



## The Neotropical green lacewing genus *Ceraeochrysa* Adams (Neuroptera: Chrysopidae)—new synonymies and combinations, a new species, and an updated key to species

FRANCISCO JOSÉ SOSA-DUQUE<sup>1</sup> & CATHERINE A. TAUBER<sup>2</sup>

<sup>1</sup>Universidade Federal Rural da Amazônia, Campus de Capitão Poço, Pará—Brazil.

✉ [fsosaduque@gmail.com](mailto:fsosaduque@gmail.com); <https://orcid.org/0000-0002-0762-2203>

<sup>2</sup>Department of Entomology, Comstock Hall, Cornell University, Ithaca, NY 14853 U.S.A. and Department of Entomology & Nematology, University of California, Davis, CA 95616, U.S.A. ✉ [cat6@cornell.edu](mailto:cat6@cornell.edu); <https://orcid.org/0000-0003-1310-8996>

### Table of contents

Abstract . . . . .	1
Introduction . . . . .	1
Materials and methods . . . . .	2
Part 1. <i>Ceraeochrysa discolor</i> (Navás), redescription and two new junior synonyms. . . . .	4
Part 2. <i>Ceraeochrysa adynatos</i> (Freitas & Penny, 2001), New Combination . . . . .	12
Part 3. <i>Ceraeochrysa sarta</i> (Banks, 1914), new combination and a new junior synonym . . . . .	14
Part 4. <i>Ceraeochrysa poujadei</i> (Navás, 1910), new combination and two new junior synonyms. . . . .	21
Part 5. <i>Ceraeochrysa silvanoii</i> (Navás, 1916) . . . . .	33
Part 6. <i>Ceraeochrysa paraensis</i> Sosa, New Species . . . . .	41
Part 7. Updated key to <i>Ceraeochrysa</i> species. . . . .	46
Acknowledgements. . . . .	49
References . . . . .	50

### Abstract

*Ceraeochrysa* Adams, 1982, with ~60 species, is a diverse and relatively well studied New World genus of green lacewings. However, nomenclatural problems and misidentifications persist; undescribed species continue to be found; and species determinations remain difficult. Here, we address several problematic issues within the genus, and we justify the following taxonomic changes: **Part 1** synonymizes *Ceraeochrysa rafaelli* Adams & Penny **syn. n.** and *Chrysopodes* (*Chrysopodes*) *nigropictus* Freitas & Penny **syn. n.** with *Ceraeochrysa discolor* (Navás). **Part 2** identifies *Ceraeochrysa adynatos* (Freitas & Penny) **comb. n.** as the new name for *Chrysopodes* (*Chrysopodes*) *adynatos* Freitas & Penny. **Part 3** renames *Chrysopa sarta* Banks as *Ceraeochrysa sarta* (Banks) **comb. n.**, and identifies it as conspecific with *Ceraeochrysa berlandi* (Navás) **syn. n.** **Part 4** names *Chrysopa poujadei* Navás as *Ceraeochrysa poujadei* (Navás) **comb. n.** and also identifies its new synonyms—*Chrysopodes* (*Chrysopodes*) *laevus* (Navás) **syn. n.** and *Ceraeochrysa forcipata* Freitas & Penny **syn. n.** **Part 5** redescribes the enigmatic *Ceraeochrysa silvanoii* (Navás) and recognizes *Ceraeochrysa tucumana* (Navás) **syn. n.** as its junior synonym. **Part 6** describes a new *Ceraeochrysa* species: *Ceraeochrysa paraensis* Sosa **sp. n.** from Brazil. Finally, to help facilitate species identifications, **Part 7** incorporates all new species and all taxonomic changes made since the last revision of the genus (2009) into an updated key to the currently valid species of *Ceraeochrysa*. Lectotypes are designated for three species: *C. discolor* Navás, *C. sarta* Banks, and *C. tucumana* Navás.

**Key words:** Taxonomy, nomenclature, identification, natural enemy, biological control

### Introduction

*Ceraeochrysa* Adams, 1982, is the largest and perhaps best studied Neotropical genus in the green lacewing tribe Chrysopini (Neuroptera: Chrysopidae: Chrysopinae). During the past forty years it has been the focus of numerous

taxonomic studies aimed at describing the adults and larvae of new species, resolving taxonomic problems, elucidating the biology and natural history of its species, and providing systematic tools for identification and use of its species in pest management (Adams 1982; Adams & Penny 1985; Brooks & Barnard 1990; Eisner *et al.* 1996; Penny 1997, 1998; López-Arroyo *et al.* 1999a, b; Tauber *et al.* 2000; Freitas & Penny 2001; Tauber & de Leon 2001; Eisner *et al.* 2002; Penny 2002; Legrand *et al.* 2008; Freitas *et al.* 2009; Viana & Albuquerque 2009; Sosa & Freitas 2010; Tauber & Flint 2010; Sosa & Freitas 2011, 2012; Tauber & Garland 2014; Tauber *et al.* 2014; Tauber 2017; Tauber *et al.* 2017; Tauber & Pantaleoni 2018; Cancino-López & Contreras-Ramos 2019; Tauber *et al.* 2019; Wheeler & Stocks 2019). The genus was revised by Freitas *et al.* (2009). At that time, sixty-four species were recognized. Since then, the discovery and description of new species and the recognition of synonymies, new taxonomic affiliations, and errors of identification resulted in the addition of five species and removal or synonymization of seven species (Sosa & Freitas 2010; Tauber & Flint 2010; Sosa & Freitas 2011, 2012; Tauber & Garland 2014; Tauber & Pantaleoni 2018; Cancino-López & Contreras-Ramos 2019). Thus, the total number of currently recognized *Ceraeochrysa* species is sixty-two.

Currently, one of the main systematic problems with this genus lies in the fairly large percentage of species (~50%) for which only one sex is known and where the possibility remains that males and females of a single species are not treated as conspecific (see Freitas *et al.* 2009; Sosa & Freitas 2010; Tauber & Flint 2010; Tauber 2017). Moreover, species in a number of chrysopine genera (e.g., *Chrysopodes* Navás, *Titanochrysa* Sosa & Freitas) are similar to those in *Ceraeochrysa*, and although there are fine characters to distinguish these genera (both males and females), their generic identity is often mistaken. Here, to help address these problems, we present new data related to the systematics of the genus. In the first six parts of the paper, we describe or redescribe a number of species that were misidentified or synonymous with previously described *Ceraeochrysa* species. This work resulted in five new synonymies, three new combinations, five redescrptions, and one new species description. The seventh and final part of the article contains an updated key to *Ceraeochrysa* species that incorporates taxonomic information published after the last revision of the genus (Freitas *et al.* 2009).

## Materials and methods

The specimens discussed here were all examined and photographed by FS or CAT; they are held in the following institutions:

CAS	California Academy of Sciences, Golden Gate Park, San Francisco, California, USA
CMNH	Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, USA
CSUC	Colorado State University, Fort Collins, Colorado, USA
EMEC	Essig Museum of Entomology, University of California, Berkeley, California, USA
INPA	Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil
LRRP	Laboratório de Sistemática e Bioecologia de Parasitoides e Predadores, Instituto Biológico, Ribeirão Preto, São Paulo, Brazil (formerly IBRP—Instituto Biológico de Ribeirão Preto, São Paulo)
MACN	Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina
MCT	M. J. and C. A. Tauber Research Collection, Davis, California, USA
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA
MIZA	Museo del Instituto de Zoología Agrícola “Dr. Francisco Fernández Yépez, Universidad Central de Venezuela, Maracay, Venezuela
MJMO	Museo Entomológico “Dr. José Manuel Osorio, Universidad Centroccidental “Lisandro Alvarado, Barquisimeto, Lara, Venezuela
MNHN	Muséum national d’Histoire naturelle, Paris, France
MPEG	Museu Paraense Emílio Goeldi, Belem do Pará, Brazil
MZUSP	Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil
NHMUK	British Museum (Natural History), London, United Kingdom
SFC	Sérgio de Freitas Entomological Collection, Universidade Estadual Paulista Júlio de Mesquita Filho, FCAV-UNESP, Jaboticabal, São Paulo, Brazil

The two authors used their previously published techniques for preparing and studying the specimens (Sosa & Freitas 2010, 2011; Tauber 2010). Measurements of the wing and body features were made with ImageJ software (<http://imagej.nih.gov/ij>) as described by Tauber (2010, 2019). Measurements of the wings themselves included the length (longest distance from the base of the wing to its tip, the horizontal axis) and the height (from costal margin to posterior margin, along the vertical axis). Because the position of the maximum height along the horizontal axis varies depending on the shape of the wings, we measured the height at its maximum, as well as at each quadrant along the horizontal axis. Measurements of wing cells included height (along the vertical axis) and breadth (along the horizontal axis). The numbers in brackets adjacent to names of body parts in the descriptions refer to the number of specimens measured; if no number is present, assume that it is one.

For a few structures, we refine or introduce terms that are new or somewhat different from those used by Freitas *et al.* (2009) or Sosa & Freitas (2010, 2011), as follows:

(i) Wing venation. Our terminology here follows the traditional scheme of Tillyard (1916), as modified by the study of Breitzkreuz *et al.* (2017) and notes by Tauber (2019). For convenience, we retained the use of the abbreviations *im1* and *ma* for the first intramedial cell and the basal section of the MP in the first intramedial cell of the forewing, respectively, and *b*, *b'*, and *t* cells, as defined by Tillyard (1916).

(ii) Male abdomen. We use the term *dorsal apodeme* (d.ap.) to identify the prominent sclerotized apodeme that extends along or slightly above the lower margin of T9+ectoproct in a more or less straight or sinuous trajectory. This apodeme usually extends distally from the lower proximal corner of T8 towards the callus cerci or to a point below or beyond the callus cerci. The dorsal apodeme often has a projection (spur or branch), which we refer to as the *ventral spur* (v.s.), *dorsal spur* (d.s.), or *distal spur* (di.s.), depending upon its position. In some species, the ventral spurs are elongate, and their tips sometimes appear to fit within a pair of more or less sclerotized or scaley atria in the terminal membrane (e.g., see Fig. 36A here and Fig. 51E of Freitas *et al.* 2009: 583). Occasionally (but not in any of the species covered here), the distal spur of the dorsal apodeme may extend as a rod or hook beyond the ectoproct; we refer to these spurs as *external terminal spurs* (ex.s.) [e.g., see Figs. 22G, 56D (above the gonarcus, not to be confused with the ventral spur), and 61D of Freitas *et al.* (2009)]. In contrast, the *ventral apodeme* (v.ap.) extends along or somewhat below the dorsal margin of S8+9. This apodeme is often significantly more diffuse than the dorsal apodeme; it occasionally has a dorsal spur. Examples of the various configurations of the dorsal and ventral apodemes and their spurs are seen in Figs 7B, 31E, 36A here and in Figs 28C, 38D, 55D, 57C of Freitas *et al.* (2009).

(iii) Gonapsis. The males of all *Ceraeochrysa* species have a gonapsis, the size and shape of which varies considerably among species. In all species, the gonapsis appears to be attached to the terminus of S9 via a relatively robust, long or short membrane. We refer to this membrane as the *terminal membrane* (t.m.). It may be variously ornamented with patches of scales or spines, or it may be smooth and without ornamentation. Some *Ceraeochrysa* species (e.g., *Ce. smithi* (Navás), *Ce. squalidens* Adams & Penny, *Ce. paraensis* sp.nov) have a rigid, flagellum-shaped process near the attached end of the gonapsis; we refer to this structure as the *process of the gonapsis* (gs.pr.).

Recognition of the point of attachment of the gonapsis calls into question the current use of terms for the two ends of the structure. Most previous work on the genus has referred to the distal end of the gonapsis, i.e., the end that is attached to the terminal membrane, as the “apex or “apical end of the gonapsis because it occurs at the apex of S9. However, the distal end of the gonapsis could be considered the “base of the gonapsis itself, rather than the “apex because of its attachment at this end. Therefore, to avoid confusion, we refer to the end of the gonapsis that is united with the terminal membrane as the *attached end* (at.e.); at rest, this end of the gonapsis would be in the distal position. We refer to the proximal end of the gonapsis (at rest) as the *free end* (fr.e.). Our use of the terms is shown on Figs 7A–B, 7F, 31B, 31F, and 36.

(iv) Mediuncus. We do not apply the term *arcessus* in reference to the structure that articulates on the mid-distal edge of the *Ceraeochrysa* gonarcular bridge. Instead, we use the term *mediuncus* (mu) to refer to the structure. Readers are referred to Tauber (2010: 7) for references and a discussion of this issue.

(v) Gonarcular projections/processes. Adams (1982) and Adams & Penny (1985) used two terms to refer to the processes on the *Ceraeochrysa* gonarcus: dorsal horn and entoprocess. Their usage of the terms was consistent:

dorsal arms projected dorsally or upward from the gonarcus, and entoprocesses projected posteriorly or ventrally. In their drawings neither structure appeared to be articulated with the gonarcus. Later, in their broad comparative study of the Chrysopidae, Brooks & Barnard (1990: 124, 196) used the terms gonocornua and lateral gonarcus horns to refer specifically to these unarticulated, dorsal and ventrolateral projections (respectively) from the gonarcus of *Ceraeochrysa*. They restricted the use of the term entoprocessus to the short, paired processes that are articulated laterally on the gonarcus of some chrysopid taxa, but not *Ceraeochrysa*. Freitas *et al.* (2009) ignored the distinction between articulated and unarticulated projections, and they used three terms to refer to *Ceraeochrysa* processes. Gonocornua (gcn, sometimes gnc) was used as generally accepted, but the distinction between the other two terms (entoprocessus and gonocornua ventral projection) was not specified, and it is not apparent to us from the text or the drawings. Both terms appear to refer to unarticulated projections; no examples of articulated processes were identified. Here, we concur with Adams (1982), Adams & Penny (1985), and Brooks & Barnard (1990) that the *Ceraeochrysa* gonarcus has two types of unarticulated processes. All species have paired gonocornua (gc; sing., gonocornu) that extend upward or outward from the top or front of the gonarcus. And, some *Ceraeochrysa* species have a second pair of processes that extend largely downward from the lower, lateral region of the gonarcus or the base of the gonarcus apodeme. We use the term *ventral gonarcus processes* (v.p.; sing., ventral gonarcus process) for these projections. Selected examples are found on Fig. 7D–E, 32B, 32D. Please note that the gonarcus processes described above are not to be confused with the lateral arms of the gonarcus.

(iv) Spermatheca. We do not use the term velum (pl. vela) in reference to the *Ceraeochrysa* female spermatheca. Tjeder (1954, 1966) used this term to identify paired, sail-like processes on the dorsal side of a box-like spermatheca that connects a more or less elongate, slit-like opening in the spermatheca to the bursa copulatrix. In *Ceraeochrysa*, the dorsal surface of the U-shaped spermatheca has a slit and the surface of the spermatheca surrounding this slit appears to be directly attached to the bursal membrane; no velum or other structure appears to be involved. Thus, at this time, we prefer not to use the term velum for the *Ceraeochrysa* spermatheca.

## Part 1. *Ceraeochrysa discolor* (Navás), redescription and two new junior synonyms

Figs 1–8

### Taxonomic Synonymy

*Chrysopa discolor* Navás, 1914 [1913–1914], *Ann. Soc. Sci. Bruxelles* 38 (pt. 2): 92, fig. 24; “Panama, V. de Chiriqui, 25–4000 ft. Champion (Mus. de Londres). Banks 1945: 144 [terminal taxon in key]. The original description mentions only one locality, but it makes no reference to a specific specimen or to the number of specimens studied. **Type Material:** Lectotype by **present designation** (male, NHMUK, not examined). Currently, there is a single specimen in the NHMUK. Thus, to help support nomenclatural stability for the species, which will now have two synonyms, and to be consistent with Recommendation 73F and Rule 74.6 of the International Code of Zoological Nomenclature, we designate this specimen as the lectotype.

*Ceraeochrysa discolor* (Navás, 1914). Adams 1982: 72 [first use of combination]; Brooks and Barnard, 1990: 269, figs 267–271 [species list]; Penny 2002: 214, figs 296–201 [regional review, illustrations]; Freitas *et al.* 2009: 540, fig. 19 [generic review, illustrations].

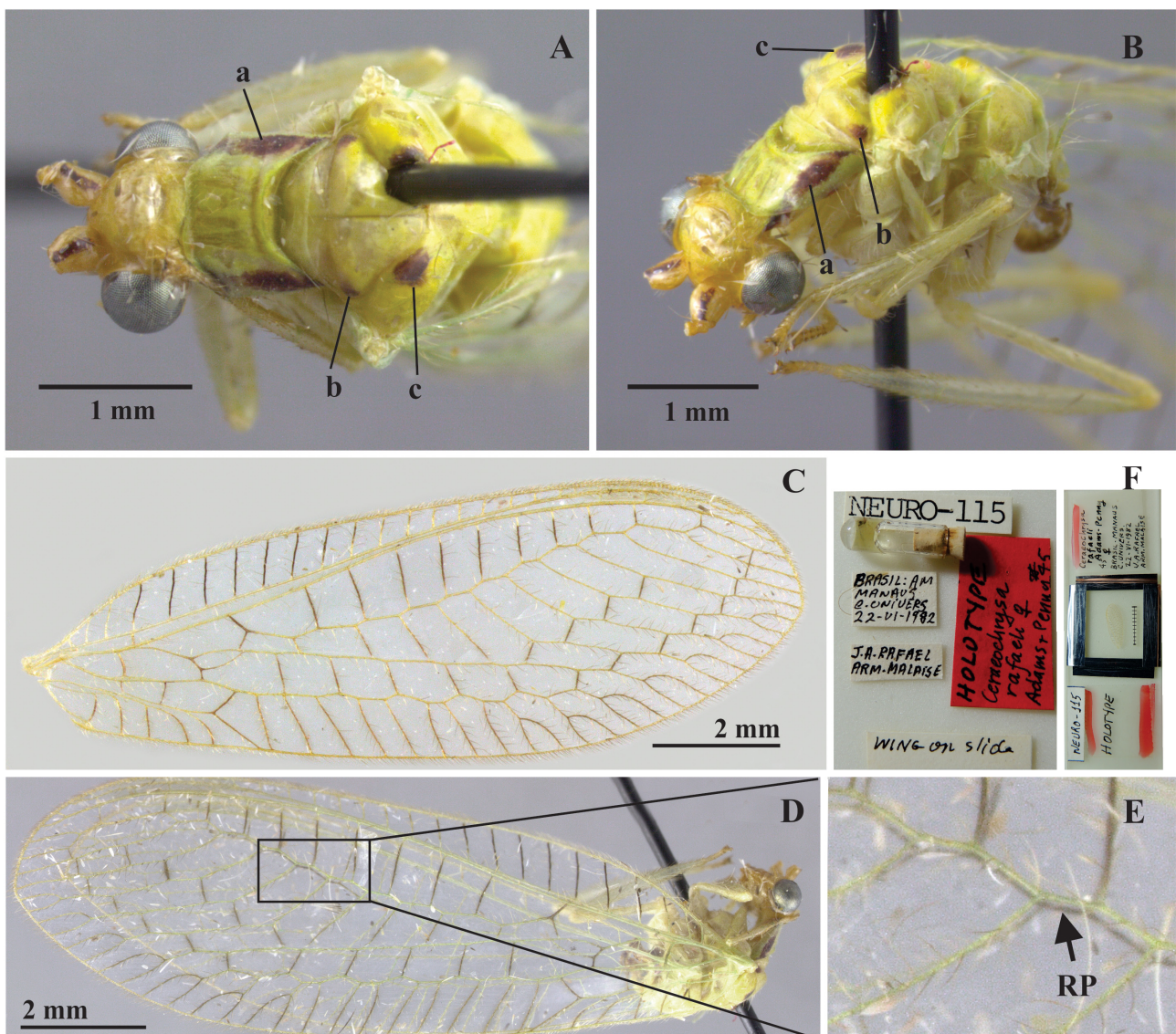
*Ceraeochrysa rafaelli* Adams & Penny, 1987 [ref. 1985], **New synonymy**. *Acta Amazonica* 15: 449, figs 147–150; “Brazil, Amazonas, campus, Univ. of Amazonas, 22-VI-1982, J. A. Rafael, Malaise trap (INPA). Freitas *et al.* 2009: 571, fig. 42 [generic review, illustrations]. **Type Material:** Holotype by original designation (female, INPA, examined by FS most recently in 2018; Figs 1–2). No other type material. When examined, the specimen was in good condition; the flagella were broken but one was glued to a label. The left fore- and hindwings were on the specimen, and one forewing was mounted on a slide identified as being from the holotype. The cleared abdomen and genitalia were in a vial containing glycerin, pinned with the specimen. The holotype label data are shown on Fig. 1F.

*Chrysopodes (Chrysopodes) nigropictus* Freitas & Penny, 2001, as *nigropicta*, **New synonymy**. *Proc. Calif. Acad. Sci.* 52: 275, fig. 34; “Female holotype, deposited at Museu de Zoologia/USP (MZUSP) São Paulo, Brazil. Labeled ‘Bra-MT-Itiquira, P. E. Michelin, 18/VIII/98, Freitas, S. 78A’ (rubber). Freitas *et al.* 2009: 540, fig. 19 [generic review, illustrations]. **Type Material:** Holotype by original designation (female, currently SFC, examined by FS most recently in 2010; Figs 3–4). No other type material. In the original description, the authors stated that their holotype was deposited in the MZUSP, but it remains in the SFC. At the time that FS examined the specimen, it was in good condition; the right wings were glued to a label pinned below the specimen; the abdomen and genitalia were cleared and held in a vial with glycerin. The abdominal features were formed and discernable, but somewhat teneral. The label data are shown on Fig. 3F.

