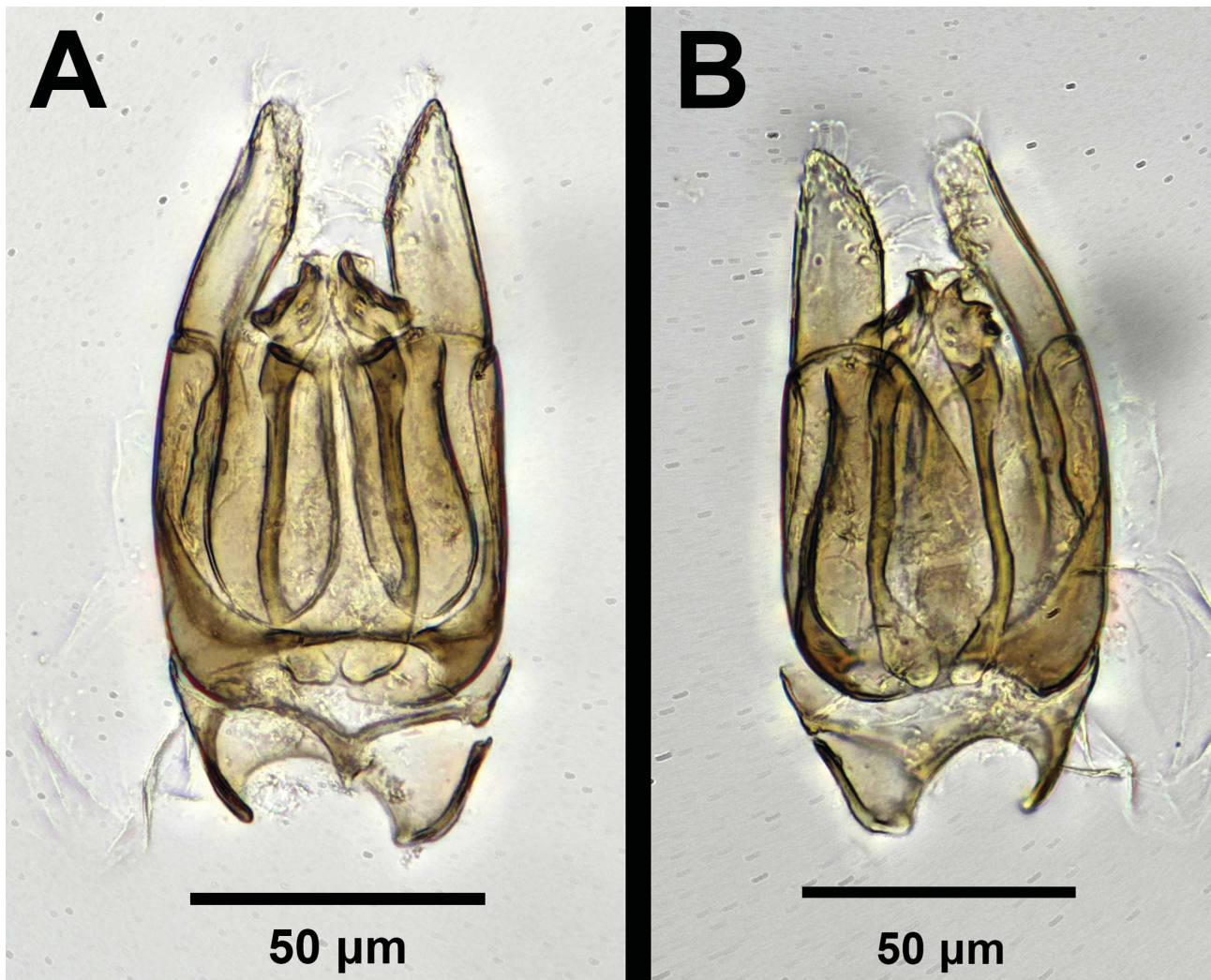
**Mesosoma:** Weber length: WL=440–600  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.7–0.9. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.4–1.7. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.8–1.2. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than  $2\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: sternaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “U” (left and right lateral propodeal carina are adjacent to the antecostal sulcus of the first abdominal tergum submedially). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection

of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

**Metasoma:** Transverse carina on petiole shape: straight. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 2.2–2.7. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.8–2.3. Syntergal translucent patch maximum width vs. minimum width: 1.0–1.8. Synsternal translucent patch maximum width vs. minimum width: 1.4–2.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear. Synsternal setiferous patch structure: comprised of a single row of setae. Synsternal setiferous patch anterior end: synsternal setiferous patch begins lateral to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



**FIGURE 68.** *Conostigmus michaeli* Trietsch **sp. nov.**, male holotype (PSUC\_FEM 34232). A. Lateral view. B. Dorsal view.



**FIGURE 69.** *Conostigmus michaeli* Trietsch **sp. nov.**, paratype male genitalia (PSUC\_FEM 34214). A. Ventral view. B. Dorsal view.

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths).

Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: straight.

**Distribution.** Nearctic.

**Etymology.** This species is named *michaeli* in honor of the first author's father, Michael Thomas Trietsch, for his love and support during the course of this research.

**Material Examined.** Holotype male: USA: Florida: PSUC\_FEM 34232, UCFC 88670 (UCFC). Paratypes (7 males): USA: Florida: 6 males. PSUC\_FEM 5345, 33153, 34055, 34141, 34156, 34214 (UCFC). USA: Texas: 1 male. PSUC\_FEM 34078 (TAMU).

### ***Conostigmus minimus* Trietsch & Mikó sp. nov.**

Figs. 70, 71

**Diagnosis.** This species shares several characters in common with *C. laeviceps*, *C. musettiae*, *C. franzinii*, and *C. bipunctatus*, including the following: facial pit present; preoccipital furrow present; median process on the intertorular carina present and acute; sternaulus present and elongate, exceeding 3/4 of the mesopleuron length at the level of the sternaulus; ventral projection of the metapleural carina present; medioventral conjunctiva absent and parossiculi fused; and gonocondyle present and acute. *Conostigmus minimus* can be differentiated from *C. laeviceps*, *C. musettiae*, *C. franzinii*, and *C. bipunctatus* by the male genitalia characters, specifically by the absence of the medioventral ridge of the gonostyle–volsella complex and the gonossicular spines of similar lengths (one spine not more than 2× as long as the others).

The female of this species is unknown.

It is worth noting that this species is known from only four specimens, and that these specimens are much smaller than most *C. franzinii*. It is possible that the medioventral ridge and gonossicular spines are simply not as developed in specimens this small, and that these specimens may be the same species as *C. franzinii*. However, if this were the case, we would also expect other characters, such as the sternaulus, the median process of the intertorular carina, and the ventral projection of the metapleural carina to be less developed or absent in *C. minimus*, but these features are as fully developed in *C. minimus* as in *C. franzinii*. In fact, the ventral projection of the metapleural carina is more than or equal to 2× as long as wide in *C. minimus* and less than 2× as long as wide in *C. franzinii*. In addition, the genitalia differences can still be seen in smaller *C. franzinii* specimens of the same size as *C. minimus* specimens (UCRC\_ENT 00457072, INHS Insect Collection 287574, INHS Insect Collection 287580), so these differences in male genitalia do not appear to be a function of body size. Based on these differences, it is our hypothesis that *C. minimus* and *C. franzinii* are separate species.

**Variability.** Other than slight differences in size and coloration, no variations were observed between the four specimens.

**Description.** Body length: 1.425–1.475 mm. Color hue pattern in male: cranium, mesosoma, posterior part of metasoma brown; scape, F1–F9, pedicel, forelegs, midlegs, hindlegs, neck of petiole and anterior portion of metasoma yellow. Color intensity pattern in male: cranium darker than mesosoma, flagellomeres darker than legs. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 3.6–5.0. Male scape length vs. F1 length: 1.9–2.1. Male F1 length vs. pedicel length: 1.8–2.6. Male F1 length vs. male F2 length: 1.0–1.3. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres; setae as long as width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

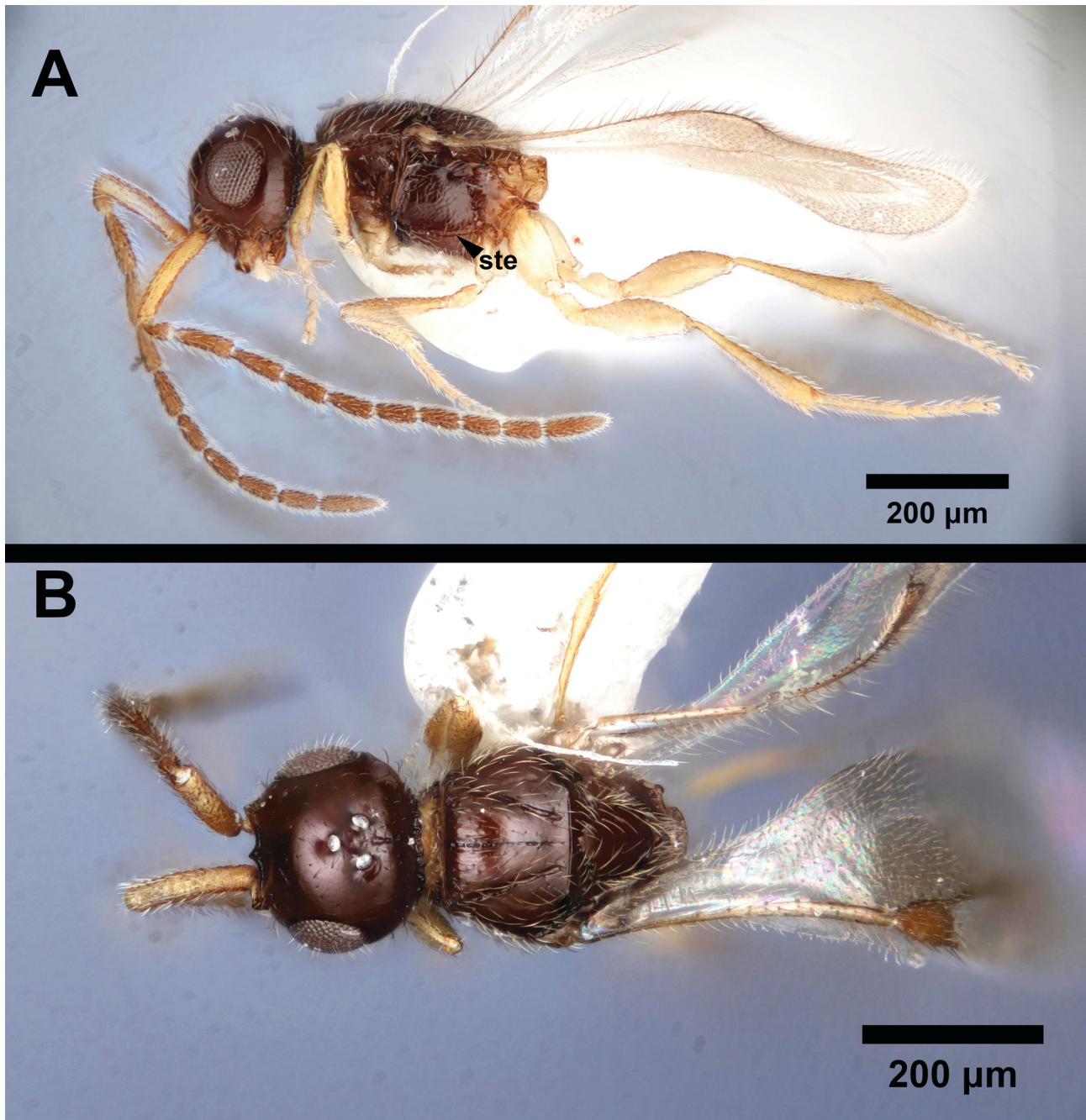
**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than me-

sosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.72–1.86. Head height (HH) vs. head length (HL): HH:HL=0.9–1.1. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.5–1.62. Head width (HW) vs. head height (HH): HW:HH=1.3–1.43. Cephalic size (csb): Mean: 225–310  $\mu$ m. Maximum eye diameter vs. minimum eye diameter: 1.1–1.3. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=2.3–3.0. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.7–3.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.3–3.0:1.0–1.4:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: absent. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process extends across intertorular area towards dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

**Mesosoma:** Weber length: WL=310–460  $\mu$ m. Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.64–0.71. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.6–2.0. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 1.0–1.2. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2 $\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 3/4 of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discrimenal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: more than or equal to 2 $\times$  as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.6–2.2. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.8–2.0. Syntergal translucent patch maximum width vs. minimum width: 1.2–1.7. Synsternal translucent patch maximum width vs. minimum width: 1.3–1.8. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterior–posteriorly. Synsternal setiferous patch shape: linear. Synsternal setiferous patch structure: comprised of a single row of setae posterior to the synsternal translucent patch and widening to a double row of setae anterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setifer-

ous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

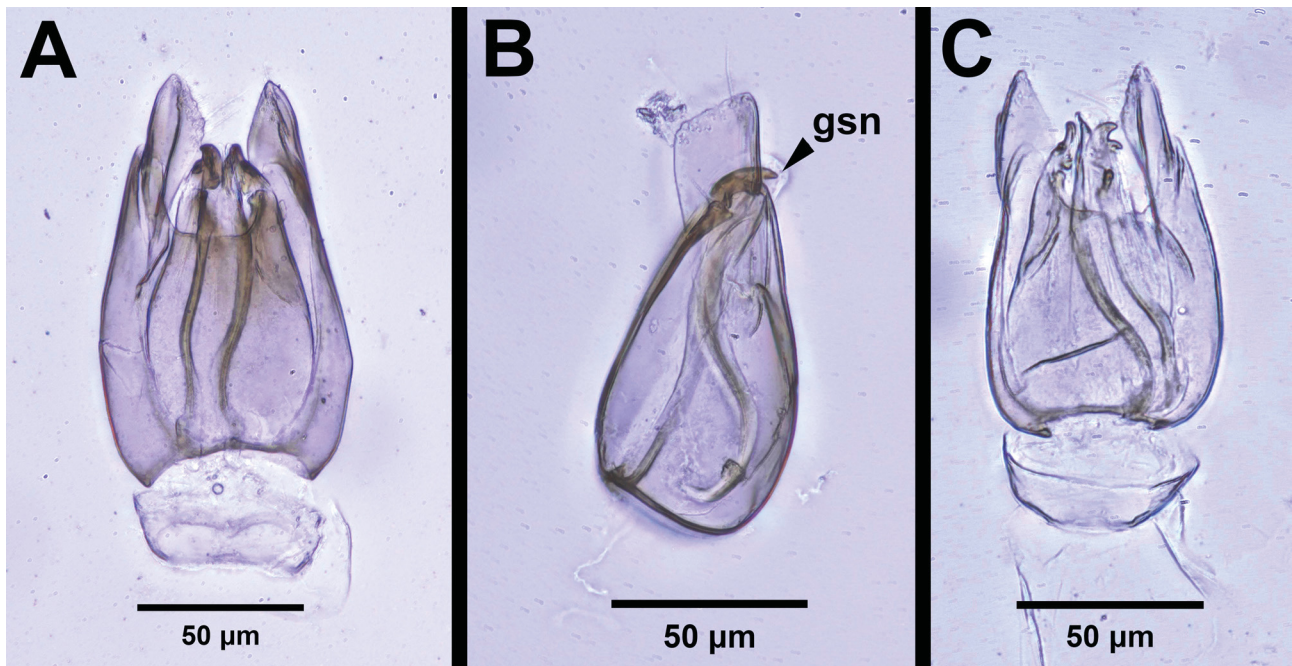


**FIGURE 70.** *Conostigmus minimus* Trietsch and Mikó **sp. nov.**, holotype male (CMNHENT0022741). A. Lateral view. B. Dorsal view. Abbreviation: sternaulus (ste).