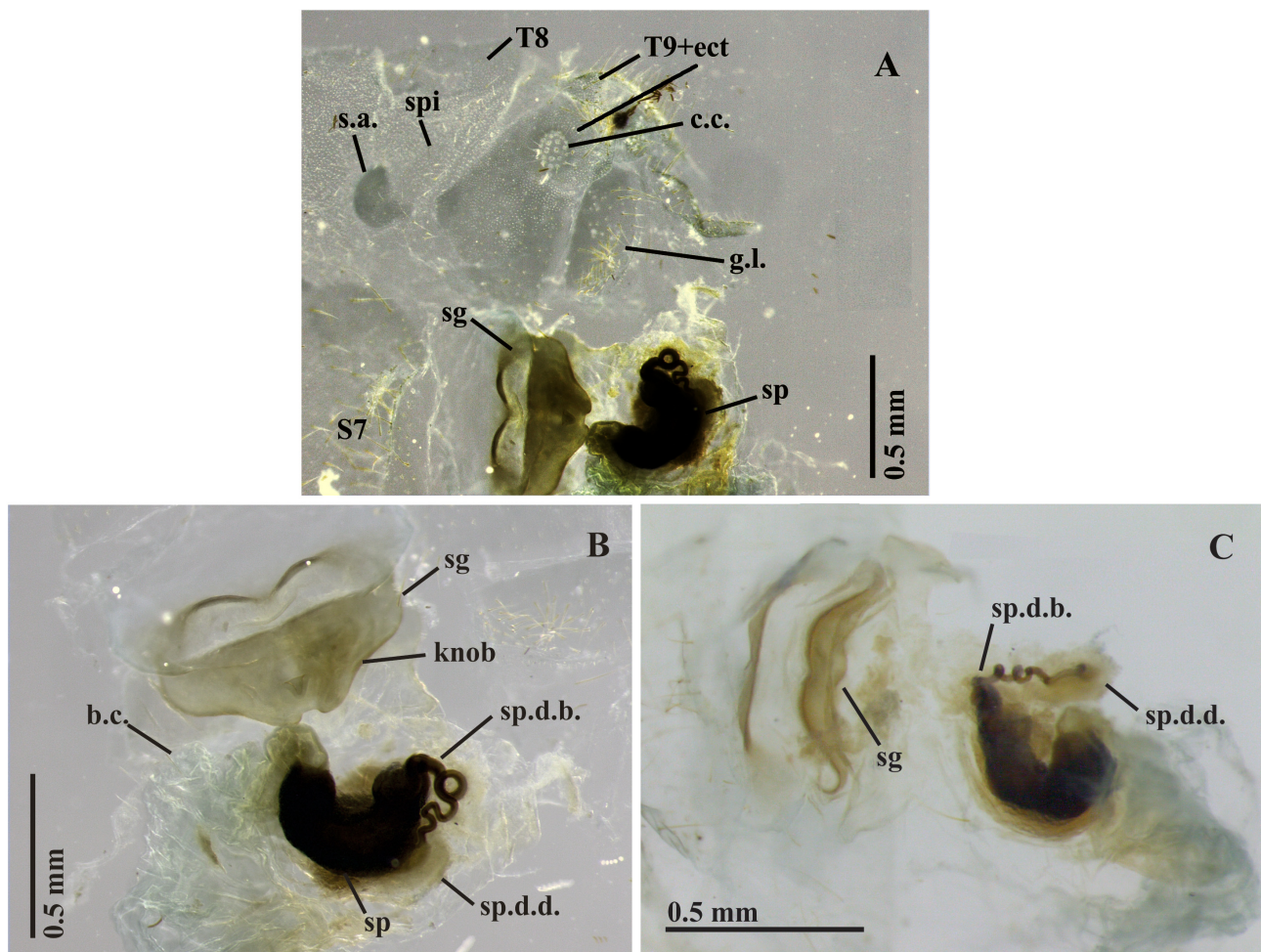
### Support for taxonomic changes

To determine the validity of the three species names, we compared images and notes from the types of both *Ce. rafaeli* and *Ch. nigropictus* (taken by FS) with information and drawings for *Ce. discolor* included in the recently published revision of the genus (Freitas *et al.* 2009). We also examined specimens fitting the species descriptions from the type locality and elsewhere, as listed below. Our comparisons involved both the external features of pinned specimens, and the abdominal and genital structures of cleared specimens. These comparisons allowed us to associate males and females of the species and thus to confirm generic identity and recognize synonymies.

*Ceraeochrysa* females express a unique suite of generic features, specifically: a simple U-shaped spermatheca opening directly into the bursa copulatrix via a dorsal longitudinal slit; there appears to be no bursal duct (see drawings by Adams 1982; Adams & Penny 1985; Brooks & Barnard 1990; Freitas & Penny 2001; Freitas *et al.* 2009; Sosa & Freitas 2011; Cancino-Lopez & Contreras-Ramos 2019). In contrast, *Chrysopodes* (*Chrysopodes*) females are characterized by a J-shaped or trumpet-shaped spermatheca, generally with an elongate terminus that connects with the bursa copulatrix via a complex bursal duct (see drawings by Adams 1982; Adams & Penny 1985; Brooks & Barnard 1990; Freitas & Penny 2001; Tauber 2010; Tauber *et al.* 2012). The *Ch. (Ch.) nigropictus* holotype expresses all of the features that typify *Ceraeochrysa* females and none of those that characterize *Chrysopodes* females.



**FIGURE 1.** *Ceraeochrysa rafaeli* Adams & Penny holotype (INPA), female. A. Dorsal view. B. Lateral view. C. Forewing. D. Habitus, box showing area depicted in 1E. E. Detail of the hindwing, arrow indicating the black line along the posterior side of the RP. F. Labels. Forewing length: 12.2 mm; hindwing length: 11.0 mm. Abbreviations: **a** pronotal stripe; **b** mesoprescutal spot; **c** mesoscutal spot; **RP** posterior branch of the Radius.



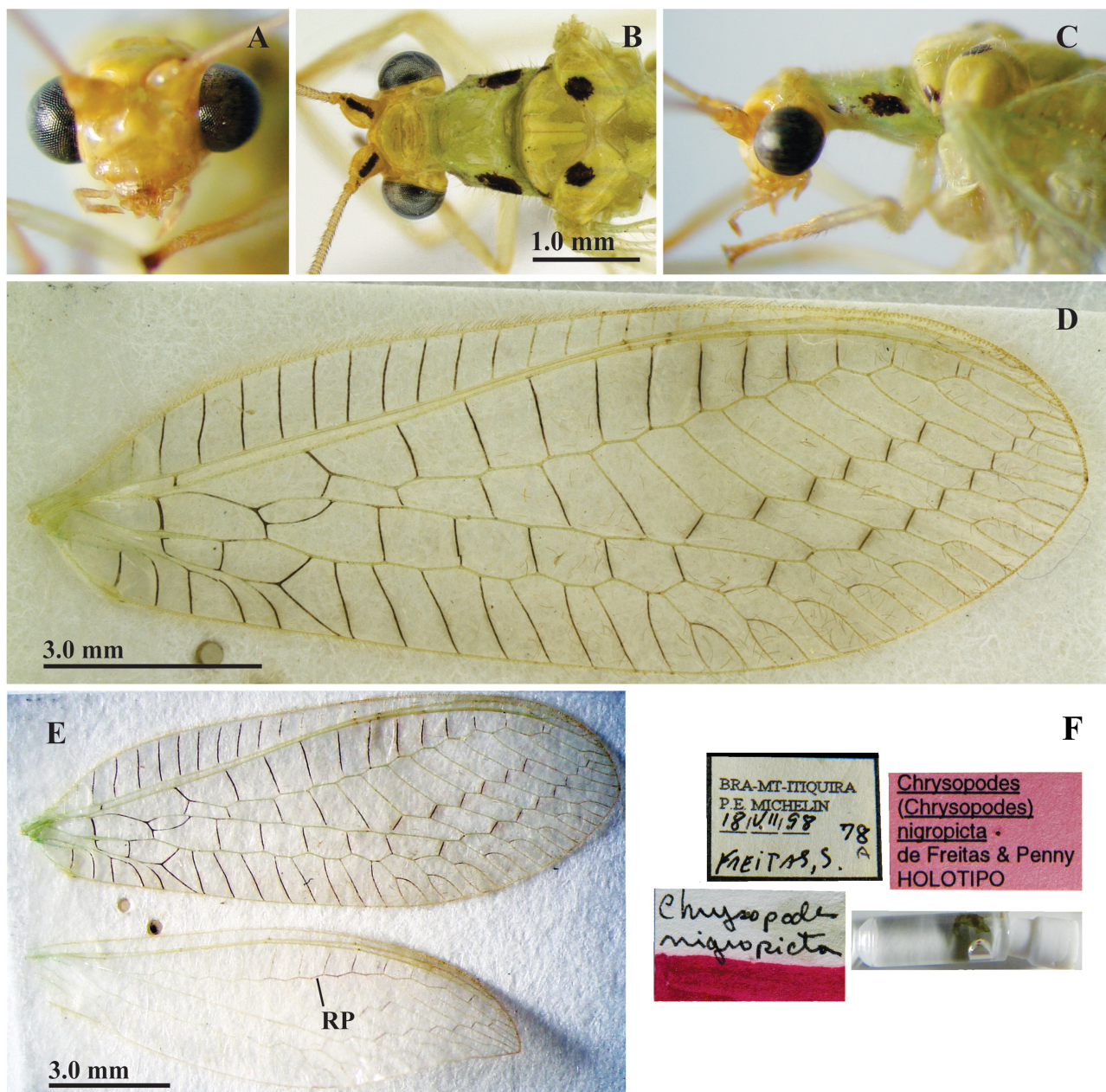
**FIGURE 2.** *Ceraeochrysa rafaели* Adams & Penny holotype (INPA), female. A. Cleared terminal abdominal segment (upper), lateral view, dissected genitalia (lower). B. Subgenitale (upper), ventral view, spermatheca and bursa (lower), right lateral view. C. Subgenitale (left), distal view, spermatheca and bursa (right), left lateral view. Abbreviations: **b.c.** bursa copulatrix; **c.c.** callus cerci; **g.l.** gonapophysis lateralis; **S7** seventh abdominal sternite; **s.a.** sclerotized area; **sg** subgenitale; **sp** spermatheca; **spi** spiracle; **sp.d.b.** basal section of spermathecal duct; **sp.d.d.** setose distal section of spermathecal duct; **T8** eighth tergite; **T9+ect** fused ninth abdominal tergite and ectoproct.

The *Ch. (Ch.) nigropictus* and *Ce. rafaели* holotypes are very similar in their (i) body coloration, (ii) markings on the thorax, (iii) pattern of dark markings on the veins of the forewings, notably on the mesal section of the RP of the hindwing, and (iv) size and shape of the spermatheca and spermathecal duct. The teneral status of the *Ch. (Ch.) nigropictus* type is consistent with the slenderness of its spermatheca and the absence of a detectible sclerotized area on the pleural region of A8 as found in the mature and well sclerotized type of *Ce. rafaели*.

**Diagnosis.** Adults of *Ce. discolor* generally are distinguished by their pale antennae, dark-reddish, oval marks on the pronotum, and circular spots on the mesopresutum. Faded specimens can be confused with *Ceraeochrysa cincta* (Schneider), and careful examination of abdominal and genital characters is necessary to distinguish the species. The males of both species have a heavily sclerotized dorsal apodeme along the length of the lateral section of the T9+ectoproct. In both species, the distal end of this apodeme surrounds the callus cerci, and mesally it has a C-shaped ventral spur that is posteriorly directed and terminates distally in an acute apex. Also, in both species, S8+9 has a sturdy terminal membrane, with a dense field of gonocristae, above which is attached the base of the gonapsis; the gonapsis is long and slender, with the free end being rounded and without apical projections. In comparison, *Ce. cincta* males have shorter gonocornua (~2/3 the length of *Ce. discolor* gonocornua), and they lack the two small, horn-like processes on the mediuncus that are found on *Ce. discolor* males. *Ceraeochrysa discolor* females have a U-shaped spermatheca, and the subgenitale has a sclerotized bilobate knob; both of these features are common to other *Ceraeochrysa* species with pale antennae [e.g., *Ce. cincta*, *Ce. cornuta* (Navás)]. However, *Ce.*

*discolor* is the only *Ceraeochrysa* species in the *cincta* species group reported to have a small, smooth sclerite on the pleuron, posterior to the spiracle of A8. [Note: this character should be examined in other species in the group with special care, because it expresses developmental variation and appears to be visible only on mature specimens.]

**Redescription.** Our sample of *Ce. discolor* specimens exhibited two color patterns—one having a yellow head and light-greenish body with reddish-orange thoracic marks, and the other having a green head and slightly greener body with dark red marks. Both color patterns are expressed in males and females; they do not represent sexual dimorphs. However, they might indicate seasonal or developmental patterns of color change, such as that reported for another Neotropical species of lacewings (Silva *et al.* 2013).

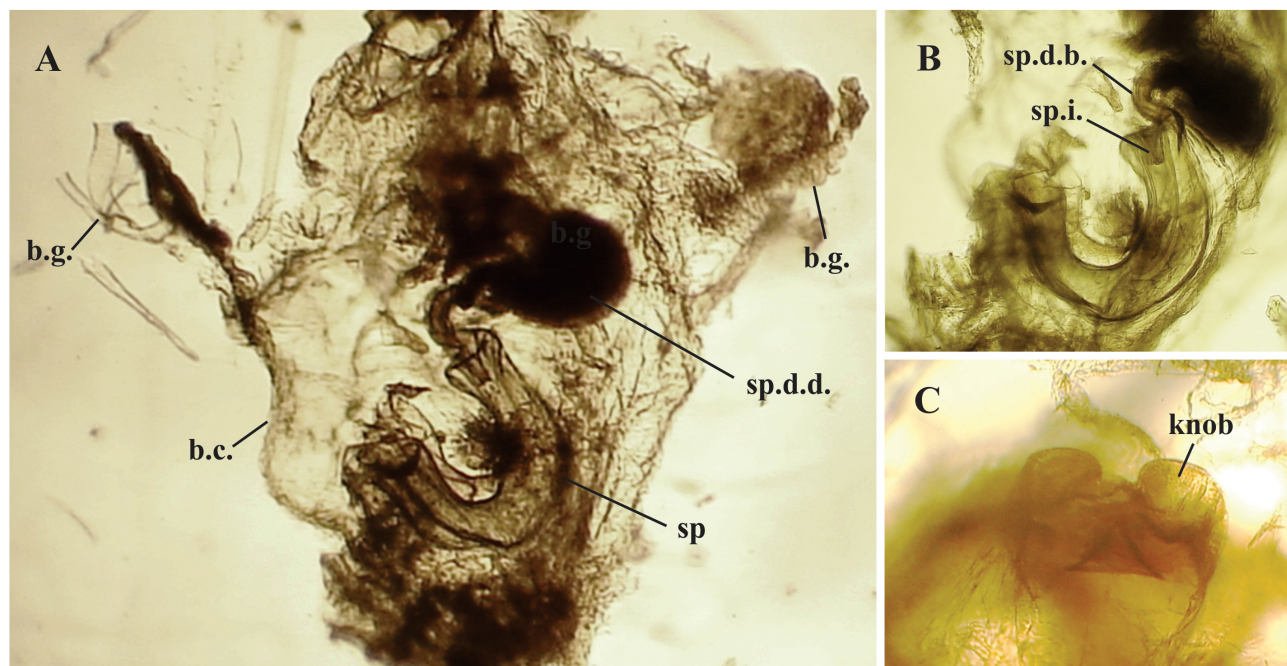


**FIGURE 3.** *Chrysopodes nigropicta* Freitas & Penny holotype (SFC), female. A. Head, frontal. B. Head and thorax, dorsal. C. Head and thorax, lateral. D. Forewing. E. Wings. F. Labels and genitalia vial. Note: On Fig. 3E the line leading to the RP vein indicates the dark portion of the vein. **RP** posterior branch of the Radius.

**Head** (n=2; Figs 1A–B, 3A–C, 5A–K). Width (dorsal, including eyes) 1.6–1.7 mm. Vertex with lightly striated surface. Frons square shaped, smooth, shiny throughout. Clypeal margin straight basally, center with small, smooth, transverse raised fold; surface longitudinally striated. Labrum with dorsal surface smooth, apex slightly incised. **Coloration.** Frons, clypeus, labrum, and genae yellowish or dark green, unmarked. Scape yellowish or dark green,

with red dorsal stripe reaching or approaching torulus; pedicel unmarked; flagellum pale, with golden bristles. Maxillary and labial palps pale, unmarked.

Thorax (n=3; Figs 1A–B, 3B–C, 5B–C, E–F, H–I, K). Pronotum length 0.6–0.9 mm, width 1.0–1.2 mm, with ovate spots laterally; mesothorax with round marks on anterior corners of prescutum and on scutal middorsal margin; marks variably reddish orange on yellowish specimens or darker-red tinged on green specimens. Pleuron and legs unmarked.



**FIGURE 4.** *Chrysopodes nigropicta* Freitas & Penny holotype (SFC), female genitalia. A. Spermatheca, bursa copulatrix with bursal glands. B. Spermatheca. C. Subgenitale with bilobed knob. Abbreviations: **b.c.** bursa copulatrix; **b.g.** bursal gland; **sp** spermatheca; **sp.d.b.** basal section of spermathecal duct; **sp.d.d.** setose distal section of spermathecal duct; **sp.i.** spermathecal invagination.

Wings (n=4; Figs 1C–E, 3D–E, 6). Forewing length 12.2–16.0 mm; maximum height 3.3–5.8 mm; slightly tall throughout, with tallest portion of wing being in third distal quadrant; height at base of second quadrant, at base of fourth quadrant 3.1–4.3 mm, 4.1–4.7 mm, respectively; anterior margin relatively straight; apex broad, rounded. Costal area slightly expanded basally; tallest costal vein (#5–#6) ~0.18–0.2x maximum height of wing. Eleven to twelve closed radial cells; height of tallest radial cell (#4) ~4x breadth. First intramedian cell ovate, breadth ~0.55–0.62x breadth of third medial cell (*m3*); two rows of gradate veins, with four to six inner gradates, six to eight outer gradates; both rows parallel or converging slightly near wing apex. Four to five *b* cells, three to four *b'* cells. Three intracubital cells (*icu1*, *icu2*, *icu3*), distal one open at wing margin; breadth of *icu1* less than those of either *icu2* or *icu3*; both *icu2* and *icu3* of approximately equal breadth. 1A, forked. *Coloration*. Membrane unmarked except for light shading around dark gradate veins. Longitudinal veins usually green, unmarked, base of RP and first rp-m crossvein usually dark; costal and radial crossveins, gradate veins, second intracubital crossvein, anal veins variously marked, usually with A1, CuP terminal veinlets heavily black marked.

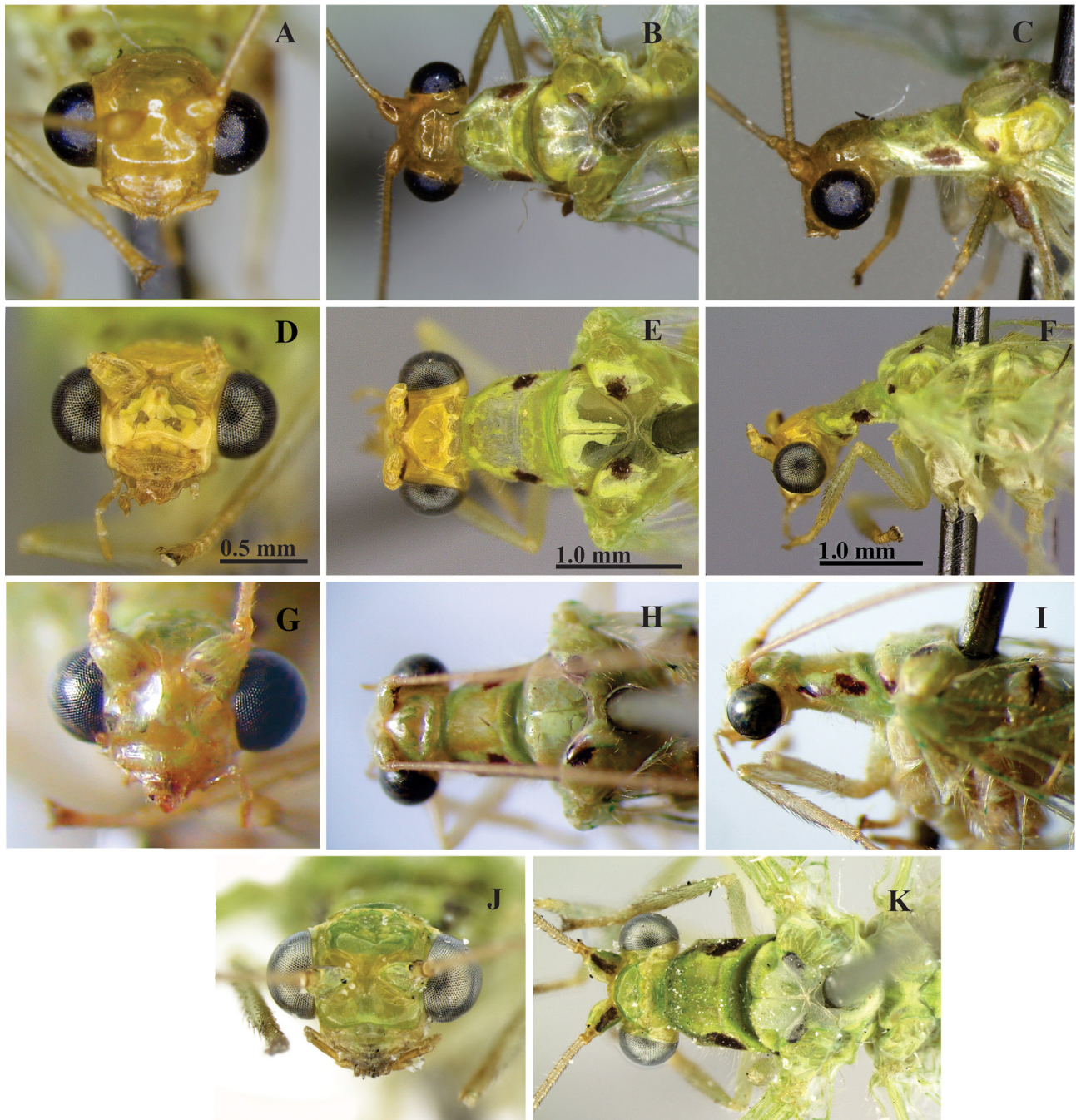
Hindwing length 12.2–13.4 mm, height 3.5–4.2 mm. Ten to eleven radial crossveins; base of M merged with R, *t* cell present in all specimens examined; four *b* cells; four *b'* cells. Two rows gradate veins, in parallel series, with four to five inner gradates, five to seven outer. *Coloration*. Venation green, except RP with middle section notably marked with black.