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: patch of setae occurring medially. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: absent. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute.



Distodorsal margin of cupula shape: straight. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending equal to or less than 1/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight without a median projection. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva absent and parossiculi fused. Medioventral ridge of the gonostyle–volsella complex count (only applicable if medioventral conjunctiva of the gonostyle–volsella complex absent): absent. Apical parossicular setae count: two. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its proximal 1/3rd. Distal margin of harpe in lateral view: blunt or straight. Lateral setae of harpe count: absent. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: present. Distal setae on harpe length: setae not of equal length, longer setae present on distoventral edge of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distally. Sensillar ring area of harpe orientation: distoventrally. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: straight; convex.



**FIGURE 71.** *Conostigmus minimus* Trietsch and Mikó **sp. nov.**, male genitalia. A. Ventral view of holotype (CMNHENT0022741). B. Lateral view of paratype (CMNHENT0022743). C. Dorsal view of paratype (CMNHENT0022732). Abbreviation: gonossiculus spine (gsn).

**Distribution.** Nearctic.

**Etymology.** The name for this species is derived from the Latin *minimus* meaning “smallest”. This species is the smallest macropterous species of *Conostigmus* found in the Nearctic. Other species of similar size, such as *C. muesebecki* and *C. dimidiatus*, lack fully-formed (macropterous) wings.

**Material Examined.** Holotype male: USA: Tennessee: CMNHENT0022741 (CLEV). Paratypes (3 males): USA: Tennessee: 3 males. CMNHENT0022732, 0022743 (CLEV); CMNHENT0022733 (PSUC).

## *Conostigmus muratorei* Trietsch sp. nov.

Figs. 72, 73, 74

**Diagnosis.** This species can be distinguished from all other Nearctic *Conostigmus* by the presence of the mesopost-scutellum, the absence of the sternaulus, the width of the crenulae of the notauli increasing more than 2× anteriorly, and the presence of the dorsomedian projection of the gonostyle–volsella complex. This is also the only known *Conostigmus* species where the dorsomedian projection of the gonostyle–volsella complex is bilobed. Whereas most male *Conostigmus* have flagellomere length gradually decreasing apically, in this species F1–F5 are of similar lengths, with some specimens having F4 and F5 longer than F1, though this can vary between specimens.

The female of this species is unknown.

The habitus of this species is unique. Its wide head and long, narrow mesosoma, coupled with the absence of the sternaulus and independent parossiculi (medioventral conjunctiva of the gonostyle–volsella complex present), make this species a member of the *Dolichoceraphron* subgenus (Dessart and Cancemi, 1987). The type species of this genus is the Palearctic species *C. linearis*, of which the male is unknown. *Conostigmus muratorei* is the first member of this subgenus recognized from the Nearctic.

**Variability.** There is intraspecific variability in the anterior preoccipital furrow end—in some specimens it ends just before the ocellar triangle (PSUC\_FEM 34239), whereas in other specimens it extends inside the ocellar triangle (PSUC\_FEM 34093, PSUC\_FEM 9055). Whereas most male *Conostigmus* have flagellomere length gradually decreasing apically, in this species F1–F5 are of similar lengths, with some specimens having F4 and F5 longer than F1 (PSUC\_FEM 34093, UCRC\_ENT 00457090). This species has 2 mandibular points present, but there is variation in the length of these mandibular points. The dorsal mandibular point can appear much shorter than the ventral mandibular point, which also occurs in *C. bipunctatus* and *C. madagascariensis* (see Mikó *et al.*, 2016, Fig. 37).

**Description.** Body length: 1.275–2.0 mm. Color hue pattern in male: cranium, mesosoma, metasoma brown to dark brown; F1–F9 light brown to brown; scape, pedicel ochre to brown; legs ochre to light brown. Color intensity pattern in male: metasoma and mandible lighter than mesosoma; metasoma lighter than mesosoma and cranium; pedicel lighter than scape. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 2.5–3.6. Male scape length vs. F1 length: 1.3–1.7. Male F1 length vs. pedicel length: 1.5–2.8. Male F1 length vs. male F2 length: 1.0–1.2. Longest male flagellomere: F1–F5; sometimes F4 or F5 longer than F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.

**Head:** Head width, dorsal view: at least 1.3× wider than mesosoma. Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.5–1.9. Head height (HH) vs. head length (HL): HH:HL=1.1–1.5. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.6–1.9. Head width (HW) vs. head height (HH): HW:HH=1.0–1.4. Cephalic size (csb): Mean: 300–500 µm. Maximum eye diameter vs. minimum eye diameter: 1.2–1.4. POL: OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=2.0–2.7. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.0–1.8. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 2.0–2.7:1.3–2.4:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: absent. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: smooth. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process

on intertorular carina shape: acute. Median process of intertorular carina structure: process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.

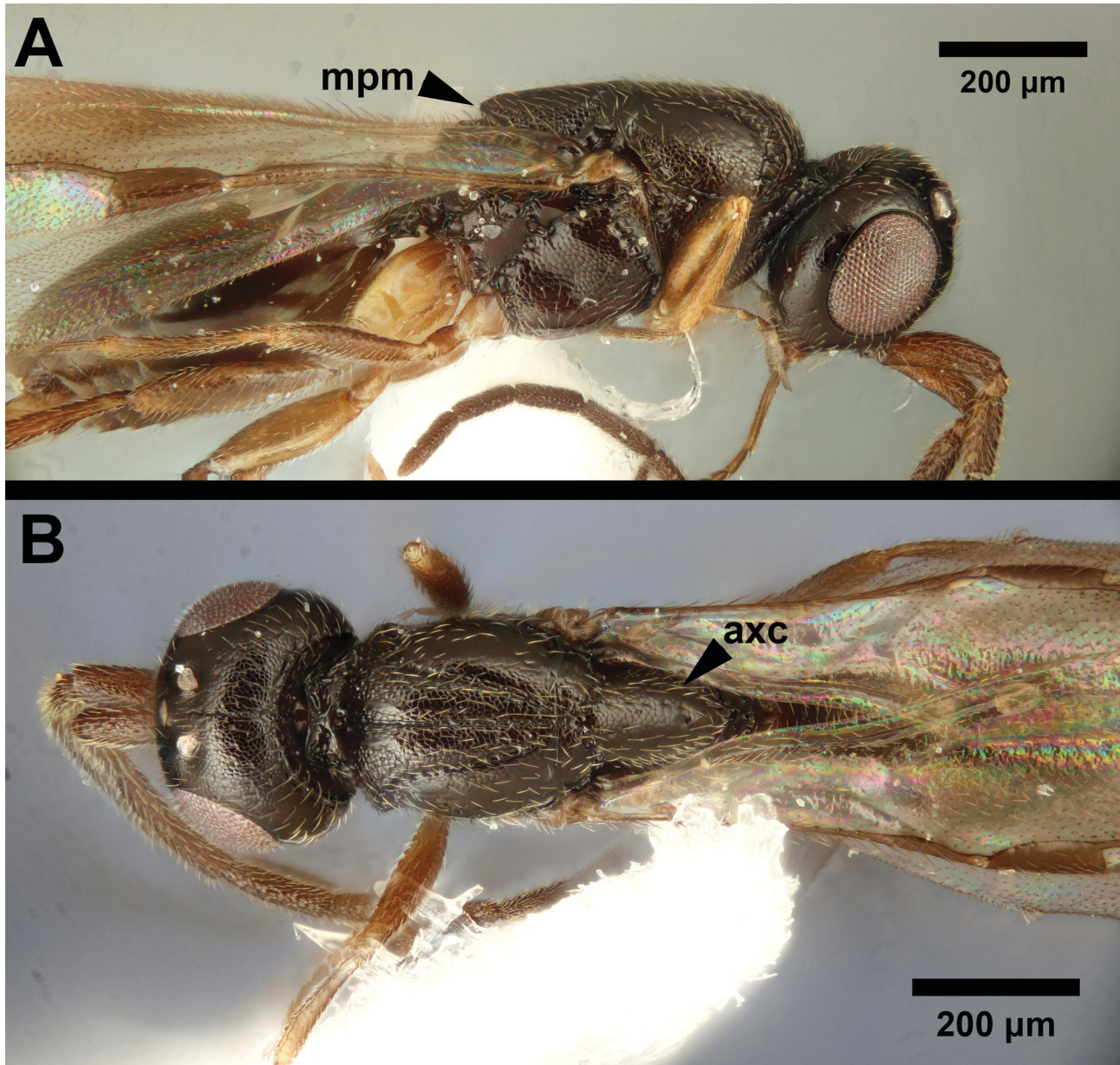


**FIGURE 72.** *Conostigmus muratorei* Trietsch **sp. nov.**, habitus of male holotype (PSUC\_FEM 34093).

**Mesosoma:** Weber length: WL=390–770  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.9. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.8–2.4. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.2. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae increases more than 2 $\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus curves and is adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Meso-metapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: sterneulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Ventral projection of the metapleural carina length: less than 2 $\times$  as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: present (posterior margin of scutellum appears raised). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite

count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.5. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 0.75, 1.13. Syntergal translucent patch maximum width vs. minimum width: 2.0. Synsternal translucent patch maximum width vs. minimum width: 2.0–2.7. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterior–posteriorly. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



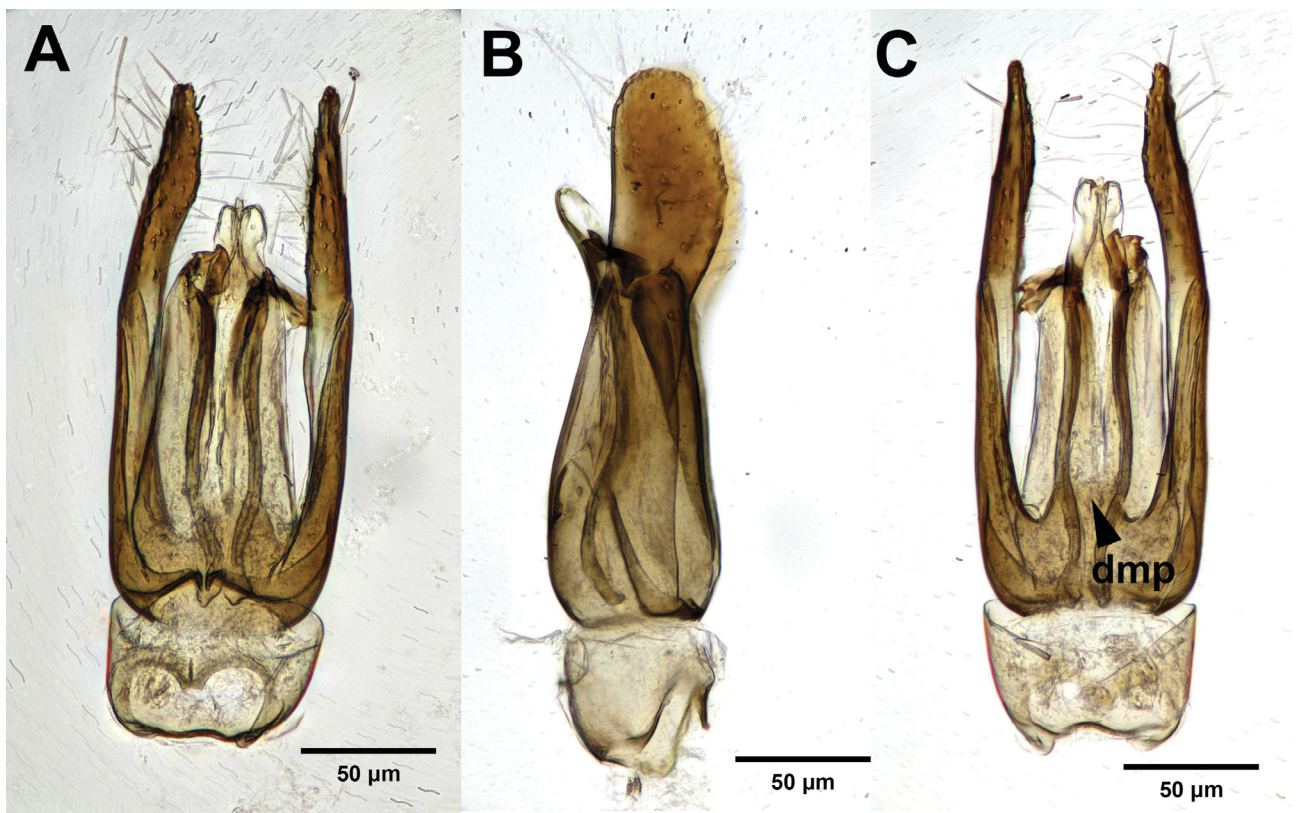
**FIGURE 73.** *Conostigmus muratorei* Trietsch **sp. nov.**, habitus of male holotype (PSUC\_FEM 34093). A. Lateral. B. Dorsal. Abbreviations: axillular carinae (axc); mesopostscutellum (mpm).

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal

line / setal patch structure: single transverse row of distal setae occurring medially with less than 4 setae below it. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Dorsomedian projection of the gonostyle–volsella complex count: present. Dorsomedian projection of the gonostyle–volsella complex shape: bilobed. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending more than or equal to 2/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight with a median projection. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: three. Distal projection of the parossiculus count: present. Distal projection of the penis-valva count: absent. Gonossiculus spine count: 3. Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its proximal 2/3rds. Distal margin of harpe in lateral view: blunt or straight. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distolaterally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distally. Sensillar ring area of harpe orientation: medially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Etymology.** This species is named *muratorei* in memory of the first author's grandfather, Dr. Joseph F. Muratore, who was passionate about entomology and passed away during the course of this research.



**FIGURE 74.** *Conostigmus muratorei* Trietsch **sp. nov.**, paratype male genitalia. A. Ventral (PSUC\_FEM 9055). B. Lateral (UCRC\_ENT 00457090). C. Dorsal (PSUC\_FEM 9055). Abbreviation: dorsomedian projection of the gonostyle–volsella complex (dmp).

**Material Examined.** Holotype male: USA: California: PSUC\_FEM 34093, UCFC 349597 (UCFC). Paratypes (12 males): USA: California: 12 males. PSUC\_FEM 36106, 92612 (PSUC); PSUC\_FEM 9055 (ROME); PSUC\_FEM 32929, 34042, 34084, 34100, 34239, 34262, 88170 (UCFC); UCRC\_ENT 00457088, 00457090 (UCRC).