Abdomen—Male (Fig. 7). Ninth tergite+ectoproct (lateral view) with heavily sclerotized apodeme extending along entire ventral margin, with distal end surrounding callus cerci, with C-shaped spur extending ventrally from midsection, terminating in acute apex. Fused S8+9 approximately 2x longer than tall, with posterior margin rounded, terminal membrane robust, bearing dense field of gonocristae apically. Gonarcual bridge lightly curved, upper surface with gonocornua extending upward from lateral region; lateral apodemes elongate, rounded. Mediuncus robust, with basal section bearing two small, curved horn-like processes mesally, distal section with stout tip, ventrally

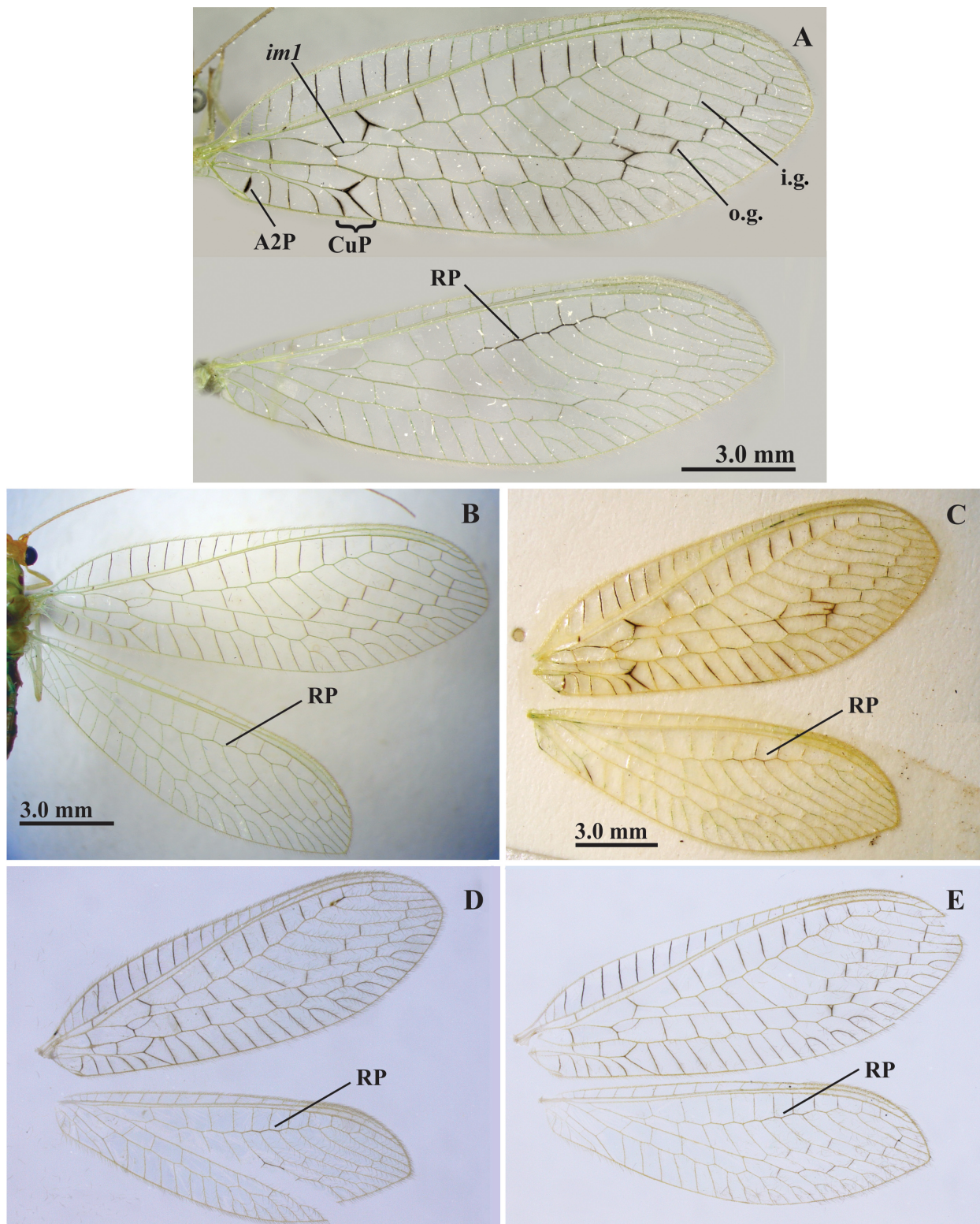


directed and flanked subapically by triangular processes. Gonosaccus with two lateral fields of gonosetae, lateral field of tiny gonocristae arranged in rows. Gonopsis length ~ length of S8+9, slender, free end rounded, without projections, attached (distal) end connected to terminal membrane above field of gonocristae.

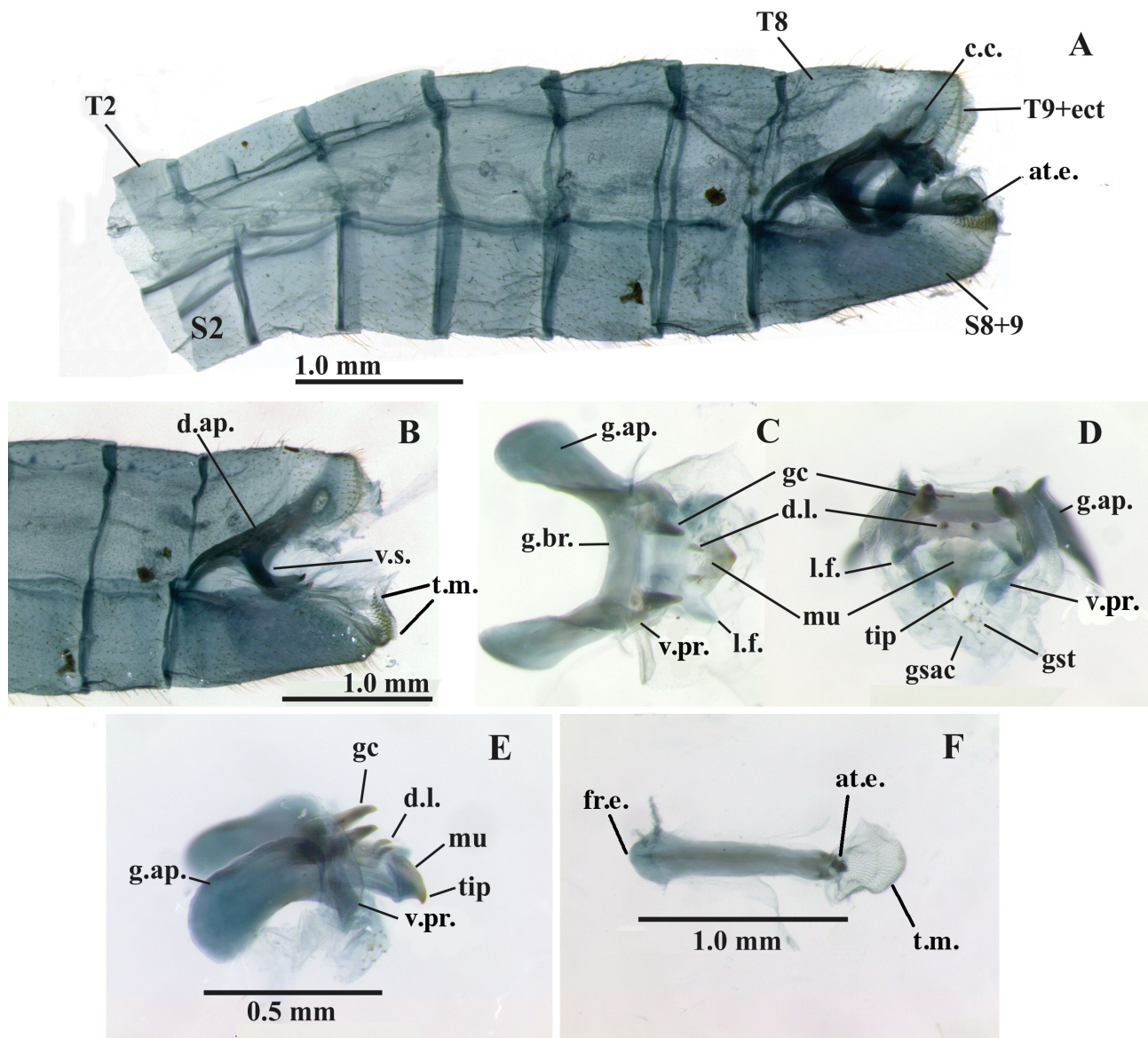
Female (Figs 2, 4, 8). The description and illustrations of the female abdomen and genitalia provided by Adams & Penny (1985: 449, figs 148–150) are detailed and accurate. See Figs 2, 4, and 8 here for supplementary photographs of both teneral and mature specimens.



**FIGURE 5.** Four freshly collected *Ceraeochrysa discolor* (Navás) specimens illustrating intraspecific color variation. A–C. Female (Venezuela, Yaracuy, Nirgua, 751 m.). D–F. Female (Brazil, Minas Gerais, Barroso, ~1000 m.). G–I. Female (Venezuela, Aragua, Henry Pittier National Park, 1100 m.). J, K. Male (Venezuela, Yaracuy, Chivacoa, 1075 m.).



**FIGURE 6.** *Ceraeochrysa discolor* (Navás), fore and hind wings of five specimens showing intraspecific variation in vein markings. A. Male (Venezuela, Yaracuy, Chivaca). B. Female (Venezuela, Yaracuy, Nirgua). C. Female (Venezuela, Aragua, Henry Pittier National Park). D. Female (Brazil, Amazonas, Manaus). E. Female (Brazil, Amazonas, Manaus). Note the variation in the darkening of the hindwing *RP*. Abbreviations: **A2P** posterior branch of second anal vein; **CuP** terminal branches of Cubitus Posterior; *im1* first intramedian cell; *i.g.* inner gradate vein; *o.g.* outer gradate vein; **RP** posterior branch of Radius.

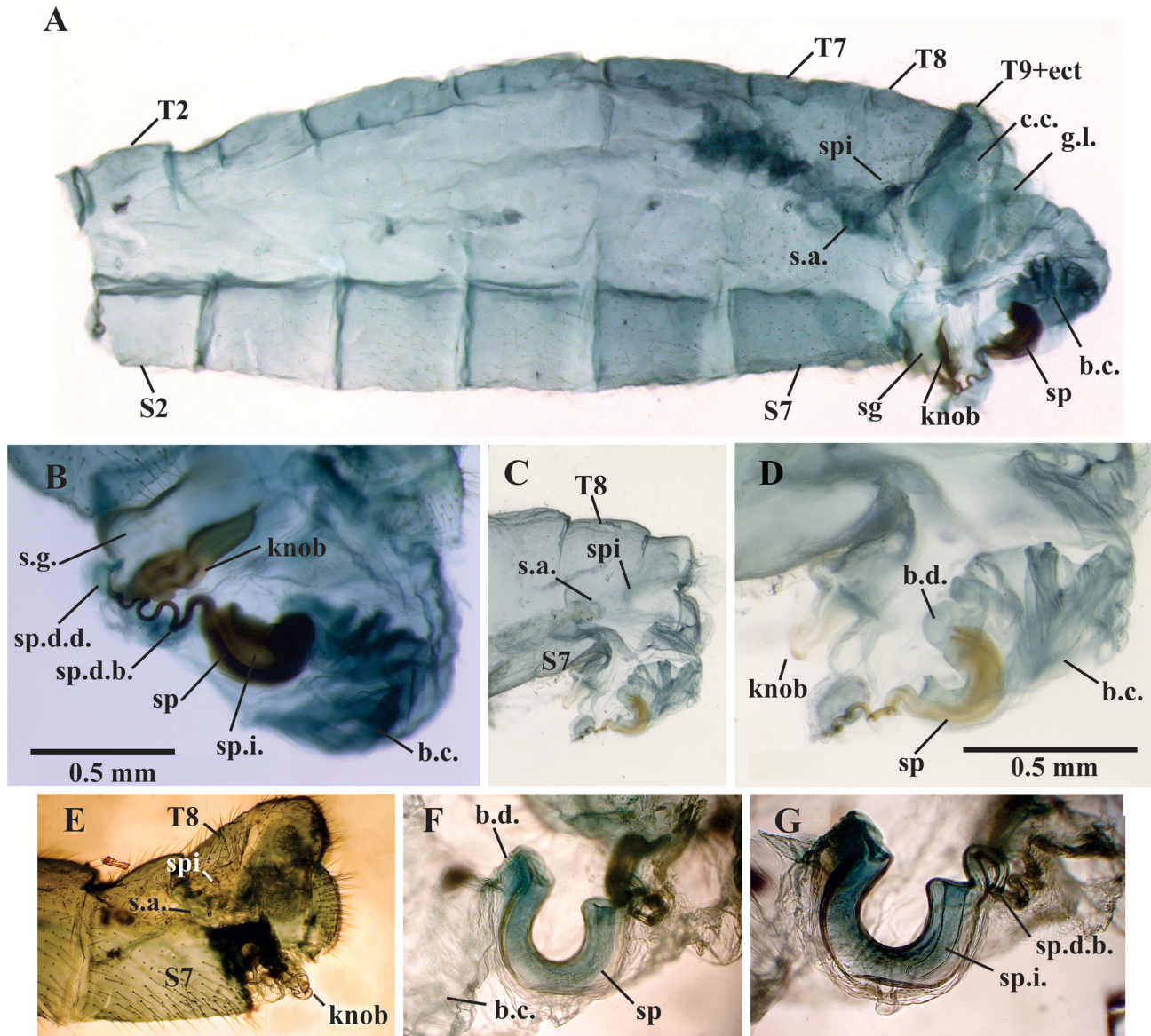


**FIGURE 7.** *Ceraeochrysa discolor* (Navás), male genitalia (Brazil, Amazonas, Manaus). A. Abdomen, lateral. B. Terminalia, lateral. C–E. Gonarcus complex, dorsal, frontal, and lateral respectively. F. Gonapsis (dorsal). Note: The attached end of the gonapsis (**at.e.**, Fig. 7A) is connected to the membrane at the tip of S8+9 (**t.m.**, Fig. 7B). Abbreviations: **at.e.** attached end of gonapsis; **c.c.** callus cerci; **d.ap.** dorsal apodeme; **d.l.** dorsal lobes at base of mediuncus; **fr.e.** free end of gonapsis; **g.ap.** gonarcus apodeme; **g.br.** gonarcus bridge; **gc** gonocornu; **gsac** gonosaccus; **gst** gonosetae; **l.f.** lateral flank of mediuncus; **mu** mediuncus; **S2** second abdominal sternite; **S8+9** fused eighth and ninth sternites; **tip** apex of mediuncus; **t.m.** terminal membrane; **T2**, **T8** second and eighth abdominal tergites; **T9+ect** fused ninth abdominal tergite and ectoproct; **v.pr.** ventral process of gonarcus; **v.s.** ventral spur of dorsal apodeme.

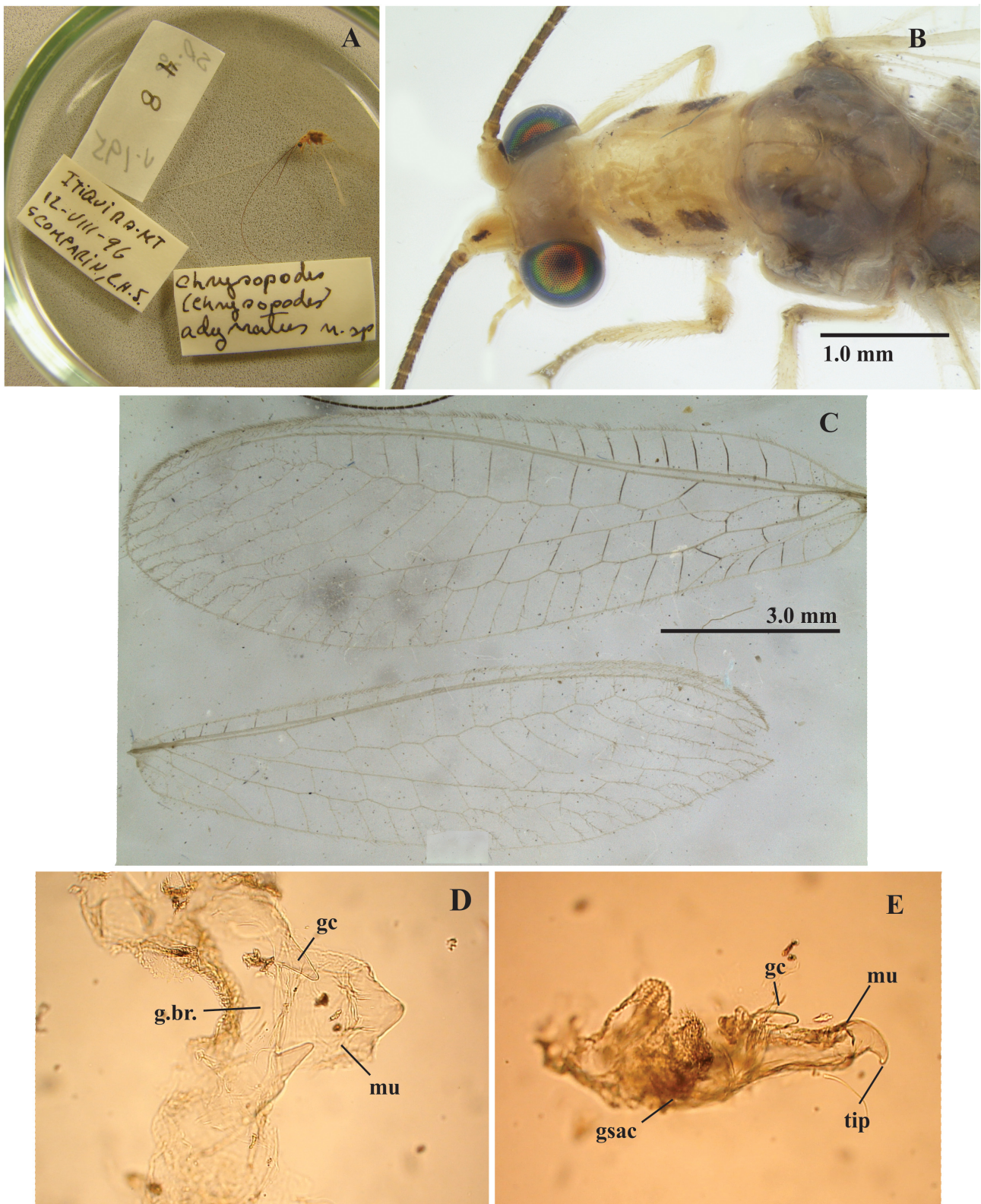
**Specimens examined** (in addition to types listed above). **COSTA RICA:** Puntarenas, Las Cruces Biol. St., 1♀, 19.vi.2003, black lights, W. D. Shepard. **VENEZUELA:** *Aragua*, Parque Nacional Rancho Grande (currently Parque Nacional Henry Pittier), 1100 m, 23.vi.1981, 1♀, J. González col (MIZA); *Yaracuy*, Nirgua, (Finca Potrerito, 1009' N, 6835' W, 751 m), 19.ii.2008, 1♀, en *C. sinensis* var. Valencia, F. Sosa, F. Díaz & R. Zuñiga cols (MJMO); *idem*: 26.ii.2008, 1♀ F. Sosa col (MJMO); Chivacoa (La Cumbre), 1075 m, 1014'N / 6858' W, 23.iv.2013, 1♂ in *Coffea arabica*, F. Sosa, C. Martins & F. Díaz (MJMO); **BRAZIL:** *Amazonas*, Manaus, BR 174, km 15 (25°12,6 S—6002'40,6 W) 2.ii.2012, 1♀, coleta manual, Gonçalves, M. S leg., Neuroptera, Chrysopidae, Gonçalves, M. S. (INPA); *idem*: 21.v.2012, 1♂, Coleta manual, Gonçalves, M. S., (INPA); *idem*: 8.vi.2012, 1♂, Coleta manual, Gonçalves, M. S., (INPA); *idem*: 2.vii.2012, 1♀, Coleta manual, Gonçalves, M. S., (INPA); *idem*, 14.ix.2012,

1♀, Coleta manual, Gonçalves, M. S. (INPA); *idem*: 26.ix.2012, 1♀, Coleta manual, Gonçalves, M. S., (INPA); *idem*. 22.x.2012, 1♂, Coleta manual, Gonçalves, M. S. (INPA); *Bahia*: Victoria da Conquista, no collection date or collector (SFC); *Minas Gerais*: Barroso (Mata do Baú, ciliar), 28.viii.2010, Silva, M. (LRRP); *Santa Catarina*, Brasilien, Nova Teutônia [Seara], 2711' B—5223' L, 300–500 m, vi.1976, 1♀, Fritz Plaumann (INPA).

**Known geographical distribution.** *Costa Rica*: Puntarenas; *Panama*: Chiriqui; *Venezuela*: Aragua, Yaracuy (New records); *Brazil*: Amazonas, Mato Grosso, São Paulo (Adams & Penny 1985; Freitas & Penny 2001; Freitas *et al.* 2009), Bahia, Minas Gerais, Santa Catarina (New records).



**FIGURE 8.** *Cereochrysa discolor* (Navás), female genitalia. A. Abdomen, mature, lateral. B. Genitalia, mature, ventrolateral. C, D. Terminalia, mature, lateral. E–G. Terminalia, teneral, lateral. A, B: Brazil, Amazonas, Manaus. C, D: Brazil, São Paulo, Teodoro Sampaio; E–G: Venezuela, Aragua, Henry Pittier National Park. Abbreviations: **b.c.**, bursa copulatrix; **c.c.** callus cerci; **g.l.** gonapophysis lateralis; **sg** subgenitale; **sp** spermatheca; **spi** spiracle; **s.a.** sclerotized area; **sp.d.b.** basal section of spermathecal duct; **sp.d.d.** setose distal section of spermathecal duct; **sp.i.** spermathecal invagination; **S2**, **S7**, **S8+9**, second, seventh, and fused eighth and ninth sternites; **T2**, **T7**, **T8**, second, seventh, and eighth tergites; **T9+ect** fused ninth abdominal tergite and ectoproct.



**FIGURE 9.** *Chrysopodes (Chrysopodes) adynatos* Freitas & Penny holotype (= *Ceraeochrysa adynatos* **comb. nov.**). A. Labels. B. Head and thorax, dorsal. C. Wings. D, E. Gonarcus, dorsal and lateral respectively. Abbreviations: **gc** gonocornu; **g.br.** gonarcal bridge; **gsac** gonosaccus; **mu** mediuncus; **tip** apex of mediuncus.

## Part 2. *Ceraeochrysa adynatos* (Freitas & Penny, 2001), New Combination

Fig. 9

### Taxonomic Synonymy

*Chrysopodes* (*Chrysopodes*) *adynatos* Freitas & Penny, 2001. *Proc. Calif. Acad. Sci.* 52: 272, fig. 29; deposited at Museu de Zoologia/USP (MZUSP) Mato Grosso, Brazil, labeled 'Itiquira, 12-VII-96, Scomparin C.H.J.' (rubber). **Type material.** Holotype by original designation (male, SFC, examined by FS, Fig. 9). In the original description, the authors stated that their holotype was deposited in the MZUSP, but it remains in the SFC where FS examined and photographed it (most recently in 2010). Its labels are shown in Fig. 9A. No other specimens were known at the time of the description, and none are known now. When examined, the holotype, preserved in alcohol, was teneral and in poor condition; the left wing was held in a vial; the abdomen was lost, and parts of the genitalia (gonarcus) were in a small vial with glycerine; no gonapsis was found. Both, the specimen and the vial containing the gonarcus were placed inside of a tube numbered 921.

*Ceraeochrysa adynatos* (Freitas & Penny, 2001). **New Combination.** [The adjective *adynatos* is taken from Greek and is appropriate for masculine, feminine, and neuter usage (Freitas & Penny 2001: 272; Oswald 2020).]

### Support for new combination

*Chrysopodes* (*Chrysopodes*) and *Ceraeochrysa* adults often appear similar (Adams & Penny 1985; Brooks & Barnard 1990; Tauber *et al.* 2012). Our examination of the genital features of the *Ch.* (*Ch.*) *adynatos* holotype (Fig. 9) and our reevaluation of the species description and drawings of Freitas & Penny (2001: 272) indicate that this species does not belong in *Chrysopodes* (*Chrysopodes*). The holotype has a gonarcus with weakly developed (teneral) but distinct gonocornua, a broad, quadrate mediuncus, and a sac-like gonosaccus bearing several long gonosetae in one small section, as well as conspicuous gonocristae in another section (Figs 9D–E). These are all features that characterize *Ceraeochrysa* males but are not found in *Chrysopodes*. The only feature of *Ceraeochrysa* that this specimen appears to lack is a gonapsis; however, its absence is readily attributable to the specimen's teneral state; the gonapsis is often poorly formed and could be overlooked in teneral *Ceraeochrysa* specimens. Currently, we do not have other specimens of this species that are mature, so we cannot conclusively confirm the validity of the species.

**Discussion.** Given the lack of specimens other than the type, we cannot add much information that is not in the original description, except the following measurements and notes. See Fig. 9.

**Measurements.** Head width (dorsal, including eyes) 1.3 mm. Pronotum width 0.9 mm, length 0.57 mm. *Forewing* length 13.0 mm, maximum height 4.5 mm, with tallest portion of wing being third distal quadrant; height at base of second quadrant, at base of fourth quadrant ~2.8 mm and ~3.8 mm, respectively; anterior margin relatively straight; apex broad, rounded. Costal area slightly expanded basally; tallest costal vein (#6) ~0.30x maximum height of wing. Twelve closed radial cells, height of tallest radial cell (#4) ~1.4x breadth. First intramedian cell ovate, ~0.5x as broad as third medial cell; two parallel rows of gradate veins, with six inner, six outer. Five *b* cells, five *b'* cells. Three intracubital cells, distal one open, *icu2* ~0.58x longer than either *icu1* or *icu3*. Vein 1A forked. *Hindwing* fairly tall, with apex acute; length 11.8 mm, height 3.4 mm. Ten closed radial cells; base of M merged with R, *t* cell present; two parallel rows of gradate veins, with four inner, six outer; five *b* cells; five *b'* cells.

**Specimens examined** (in addition to types listed above). None.

**Known geographical distribution.** Type locality only. **Brazil:** Mato Grosso.

## Part 3. *Ceraeochrysa sarta* (Banks, 1914), new combination and a new junior synonym

Figs 10–15

### Taxonomic Synonymy

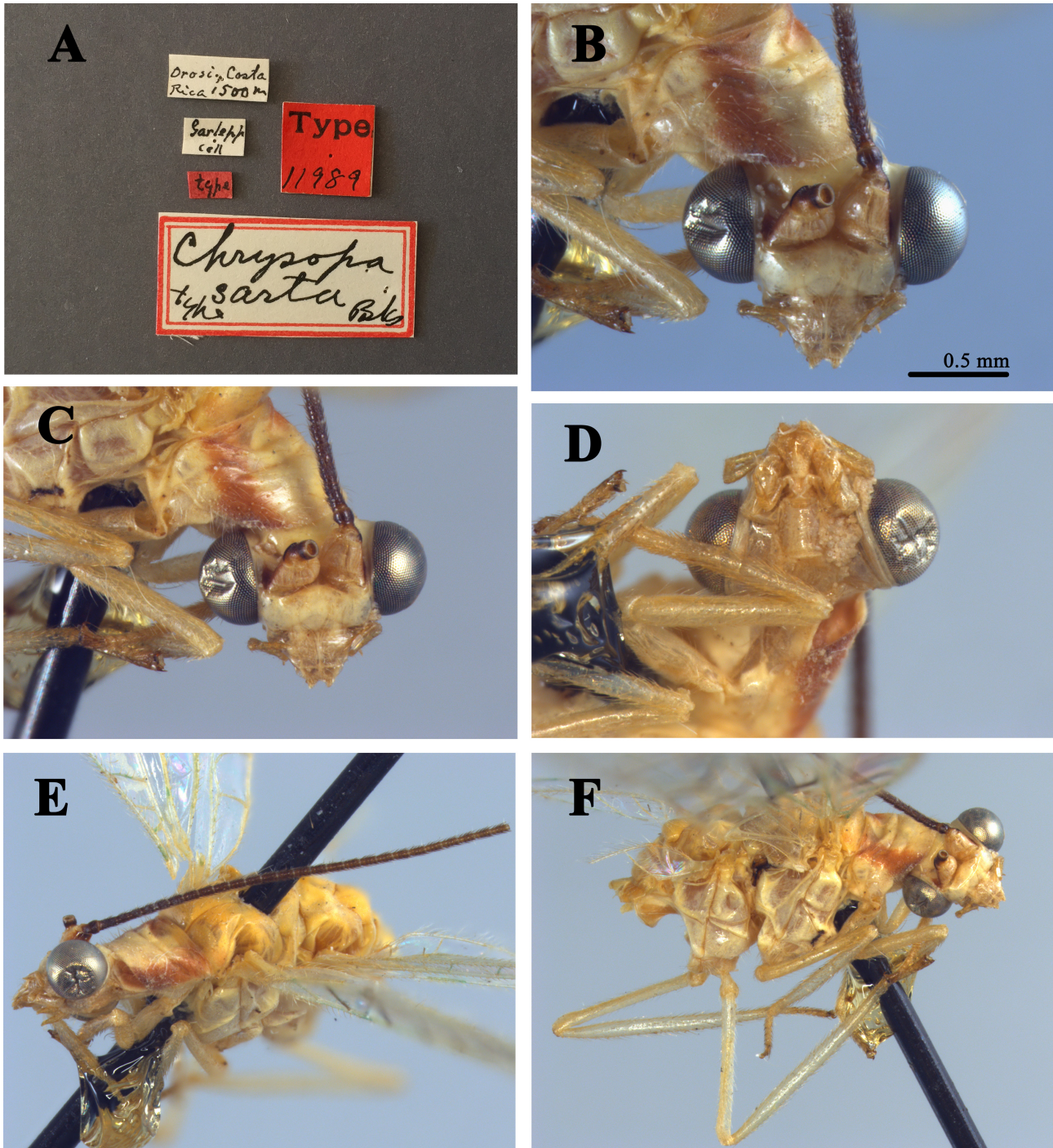
*Chrysopa sarta* Banks, 1914 *Canad. Entomol.* 46: 25; 'Orosi, Costa Rica, 500 m. (Garlepp).; number of syntypes not mentioned. Banks 1945: 146–147, 149 [key, taxonomic notes]; Banks 1948: 152, 162, fig. 15 [key, brief redescription, drawing]; Penny 1977: 20 [species list]; Brooks & Barnard 1990: 280, [species list, as *incertae sedis*]; Oswald 2020 [catalog listing]. **Type Material:** Lectotype by **present designation** (female, MCZ, examined, CAT; Figs 10–13); abdomen cleared, in vial with glycerine. Only one type is present in the MCZ. Because Banks did not indicate how many specimens he had studied, to help stabilize the nomenclature surrounding *Ceraeochrysa* we designate the sole MCZ syntype as the lectotype.

*Ceraeochrysa sarta* (Banks, 1914) **New Combination.**

*Chrysopa berlandi* Navás, 1923 [1924] **New Synonymy.** *Rev. Chilena Hist. Nat.* 27: 114; 'Costa Rica. Paul Serre, 1920' (Museo de Paris); number of syntypes not mentioned. Banks 1945: 146, 149 [key, collection record]; Banks 1948: 152, 162 [key,

geographic distribution, notes]; Penny 1977: 16 [species list]. **Type Material:** Lectotype designated by Legrand *et al.* 2008: 118) (female, MNHN, examined, CAT; Fig. 14); abdomen cleared, in vial with glycerine. The specimen carries a label in J. Legrand's handwriting stating that the lectotype was designated in 1992; this designation was not published.

*Ceraeochrysa berlandi* (Navás, 1924). Adams 1982: 71 [first use of combination]; Brooks & Barnard 1990: 268 [species list]; Tauber & de Leon 2001: 200 [larval descriptions, species determination in error; see last paragraph of section below]; Penny 2002: 211, figs 153–158 [regional treatment, drawings]; Freitas *et al.* 2009: 524, fig. 10 [generic revision]; Oswald 2020 [catalog listing].



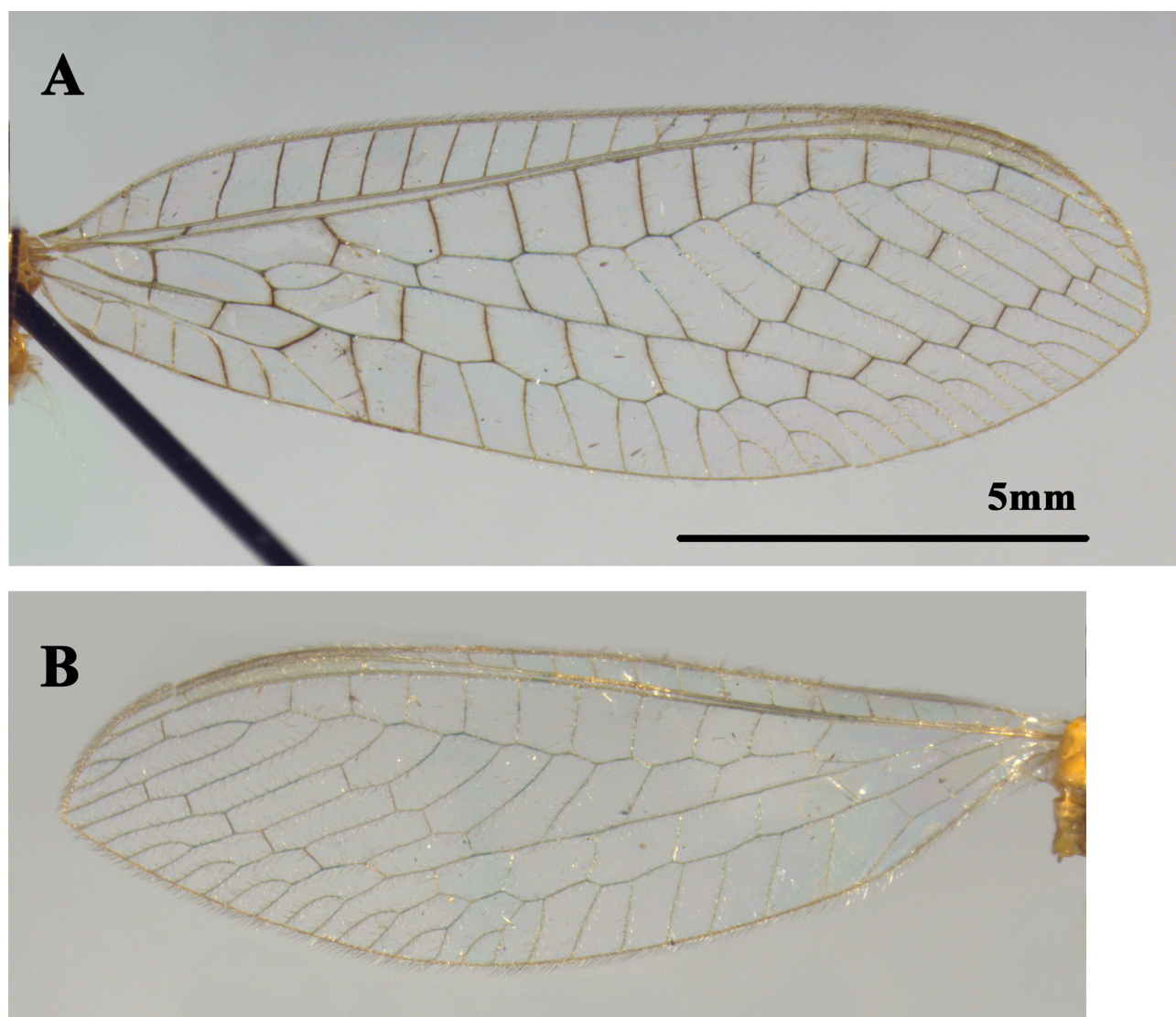
**FIGURE 10.** *Chrysopa sarta* Banks lectotype (MCZ), female. A. Labels. B. Head, frontal. C. Head, prothorax, frontolateral. D. Head, ventral. E. Head, thorax, dorsolateral. F. Body, lateral.

#### Support for taxonomic changes

The following genitalic features of the *Chrysopa sarta* lectotype (female) confirm that this species belongs in the genus *Ceraeochrysa*: curved spermatheca with a longitudinal, dorsal slit opening directly to the bursa copulatrix;

absence of a bursal duct. The lectotype also expresses external features that, although not definitive, are frequently expressed by *Ceraeochrysa* species; these features include: prothorax with pair of reddish lateral stripes; scape with lateral stripe; genae unmarked; wings without marked stigma or enlarged costal area; and outer series of gradate veins continuing at least several cells distal to the last inner gradate vein.

The species that Banks described as *Chrysopa berlandi* has long been recognized as belonging in the genus *Ceraeochrysa* (Adams 1982: 71), and specifically within the group of *Ceraeochrysa* species with a dark flagellum and a dark lateral stripe on the scape (Freitas *et al.* 2009). Comparison (CAT) of the *Chrysopa berlandi* and *Chrysopa sarta* types revealed a number of shared features indicative of a synonymy, the most notable being the distinctively wide, red prothoracic stripes, and the almost identical forewing size, shape, pattern of venation, and pattern of darkened veins (Figs 11, 14D). The report by Banks (1948), which mentions differences in wing venation between the species, includes several errors, and the actual differences appear to us as typical of intraspecific variation generally expressed by *Ceraeochrysa* species. The abdomen of the *Chrysopa sarta* type is in fairly good condition, whereas the dissected abdomen of the *Chrysopa berlandi* female type, as noted by Navás, is poorly preserved; we found it too fragile and unclear for satisfactory examination. However, the overall size and shape of the abdominal segments of the two types are without notable differences (Figs 12, 13, 14E–F). Primarily on the basis of their external similarities, we propose the synonymy of *Ce. berlandi* with *Ce. sarta*. Both species were described from Costa Rica—*Ce. sarta* from the province of Cartago, and *Ce. berlandi* with province not specified.



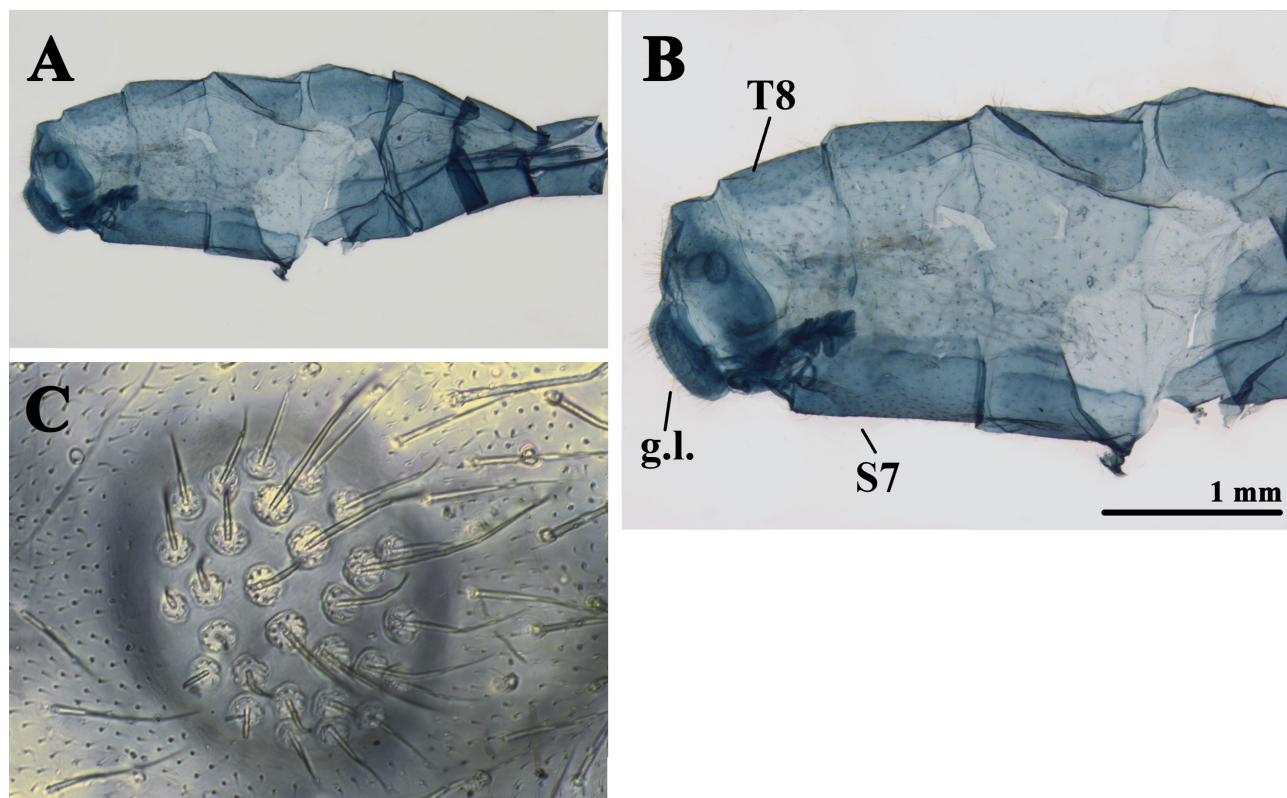
**FIGURE 11.** *Chrysopa sarta* Banks lectotype (MCZ), female. A. Forewing. B. Hindwing. Scale applies to both A and B.



It should be noted that the redescription of *Ce. berlandi* by Freitas *et al.* (2009: 524) includes character states that are inconsistent with Navás' original description and with the type specimen itself. For example, the prothorax of the *Ce. berlandi* type has a pair of broad, red, lateral stripes extending along the full length of the segment and to the lateral margin. They are not brown stripes that extend only partially to the lateral margins as described/illustrated by Freitas *et al.* (2009). It also should be noted that the redescription of *Ce. berlandi* by Freitas *et al.* (2009: 524) includes considerable information on male characters. However, we do not know, nor did the authors explain, how they associated males and females of the species or how they confirmed the species identity of the nontype specimens that they studied. Indeed, we examined two specimens from the EMEC collection that were listed as *Ce. berlandi*; neither of these specimens are conspecific with the *Chrysopa berlandi* type. Because of the probable misidentified specimens, we recommend not referring to the redescription by Freitas *et al.* (2009) when attempting to identify this species.

We also note that the identification of *Ce. berlandi* in a previous taxonomic study of *Ceraeochrysa* larvae (Tauber & de Leon 2001: 200) is in error. This study was made prior to the generic revision by Freitas *et al.* (2009); the specific determination of these specimens is now under study.