***Conostigmus musettiae* Trietsch & Mikó sp. nov.**

Figs. 75, 76, 77

**Diagnosis.** This species can be recognized by the following combination of characters: sternaulus present and elongate, exceeding 3/4 of the mesopleuron length at the level of the sternaulus; axillular carinae present; dense patch of setae on the distoventral edge of the harpe present; medioventral conjunctiva absent and parossiculi fused; and medioventral ridge of the gonostyle–volsella complex present.

The female of this species is unknown.

This species shares several characters in common with *C. franzinii* and *C. bipunctatus*, including the following: facial pit present; preoccipital furrow present; median process on the intertorular carina present and acute; sternaulus present and elongate, exceeding 3/4 of the mesopleuron length at the level of the sternaulus; ventral projection of the metapleural carina present; medioventral conjunctiva absent and parossiculi fused; and gonocondyle present and acute. *Conostigmus musettiae* can be differentiated from these two species by the presence of the axillular carinae (absent in both *C. bipunctatus* and *C. franzinii*).

Other similar species include *C. minimus*, which differs in that it lacks the medioventral ridge of the gonostyle–volsella complex and has gonossicular spines of similar lengths (one spine not more than 2× as long as the others), and *C. laeviceps*, which lacks the dense patch of setae on the distoventral edge of the harpe.

**Variability.** Other than intraspecific differences in size and coloration, no variations were observed between specimens.

One specimen (PSUC\_FEM 9082) has one synsternal translucent patch with a different size and shape than the other. This is not a diagnostic feature or unique character of this or any other known *Conostigmus* species; rather, this is a teratology that has been observed occasionally before in other *Conostigmus* specimens.

**Description.** Body length: 1.425–1.475 µm. Color hue pattern in male: cranium and mesosoma reddish–brown to black; flagellomeres light brown; legs, scape, pedicel, neck of petiole and anterior portion of metasoma yellow; posterior portion of metasoma reddish–brown. Color intensity pattern in male: cranium darker than mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite lighter in coloration than the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

**Antennae:** Male scape length vs. pedicel length: 3.5–4.8. Male scape length vs. F1 length: 1.1–1.3. Male F1 length vs. pedicel length: 2.8–3.8. Male F1 length vs. male F2 length: 1.2–1.4. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.5–1.7. Head height (HH) vs. head length (HL): HH:HL=1.0–1.2. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.5–1.7. Head width (HW) vs. head height (HH): HW:HH=1.3–1.5. Cephalic size (csb): Mean: 300–400 µm. Maximum eye diameter vs. minimum eye diameter: 1.2–2.0. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.8–2.5. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=1.5–2.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8–2.5:1.0–1.5:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count:

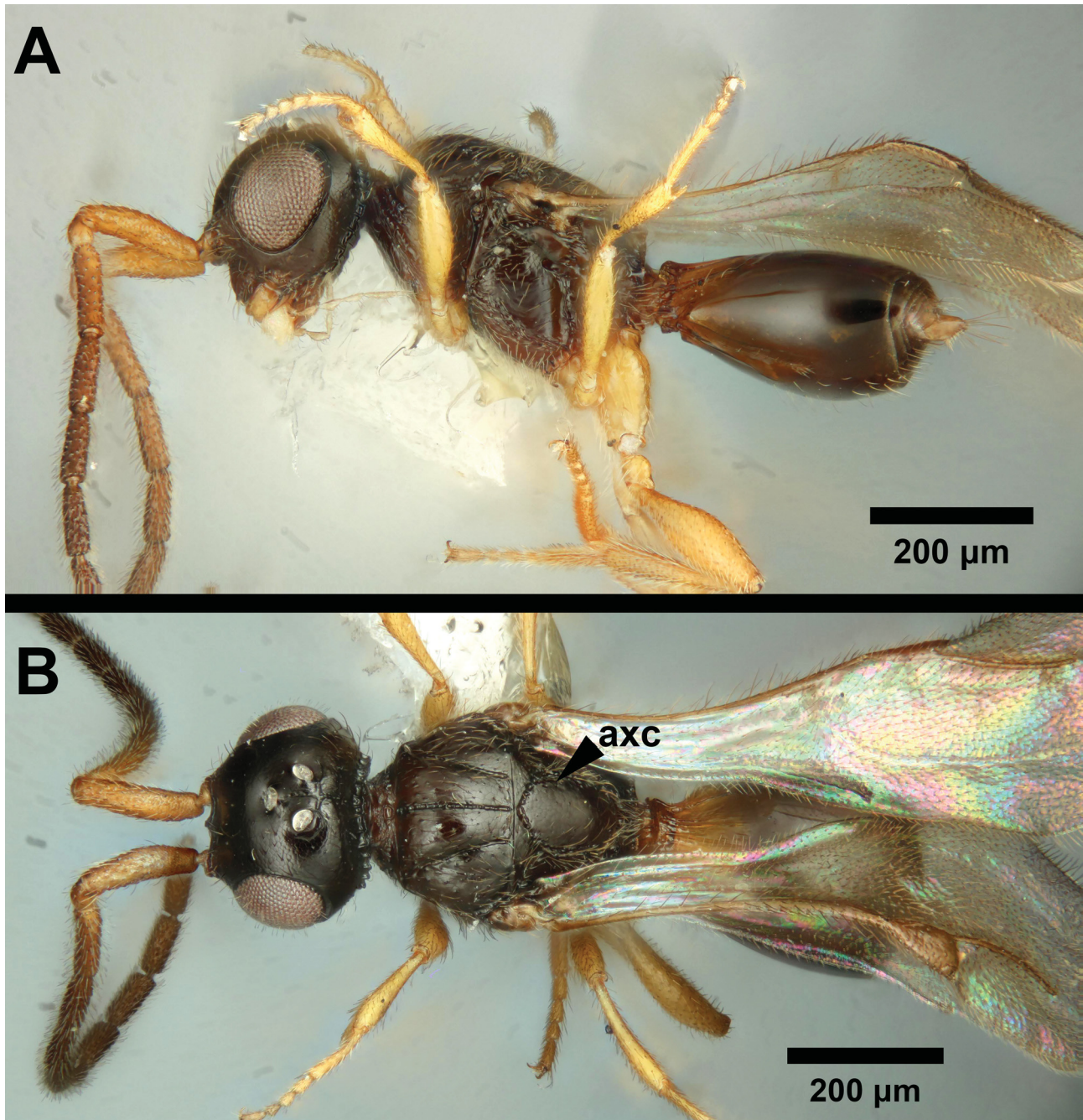
absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present. Facial pit count: present. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process extends across intertorular area towards dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.



**FIGURE 75.** *Conostigmus musettiae* Trietsch and Mikó **sp. nov.**, habitus of holotype male (PSUC\_FEM 9027).

**Mesosoma:** Weber length: WL=400–600  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.4–1.7. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.8–1.1. Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than 2 $\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding 3/4 of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural

carina count: present. Ventral projection of the metapleural carina length: more than or equal to  $2\times$  as long as wide. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.

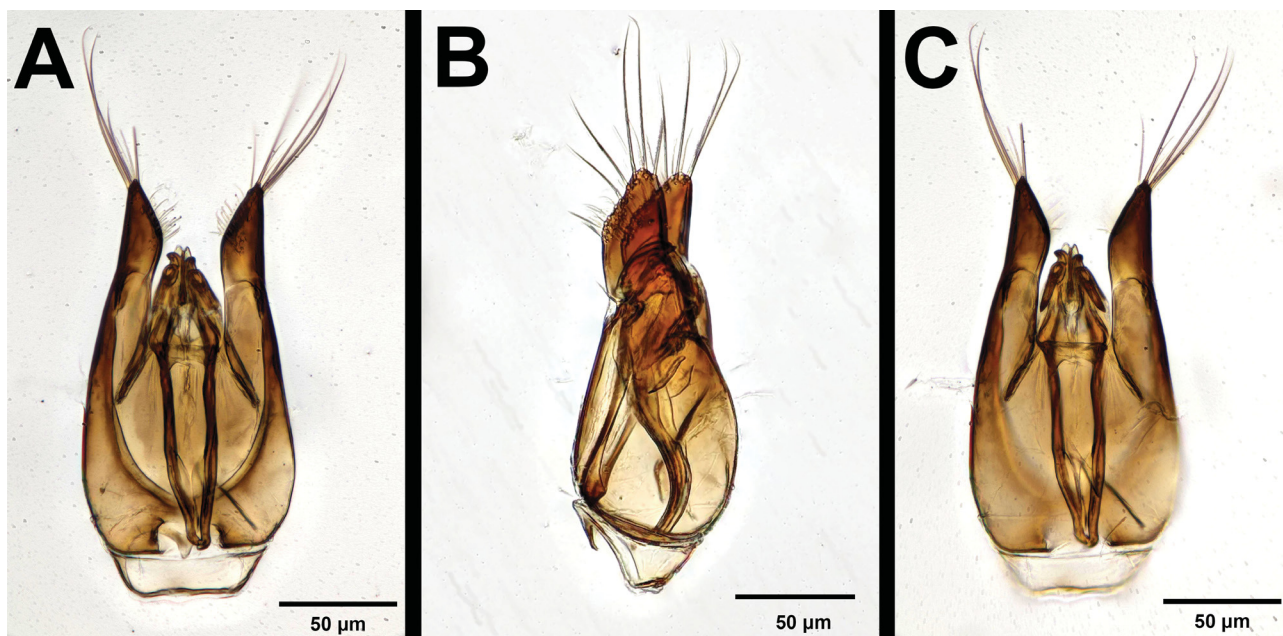


**FIGURE 76.** *Conostigmus musettiae* Trietsch and Mikó **sp. nov.**, holotype male (PSUC\_FEM 9027). A. Lateral view. B. Dorsal view. Abbreviation: axillular carinae (axc).

**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.5–2.0. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 1.8–2.5. Syntergal translucent patch maximum width vs. minimum width: 1.6–2.7. Synsternal translucent patch maximum width vs. minimum width: 1.4–1.8. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum



width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single row of setae anterior to the synsternal translucent patch, with a patch of setae posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.



**FIGURE 77.** *Conostigmus musettiae* Trietsch and Mikó **sp. nov.**, male genitalia of paratype male (PSUC\_FEM 6725). A. Ventral view. B. Lateral view. C. Dorsal view.

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: acute. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single transverse row of distal setae occurring medially with less than 4 setae below it. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: absent. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: straight. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending equal to or less than 1/3 of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight without a median projection. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva absent and parossiculi fused. Medioventral ridge of the gonostyle–volsella complex count (only applicable if medioventral conjunctiva of the gonostyle–volsella complex absent): present. Medioventral ridge of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: ridge extending 2/3 of length of gonostyle–volsella complex in ventral view. Apical parossicular setae count: one. Distal projection of the parossiculus count: present. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2. Gonossiculus spine length: one spine more than 2× as long as the other(s). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is in its proximal 1/3rd. Distal margin of harpe in lateral view: blunt or straight. Lateral setae of harpe count: absent. Lateral

setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: present. Distal setae on harpe length: setae not of equal length, longer setae present on distodorsal edge of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distally. Sensillar ring area of harpe orientation: medially; distoventrally. Sensillar ring shape: elongate. Distoventral margin of harpe in lateral view: straight but can be more convex or concave in some specimens.

**Distribution.** Nearctic.

**Etymology.** This species is named *musettiae* in honor of Luciana Musetti for her valuable contributions to the taxonomy and systematics of Ceraphronoidea.

**Material Examined.** Holotype male: USA: Arizona: PSUC\_FEM 9027 (OSUC). Paratypes (20 males): USA: Arizona: 5 males. PSUC\_FEM 6725, 8992, 9029, 9097 (OSUC); PSUC\_FEM 8738 (PSUC). USA: Ohio: 15 males. PSUC\_FEM 9082, 26678, 27002, 27081, 27108, 27259, 27266, 28955, 29308, 50077, 50235, 50373 (OSUC); PSUC\_FEM 26920, 26814, 26831 (PSUC).

### ***Conostigmus rosemaryae* Trietsch sp. nov.**

Figs. 78, 79, 80

**Diagnosis.** This species can be distinguished from all other species of *Conostigmus* by the following combination of characters: facial sulcus present; sternaulus present and elongate, exceeding 1/2 of the mesopleuron length at the level of the sternaulus; dorsomedian projection of the gonostyle–volsella complex present; harpe not spatulate or spoon-shaped; and harpe shorter than the gonostipes in lateral view.

This species is most similar to *C. pulchellus* and *C. abdominalis*, but is distinguishable from both by the male genitalia. *Conostigmus rosemaryae* has the dorsomedian projection of the gonostyle–volsella complex present, harpe that are shorter than the gonostipes in lateral view and harpe that are not spoon-shaped or spatulate. *Conostigmus rosemaryae* also has 1 apical parossicular seta, whereas *C. pulchellus* has 4 or more (*C. abdominalis* can have 1–3).

**Variability.** The sternaulus is elongate in all specimens, but in some it exceeds 3/4 of the mesopleuron length at the level of the sternaulus (CMNHENT0022801, CMNHENT0022798) whereas in others it reaches between 1/2 and 3/4 of the mesopleuron length at the level of the sternaulus (CMNHENT0022821, CMNHENT0022771). The median process on the intertorular carina is present and acute in all specimens, but extends towards the dorsal margin of the clypeus in some (CMNHENT0022821, CMNHENT0022801) and not in others (PSUC\_FEM 9042). There is also variation in the POL to OOL ratio, with POL equal to or shorter than OOL (ocellar triangle with short base) in most specimens, but POL longer than OOL (ocellar triangle with a wide base) in one specimen (PSUC\_FEM 9042).

**Description.** Color hue pattern in male: cranium, mesosoma, metasoma brown to black except pronotum; pronotum light brown to black; F1–F9 brown to dark brown; scape, pedicel ochre to brown; legs ochre to brown. Color intensity pattern in male: metasoma and mandible lighter than mesosoma; flagellomeres and pedicel darker than scape; pronotum sometimes lighter than rest of mesosoma. Color intensity dorsal and ventral to the site of the sternaulus: concolorous. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: present on head. Rugose region on upper face count: present.