**Diagnosis.** *Ceraeochrysa sarta* is recognized by the following external features: black flagellum and pedicel; tan-colored scape with a dark-reddish-brown to dark-brown lateral stripe that diffuses slightly onto the dorsolateral surface of the scape; unmarked gena (gena probably discolored on *Chrysopa berlandi* type); pale palpi; prothorax with broad red lateral stripe extending to lateral margin; forewing with most crossveins at least somewhat darkened and very lightly suffused (Figs 11, 14D, 15C).

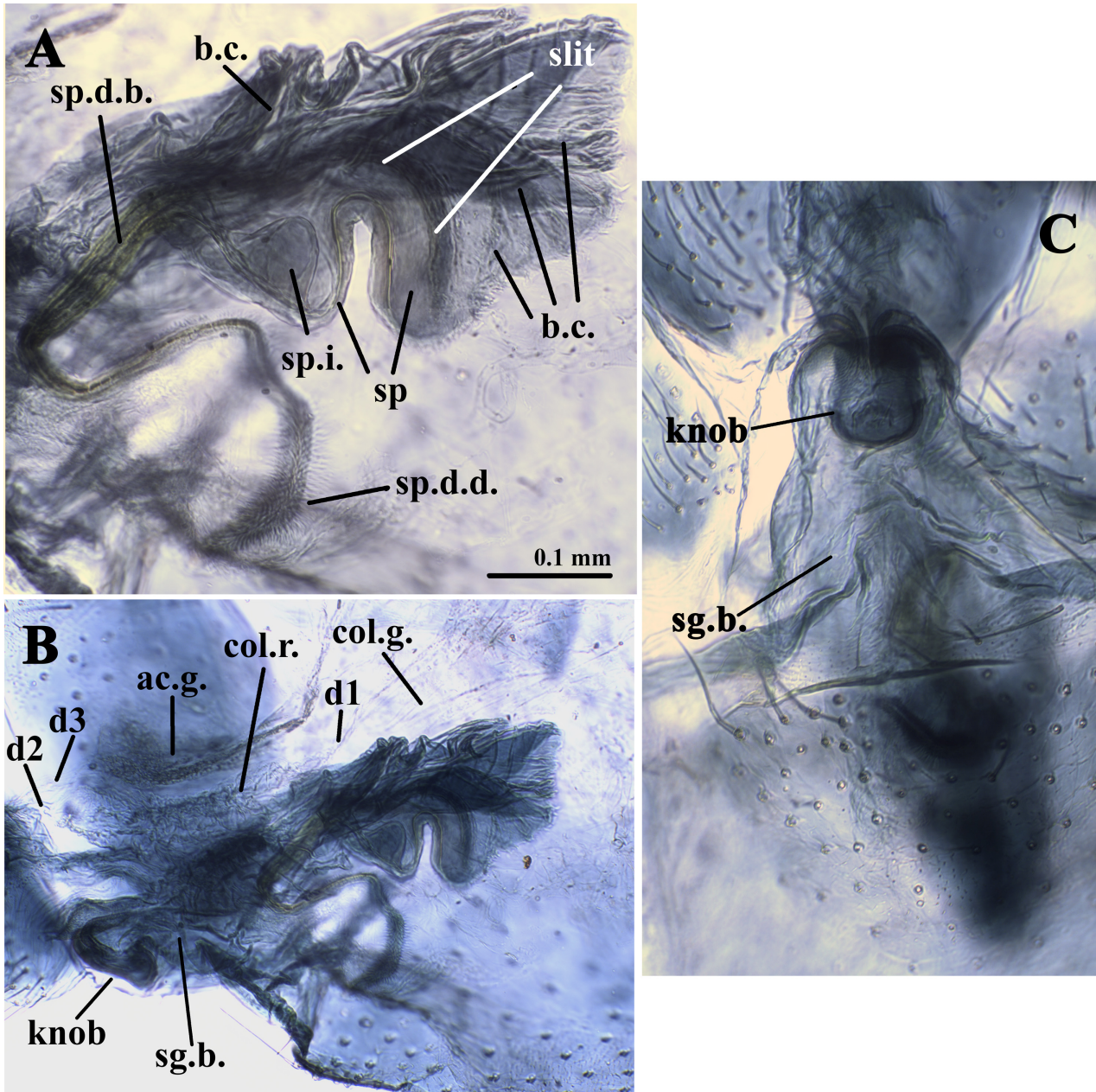


**FIGURE 12.** *Chrysopa sarta* Banks lectotype (MCZ), female. A. Abdomen, lateral. B. Terminal abdominal segments, lateral. C. Callus cerci. Abbreviations: **g.l.** gonapophysis lateralis; **S7** seventh abdominal sternite; **T8** eighth abdominal tergite.

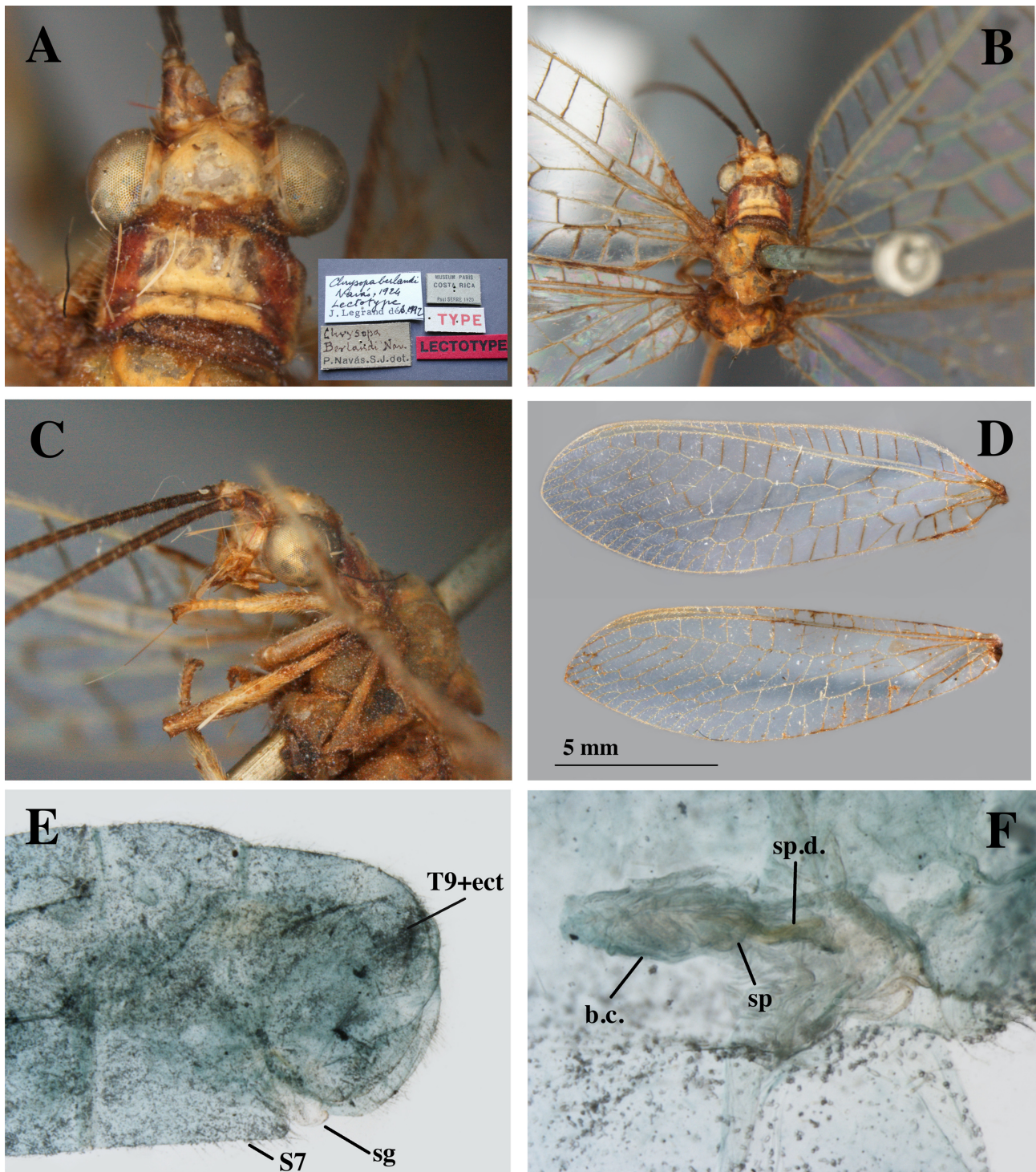
**Redescription.** The following redescription is based primarily on the two type specimens and also on one other female specimen (with endoparasitoid in abdominal cavity) from Veracruz, Mexico. Measurements from the parasitized specimen were included in the description for all parts of the body except the abdomen which was weakly sclerotized.

**Head** ( $n=1-2$ ; Figs 10B–F, 14A–C, 15A–B). Width (frontal, including eyes) 1.46–1.47 mm; width between tentorial pits 0.41–0.46 mm; length mid-antenna to midway between tentorial pits 0.44–0.46 mm; length midway between tentorial pits to tip of clypeus ~0.22–0.28 mm. Surface of vertex, frons, clypeus smooth, shiny; frons

with broadly obtuse transverse fold above distal margin; clypeus with distal margin straight. Labrum with distal margin straight to slightly indented mesally. Scape with lateral margin straight, mesal margin rounded. *Coloration*. Dorsum cream to yellowish; frons white; toruli pale, unmarked; genae pale, unmarked; clypeus, labrum amber. Scape cream to amber, with broad reddish-brown to dark brown lateral stripe that diffuses slightly onto dorsal surface of cranium; pedicel brown to pale basally, black to dark brown mesally, distally; flagellum, flagellar setae black basally, becoming lighter distally; maxillary and labial palpi pale, without marks. Venter cream, unmarked. [Note: Freitas *et al.* (2009) reported a dark mark on the gena; such a mark was not present on the *C. sarta* type (or the nontype specimen). We also could not perceive a distinct genal mark on the discolored *C. berlandi* type; only a slight darkening of the area adjacent to the eyes is visible (Fig. 14C).]

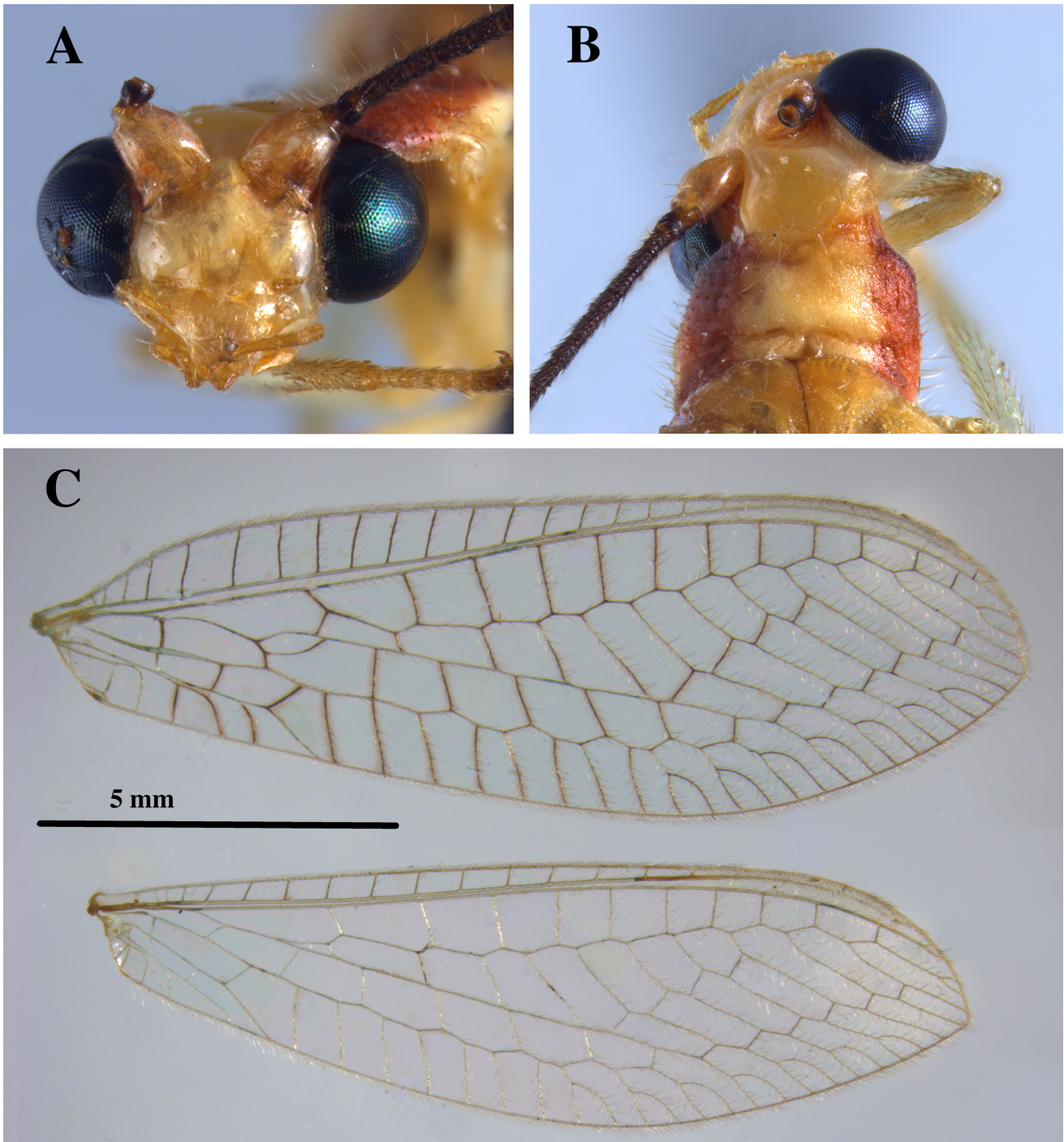


**FIGURE 13.** *Chrysopa sarta* Banks lectotype (MCZ), female. A. Spermathecal complex, lateral. B. Colleterial complex, subgenitale, and spermathecal complex, lateral. C. Subgenitale, ventral. Abbreviations: **ac.g.** accessory colleterial gland; **b.c.** bursa copulatrix; **col.g.** colleterial gland; **col.r.** colleterial reservoir; **d1** first colleterial duct (colleterial gland to reservoir); **d2** second colleterial duct (colleterial reservoir to oviduct); **d3** third colleterial duct (colleterial accessory gland to second colleterial duct); **knob** lobate knob of subgenitale; **sg.b.** base of subgenitale; **slit** elongate opening along dorsal surface of spermatheca leading to bursa copulatrix; **sp** spermatheca; **sp.d.b.** basal section of spermathecal duct; **sp.d.d.** setose distal section of spermathecal duct; **sp.i.** spermathecal invagination.



**FIGURE 14.** *Chrysopa berlandi* Navás lectotype (MNHN), female. A. Head, prothorax, dorsal [Insert: labels]. B. Head, thorax, base of wings, dorsal. C. Head, prothorax, mesothorax, lateral. D. Wings E. Terminalia, lateral. F. Genitalia, ventral. Abbreviations: **b.c.** bursa copulatrix; **sg** subgenitale; **sp** spermatheca; **sp.d.** spermathecal duct; **S7** seventh sternite; **T9+ect** fused ninth abdominal tergite and ectoproct.

**Thorax** (Figs 10C, 15B). Pronotum pale, with pair of wide, dark red lateral stripes extending to lateral margin, numerous long, pale setae dorsally and laterally. Meso-, metanota gold colored, without marks; pleural regions whitish to cream. Legs pale without markings, with mostly blonde setae; tarsi amber colored. Tarsal claws dark amber, recurved, with deep cleft, quadrate base.



**FIGURE 15.** *Ceraeochrysa sarta* (Banks) female, Veracruz, Mexico (EMEC). A. Head, frontal. B. Head, prothorax, dorsal. C. Wings.

**Wings** (n= 3; Figs 11, 14D, 15C). Forewing length 13.6–14.2 mm, maximum height 4.3–4.7 mm, with tallest portion of wing being in third distal quadrant; height at basal, distal 1/4<sup>th</sup> points 3.2–3.5 mm, 4.2–4.4 mm, respectively; anterior margin relatively straight; apex broad, rounded. Costal area very slightly raised basally; tallest costal cell (#6) ~ 0.18–0.19x maximum height of wing; most costal veinlets straight, slanted. Subcosta, Radius fairly straight; radial crossveins mostly straight. Eleven to twelve closed radial cells, height of tallest radial cell (#3) ~1.2–1.5x breadth. First intramedian cell ovate, breadth ~0.58x breadth of third medial cell; two rows of gradate veins, regularly spaced, slightly divergent distally, with five inner gradates, six to seven outer gradates. Four *b* cells, four to five *b'* cells. Three intracubital cells with distal one open; *icu1*, *icu2* each shorter than *icu3*; *icu1* considerably shorter than *icu2*. Vein A1 forked. **Coloration.** Membrane hyaline, glossy; stigma transparent to slightly opaque. All longitudinal veins, except base of RP, base of MP, mostly greenish, some with brown marks at intersections with

brown crossveins; distal and posterior margins with terminal veinlets of green, except bases of upper branches of forked terminal veinlets brown to light brown; all crossveins at least somewhat darkened; very light suffusion on surrounding membrane of some crossveins, including inner and outer gradates, basal c-sc crossveins, 1sc-r, ra-rp, m-cu, mp-cua, intracubital crossveins; suffusion also on membrane surrounding basal two terminal veinlets of CuA, terminal veinlets of A1.

Hindwing fairly broad, with apex acute; length 12.0–12.8 mm, maximum height 3.5–4.0 mm. Ten to twelve radial crossveins; base of M merged with R, *t* cell present; two rows of gradate veins with three to four inner gradates, six to seven outer; three *b* cells; four *b'* cells. *Coloration*. Membrane hyaline, glossy, with all veins green, except outer gradates brownish. Stigma as on forewing.

**Abdomen—Male.** Unknown. **Female** (Figs 12, 13, 14E–F). Pale green, with yellow mesal stripe dorsally; no markings visible (Banks 1914). Tergites, sternites quadrate, with relatively straight margins (lateral view), rounded corners. Sixth sternite (lateral view) about 2x longer than tall. Spiracles small, round, not enlarged, atria not enlarged. Tergites, sternites, pleural regions of A6–A8, gonapophysis lateralis, with relatively short, thin setae throughout. Ninth tergite+ectoproct (lateral view) with proximal margin sinuate, extending well below T8; ventral margin approximately at level of gonapophysis lateralis. Seventh sternite (lateral view) ~1.5x longer than tall, dorsal margin not sloping except distally; terminus sloped. Callus cerci slightly taller than broad (height 0.17 mm tall, breadth 0.15 mm), with approximately 28 trichobothria. Gonapophysis lateralis tall (height ~1.7 mm) slender. Subgenitale of moderate size, consisting of relatively narrow, somewhat sclerotized base and distal bilobed extension, with rounded knob at tip; base with wavy, folded texture ventrally, giving rise to bursa copulatrix dorsally, curved U-shaped bend of spermathecal duct within. Bursa copulatrix narrow, longitudinally striated, extensively folded and fluted, extending beyond spermatheca. Bursal glands not found. Spermatheca smallish (~0.30 mm long, ~0.15 mm wide at mouth), round, funnel-like at tip, with elongate slit along dorsal margin opening to bursa copulatrix. Spermathecal invagination moderately large, ~0.07 mm in diameter, ~0.07 mm in depth. Spermathecal duct elongate, ~0.6 mm long, 0.03 mm wide at base, extending from dorsal margin of spermatheca; entire length of duct with dorsal slit contiguous with dorsal slit on spermatheca; duct making two right-angle bends within subgenitale, returning to abdominal cavity; basal ~one third smooth, well sclerotized, without setae; middle third narrower, with light setation; distal one third expanded, with heavy setation. Colleterial gland delicate, striated, extending well into segment A7, connected distally to colleterial reservoir via narrow delicate duct; colleterial reservoir fluted, positioned above subgenitale, with narrow duct terminally. Transverse sclerification present; shape, size not defined.

**Specimens examined** (in addition to types listed above). **MEXICO.** Veracruz. Fortín de las Flores, VIII-12-1987, Brown (1♀, parasitoid larva in genitalia vial with abdomen EMEC).

**Confirmed geographic distribution.** **Mexico:** Veracruz. **Costa Rica:** Cartago.

#### Part 4. *Ceraeochrysa poujadei* (Navás, 1910), new combination and two new junior synonyms

Figs 16–26

##### Taxonomic Synonymy

*Chrysopa poujadei* Navás, 1910. *Rev. R. Acad. Cienc. exactas fis. Nat. Madrid* 9: 478; “Loja (Ecuador). A. Poujade, 1909 (Museo de París); number of syntypes not mentioned. Navás 1913: 78, 84 [key, brief redescription]; Banks 1944: 5, 12 [key, locality data]; Penny 1977: 19 [species list]; Legrand *et al.* 2008: 163 [taxonomic information]. **Type Material:** Lectotype by previous designation (Legrand *et al.* 2008: 163), MNHN, male, abdomen cleared, in vial with glycerine, good condition for its age; slightly teneral, fragile, and discolored (examined, CAT; Figs 16–18).

*Chrysopodes (Neosuarius) poujadei* (Navás, 1910). Brooks & Barnard 1990: 272 [generic combination]; Tauber 2010: 12 [designation as “genus, subgenus *incertae sedis*”]; Oswald 2020 [catalog listing, as *Chrysopodes*].

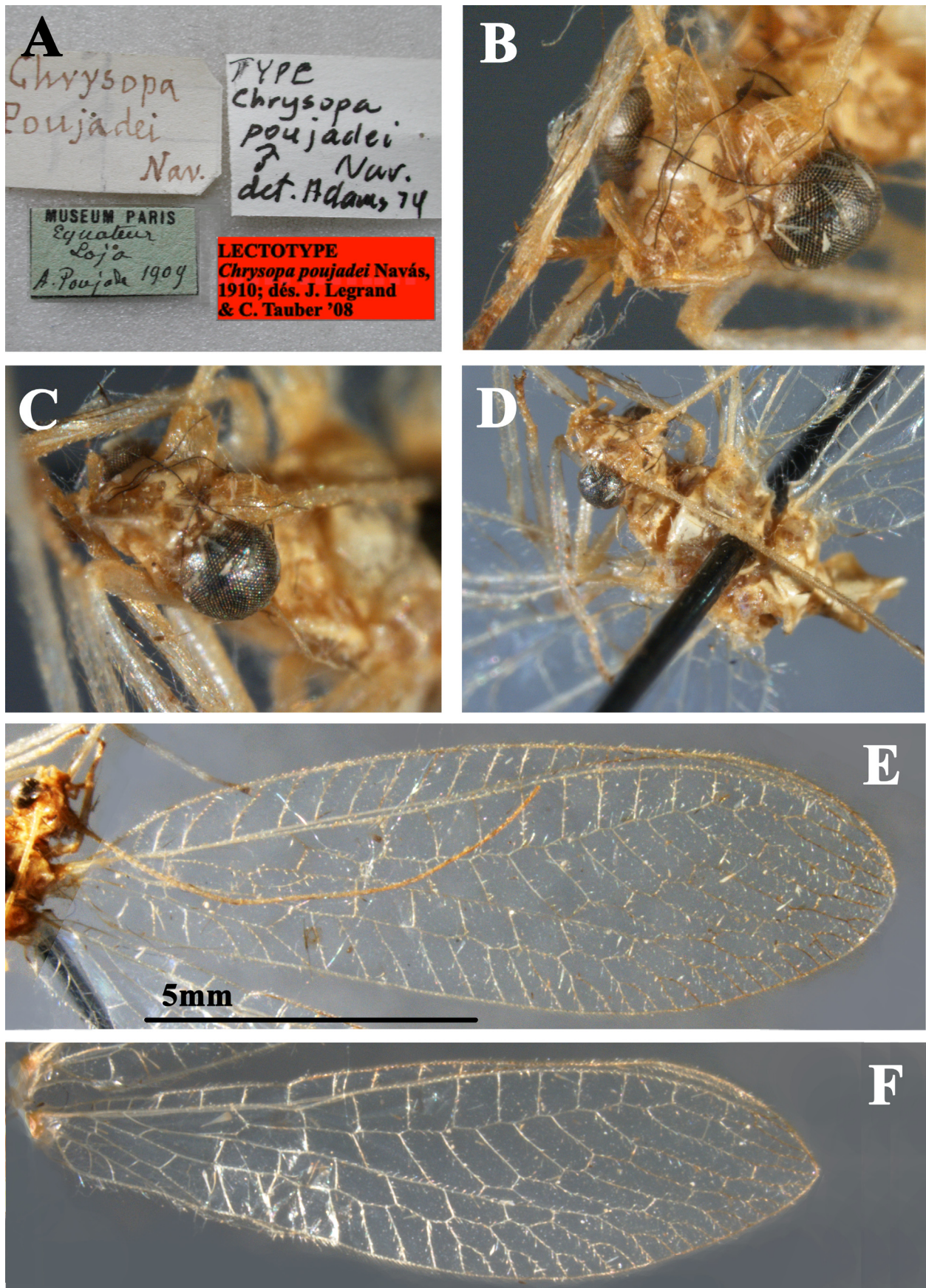
*Ceraeochrysa poujadei* (Navás, 1910), **New combination.**

*Chrysopa laeva* Navás, 1910, **New synonymy.** *Rev. R. Acad. Cienc. exactas fis. Nat. Madrid* 9: 477; “Loja (Ecuador). A. Poujade, 1909). Un ejemplar comunicado por el Museo de París.. Navás 1913: 77, 81, fig. 3 [key, brief redescription, sketch of forewing]; Banks 1944: 5, 12 [key, locality data]; Penny 1977: 19 [species list]. **Type Material:** Holotype by monotypy, MNHN, slightly teneral, fragile; female, abdomen in vial with glycerine, poorly cleared (examined, CAT; Figs 19–20).

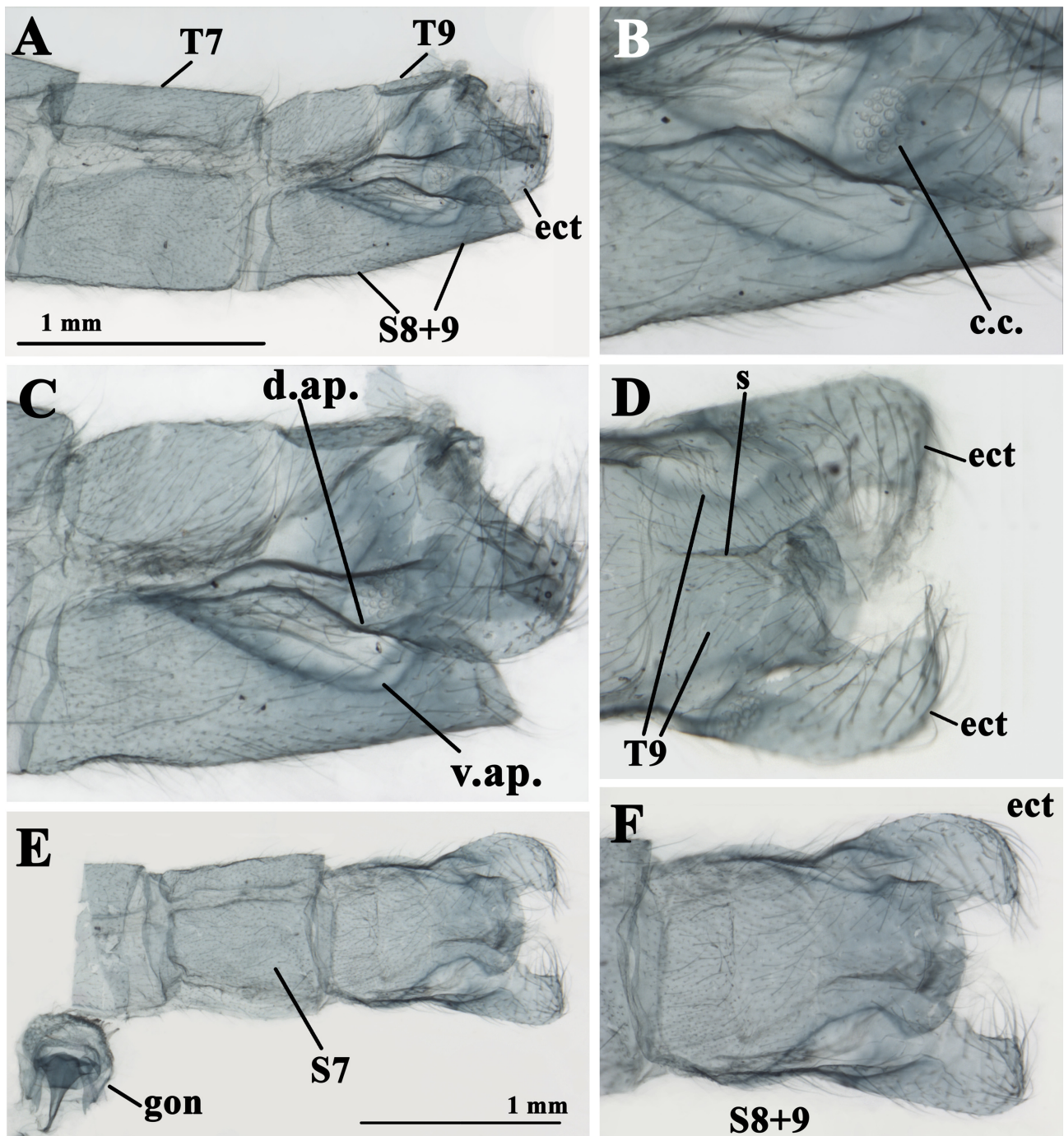
*Chrysopodes laevus* (Navás, 1910). Adams 1985: 5 [generic combination, as *laeva*]. Brooks & Barnard 1990: 272 [species list]; Legrand *et al.* 2008: 148 [taxonomic information]; Oswald 2020 [catalog listing].

*Chrysopodes (Chrysopodes) laevus* (Navás, 1910). Adams & Penny 1985: 423 [assignment to subgenus *Chrysopodes*].

*Ceraeochrysa forcipata* Freitas & Penny, 2009, **New synonymy.** *Proc. Calif. Acad. Sci., Ser. 4, 60 (16): 604*; “Bolivia: Cochabamba, Carrasco, Siberia, (1650 m, January 1964, F. M. Walz (CAS). **Type Material:** Holotype by original designation, CAS, male (examined, CAT; Figs 21–22; twenty paratypes (17 females, 3 males, all with same locality data as holotype, collection dates Oct. 1963–Jan. 1964, some examined, CAT).



**FIGURE 16.** *Chrysopa poujadei* Navás lectotype (MNHN), male. A. Labels. B. Head, frontodorsal. C. Head, frontolateral. D. Body, dorsal. E. Forewing. F. Hindwing. Scale applies to both E and F.



**FIGURE 17.** *Chrysopa poujadei* Navás lectotype (teneral, MNHN), male abdomen. A–C. Terminal segments, lateral. D–F. Terminal segments, ventral, with genitalia (17E) for scale. (Note expanded lobes of ectoproct.) Abbreviations: **c.c.**, callus cerci; **d.ap.** dorsal apodeme; **ect** ectoproct; **gon** gonarcial complex (not attached to abdomen); **s** suture and invagination of midline, ninth tergite; **S7** seventh abdominal sternite; **S8+9** fused eighth and ninth sternites; **T7, T9** seventh and ninth abdominal tergites; **v.ap.** ventral apodeme.

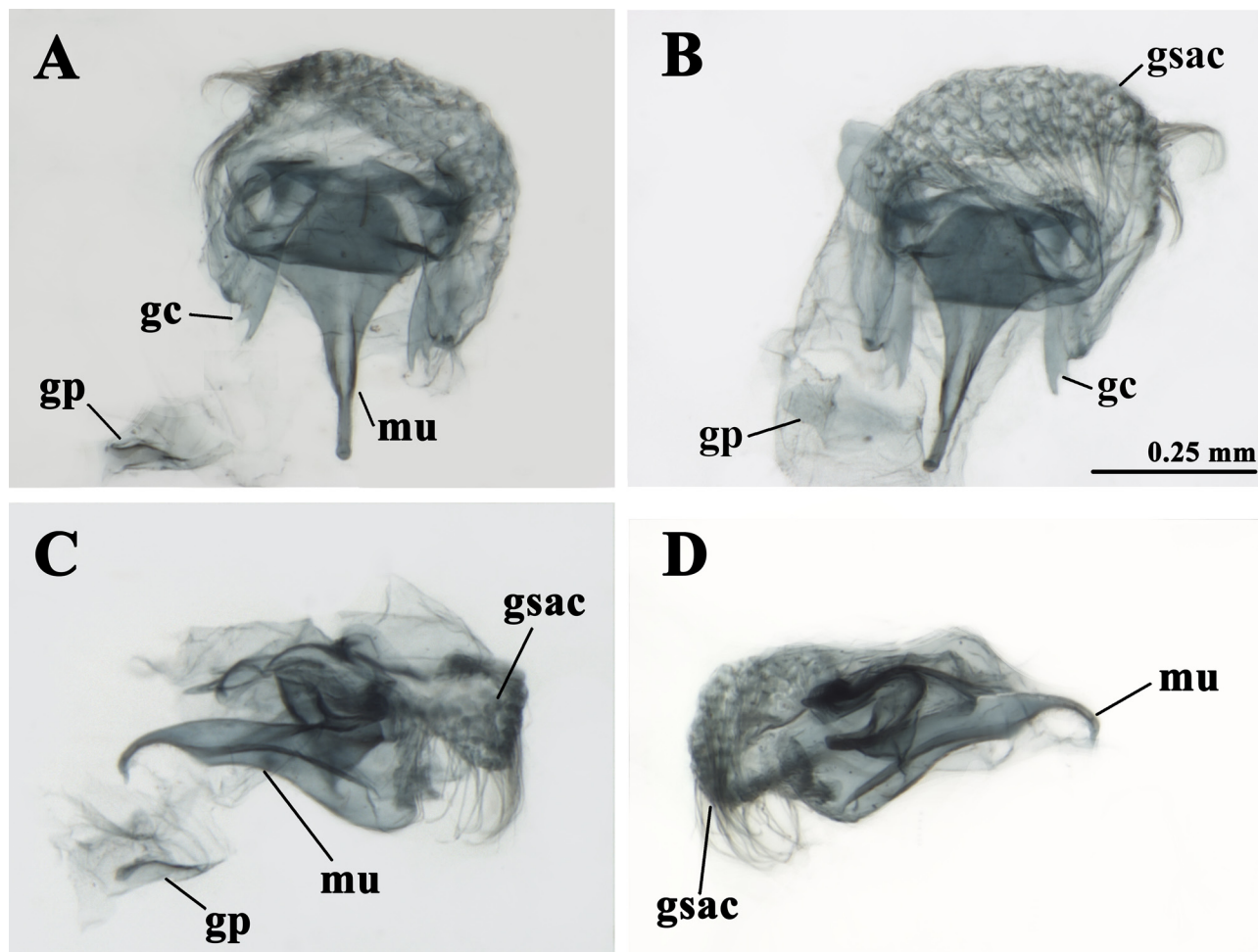
### Support for taxonomic changes

Over the years, *C. poujadei* and *C. laeva* have never been associated with *Ceraeochrysa*. However, recent taxonomic work on the genus (e.g., Freitas *et al.* 2009; Sosa & Freitas 2010, 2011) has provided a fuller understanding of the diversity that this genus encompasses. Indeed, the synonym *Ce. forcipata* was originally described in the genus. Now we recognize that the primary types of *C. poujadei* (male), *C. laeva* (female), and *Ce. forcipata* (male) express wing and genitalic features that support their inclusion within *Ceraeochrysa* and their synonymy. The

overlapping collection data and the similarity in external features between the *C. laeva* holotype and the *C. poujadei* lectotype further support the synonymy.

Because the species names for *C. laeva* and *C. poujadei* were published simultaneously, in accordance with ICZN Rule 24.2, we as First Revisers chose *C. poujadei* to have precedence. Our choice was made because of the better quality of the species' type specimen.

**Diagnosis.** Adults of this species are distinguished by the round shape of the wings and enlarged terminal lobes on the male abdomen. However, reliable identification requires examination of the genital structures. The male S8+9 terminus has a relatively small gonapsis and small distolateral gonocristae-covered pips/lobes, as well as a highly distinctive and elaborate gonarcal complex with forked gonocornua and a gonosaccus densely covered with long, robust gonosetae extending from large chalazae (Figs 17, 18, 22, 24, 25). In the female, the size and shape of the spermatheca and spermathecal duct, absence of a bursal duct, and the structure of the subgenitale are distinctive (Figs 20, 26).

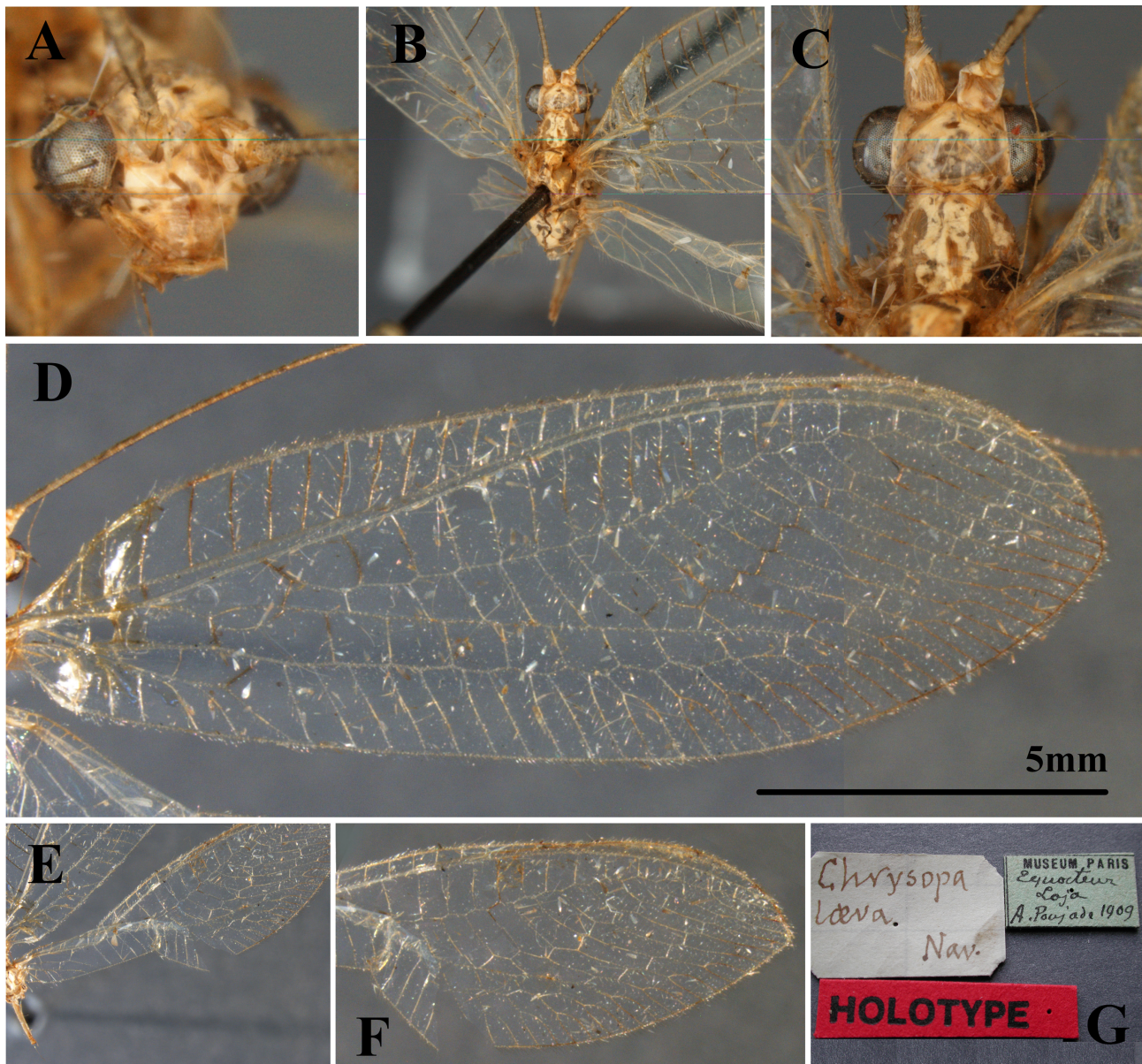


**FIGURE 18.** *Chrysopa poujadei* Navás lectotype (MNHN) male, gonarcal complex (probably slightly teneral) with weakly sclerotized gonapsis, teneral. A. Dorsal with gonapsis in lateral view. B. Ventral with gonapsis in ventral view. C. Lateral (left), with gonapsis in lateral view. D. Lateral (right), gonapsis not shown. Note: Because the specimen is teneral, some structures may not be fully formed or of normal shape. Abbreviations: **gc** gonocornu; **gp** gonapsis; **gsac** gonosaccus; **mu** mediuncus.

It should be noted that the specimens that we studied exhibit significant variation in a range of external features, including head and body markings (from none to bright red) (Figs 16, 21, 24), body size and wing size and venation (as illustrated in Fig. 23). The male abdominal and genital features also express some variation (Figs 17, 18, 22, 25), but most of this variation (*e.g.*, in the degree to which the sclerites are hardened, the flexibility of the mediuncal attachment to the gonarcal arch, the ornamentation of the mediuncus and gonocornua) may be related to differences in maturation and sclerotization. These features would be of interest to compare when additional specimens of this species become available.



**Redescription** (Also see Freitas *et al.* 2009: 604, fig. 65). **Head** (n=2–3; Figs 16B–D, 19A–C, 21A–C, 24A–D). Width (dorsal, including eyes) 1.23–1.67 mm; ratio head width : eye width = 2.2–2.6:1; head width (frontal, including eyes) 1.3 mm. Vertex raised, with small upward fold posteriorly; surface smooth, without setae. Frontal: distance (straight-line) between tentorial pits 0.41–0.54 mm; distance between antennae ~0.09–0.10 mm; length of frons (mid-antenna—midway between tentorial pits) ~0.47–0.72 mm; length midway between tentorial pits to tip of clypeus ~0.28 mm. Frons smooth, shiny throughout; frontoclypeal margin slightly concave, with small, slightly sinuous transverse fold ~1/5th distance to antennal bases above. Clypeus with surface striated. Labrum with proximal margin slightly convex mesally; distal margin clefted. *Coloration*. Head usually pale, unmarked, appearing faded, except for a few specimens with a pair of red marks on dorsum of vertex. Antenna pale, except a few specimens with faint to dark red lateral marks on scape. Maxillary, labial palpi pale to amber, without marks except sometimes light brown on distal segment of maxillary palp. Venter unmarked.