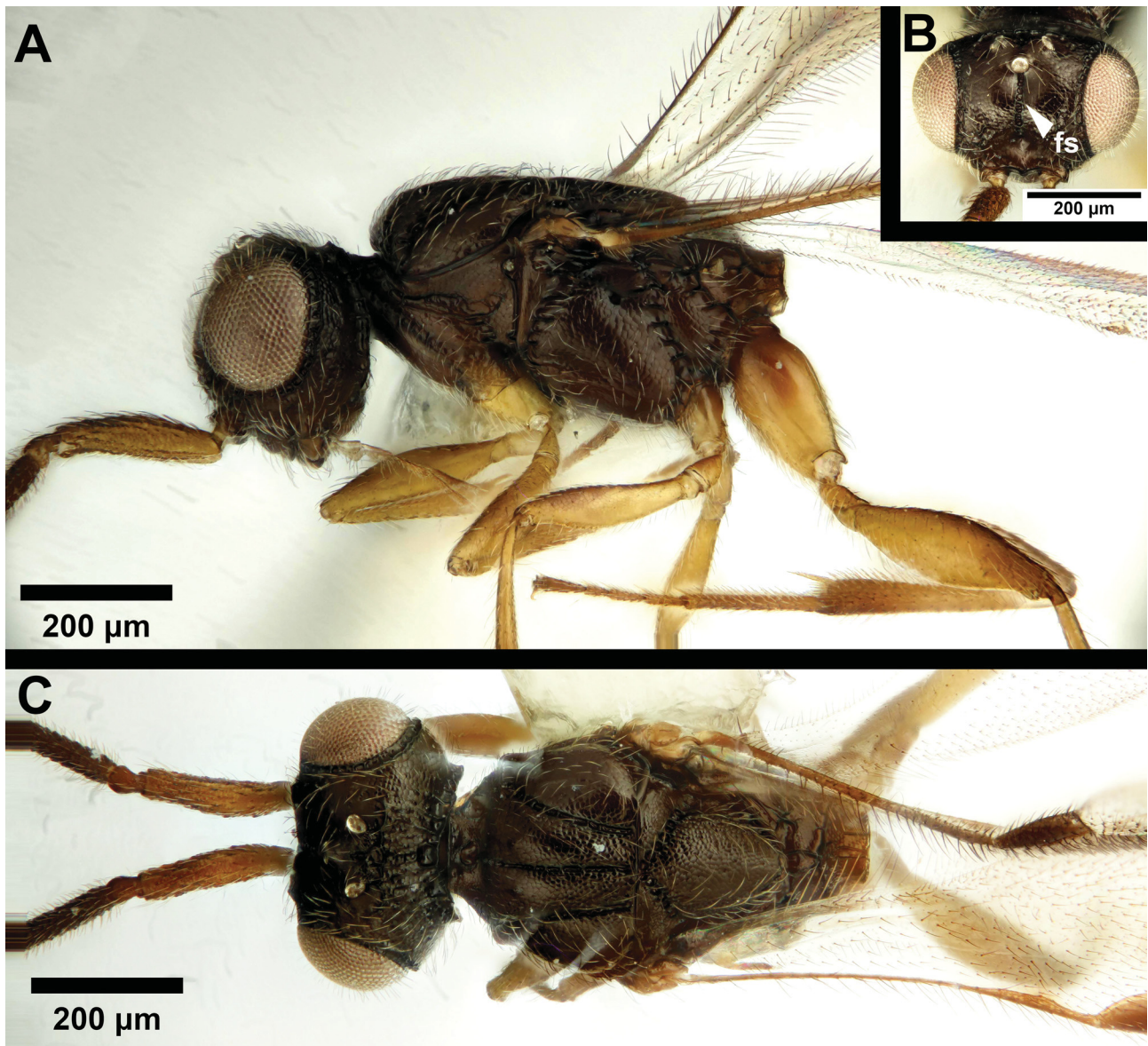
**Antennae:** Male scape length vs. pedicel length: 3.6–6.4. Male scape length vs. F1 length: 0.8–1.2. Male F1 length vs. pedicel length: 3.6–6.5. Male F1 length vs. male F2 length: 1.3–1.5. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F5–F9.

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.4–1.8. Head height (HH) vs. head length (HL): HH:HL=1.1–1.3. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.7–1.9. Head width (HW) vs. head height (HH): HW:HH=1.3–1.6. Cephalic size (csb): Mean: 450–650 µm. Maximum eye diameter vs. minimum eye diameter: 1.1–1.3. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base OR POL longer than OOL and ocellar triangle with wide base. Male ocular ocellar line (OOL) vs. lateral ocellar

line (LOL): OOL:LOL=1.6–2.5. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.8–1.2. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.8–2.5:1.6–2.3:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow ends inside ocellar triangle, but ends posterior to the anterior ocellus. Preoccipital furrow sculpture: crenulate. Postocellar carina count: present. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial sulcus present. Facial sulcus count: present. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: present medially, inverted U-shaped. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: present. Median process on intertorular carina shape: acute. Median process of intertorular carina structure: process extends across intertorular area towards dorsal margin of clypeus; process does not extend across intertorular area to dorsal margin of clypeus. Median region of intertorular area shape: convex. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.



**FIGURE 78.** *Conostigmus rosemaryae* Trietsch **sp. nov.**, male holotype (CMNHENT0022770).



**FIGURE 79.** *Conostigmus rosemaryae* Trietsch **sp. nov.**, male holotype (CMNHENT0022770). A. Lateral. B. Anterior view showing facial sulcus. C. Dorsal. Abbreviation: facial sulcus (fs).

**Mesosoma:** Weber length:  $WL=700-900\ \mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW):  $AscW/PscW=0.5-0.9$ . Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW):  $MscL/AscW=1.2-2.1$ . Mesoscutal length (MscL) vs. mesoscutellar length (MscIL):  $MscL:MscIL=0.9-1.0$ . Wing count: present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae does not increase more than  $2\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Posterior region of notaulus orientation: posterior end of notaulus does not curve and is not adjacent to median mesoscutal sulcus. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscuteellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: present. Axillular carinae shape: the left and right carinae are separated posteromedially. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: present. Sternaulus length: elongate and exceeding  $1/2$  of mesopleuron length at level of sternaulus. Sternaulus sculpture: smooth. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior re-

gion of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: absent. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto–propodeo–metapecto–mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: straight.

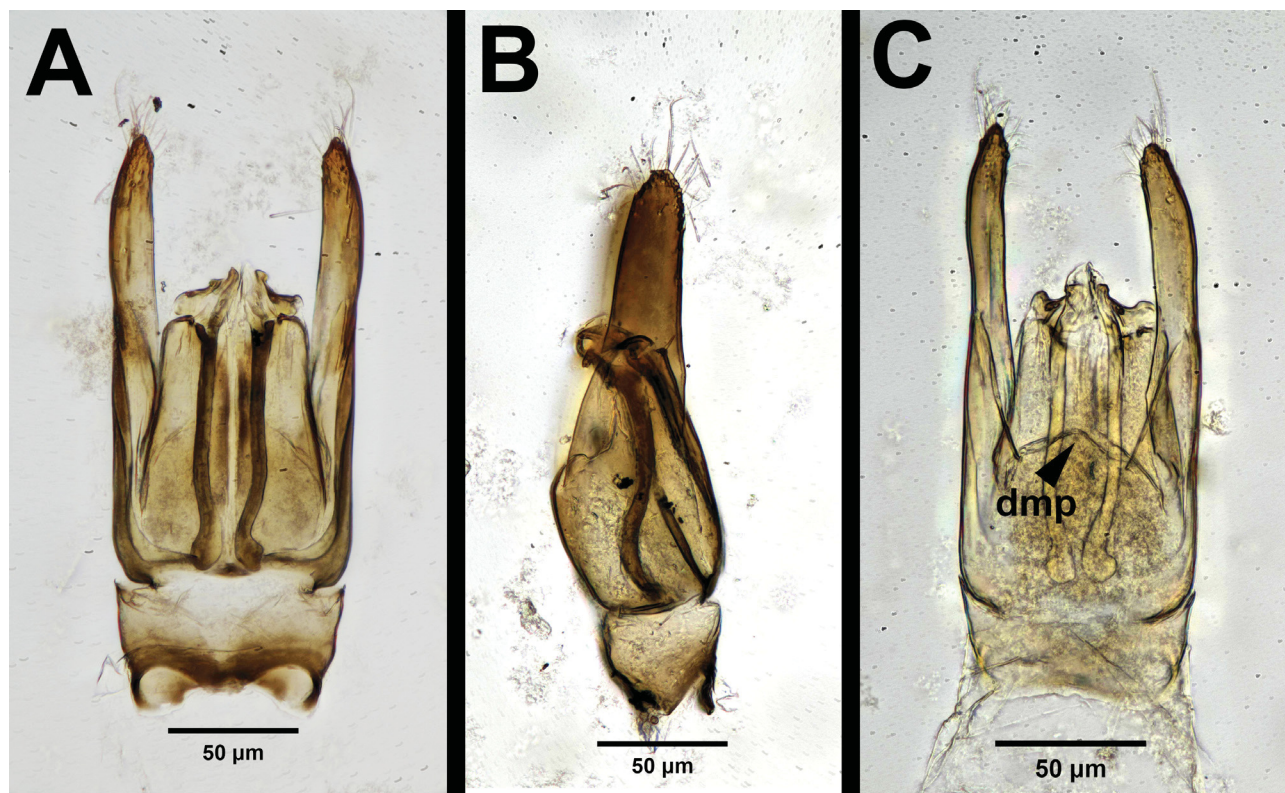
**Metasoma:** Transverse carina on petiole shape: concave. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.8–2.8. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.0–2.8. Syntergal translucent patch maximum width vs. minimum width: 1.7–2.5. Synsternal translucent patch maximum width vs. minimum width: 1.1–2.3. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anteromedially. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior to the synsternal translucent patch, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends lateral to the synsternal translucent patch posterior margin; synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least 2× as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

**Male Genitalia:** Distal margin of male S9 shape: convex. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than 1/2 the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: acute. Gonocondyle count: present. Gonocondyle shape: blunt. Distodorsal margin of cupula shape: straight. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: present. Dorsomedian projection of the gonostyle–volsella complex shape: simple (not bilobed). Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending between 1/3 to 1/2 the length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: straight with a median projection. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: blunt or straight. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 2. Gonossiculus spine length: one spine not more than 2× as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: blunt. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae of equal length across distal end of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae as long as or shorter than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Etymology.** This species is named *rosemaryae* after the first author’s mother, Rosemary Trietsch, who underwent 2 surgeries, 4 chemotherapy sessions, a month of radiation, and triumphantly beat breast cancer during the course of this research.

**Material Examined.** Holotype male: USA: Ohio: CMNHENT0022770 (CLEV). Paratypes (7 males): USA: Ohio: 7 males. CMNHENT0022771, 0022798, 0022801, 0022821 (CLEV); PSUC\_FEM 9042, 27292, 86284 (OSUC).



**FIGURE 80.** *Conostigmus rosemaryae* Trietsch **sp. nov.**, paratype male genitalia. A. Ventral view (CMNHENT0022798). B. Lateral view (PSUC\_FEM 9042). C. Dorsal showing the dorsomedian projection of the gonostyle–volsella complex (CMNHENT0022771). Abbreviation: dorsomedian projection of the gonostyle–volsella complex (dmp).

***Conostigmus washburni* Trietsch **sp. nov.****

Figs. 81, 82, 83

**Diagnosis.** This Nearctic species can be recognized by the following combination of characters: facial pit present; occipital carina not complete; median process on the intertorular carina absent; postocellar carina absent; preoccipital lunula present; preoccipital furrow present and crenulate; sternaulus absent; wings present and macropterous; crenulae width of the notaulus increasing more than 2× anteriorly; medioventral conjunctiva of the gonostyle–volsella complex present (parossiculi independent); and proximal end of the dorsomedian conjunctiva of the gonostyle–volsella complex shape acute.

The female of this species is unknown.

*C. washburni* has similar male genitalia to *C. erythrothorax* and *C. michaeli*, but this species can be differentiated from the others by the presence of the preoccipital lunula (absent in *C. michaeli* and *C. erythrothorax*), and the presence and sculpturing of the preoccipital furrow. The preoccipital furrow is always present and has crenulate sculpturing in *C. washburni*. In *C. michaeli* and *C. erythrothorax*, the preoccipital furrow can be present or absent, but if present, it appears only as a faint impression and is never crenulate.

This species can also resemble *C. muratorei* due to the width of the crenulae of the notauli increasing more than 2× anteriorly, as well as the absence of the postocellar carina and sternaulus, but they are easily distinguished by the presence of the mesopostscutellum (present in *C. muratorei* and absent in *C. washburni*), the presence and shape of the median process on the intertorular carina (absent in *C. washburni*, present and acute in *C. muratorei*), and the male genitalia. *Conostigmus muratorei* has the dorsomedian projection of the gonostyle–volsella complex present and bilobed, while *C. washburni* does not have the dorsomedian projection of the gonostyle–volsella complex.

**Variability.** There are variations in color, with some specimens being darker (PSUC\_FEM 34197, PSUC\_FEM 33185) than others (PSUC\_FEM 34114, PSUC\_FEM 34135), and some specimens having lighter coloration ventral to the site of the sternaulus (PSUC\_FEM 34135, PSUC\_FEM 34048) while others do not (PSUC\_FEM 34142, PSUC\_FEM 34240). The facial pit is always present, but it can be difficult to see on darker specimens (PSUC\_FEM 34197, PSUC\_FEM 33185).

**Description.** Body length: 1.125–1.725 mm. Color hue pattern in male: cranium, mesosoma and metasoma brown to black; mandible and legs ochre to light brown; pedicel, scape, F1–F9 brown to dark brown; mesosoma sometimes with lighter coloration ventral to site of sternaulus. Color intensity pattern in male: mandible lighter than cranium; area ventral to the site of the sternaulus lighter than the area dorsal to the site of the sternaulus on some specimens. Color intensity dorsal and ventral to the site of the sternaulus: area ventral to the site of the sternaulus lighter than the area dorsal to the site of the sternaulus. Color intensity pattern of syntergite: petiole neck and anterior region of syntergite concolorous with the posterior region of the syntergite. Foveolate sculpture on body count: absent. Rugose sculpturing count: absent. Rugose region on upper face count: absent.