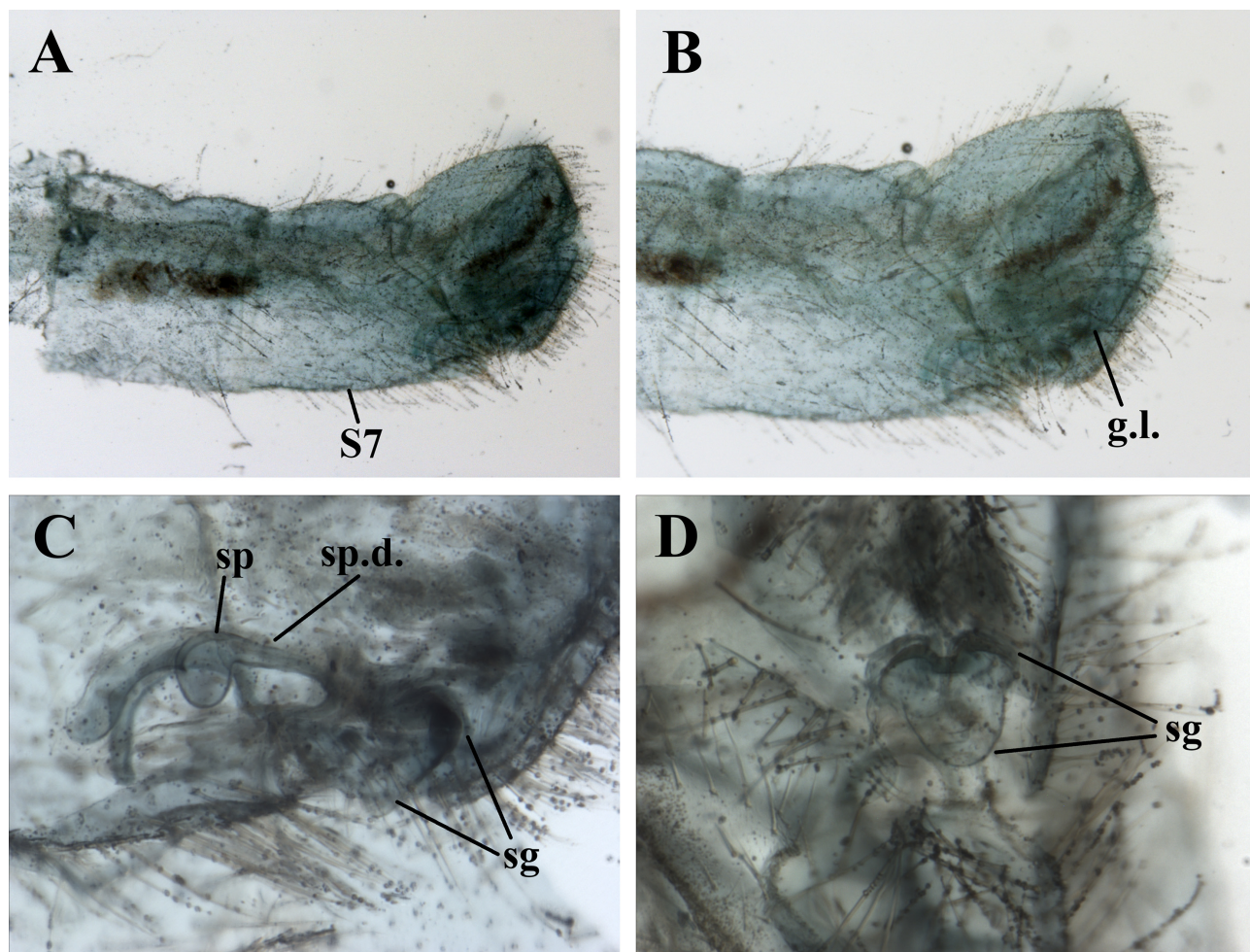
**FIGURE 19.** *Chrysopa laeva* Navás holotype (MNHN), female. A. Head, frontodorsal. B. Head, body, dorsal. C. Head, prothorax, dorsal. D. Forewing. E, F. Hindwing. G. Labels. Scale applies only to D.

**Thorax** (Figs 19C, 24D). Slightly longer than broad; measurements not possible. Pronotum probably green to cream-colored mesally, with light to dark red stripe extending along entire lateral margin or with midregion of stripe broken; mesonotum, metanotum light green laterally, white to cream mesally. Pleural regions pale yellow without

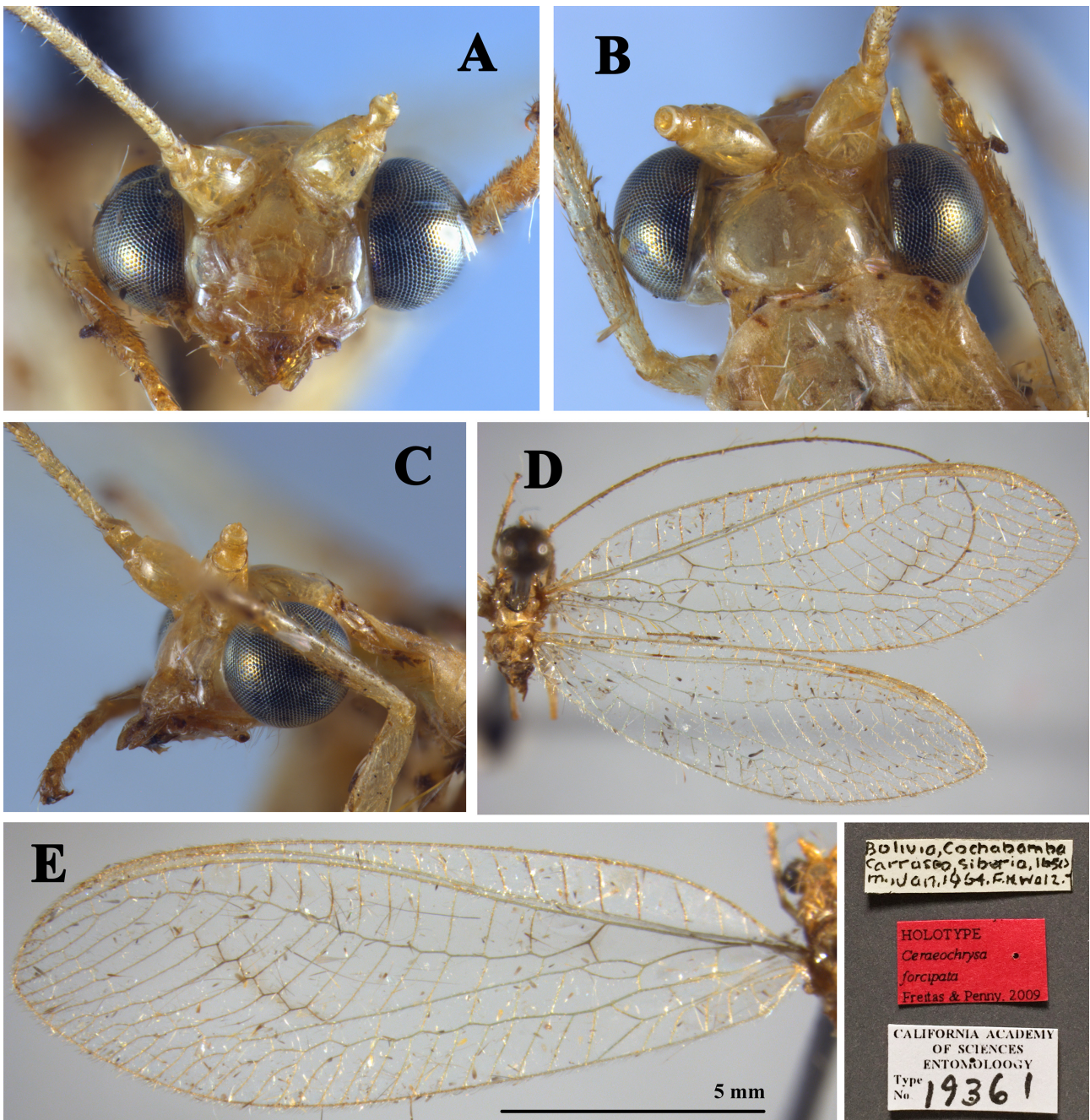
markings. Legs pale without markings; tarsi amber tinged. Tarsal claws amber, slender, with deep, narrow cleft, quadrate base.

**Wings** (n=5–7; Figs 16, 19, 21, 23). Wing size notably variable; forewing length 11.7–16.4 mm, maximum height 4.0–5.4 mm; shape tall throughout, with middle and distal quadrants taller than basal quadrant; anterior margin noticeably curved upward through basal quadrant, relatively straight through second and third quadrants, curved through distal quadrant, with broad, rounded apex. Costal area broad over basal one-half of wing, narrow thereafter; tallest costal cells (#5, #6) tall, ~0.21–25x maximum height of wing. Subcosta, Radius straight to slightly sinuate; most costal veinlets straight or very slightly curved, slanted; most radial crossveins straight. Twelve to sixteen closed radial cells, height of tallest radial cell 1.7–2.8x width. First intramedian cell ovate, elongate; breadth of *im1* ~2.9–6.6x height (at *ma*), ~0.6–0.7x breadth of *m3*; two rows gradate veins ~regularly stepped, roughly parallel to each other, slightly convergent distally, with six to eight inner gradates; seven to nine outer gradates; four to six *b* cells, four to six *b'* cells; three intracubital cells, distal one open; *icu1* usually slightly shorter than *icu2* and *icu3*. Vein A1 forked. **Coloration.** Membrane clear, slightly hyaline, except with very light brownish diffusion adjacent to brownish veins; stigma transparent to slightly opaque. Venation pale except middistal section of Sc, base of RP, small sections of MP, sections of A1 brownish; inner gradate veins, basal outer gradate veins, mp-cua, intracubital crossveins brown.

Hindwing narrow, with apex acute; length 11.1–14.3 mm, height 3.2–4.4 mm. Twelve to fifteen closed radial cells; base of M merged with R; two rows of gradate veins with five to eight inner, six to eight outer veins; three to five *b* cells; five to seven *b'* cells; *t* cell usually present. **Coloration.** Stigma transparent or slightly opaque; all veins pale.



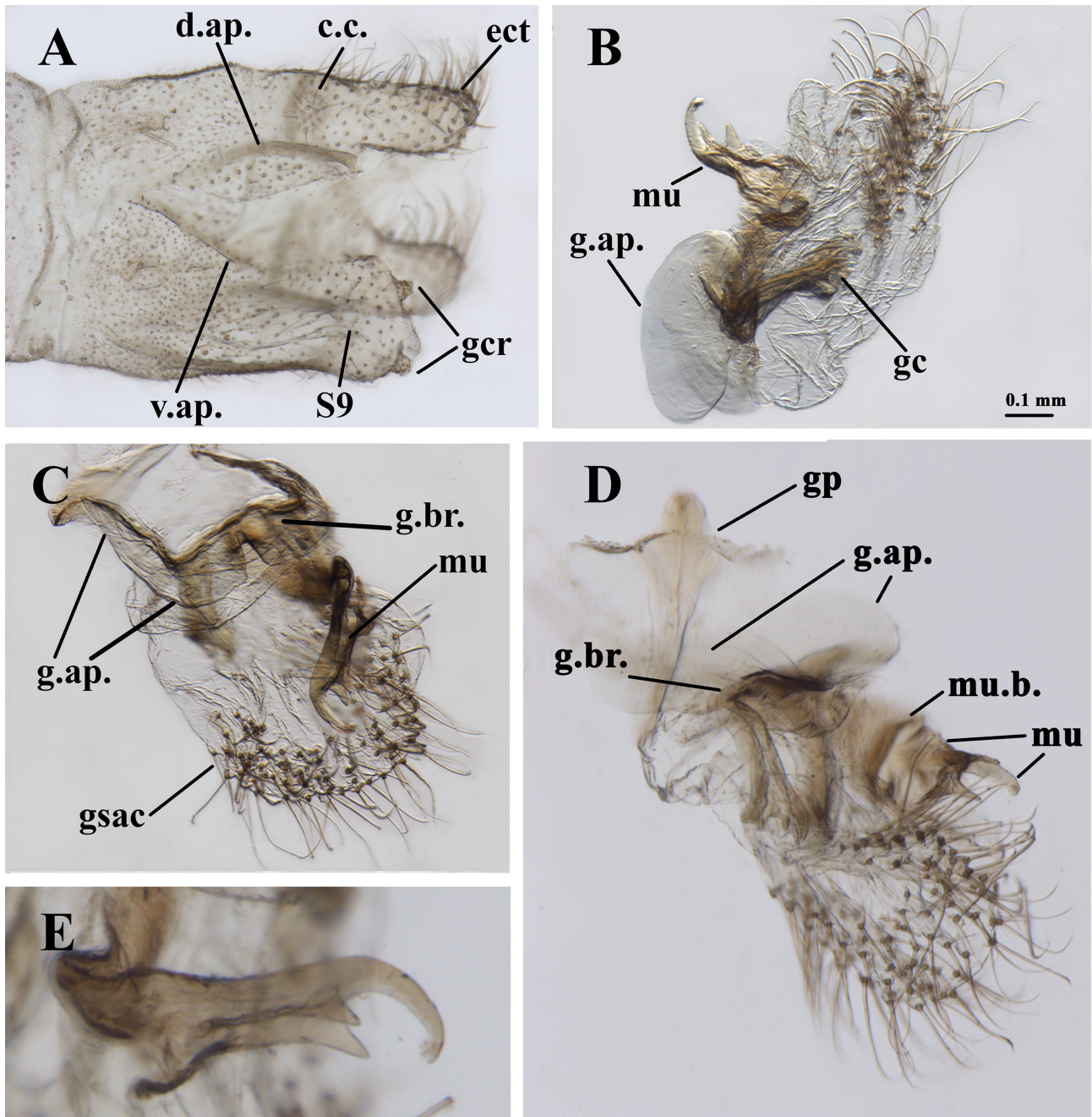
**FIGURE 20.** *Chrysopa laeva* Navás holotype (MNHN). Abdomen and genitalia, female. A. Abdominal segments A6 to terminus, lateral. B. Seventh segment and terminus, lateral. C. Spermathecal complex and subgenitale *in situ*, lateral. D. Subgenitale, frontal. Abbreviations: **g.l.** gonapophysis lateralis; **S7** seventh abdominal sternite; **sg** subgenitale; **sp** spermatheca; **sp.d.** spermathecal duct.



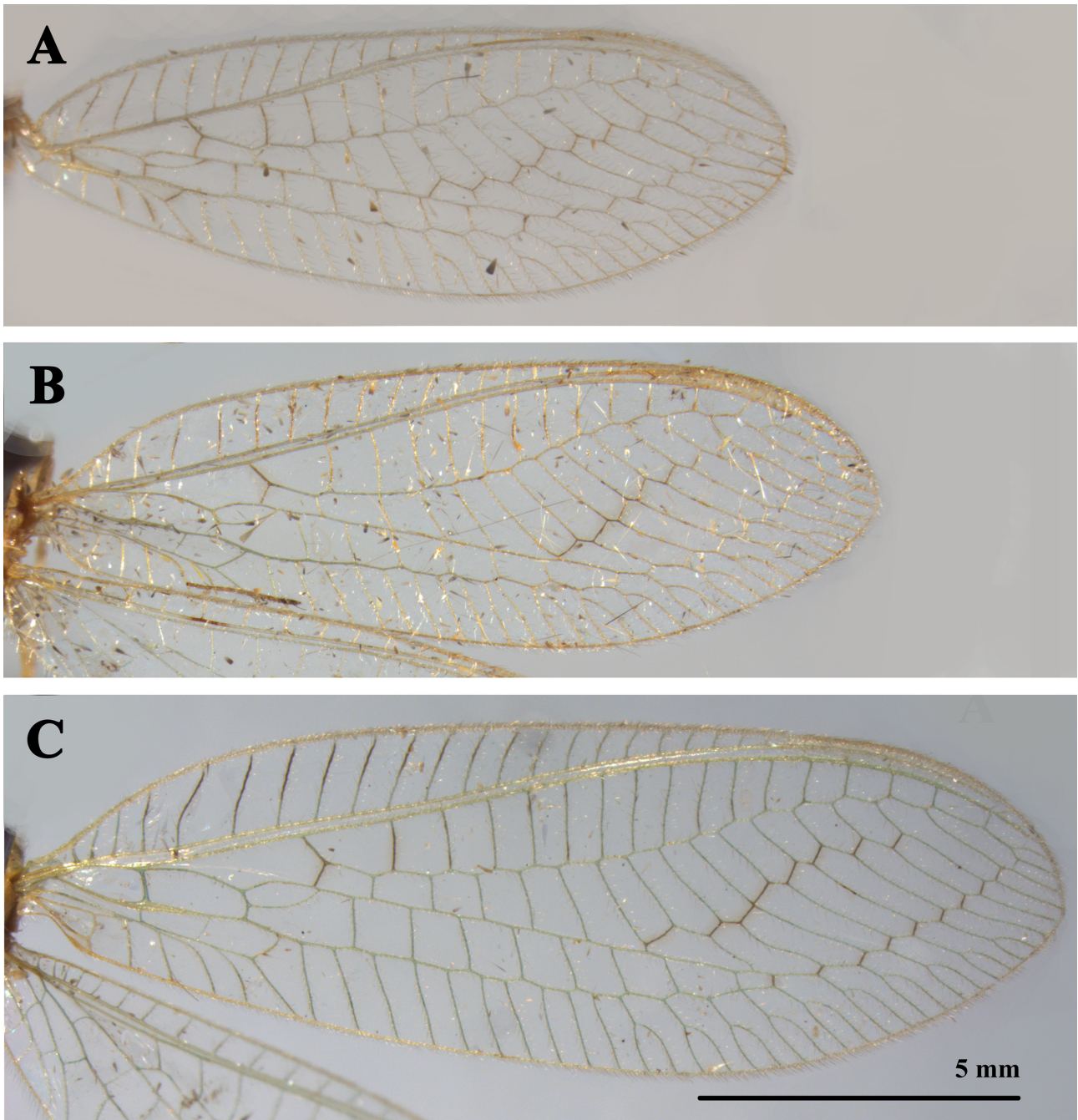
**FIGURE 21.** *Ceraeochrysa forcipata* Freitas & Penny holotype (CAS), male. A. Head, frontal. B. Head, dorsal. C. Head, lateral. D. Right wings. E. Left forewing and labels.

**Abdomen—Male** (n=3; Figs 17, 18, 22, 24E–F, 25). Tergites, sternites with long, straight setae; ectoproct with curved, longer, more robust, less dense setae. Tergites roughly quadrate in dorsal view, longer than broad. Ninth tergite+ectoproct expanded distolaterally into large, curved, setose lobes; dorsal apodeme elongate, extending from lower margin of ectoproct well basal to midregion of T8, with dorsal spur extending along basal margin of callus cerci; area ventral to apodeme with single row of robust, elongate setae. Callus cerci taller than wide (0.13–0.16 mm tall, ~0.09–0.12 mm wide), with ~21–25 trichobothria. Sternites tall, with long, dense setae; ratio length to height (lateral view): S6 = 2.0–2.1:1, S7 = 1.8–2.2:1. Fused S8+9, without suture; anterior margin approximately as tall as adjoining distal margin of S7; dorsal margin sloping steeply through midregion of sternite, expanding slightly distally; ventral apodeme along margin of S8+9. Terminus of S9 with two small lobes/pips covered with gonocristae. Spiracular atria not enlarged. Gonarcus with quadrate shape; gonarcular apodemes attached perpendicularly to ends of gonarcular bridge, extending in flat plane perpendicular to gonarcular bridge. Gonarcular apodeme somewhat

oblong (lateral view), small (shorter than mediuncus and gonocornua), with margins, surface smooth. Mediuncus heavily sclerotized, long, tapering distally from broad base, with terminus narrow, curved downward; base attached to gonarcus via relatively long, heavy, folded, broadly U-shaped membrane; tip narrowing, curving downward, simple or flanked by small angulate projections (probably only in well sclerotized, mature individuals). Gonocornu extending distally from gonarcal bridge, elongate, slightly curved downward, with bifurcate or trifurcate terminus. Gonosaccus large, eversible, with large, undivided, dense field of well sclerotized chalazae each bearing a single robust, hooked gonoseta. Gonapsis small, narrow, tip extending distally from membrane above gonocristae-bearing pips. Hypandrium internum not found.