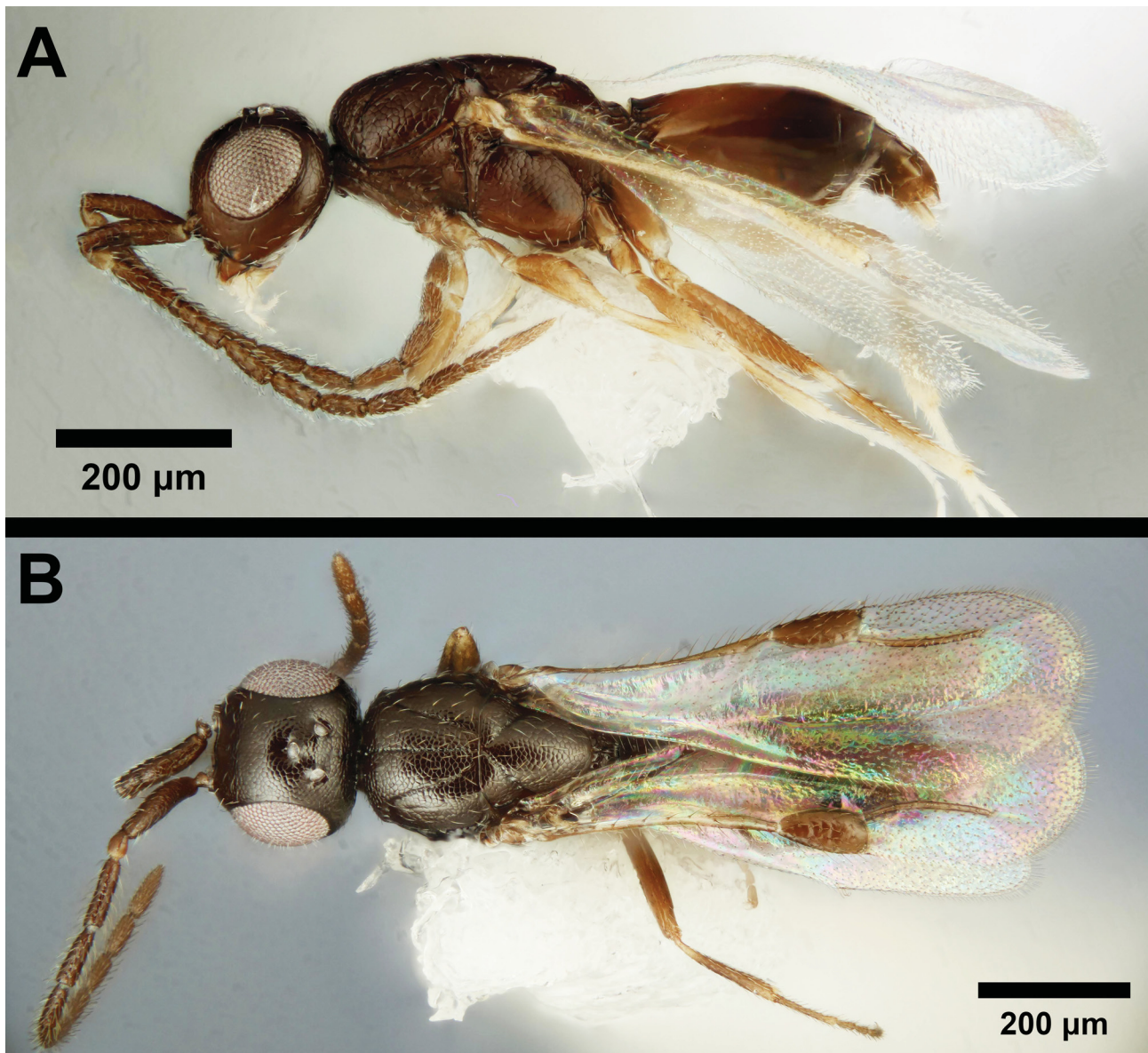
**Antennae:** Male scape length vs. pedicel length: 2.6–4.5. Male scape length vs. F1 length: 1.3–1.5. Male F1 length vs. pedicel length: 1.8–3.4. Male F1 length vs. male F2 length: 1.1–1.2. Longest male flagellomere: F1. Length of setae on male flagellomere vs. male flagellomere width: setae as long as or shorter than width of flagellomeres. Sensillar patch of the male flagellomere pattern: F6–F9.



**FIGURE 81.** *Conostigmus washburni* Trietsch **sp. nov.**, male holotype (UCFC 207381).

**Head:** Head width, dorsal view: equal to or only slightly wider than mesosoma (less than 1.3× wider than mesosoma). Head height (HH, lateral view) vs. eye height (EHf, anterior view): HH:EHf=1.3–1.7. Head height (HH) vs. head length (HL): HH:HL=1.1–1.4. Head width (HW) vs. interorbital space (IOS): HW:IOS=1.6–2.1. Head width (HW) vs. head height (HH): HW:HH=1.2–1.5. Cephalic size (csb): Mean: 265–420 µm. Maximum eye diameter vs. minimum eye diameter: 1.2–1.4. POL:OOL: POL equal to or shorter than OOL and ocellar triangle with short base. Male ocular ocellar line (OOL) vs. lateral ocellar line (LOL): OOL:LOL=1.5–1.8. Male ocular ocellar line (OOL) vs. posterior ocellar line (POL): OOL:POL=0.8–1.0. Male ocular ocellar line (OOL): posterior ocellar line (POL): lateral ocellar line (LOL): 1.5–1.8:1.5–1.8:1.0. Head shape (anterior view): circular or triangular. Preoccipital lunula count: present. Preoccipital carina count: absent. Occipital carina structure: occipital carina not complete. Occipital carina sculpture: crenulate. Preoccipital furrow count: present. Preoccipital furrow anterior end: preoccipital furrow

ends inside ocellar triangle, but ends posterior to the anterior ocellus; preoccipital furrow ends at site of postocellar carina. Preoccipital furrow sculpture: crenulate. Postocellar carina count: absent. Dorsal margin of occipital carina vs. dorsal margin of lateral ocellus in lateral view: occipital carina ventral to lateral ocellus in lateral view. Transverse scutes on upper face count: absent. Transverse frontal carina count: absent. Randomly sized areolae around setal pits on upper face count: absent. Setal pit on vertex size: smaller than diameter of scutes. Ventromedian setiferous patch and ventrolateral setiferous patch count: absent. White, thick setae on upper face count: absent. Antennal scrobe count: absent. Facial structure count: facial pit present, but can be difficult to see on darker specimens. Facial pit count: present but can be difficult to see on darker specimens. Facial sulcus count: absent. Median facial keel count: absent. Supraclypeal depression count: present. Supraclypeal depression structure: absent medially, represented by two grooves laterally of facial pit. Intertorular area count: present. Intertorular carina count: present. Median process on intertorular carina count: absent. Median region of intertorular area shape: flat. Ventral margin of antennal rim vs. dorsal margin of clypeus: not adjacent. Torulo–clypeal carina count: present. Subtorular carina count: absent. Mandibular tooth count: 2. Mandibular lancea count: absent.



**FIGURE 82.** *Conostigmus washburni* Trietsch **sp. nov.**, paratype males. A. Lateral view (PSUC\_FEM 34114). B. Dorsal view (PSUC\_FEM 36073).

**Mesosoma:** Weber length: WL=400–600  $\mu\text{m}$ . Anterior mesoscutal width (AscW) vs. posterior mesoscutal width (PscW): AscW/PscW=0.6–0.8. Mesoscutal length (MscL) vs. anterior mesoscutal width (AscW): MscL/AscW=1.2–1.9. Mesoscutal length (MscL) vs. mesoscutellar length (MscIL): MscL:MscIL= 0.9–1.1. Wing count:



present. Fore wing size: wings present and macropterous with apex extending past petiole. Pronotum median length: less than longest median anatomical line of the mesoscutum. Notaulus count: present. Crenulae of notaulus width: width of the crenulae increases more than  $2\times$  anteriorly. Notaulus posterior end location: adjacent to transscutal articulation. Median mesoscutal sulcus count: present. Median mesoscutal sulcus posterior end: adjacent to transscutal articulation. Scutoscutellar sulcus vs. transscutal articulation location: adjacent. Axillular carinae count: absent. Speculum ventral limit: not extending ventrally of pleural pit line. Metapleural sulcus shape: straight. Mesometapleural sulcus count: present. Ventrolateral invagination of the pronotum count: present. Sternaulus count: absent. Sternaulus length: stermaulus absent. Epicnemial carina count: complete. Epicnemium posterior margin shape: anterior discriminal pit present; epicnemial carina curved. Transverse striations on the ventral metapleural area count: absent. Scutes on posterior region of mesoscutum and dorsal region of mesoscutellum convexity: flat. Ventral projection of the metapleural carina count: present. Lateral propodeal carina count: present. Lateral propodeal carina shape: inverted “Y” (left and right lateral propodeal are adjacent medially posterior to antecostal sulcus of the first abdominal tergum, and connected to the antecostal sulcus by a median carina representing the median branch of the inverted “Y”). Mesopostscutellum count: absent (scutellum flat). Anteromedian projection of the metanoto-propodeo-metaplecto-mesopectal complex count: absent. Posterior margin of nucha in dorsal view shape: concave.

**Metasoma:** Transverse carina on petiole shape: straight. Paired blue iridescent ovoid patches on the syntergite count: absent. Shortest width of petiole neck vs. syntergal translucent patch maximum width: 1.8–3.0. Shortest width of petiole neck vs. synsternal translucent patch maximum width: 2.1–2.6. Syntergal translucent patch maximum width vs. minimum width: 1.2–1.7. Synsternal translucent patch maximum width vs. minimum width: 1.4–2.0. Syntergal translucent patch maximum width orientation: anterolaterally. Synsternal translucent patch maximum width orientation: anterolaterally. Synsternal setiferous patch shape: linear, with a patch of setae lateral or posterior to the synsternal translucent patch. Synsternal setiferous patch structure: comprised of a single or double row of setae anterior and lateral to the synsternal translucent patch, with a patch of setae posterior to the synsternal translucent patch. Synsternal setiferous patch anterior end: synsternal setiferous patch begins anterior to the synsternal translucent patch anterior margin. Synsternal setiferous patch posterior end: synsternal setiferous patch ends posterior to the synsternal translucent patch posterior margin. Synsternal setiferous patch length vs. synsternal translucent patch maximum width: synsternal setiferous patch at least  $2\times$  as long as the maximum width of the synsternal translucent patch. S1 length vs. shortest width: S1 wider than long.

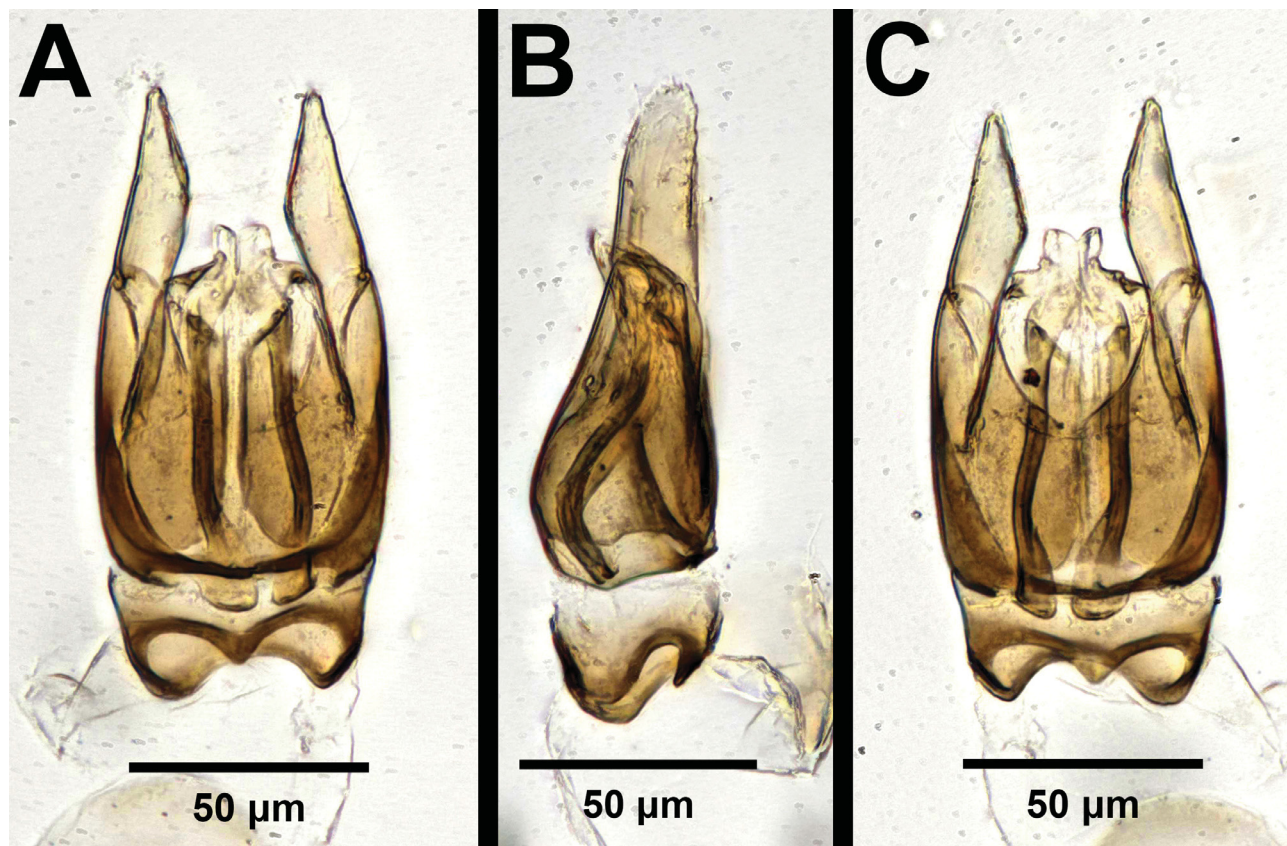
**Male Genitalia:** Distal margin of male S9 shape: straight. Proximolateral corner of male S9 shape: blunt. Male S9 distal setal line/setal patch count: distal setae composing transverse setiferous line or lines. Male S9 distal setal line / setal patch structure: single or double transverse row of distal setae. Distomedian hairless area interrupting transverse row of setae or patch on male S9 count: absent with distal setiferous patch/line continuous medially. Submedial projections on proximal margin of S9 count: absent. Cupula length vs. gonostyle–volsella complex length: cupula less than  $1/2$  the length of gonostyle–volsella complex in lateral view. Proximodorsal notch of cupula count: present. Proximodorsal notch of cupula shape: arched (inverted U-shape). Proximodorsal notch of cupula width vs length: wider than long. Proximolateral projection of the cupula shape: blunt. Gonocondyle count: present. Gonocondyle shape: acute. Distodorsal margin of cupula shape: concave. Distoventral submedian corner of the cupula count: absent. Dorsomedian projection of the gonostyle–volsella complex count: absent. Dorsomedian conjunctiva of the gonostyle–volsella complex count: present. Dorsomedian conjunctiva of the gonostyle–volsella complex length relative to length of gonostyle–volsella complex: dorsomedian conjunctiva extending greater than  $1/3$  of length of gonostyle–volsella complex in dorsal view. Dorsomedial margin of gonostyle–volsella complex shape: V-shaped. Proximal end of dorsomedian conjunctiva of the gonostyle–volsella complex shape: acute or V-shaped. Parossiculus count or parossiculus and gonostipes fusion: present and parossiculi not fused with the gonostipes. Medioventral conjunctiva of the gonostyle–volsella complex count or fusion of parossiculi: medioventral conjunctiva present and parossiculi independent or fused proximally. Apical parossicular setae count: one. Distal projection of the parossiculus count: absent. Distal projection of the penisvalva count: absent. Gonossiculus spine count: 3. Gonossiculus spine length: one spine not more than  $2\times$  as long as the other(s) (spines of similar lengths). Harpe length: harpe shorter than gonostipes in lateral view. Harpe shape: simple and not bilobed. Harpe orientation: medial. Lateral margin of harpe shape: widest point of harpe is at its articulation site with gonostyle–volsella complex. Distal margin of harpe in lateral view: acute or pointed. Lateral setae of harpe count: present. Lateral setae of harpe orientation: oriented distally. Lateral setae on harpe density: setae sparse. Dense patch of setae on the distoventral edge of the harpe count: absent. Distal setae on harpe length: setae not of equal length, longer setae present on distoventral edge of harpe. Distodorsal setae of sensillar ring of harpe length vs. harpe width in lateral view: setae longer

than harpe width. Distodorsal setae of sensillar ring of harpe orientation: distomedially. Sensillar ring area of harpe orientation: distomedially. Sensillar ring shape: circular. Distoventral margin of harpe in lateral view: convex.

**Distribution.** Nearctic.

**Etymology.** This species is named *washburni* in memory of Major Kent G. Washburn: a veteran who served an extended tour of duty in Vietnam plus two combat tours in Korea; an officer who served for more than 20 years in the US Army Medical Service Corps; a lifelong student who earned Master's degrees in education, hospital administration and military science following his military career; and a close family friend of the first author who passed away suddenly during the course of this research.

**Material Examined.** Holotype male: USA: Arizona: PSUC\_FEM 34274, UCFC 207381 (UCFC). Paratypes (21 males): USA: Arizona: 21 males. PSUC\_FEM 32265, 36073 (PSUC); PSUC\_FEM 4278, 33147, 33185, 33195, 34048, 34081, 34086, 34114, 34117, 34120, 34135, 34142, 34197, 34201, 34220, 34240, 34280 (UCFC); UCFC 207086, 208184 (UNHC).



**FIGURE 83.** *Conostigmus washburni* Trietsch **sp. nov.**, paratype male genitalia. A. Ventral (PSUC\_FEM 34135). B. Lateral (PSUC\_FEM 34220). C. Dorsal (PSUC\_FEM 34135).

## Other species

### *Conostigmus lucidus* Mikó and Trietsch 2016

While reviewing the literature for this study, we came across a mistake we would like to correct here. Mikó et. al (2016) included the description of a new Malagasy species named *Conostigmus lucidus* Mikó and Trietsch, 2016. This species name was derived from the Latin *lucidus*, meaning “shining”, referring to the shining appearance of the cuticle. However, this species name is a junior homonym, as the name is already preoccupied by *Conostigmus lucidus* Kieffer, 1907. These are two different distinct and valid species. To remedy this situation, we offer the replacement name *Conostigmus fulgidus* Mikó and Trietsch as a *nomen novum* for *Conostigmus lucidus* Mikó and Trietsch, 2016. This name is derived from the Latin *fulgidus*, which has a similar meaning to the word *lucidus* and also references the shining appearance of the cuticle.

## Discussion

### Distinguishing Male *Conostigmus* and *Dendrocerus* (Table 3)

*Dendrocerus* and *Conostigmus* can be incredibly difficult to distinguish (Mikó *et al.*, 2011). There are both *Dendrocerus*-like *Conostigmus* species (including *C. lepus* and *C. triangularis*) and *Conostigmus*-like *Dendrocerus* species (such as *D. punctipes* and *D. penmaricus*). It is unclear to which genus *C. fasciatipennis* belongs. Dessart (1972b) kept the species within the genus *Conostigmus* based on the presence of the medioventral conjunctiva (medioventral conjunctiva always absent and parossiculi fused with the gonostipes in *Dendrocerus*). Dessart (1972b) also noted its cylindrical male flagellomeres, which were typical of *Conostigmus*.

However, this species also lacks a facial pit (absent in most *Dendrocerus*) and has a *Dendrocerus*-like obtuse ocellar triangle in males (POL greater than LOL), where the two posterior ocelli are closer to the compound eyes than to each other (POL greater than OOL). Molecular data has so far been unable to delimit *Conostigmus* and *Dendrocerus* and determine the generic placement for *C. fasciatipennis*. Based on preliminary ultraconserved element (UCE) data, *Conostigmus* is paraphyletic and *Dendrocerus* is polyphyletic, with a few *Dendrocerus* species (*D. carpenteri* and *D. conwentziae*) nested within *Conostigmus* and *C. fasciatipennis* separating those species from the rest of *Dendrocerus* (Blaimer *et al.*, in prep.).

Some commonly-used morphological characters for distinguishing *Conostigmus* and *Dendrocerus* males are the ocellar ratios and the shape of the ocellar triangle (Dessart, 1995b; Dessart and Cancemi, 1987). *Dendrocerus* males are usually distinguished as having an obtuse ocellar triangle (POL greater than LOL) where the two posterior ocelli are closer to the compound eyes than to each other (POL greater than OOL), whereas *Conostigmus* males are usually thought to have an acute or equilateral ocellar triangle (POL equal to or less than LOL) where the posterior ocelli are closer to each other than to the compound eyes (POL less than OOL).

However, this does not hold true for all *Conostigmus*. Some species have more obtuse ocellar triangles (POL greater than LOL) in the males, including *C. nigrorufus*, *C. duncani*, and *C. bipunctatus*. Some male *Conostigmus* even have the posterior ocelli closer to the compound eyes than to each other (POL greater than OOL), including *C. lepus* and *C. triangularis*. As of now, there are no known *Dendrocerus* species with *Conostigmus*-like ocellar ratios, but more revisionary work on *Dendrocerus* is needed to investigate this before a conclusion can be made.

Male antennal characters are also commonly used for distinguishing between *Dendrocerus* and *Conostigmus* (Dessart, 1995b; Dessart and Cancemi, 1987). Female antennae are indistinguishable between the two genera, but male antennae of *Conostigmus* are symmetrical and cylindrical in shape, whereas the male flagellomeres of *Dendrocerus* are usually asymmetrical and can be serrate or trapezoidal. Some *Dendrocerus* also have branched flagellomeres (*D. mexicali* group), a state which is never found in *Conostigmus* (Dessart, 1995a, 1995b, 1999, 2001).

Of course, there are some exceptions in *Dendrocerus*. Both the *D. penmaricus* species group and the *D. punctipes* species group have symmetrical, cylindrical male flagellomeres that resemble those of *Conostigmus* (Dessart, 1983b, 1995a). Members of the *D. penmaricus* group can be differentiated from *Conostigmus* by the maximum scape width, which is greater than the pedicel length in *D. penmaricus* species group members (maximum scape width less than pedicel length in all *Conostigmus*) (Dessart, 1995a). The *D. punctipes* species group is more difficult to distinguish from *Conostigmus*, but can be differentiated by the combination of the fused parossiculi, absence of the facial pit, and *Dendrocerus*-like ocellar triangle (Dessart, 1983b).

Though the characters discussed above can be useful for distinguishing male *Conostigmus* and *Dendrocerus* specimens, they should not be used individually to make an identification. We recommend using a combination of characters to distinguish genera due to the numerous exceptions and overlap between these two genera. In addition to the characters above, some useful characters include the presence of the sternaulus (always absent in *Dendrocerus*, but present or absent in *Conostigmus*), wing presence (wings never absent in *Dendrocerus*, but present or absent in *Conostigmus*), notauli posterior end (always adjacent to the transscutal articulation in *Conostigmus*, but not adjacent in some *Dendrocerus*) and male genitalia characters including the presence of the parossiculi (parossiculi fused with the gonostipes in *Dendrocerus* but never in *Conostigmus*) and the medioventral conjunctiva of the gonostyle–volsella complex (parossiculi never independent in *Dendrocerus*, but independent or fused in *Conostigmus*). (Dessart, 1985, 1995a, 1995b, 1999, 2001; Mikó *et al.*, 2011, 2013). The facial pit is present in most *Conostigmus* (exceptions include *C. dimidiatus* and *C. erythrothorax*) and absent in most *Dendrocerus* (exceptions include *D. carpenteri*, *D. flavipes* and *D. rectangularis*). Other characters that can be useful but are more subjective include metapleural sulcus shape (usually curved in *Dendrocerus* and straight in *Conostigmus*, though it appears curved in

some *Dendrocerus*-like *Conostigmus* such as *C. lepus* and *C. triangularis*), as well as head shape (usually triangular in *Dendrocerus* and globulose or circular in *Conostigmus*).

**TABLE 3.** A table listing all of the morphological differences between male and female *Conostigmus* and *Dendrocerus*.

Character	Male <i>Conostigmus</i>	Male <i>Dendrocerus</i>
Facial Pit	Absent in most species	Present in most species
Flagellomere Shape	Symmetrical (cylindrical)	Assymetrical (serrate, toothed, trapezoidal, or branched), except in <i>D. punctipes</i> species group and <i>D. penmaricus</i> species group
Gonostyle-volsella complex medioventral conjunctiva (parossiculi fusion)	Present or Absent (parossiculae independent or fused)	Absent (parossiculae never independent)
Head shape	Usually globular or circular	Usually triangular
Metapleural sulcus shape	Usually curved	Usually straight
Notauli posterior end	Always adjacent to transscutal articulation	Adjacent or not adjacent to transscutal articulation
Ocellar triangle shape (POL to LOL)	Equilateral or Acute (POL equal to or less than LOL) in most species	Obtuse (POL greater than LOL) in all species
Parossiculi presence (fusion with gonostipes)	Always Present (not fused with gonostipes)	Present (not fused with gonostipes) or absent (fused with gonostipes)
POL to OOL	POL less than OOL in most species	POL greater than OOL in all species
Sternaulus	Present or Absent	Never Present
Wings	Present or Absent	Never Absent
Character	Female <i>Conostigmus</i>	Female <i>Dendrocerus</i>
Facial pit	Absent in most species	Present in most species
Head shape	Usually globular or circular	Usually triangular
Metapleural sulcus shape	Usually curved	Usually straight
Notauli posterior end	Always adjacent to transscutal articulation	Adjacent or not adjacent to transscutal articulation
Sternaulus	Present or Absent	Never Present
Wings	Present or Absent	Never Absent

### Distinguishing Female *Conostigmus* and *Dendrocerus*, and matching males and females (Table 3)

As discussed above, it can be difficult to distinguish *Dendrocerus* males from *Conostigmus* males; in the case of females, it can be nearly impossible. Females of both genera have similar antennal, genitalia and ovipositor characters. Females of both genera also have more similar ocellar triangle shapes and POL vs. OOL ratios than males. Characters that do occur across both male and female specimens include the presence of the sternaulus (never present in *Dendrocerus*, absent or present in *Conostigmus*), notauli posterior end (always adjacent to transscutal articulation in *Conostigmus*, but not adjacent in some *Dendrocerus*) and wing presence (wings always present and macropterous in *Dendrocerus*). However, the numerous exceptions that exist prevent these characters from being applied to all species. Other characters such as facial pit presence, as well as more subjective characters such as metapleural sulcus shape, head shape and general habitus, can be useful but are more variable and should not be used independently to make generic identifications.

It is difficult to distinguish females of *Conostigmus* and *Dendrocerus*, let alone females of different *Conostigmus* species. Even males cannot always be differentiated by somatic characters alone, as demonstrated by the morphometric analysis with the shape PCAs. This revision relies mainly on male genitalia characters, as this can be the only way to distinguish *Conostigmus* species in some cases (Dessart, 1997a, 1997b; Mikó *et al.*, 2013, 2016).

Some species do have unique combinations of somatic characters that can be used to match males and females, including *C. muesebecki*, *C. dimidiatus*, *C. erythrothorax*, *C. nigrorufus*, *C. bipunctatus*, *C. triangularis*, and *C.*

*lepus*. We were also able to confirm the female of *C. pulchellus* based on a male specimen that exhibited the same coloration found in the female specimens, but we avoid redescribing females of *C. abdominalis* from the Nearctic, as this species can only be distinguished from *C. rosemaryae* using male genitalia characters. Several Nearctic *Conostigmus* species were described from single female type specimens, but because females cannot be identified to species in most cases, we consider these as *species inquirenda*. Advances in molecular taxonomy and future work rearing live *Conostigmus* males and females will shed more light on this subject, and we eagerly anticipate what will be found.

### Estimating the Phylogeny of Megaspilidae with Morphology

Male genitalia characters have been used previously to infer evolutionary relationships within Ceraphronoidea and have suggested that Megaspilinae is monophyletic, but found that the genera of Megaspilinae formed a polytomy (Mikó *et al.*, 2013). We tested whether a combination of male genitalia and somatic characters could be used to infer evolutionary relationships within Megaspilinae. While our analysis showed that Lagynodinae formed a monophyletic group, the megaspiline genera formed a polytomy. Although there were groupings of both *Conostigmus* and *Dendrocerus* species in the analysis of somatic characters independently and the combined analysis of somatic and male genitalia characters together, these groupings all had jackknife and bootstrap values lower than 80 and were not supported in our analysis. While the somatic and male genitalia characters that were used in the analysis have value as diagnostic tools to differentiate between different species, it does not appear that this combination of diagnostic characters can be used to infer phylogenetic relationships within the subfamily.

It is not surprising that these diagnostic morphological characters were not able to infer phylogenetic relationships within Megaspilinae because the different megaspiline genera are morphologically very similar. In addition to the difficulties of distinguishing *Dendrocerus* and *Conostigmus* discussed above, there are very few morphological characters that distinguish these genera from *Trichosteresis* and *Megaspilus*. The only characters that differentiate *Megaspilus* from *Conostigmus* are the presence of a bifurcated anteromedian projection and elongate female proximal flagellomeres (Mikó *et al.*, 2018). *Trichosteresis* only differs from *Dendrocerus* by the presence of a shortened radial vein and a lack of setae across the wings and mesonotum. Based on the limited morphological differences between them, it is likely that *Conostigmus* and *Megaspilus* are the same genus (Blaimer *et al.*, in prep., Fig. 84; Mikó *et al.*, 2018); the same could be true for *Trichosteresis* and *Dendrocerus* as well.

Even different species within the genera can be morphologically very similar. The PCA analysis of 19 different body measurements was not able to separate *C. abdominalis*, *C. pulchellus* and *C. rosemaryae*. As is the case with many other *Conostigmus* species (discussed in the sections above), male specimens of these three species can only be distinguished by male genitalia characters, and the females of *C. abdominalis* and *C. rosemaryae* cannot be distinguished at this time.

Our morphological cladistic analysis was limited in that it only included 44 taxa, and focused only on the limited number of diagnostic characters that are available for this group, including 33 somatic characters and 11 male genitalia characters (44 characters total). However, a previous cladistic analysis that used more taxa (123 total) and slightly more characters (48 total) than our study and focused only on male genitalia characters was also unable to resolve the phylogeny of Megaspilinae (Mikó *et al.* 2013). Both our study and Mikó *et al.* (2013) reveal that Megaspilinae is a challenging lineage for inferring phylogenetic relationships when using morphological data. We consider it to be highly likely that Megaspilinae contains cryptic species that evolved rapidly. One likely cause of rapid speciation in the group is host identity and specificity, which could lead to cryptic species that are behaviorally, ecologically, biogeographically and phylogenetically distinct (Heraty *et al.* 2007; Templeton 1989). However, so little is known about the behavior, ecology and even the biogeography of megaspiline species that much work remains to be done before cryptic species can be verified.

### Conclusion

*Conostigmus* can be a difficult genus to work with, but species can be distinguished by morphological characters, especially male genitalia characters. Here, we revise *Conostigmus* for the first time in North America, north of Mexico. This revision and key are by no means final products, as there will always be more specimens to collect and observe, and more species to describe, but we have taken an important first step in describing the Nearctic diversity of *Conostigmus*. We hope this work will help those identifying *Conostigmus* presently, as well as providing a solid foundation for taxonomists to build upon in the future.

## Acknowledgments

We would like to thank Elijah Talamas and an anonymous reviewer for their comments and help in improving this manuscript. We would also like to thank all of the museums listed in the methods section that contributed material to this study, and all of the staff and curators at these museums who helped us loan and acquire specimens, including James M. Carpenter, Gavin Svenson, Nicole Gunter, Leland Humble, Megan Noseworthy, Jason Dombroskie, Gisèle Deschênes Wagner, Philip D. Perkins, Rachel L. Hawkins, Chris Darling, Brian Fisher, Antonia Guidotti, John Oswald, Norman Johnson, Luciana Musetti, Gary L. Parsons, Anthony Cognato, Eugene Drake, Serguei Triapitsyn, Derek Sikes, Robin E. Thomson, Craig Brabant, Larry Gall, Raymond Pupedis, Leonard Munstermann, Terence Lee Schiefer, Melissa Calahan, Gavin Broad, Andy Polaszek, Edward R. Hoebeke, Doug Yanega, Sophie Cardinal, Chris Grinter, and Joe McHugh. A special thanks to Lubo Masner, Matt Buffington, David Notton, Agnèle Touret-Alby, Shawn Clark, Robert Zuparko and Christy Bills for their help with coordinating museum visits and accessing material on-site, and to Roberto Poggi, Maria Tavano, Jadranka Rota, and Christoffer Fägerström for help accessing and imaging type specimens at museums we could not visit. We thank Marlyse Duguid and Shannon Murray at the Yale School Forests and Audrey Barker-Plotkin at the Harvard Forests for allowing us to sample for Ceraphronoidea. We thank Matt Bertone, Miles Zhang, and Mike Sharkey for their gifts of specimens. We thank Mike Skvarla and Barry O'Connor for their help with mite identification and Emily L. Sandall for her advice and assistance with georeferencing specimens. Finally, we thank Joseph F. Muratore, Patrick Lhomme, and Benoit Dayrat for their assistance with translations. This material is based upon work supported by the U. S. National Science Foundation, under Grant Numbers DBI-1356381 and DEB-1353252. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

## References

- Alekseev, V.N. (1978) Superfamily Ceraphronoidea. *In: Determination of Insects of the European Portion of the USSR*, 3 (2), pp. 1213–1257.
- Arnett, R.H., Samuelson, G.A. & Nishida, G.M. (1993) *The insect and spider collections of the world. 2<sup>nd</sup> Edition*. Crane Press, Inc, Gainesville, Florida, 310 pp.
- Arnold, J.B. (2017) ggthemes: Extra Themes, Scales and Geoms for “ggplot2”. Available from: <https://CRAN.R-project.org/package=ggthemes> (accessed 12 January 2020)
- Ashmead, W.H. (1887) Studies on the North American Proctotrupidae, with descriptions of new species from Florida. *Entomologica Americana*, 3, 73–119.
- Ashmead, W.H. (1888) Descriptions of some new genera and species of Canadian *Proctotrupidae*. *Canadian Entomology*, 20, 48–55.  
<https://doi.org/10.4039/Ent2048-3>
- Ashmead, W.H. (1893) A monograph of the North American Proctotrypidae. *Bulletin of the United States National Museum*, 45, 1–472.  
<https://doi.org/10.5479/si.03629236.45.1>
- Baur, H. & Leuenberger, C. (2011) Analysis of ratios in multivariate morphometry. *Systematic Biology*, 60, 813–825.  
<https://doi.org/10.1093/sysbio/syr061>
- Bennett, A.M.R., Sheffield, C.S. & deWaard, J.R. (2019) Hymenoptera of Canada. *ZooKeys*, 819, 311–360.  
<https://doi.org/10.3897/zookeys.819.28510>
- Bijoy, M.C., Rajmohana, K. & Kumar, R. (2014) First report of the genus *Conostigmus* Dahlbom (Hymenoptera: Ceraphronoidea: Megaspilidae) from India with description of a new species. *Biodiversity Data Journal*, 2, e991.  
<https://doi.org/10.3897/BDJ.2.e991>
- Boenisch, A., Petersen, G. & Wyss, U. (1997) Influence of the hyperparasitoid *Dendrocercus carpenteri* on the reproduction of the grain aphid *Sitobion avenae*. *Ecological Entomology*, 22, 1–6.  
<https://doi.org/10.1046/j.1365-2311.1997.00038.x>
- Boheman, C.H. (1832) Försök till beskrifning af de i Sverige funne Arter, hörande till Insekt-slägtet *Ceraphron*. K. Sven. Vetenskapsakademiens Handlingar, 1831, 322–339.
- Brues, C.T. (1909) A preliminary list of the proctotrypoid Hymenoptera of Washington, with descriptions of new species. *Bulletin of the Wisconsin Natural History Society*, 7, 111–122.
- Brues, C.T. (1916) Serphoidea (Proctotrypoidea). *In: Viereck, H.L. (Ed.), The Hymenoptera, or Wasp-like Insects, of Connecticut. Guide to the Insects of Connecticut. Part III*. Bulletin State Geological and Natural History Survey of Connecticut, Hartford, Connecticut, pp. 529–576.

- Burks, K.N., Mikó, I. & Deans, A.R. (2016) *Dendrocerus mexicali* (Hymenoptera, Ceraphronoidea, Megaspilidae): Novel antennal morphology, first description of female, and expansion of known range into the U.S. *ZooKeys*, 569, 53–69. <https://doi.org/10.3897/zookeys.569.6629>
- Chow, A. & Mackauer, M. (1999a) Host handling and specificity of the hyperparasitoid wasp, *Dendrocerus carpenteri* (Curtis) (Hym. Megaspilidae): importance of host age and species. *Journal of Applied Entomology*, 123, 83–91. <https://doi.org/10.1046/j.1439-0418.1999.00322.x>
- Chow, A. & Mackauer, M. (1999b) Marking the package or its contents: host discrimination and acceptance in the ectoparasitoid *Dendrocerus carpenteri* (Hymenoptera: Megaspilidae). *Canadian Entomology*, 131, 495–505. <https://doi.org/10.4039/Ent131495-4>
- Cooper, K.W. & Dessart, P. (1975) Adult, larva and biology of *Conostigmus quadratogenalis* Dessart & Cooper, sp. n. (Hym. Ceraphronoidea), parasite of *Boreus* (Mecoptera) in California. *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 111, 37–53.
- Dahlbom (1858) Svenska sma-ichneumonernas familjer och slaegten. *Öfversigt Af Kongliga Vetensk.-Akademiens Förh.*, 14, 289–298.
- Dessart, P. (1967) Description de *Dendrocerus (Macrostigma) noumeae* sp. nov. de Nouvelle Calédonie (Ceraphronoidea Megaspilidae). *Entomophaga*, 12, 343–349. <https://doi.org/10.1007/BF02376920>
- Dessart, P. (1972a) Contribution à la revision du genre *Megaspilus* Westwood, 1829 (Hymenoptera, Ceraphronoidea Megaspilidae). *Bulletin of the Royal Belgian Institute of Natural Sciences*, 48, 1–55.
- Dessart, P. (1972b) Revision des especes europeenes du genre *Dendrocerus* Ratzeburg, 1852 (Hymenoptera Ceraphronoidea). *Mémoires de la Société entomologique de Belgique*, 32, 310.
- Dessart, P. (1973) *Dichogmus* Thomson, 1858, un genre invalide. (Hym. Ceraphronoidea Megaspilidae). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 108, 104–130.
- Dessart, P. (1974) Les megaspilides europeens [Hym. Ceraphronoidea] parasites des dipteres syrphides avec une revision du genre *Trichostereis*. *Annales de la Société Entomologique de France*, New Series, 10, 395–448.
- Dessart, P. (1975) Matériel typique des microhymenoptera myrmécophiles de la Collection Wasmann déposé au Muséum Wasmannianum à Maastricht (Pays-Bas). *Publicaties van het Natuurhistorisch Genootschap in Limberg*, 24, 1–94.
- Dessart, P. (1978) *Dendrocerus rodhaini* (Bequaert, 1913), nouvelle combinaison (Hym., Ceraphronoidea, Megaspilidae). *Revue de zoologie africaine*, 92, 224–232.
- Dessart, P. (1980a) Description et redescription de quelques Ceraphronoidea (I). (Hymenoptera). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 116, 185–199.
- Dessart, P. (1980b) Redescription de *Conostigmus triangularis* (Thomson, 1858) comb. nov. (Hym. Ceraphronoidea Megaspilidae). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 116, 19–28.
- Dessart, P. (1981) Notule hyménoptérologique no. 7. *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 116, 205–206.
- Dessart, P. (1983a) Les Hyménoptères Ceraphronoidea du Mecsek: un coup de balai. *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 119, 111–122.
- Dessart, P. (1983b) *Dendrocerus psyllarum* n. sp. (Hym. Ceraphronoidea Megaspilidae) parasite ou hyperparasite de psylles (Hom. Psyllidae) en France et en Belgique. *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 119, 222–226.
- Dessart, P. (1985) Les *Dendrocerus* a notaulices incompletes (Hymenoptera Ceraphronoidea Megaspilidae). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 121, 409–458.
- Dessart, P. (1992) Revision d'*Aphanogmus fulmeki* Szelényi, 1940 (Hymenoptera, Ceraphronoidea, Ceraphronidae) avec remarques biologiques. *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 62, 83–91.
- Dessart, P. (1993) Un *Conostigmus* et un *Ceraphron* a antennes teratologiques (Hymenoptera: Ceraphronoidea). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 63, 51–58.
- Dessart, P. (1995a) A propos du genre *Dendrocerus* Ratzeburg, 1852. Les espèces du group “*penmaricus*” (Hymenoptera Ceraphronoidea Megaspilidae). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 131, 349–382.
- Dessart, P. (1995b) 8.6 Megaspilidae. In: Hanson, P. & Gauld, I.D. (Eds.), *Hymenoptera of Costa Rica*. Oxford University Press, Oxford, pp. 203–208.
- Dessart, P. (1996) Notule hyménoptérologiques nos 10-21 (Ceraphronoidea; Chalcidoidea Pteromalidae). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 132, 277–299.
- Dessart, P. (1997a) Trois *Conostigmus* roux-noir nord-américains (Hymenoptera Ceraphronoidea Megaspilidae). *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 133, 23–44.
- Dessart, P. (1997b) Les Megaspilinae ni européens, ni américains. 1. Le genre *Conostigmus* Dahlbom, 1858 (Hym. Ceraphronoidea Megaspilidae). *Mémoires de la Société entomologique de Belgique*, 37, 3–144.
- Dessart, P. (1999) Révision des *Dendrocerus* du groupe «*halidayi*» (Hym. Ceraphronoidea Megaspilidae). *Belgian Journal of Entomology*, 1, 169–275.
- Dessart, P. (2001) Les Megaspilinae ni européens, ni américains 2. Les *Dendrocerus* Ratzeburg, 1852, à mâles non flabellicornés (Hymenoptera Ceraphronoidea Megaspilidae). *Belgian Journal of Entomology*, 3, 3–124.
- Dessart, P. & Cancemi, P. (1987) Tableau dichotomique des genres de Ceraphronoidea (Hymenoptera) avec commentaries et nouvelles espèces. *Frustula Entomologie*, 7–8, 307–372.

- Dessart, P. & Masner, L. (1965) Contribution à l'étude des Hyménoptères Proctotrupeoidea (VII). *Ecnomothorax*, genre nouveau de Ceraphronidae Megaspilinae. *Bulletin et Annales de la Société Royale Belge d'Entomologie*, 101, 275–288.
- Dodd, A.P. (1914) Australian Hymenoptera Proctotrypoidea. No. 2. *Transactions of The Royal Society of South Australia*, 38, 58–131.
- Dowle, M. & Srinivasan, A. (2017) data.table: Extension of `data.frame`. R package. Version 1.10.4. Available from: <https://CRAN.R-project.org/package=data.table> (accessed 12 January 2020)
- Evans, G.A., Dessart, P. & Glenn, H. (2005) Two new species of *Aphanogmus* (Hymenoptera: Ceraphronidae) of economic importance reared from *Cybocephalus nipponicus* (Coleoptera: Cybocephalidae). *Zootaxa*, 1018 (1), 47. <https://doi.org/10.11646/zootaxa.1018.1.3>
- Evenhuis, N.L. (2018) The insect and spider collections of the world website. Available from: <http://hbs.bishopmuseum.org/codens/> (accessed 27 March 2018)
- Fergusson, N.D.M. (1980) A revision of the British species of *Dendrocerus* Ratzeburg (Hymenoptera: Ceraphronoidea) with a review of their biology as aphid hyperparasites. *Bulletin of the British Museum (Natural History), Entomology Series*, 41, 255–314. <https://doi.org/10.5962/bhl.part.28549>
- Ferrière, C. (1933) Chalcidoid and proctotrupoid parasites of pests of the coconut palm. *Stylops*, 2, 86–108. <https://doi.org/10.1111/j.1365-3113.1993.tb00980.x>
- Förster, A. (1856) *Hymenopterologische Studien*. II. Heft. Chalcidae und Proctotrupii. Ernst ter Meer, Aachen, 152 pp.
- Gahan & Rowen (1917) Lectotypes of the species of Hymenoptera (except Apoidea) described by Abbé Provancher. *Canadian Entomology*, 49 (12), 298–508. <https://doi.org/10.4039/Ent49298-9>
- Goloboff, P.A., Farris, J.S. & Nixon, K.C. (2008) TNT, a free program for phylogenetic analysis. *Cladistics*, 24, 774–786. <https://doi.org/10.1111/j.1096-0031.2008.00217.x>
- Goulet, H. & Huber, J.T. (1993) *Hymenoptera of the world: an identification guide to families* Centre for Land and Biological Resources Research, Ottawa, Ontario, 680 pp.
- Graham, M.W.R.de.V. (1984) Madeira insects, mainly Hymenoptera Proctotrupeoidea, Ceraphronoidea, and Bethyloidea. *Boletim do Museu Municipal do Funchal*, 36, 83–110.
- Guppy, J.C. (1961) Life-History, Behaviour, and Ecology of the Clover Seed Midge, *Dasyneura leguminicola* (Lint.) (Diptera: Cecidomyiidae), in Eastern Ontario. *Canadian Entomology*, 93, 59–73. <https://doi.org/10.4039/Ent9359-1>
- Harrington, W.H. (1900) Catalogue of Canadian Proctotrypidae. *Transactions of the Royal Society of Canada*, 2, 169–206. <https://doi.org/10.5962/bhl.part.25118>
- Harris, R.A. (1979) Glossary of surface sculpturing. *Occasional Papers of Entomology, California Department of Food and Agriculture*, 28, 1–31.
- Haviland, M.D. (1920) Memoirs: On the Bionomics and Development of *Lygocerus testaceimanus*, Kieffer, and *Lygocerus cameroni*, Kieffer (Proctotrypoidea-Ceraphronidae), Parasites of *Aphidius* (Braconidae). *Quarterly Journal of Microscopical Science*, 2, 101–127.
- Hayat, M., Narendran, T.C., Remadevi, O.K. & Manikandan, S. (2003) Parasitoids (Hymenoptera: Chalcidoidea; Ceraphronoidea) reared mainly from Coccoidea (Homoptera) attacking Sandalwood, *Santalum album* L. *Oriental Insects*, 37, 309–334. <https://doi.org/10.1080/00305316.2003.10417352>
- Heraty, J.M., Woolley, J.B., Hopper, K.R., Hawks, D.L., Kim, J.W. & Buffington, M. (2007) Molecular phylogenetics and reproductive incompatibility in a complex of cryptic species of aphid parasitoids. *Molecular Phylogenetics and Evolution*, 45 (2), 480–493. <https://doi.org/10.1016/j.ympev.2007.06.021>
- Hoebcke (1980) Catalogue of the Hymenoptera types in the Cornell University Insect Collection. Part I: Symphyta and Apocrita (Parasitica). *Cornell University Agricultural Experiment Station*, 9, 1–36.
- International Commission on Zoological Nomenclature (ICZN). (1999) *International code of zoological nomenclature. 4th Edition*. The International Trust for Zoological Nomenclature, London. Available from <https://www.iczn.org/the-code/the-international-code-of-zoological-nomenclature/the-code-online/> (accessed 12 January 2020)
- Johnson, N.F. & Musetti, L. (2004) Catalog of the systematic literature of the superfamily Ceraphronoidea (Hymenoptera). *Contributions of the American Entomological Institution*, 33, 1–149.
- Kamal, M. (1926) Four new species of parasites from aphidiophagous Syrphidae (Hymenoptera). *Canadian Entomology*, 58, 283–286. <https://doi.org/10.4039/Ent58283-11>
- Kamal, M. (1939) Biological studies on some Hymenopterous parasites of aphidophagous Syrphidae. *Bulletin of the Ministry of Agriculture of Egypt, Entomology Section*, 207, 1–111.
- Kamarudin, N.H., Walker, A.K., Wahid, M.B., LaSalle, J. & Polaszek, A. (1996) Hymenopterous parasitoids associated with the bagworms *Metisa plana* and *Mahasena corbetti* (Lepidoptera: Psychidae) on oil palms in Peninsular Malaysia. *Bulletin of Entomological Research*, 86, 423. <https://doi.org/10.1017/S000748530003501X>



- Kieffer, J.J. (1906) Beschreibung neuer Proctotrypiden aus Nord- und Zentralamerika. *Berliner Entomologische Zeitschrift*, 50, 237–290.  
<https://doi.org/10.1002/mmnd.47919060305>
- Kieffer, J.J. (1907) Proctotrypidæ (suite). *Species Hyménoptères d'Europe & d'Algérie*, 10, 1–144.  
<https://doi.org/10.5281/zenodo.24299>
- Kieffer, J.J. (1908) Nouveaux proctotrypides et cynipides d'Amérique recueillis par M. Baker. *Annales de la Société Scientifique de Bruxelles*, 32, 7–64.
- Kieffer, J.J. (1909) Hymenoptera. Fam. Ceraphronidae. *Genera Insectorum*, 94, 1–27.
- Kieffer, J.J. (1914) *Serphidae* (= *Proctotrupidae*) et *Calliceratidae* (= *Ceraphronidae*). *Das Tierreich*, 42. lfg. R. Friedländer und sohn., Berlin, 254 pp.  
<https://doi.org/10.5962/bhl.title.1219>
- Laborius, A. (1972) Untersuchungen über die Parasitierung des Kohlschotenrüblers (*Ceuthorrhynchus assimilis* Payk.) und der Kohlschotengallmücke (*Dasyneura brassicae* Winn.) in Schleswig-Holstein. *Zeitschrift für Angewandte Entomologie*, 72, 14–31.  
<https://doi.org/10.1111/j.1439-0418.1972.tb02213.x>
- László, Z., Baur, H. & Tóthmérész, B. (2013) Multivariate ratio analysis reveals *Trigonoderus pedicellaris* Thomson (Hymenoptera, Chalcidoidea, Pteromalidae) as a valid species. *Systematic Entomology*, 38, 753–762.  
<https://doi.org/10.1111/syen.12026>
- Mackauer, M. (2017) Resource rivalry between brood mates of a facultative gregarious parasitoid *Dendrocerus carpenteri*: Resource rivalry in parasitoid larvae. *Physiological Entomology*, 42, 65–72.  
<https://doi.org/10.1111/phen.12167>
- Mackauer, M. & Chow, A. (2015) Facultative gregarious development in a solitary parasitoid wasp, *Dendrocerus carpenteri*: larvae may share nutritional resources. *Experimentalis et Applicata*, 157, 170–180.  
<https://doi.org/10.1111/eea.12352>
- Mackauer, M. & Chow, A. (2016) Females of the parasitoid wasp, *Dendrocerus carpenteri* (Hymenoptera: Megaspilidae), adjust offspring sex allocation when competing for hosts. *European Journal of Entomology*, 113, 542–550.  
<https://doi.org/10.14411/eje.2016.074>
- Mann, M. (1920) A proctotrypid inquiline with *Formica exsectoides* Forel. *Proceedings of the Entomological Society of Washington*, 22, 59–60.
- Märkel, F. (1844) Beiträge zur Kenntniss der unter Ameisen lebenden Insekten. Zweites Stück. *Zeitschrift für Angewandte Entomologie*, 5, 193–271.
- Martinez de Murgia, L., Angeles Vazquez, M. & Nieves-Aldrey, J.L. (2001) The families of Hymenoptera (Insecta) in an heterogeneous acidophilous forest in Artikutza (Navarra, Spain). *Frustula Entomologica*, 24, 81–98.
- Masner, L. (1964) A comparison of some Nearctic and Palearctic genera of Proctotrupeoidea (Hymenoptera) with revisional notes. *Časopis Československé společnosti entomologické*, 61, 123–155.
- Masner, L. (1969) The Provancher species of Proctotrupeoidea (Hymenoptera). *Naturaliste Canadien*, 96, 775–784.
- Masner, L. (2006) Familia Megaspilidae. In: Fernandez, F. & Sharkey, M.J. (Eds.), *Introducción a los Hymenoptera de la Región Neotropical*. Guadalupe, Bogotá, pp. 789–791.
- Masner, L. (2011) The International YPT Cookbook. *Hamuli*, 2, 26–27.
- Masner, L. & Muesebeck, C.F.W. (1968) *The types of Proctotrupeoidea (Hymenoptera) in the United States National Museum*. *Bulletin of the United States National Museum*. Smithsonian Institution Press, Washington, D.C., 143 pp.  
<https://doi.org/10.5479/si.03629236.270>
- Matsuo, K., Ganaha-Kikumura, T., Ohno, S. & Yukawa, J. (2016) Description of a new species of *Aphanogmus* Thomson (Hymenoptera, Ceraphronidae) that parasitizes acarivorous gall midges of *Feltiella* (Diptera, Cecidomyiidae) in Japan. *ZooKeys*, 596, 77–85.  
<https://doi.org/10.3897/zookeys.596.8472>
- Mikó, I. & Deans, A. (2009) *Masner*, a new genus of Ceraphronidae (Hymenoptera, Ceraphronoidea) described using controlled vocabularies. *ZooKeys*, 20, 127–153.  
<https://doi.org/10.3897/zookeys.20.119>
- Mikó, I., Vilhelmsen, L., Johnson, N.F., Masner, L. & Zsolt, P. (2007) *Skeletomusculature of Scelionidae (Hymenoptera: Platygastroidea): head and mesosoma*. *Zootaxa*, 1571 (1), 1–78.  
<https://doi.org/10.11646/zootaxa.1571.1.1>
- Mikó, I., Yoder, M.J. & Deans, A.R. (2011) Order Hymenoptera, Family Megaspilidae, Genus *Dendrocerus*. *Arthropod Fauna of the UAE*, 4, 353–374.
- Mikó, I., Masner, L., Johannes, E., Yoder, M.J. & Deans, A.R. (2013) Male terminalia of Ceraphronoidea: morphological diversity in an otherwise monotonous taxon. *Insect Systematics and Evolution*, 44, 261–347.  
<https://doi.org/10.1163/1876312X-04402002>
- Mikó, I., Trietsch, C., Sandall, E.L., Yoder, M.J., Hines, H. & Deans, A.R. (2016) Malagasy *Conostigmus* (Hymenoptera: Ceraphronoidea) and the secret of scutes. *PeerJ*, 4, e2682.  
<https://doi.org/10.7717/peerj.2682>
- Mikó, I., Kamp, T. van de, Trietsch, C., Ulmer, J.M., Zuber, M., Baumbach, T. & Deans, A.R. (2018) A new megaspilid wasp

- from Eocene Baltic amber (Hymenoptera: Ceraphronoidea), with notes on two non-ceraphronoid families: Radiophronidae and Stigmaphronidae. *PeerJ*, 6, e5174.  
<https://doi.org/10.7717/peerj.5174>
- Muesebeck, C.F.W. & Walkley, L.M. (1951) Superfamily Proctotrupeoidea. In: Hymenoptera of America North of Mexico—Synoptic Catalogue, *US Department of Agriculture Monograph*, No. 2, pp. 655–718.
- Muesebeck, C.F.W. & Walkley, L.M. (1956) Type species of the genera and subgenera of parasitic wasps comprising the superfamily Proctotrupeoidea (order Hymenoptera). *Proceedings of the United States National Museum*, 105 (3359), 319–419.  
<https://doi.org/10.5479/si.00963801.3359.319>
- Nakashima, Y., Higashimura, Y. & Mizutani, K. (2016) Host discrimination and ovicide by aphid hyperparasitoids *Asaphes suspensus* (Hymenoptera: Pteromalidae) and *Dendrocerus carpenteri* (Hymenoptera: Megaspilidae). *Applied Entomology and Zoology*, 51, 609–614.  
<https://doi.org/10.1007/s13355-016-0437-0>
- Neuwirth, E. (2014) RColorBrewer: ColorBrewer Palettes. R package. Version 1.1-2. Available from: <https://CRAN.R-project.org/package=RColorBrewer> (accessed 12 January 2020)
- Ortiz-Martínez, S.A. & Lavandero, B. (2017) The effect of landscape context on the biological control of *Sitobion avenae*: temporal partitioning response of natural enemy guilds. *Journal of Pest Science*, 91 (1), 49–53.  
<https://doi.org/10.1007/s10340-017-0855-y>
- Panis, A. (2008) *Conostigmus dimidiatus* Thomson new to France (Hymenoptera, Megaspilidae). *Nouvelle Revue d'Entomologie*, 24, 321–328.
- Pezzini, C. & Köhler, A. (2017) Annotated keys to the species of Megaspilidae (Hymenoptera: Ceraphronoidea) of the Neotropical Region. *EntomoBrasilis*, 10, 37.  
<https://doi.org/10.12741/ebrasilis.v10i1.660>
- Polaszek, A., Fitton, M.G., Bianchi, G. & Huddleston, T. (1994) The parasitoids of the African white rice borer, *Maliarpha separatella* Ragonot (Lepidoptera: Pyralidae). *Bulletin of Entomological Research*, 84 (1), 65–89.  
<https://doi.org/10.1017/S0007485300032247>
- Provancher, L. (1885) *Additions et corrections au Volume II de la Faune Entomologique du Canada*. C. Darveau, Quebec, 477 pp.
- Ridenbaugh, R.D., Barbeau, E. & Sharanowski, B.J. (2018) Description of four new species of *Eadya* (Hymenoptera, Braconidae), parasitoids of the *Eucalyptus* Tortoise Beetle (*Paropsis charybdis*) and other *Eucalyptus* defoliating leaf beetles. *Journal of Hymenoptera Research*, 64, 141–175.  
<https://doi.org/10.3897/jhr.64.24282>
- Schaffner, J.V. (1959) *Microlepidoptera and their parasites reared from field collections in the Northeastern United States*. U.S. Government Printing Office, Washington, D.C., 108 pp.  
<https://doi.org/10.5962/bhl.title.65860>
- Schmitt, G. (2004) *Parasitoid communities (Hymenoptera) in the agricultural landscape: effects of land use types and cultivation methods on structural parameters*. Doctoral dissertation, PhD thesis, Technische Universität Dresden, Tharandt. [unkown pagination]
- Schwörer, U., Völkl, W. & Hoffmann, K.H. (1999) Foraging for mates in the hyperparasitic wasp, *Dendrocerus carpenteri*: impact of unfavourable weather conditions and parasitoid age. *Oecologia*, 119, 73–80.  
<https://doi.org/10.1007/s004420050762>
- South, A. (2011) rworldmap: A New R package for Mapping Global Data. 3, 9. *The R Journal*, 3 (1), 35–43.  
<https://doi.org/10.32614/RJ-2011-006>
- Templeton, A.R. (1989) The meaning of species and speciation: a genetic perspective. In: Ereshefsky, M. (Ed.), *The Units of Evolution: Essays on the Nature of Species*. Bradford Books, Cambridge, Massachusetts, pp. 159–183.
- Thomson, C.G. (1858) Sveriges Proctotruper. Tredje Gruppen Ceraphronini. *Öfversigt Af Kongl Vetenskapsakademiens Forth*, 15, 287–305.
- Trietsch, C. & Mikó, I. (2018) Pan traps can collect live insects for morphology, histology, and more! *Hamuli*, 9, 11–13.
- Trietsch, C., Mikó, I., Ulmer, J.M. & Deans, A.R. (2017) Translucent cuticle and setiferous patches in Megaspilidae (Hymenoptera, Ceraphronoidea). *Journal of Hymenoptera Research*, 60, 135–156.  
<https://doi.org/10.3897/jhr.60.13692>
- Trietsch, C., Mikó, I. & Deans, A.R. (2019) A photographic catalog of Ceraphronoidea types at the Muséum national d'Histoire naturelle, Paris (MNHN), with comments on unpublished notes from Paul Dessart. *European Journal of Taxonomy*, 502, 1–60.  
<https://doi.org/10.5852/ejt.2019.502>
- Ulina, E., Rizali, S.A., Manuwoto, S. & Buchori, D. (2019) Does composition of tropical agricultural landscape affect parasitoid diversity and their host–parasitoid interactions? *Agricultural and Forest Entomology*, 21 (3), 318–325.  
<https://doi.org/10.1111/afe.12334>
- Whittaker, O. (1930) Eight new species of Serphoidea (Hymenoptera) from British Columbia. *Proceedings of the Entomological Society of Washington*, 32, 129–135.
- Wickham, H. (2016) *ggplot2: Elegant Graphics for Data Analysis*. Springer-Verl, New York, 260 pp.  
<https://doi.org/10.1007/978-3-319-24277-4>

Yoder, M.J., Mikó, I., Seltmann, K.C., Bertone, M.A. & Deans, A.R. (2010) A gross anatomy ontology for Hymenoptera. *PLoS One*, 5, e15991.  
<https://doi.org/10.1371/journal.pone.0015991>

#### **SUPPLEMENTARY FILES**

**SUPPLEMENTARY FILE 1.** A table containing the species, specimens and measurements used for the shape principal component analysis (PCA).

**SUPPLEMENTARY FILE 2.** A Darwincore file containing the meta data of the specimens examined in this study, using the template provided by GBIF for upload using the Integrated Publishing Toolkit (<https://www.gbif.org/news/82852/new-darwin-core-spreadsheet-templates-simplify-data-preparation-and-publishing>).

**SUPPLEMENTARY FILE 3.** A list of all species, character states and data matrices used in the cladistic analysis.