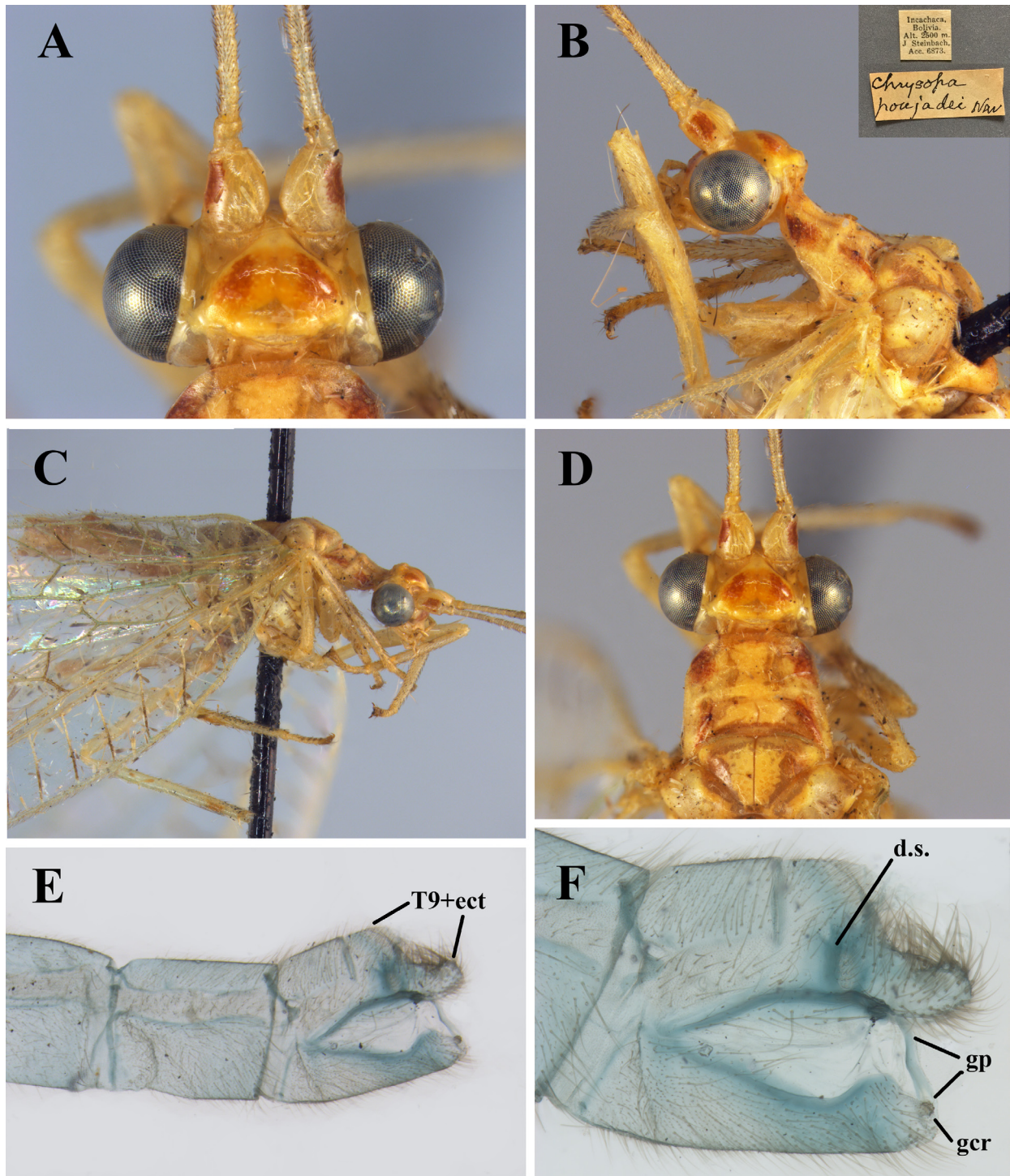
**FIGURE 22.** *Ceraeochrysa forcipata* Freitas & Penny holotype (CAS), male abdomen and genitalia (mature, well sclerotized specimen). A. Terminal segment, lateral with slight dorsal rotation so ventral surface of S9 and gonocristae-bearing terminal pips visible in lower section. B. Gonarcal complex, lateral. C. Gonarcal complex, dorsal. D. Gonarcal complex, dorsolateral, with gonapsis above, detached from S9. E. Mediuncus, lateral. Abbreviations: **c.c.** callus cerci; **d.ap.** dorsal apodeme of T9+ectoproct; **ect** ectoproct; **gc** gonocornu; **gcr** small gonocristae-carrying lobe at tip of ninth sternite; **gp** gonapsis; **gsac** gonosaccus; **g.ap.** gonarcal apodeme; **g.br.** gonarcal bridge; **mu** mediuncus; **mu.b.** base of mediuncus within membranous pouch; **S9** ninth sternite; **v.ap.** ventral apodeme. Sacle applies only to Fig. 22B.



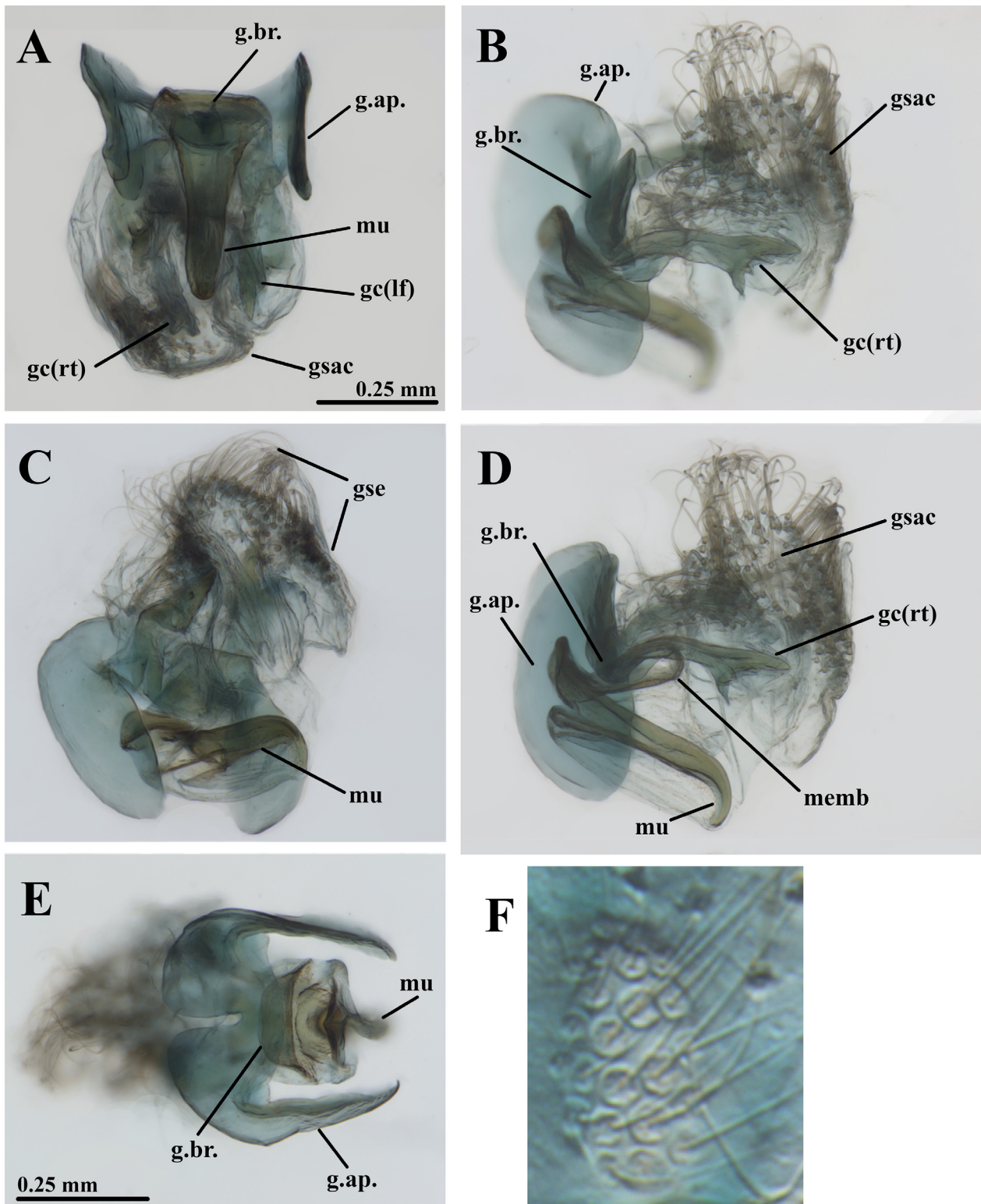
**FIGURE 23.** *Ceraeochrysa poujadei* Navás. Variation in wing size and venation. A, B. Bolivia, Cochabamba, males (CAS). C. Colombia, Cundinamarca, male (MCZ). Scale applies to all wings.

**Female** (n=2–4; Figs 20, 26). Tergites shallow; sternites quadrate, with relatively straight margins (lateral view), angular corners. S6 length approximately 1.6–2.0 times height (lateral view). Spiracles small, round (0.03–0.06 mm diameter); atria not enlarged. Tergites, sternites (A6–A8), and gonapophysis lateralis with relatively long, slender setae throughout; pleural regions with shorter, sparser setae. Ninth tergite+ectoproct (lateral view) elongate, relatively narrow, tilted below T8, extending full depth of abdomen almost to ventral margin of S7; ventral section of proximal margin with slight bulge anteriorly; distal margin straight to slightly concave, not extending below gonapophysis lateralis. Seventh sternite (lateral view) length ~2.1–2.7x greater than height, rectangular except posterior margin sloping distally toward venter, dorsal margin not sloping; terminus truncate with very slight ventral protrusion below subgenitale. Callus cerci almost circular to slightly oblong (height 0.10–0.12 mm, width 0.13–0.16 mm), with 21–33 trichobothria. Gonapophysis lateralis large, broader dorsally than ventrally; height ~0.6–0.8 mm, breadth (midregion) ~0.2–0.3 mm. Subgenitale with distal (external) section consisting of protruding, clear,

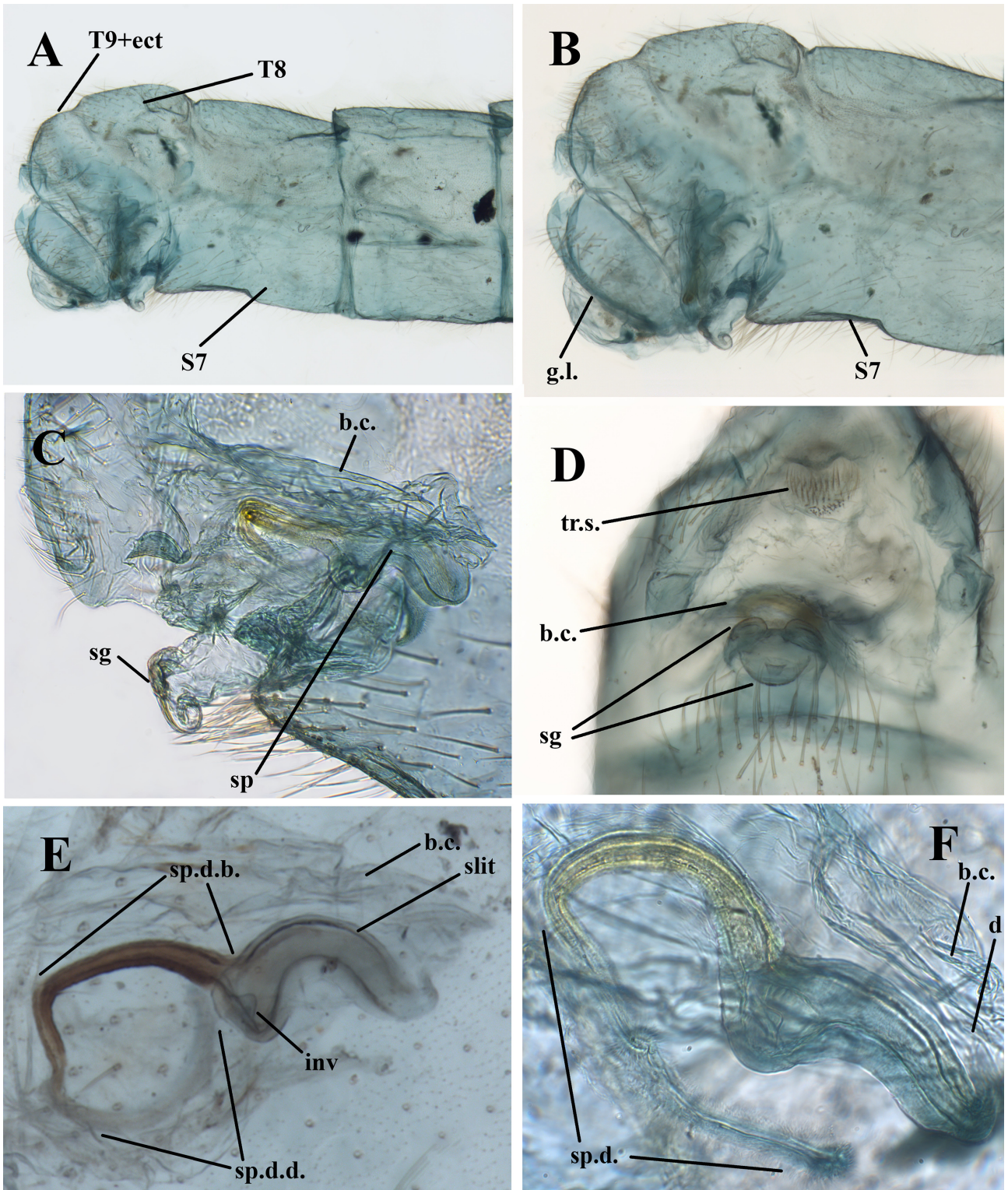
tubular neck, bilobed distal face, and ventral knob with small invagination; internal section extending below floor of bursa copulatrix, receiving the U-shaped section of the spermathecal duct. Bursa copulatrix small, flat, transparent membranous pouch, extending above spermatheca, but not beyond; dorsal surface with longitudinal folds; ventral surface, except for small distal section, attached to dorsal surface of spermatheca and spermathecal duct. Bursal glands not discerned. Spermatheca tubular, with basal section well sclerotized, slightly broadened, with small invagination,



**FIGURE 24.** *Ceraeochrysa poujadei* Navás male (MCZ), with colored markings visible, Bolivia, Cochabamba. A. Head, dorsal. B. Head, prothorax, lateral; labels. C. Head, thorax, base of abdomen, lateral. D. Head, prothorax, dorsal. E. Distal segments of abdomen, lateral. F. Terminal segments of abdomen, lateral (genitalia removed). Abbreviations: **d.s.** dorsal spur of dorsal apodeme; **gcr** gonocristae-bearing pip; **gp** gonapsis; **T9+ect** fused ninth abdominal tergite and ectoproct.



**FIGURE 25.** *Ceraeochrysa poujadei* (Navás) male (MCZ), Colombia, Cundinamarca. Gonarc complex detached from abdomen. A. Dorsal. B. Lateral, showing teeth on tip of gonocornu. C. Frontolateral. D. Lateral, showing mediuncus and membrane connecting to gonarcal bridge. E. Dorsal. F. Callus cerci. Abbreviations: **g.ap.** gonarcal apodeme; **g.br.** gonarcal bridge; **gc(lf)**, **gc(rt)** left and right gonocornua; **gsac** gonosaccus; **gse** gonosetae; **memb** sturdy membranous connection between mediuncus and gonarcal bridge; **mu** mediuncus. Scale in Fig. 25A applies to Figs 25A–25D.



**FIGURE 26.** *Ceraeochrysa poujadei* (Navás) female abdomen and genitalia, Bolivia, Cochabamba (CMNH). A. Abdominal segments A6 to terminus, lateral. B. Terminus, lateral. C. Genitalia *in situ*, lateral. D. Subgenitale, transverse sclerite, ventral. E, F. Spermathecal complex, lateral. Abbreviations: **b.c.** bursa copulatrix; **d** distal end of spermatheca; **g.l.** gonapophysis lateralis; **inv** spermathecal invagination; **S7** seventh abdominal sternite; **sg** subgenitale; **slit** elongate opening along dorsal surface of spermatheca leading to bursa copulatrix; **sp** spermatheca; **sp.d.** spermathecal duct; **sp.d.b.** basal section of spermathecal duct; **sp.d.d.** distal section of spermathecal duct; **S7** seventh abdominal sternite; **tr.s.** transverse sclerite; **T8** eighth abdominal tergite; **T9+ect** fused ninth abdominal tergite and ectoproct.



sturdy spermatheca duct protruding dorsally; tubular section of spermatheca bent mesally into broad U shape; distal end of U tapering sharply, with tight, partially membranous, second U-shaped curve terminally; total length of spermatheca (mouth to end of sclerotized section beyond second U-shaped curve) 0.32–0.36 mm; diameter at mouth 0.09–0.12 mm; invagination depth 0.08–0.11x length of spermatheca. Spermatheca with entire dorsal margin opening directly to bursa copulatrix via elongate narrow slit, with slit continuing onto dorsal surface of spermathecal duct. Spermathecal duct extending from dorsal margin of spermathecal mouth, basal ~half smooth, without setae, distal ~half narrow, brushy; basal section extending distally from spermatheca in straight trajectory, then making full U-shaped curve within base of subgenitale, a single tight coil after leaving subgenitale, and another U-shaped curve at brushy tip; total length of duct ~0.62–0.86 mm, width at base 0.04–0.06 mm. Colleterial gland and ducts not discerned; transverse sclerification broad, plate-like, with three transverse rows elongate filaments.

**Specimens examined** (in addition to type material listed above). **BOLIVIA.** *Cochabamba*: Incachaca, Alt. 2500 m., J. Steinbach. Acc 6783 (1♀, CMNH; 1♂ MCZ); Carrasco, Siberia, 1050 m, Dec. 1962–Jan. 1963, Oct 1963–Jan 1964 (18F, 3M, CAS); El Limbo, 2000 m, 28-I-1962, F. M. Walz, purchase (1♂, CAS). **COLOMBIA.** *Cundinamarca*: Pacho, Ost Cordéll, 2900 m, Fass. coll., N. Banks (1♂, MCZ). *Quindío*: Passo del Quindini, Volcanito, Nov., 3000 m., Fassl., Collection of N. Banks (1♂, teneral, identified in Banks' handwriting as "laeva, MCZ); Bogonia, Quindini Passo, 2200 m., Sept. Fassl., Collection N. Banks (1♂, MCZ, teneral, damaged, but abdomen and genitalia in good condition). [This locality label appears to refer to an Andean pass, the Quindía Pass (also called "La Linea), as well as the small settlement of Boquía, which is in a nearby valley.]. *Tolima*: Monte del Eden, Ibaqué, Dec., 2000 m., Fassl. (1♂, MCZ, genitalia missing, abdomen present). **ECUADOR.** *Napo*: Reventadora area; nr San Rafael Falls, 1500 m., E. Bergey & K. Hobson, Jan. 7 1989 (1♀, CSUC). *Pichincha*: km66, Via Quito-Pto Quito, 2200 m., 27 Jan. 1986, UV, Merc.V., S. H. McKamey (1♀, CAS).

**Known geographical distribution.** **Bolivia:** *Cochabamba*; **Colombia:** *Cundinamarca*, *Quindo*, *Tolima*; **Ecuador:** *Loja*, *Napo*, *Pichinca*.

## Part 5. *Ceraeochrysa silvano* (Navás, 1916)

Figs 27–33

### Taxonomic Synonymy

*Chrysopa silvano* Navás 1916, *Brotéria* 14: 21; "Nueva Friburgo, Enero de 1912. Leg. Ramos. (Col. m.); number of syntypes not mentioned. Penny 1977: 21 [species list]. The type locality is in the State of Rio de Janeiro, Brazil. **Type Material:** Lectotype designated by Legrand *et al.* (2008: 169) (male, originally in the Navás collection, now MNHN, examined briefly, CAT; abdomen and three wings missing).

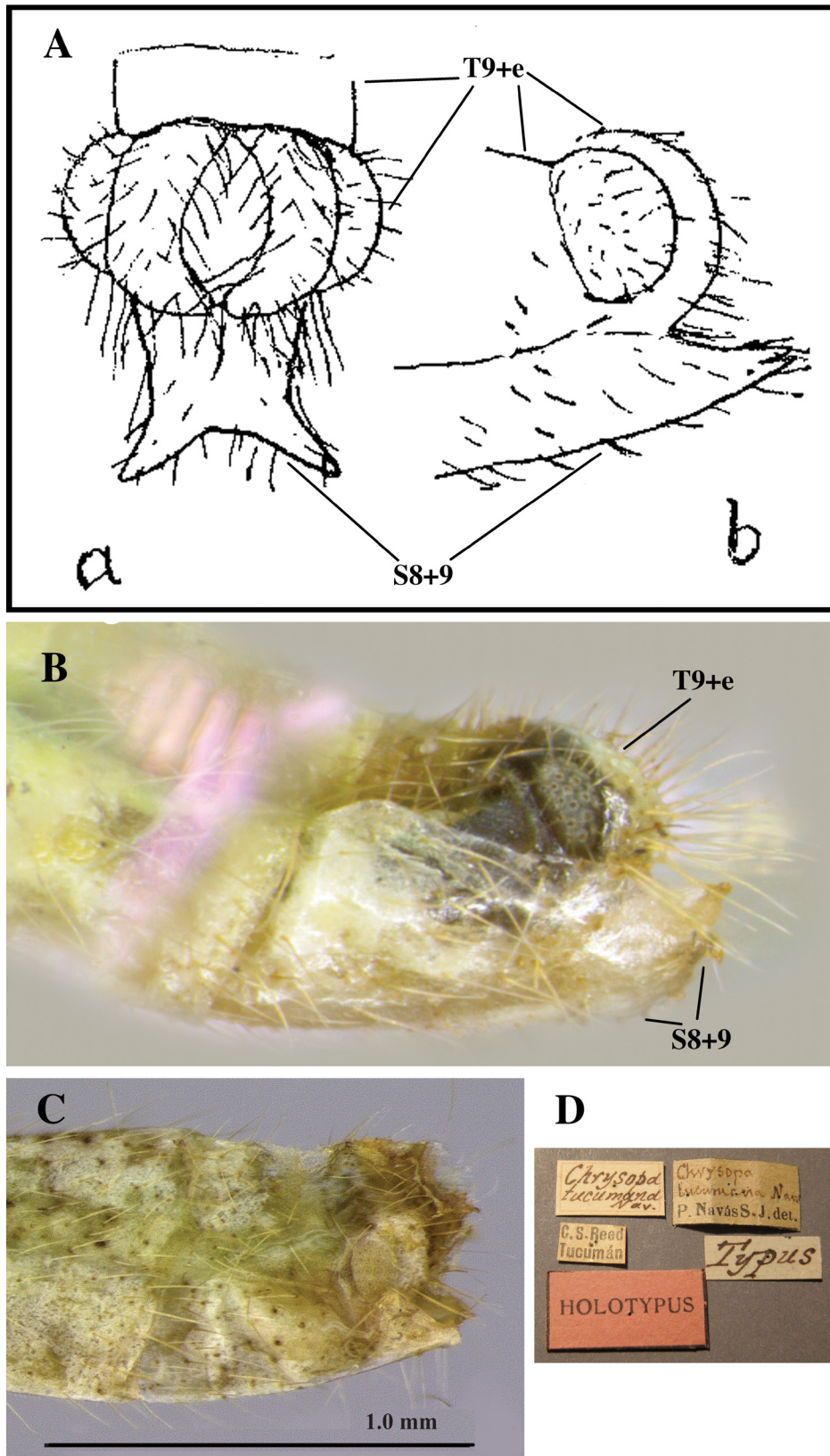
*Ceraeochrysa silvano* (Navás 1916), Brooks & Barnard (1990: 269) [first use of combination]; Freitas *et al.* 2009: 578 [revision of genus].

*Chrysopa tucumana* Navás, 1919 **New Synonymy.** *Rev. R. Acad. Cienc. exactas fis. Nat. Madrid*: 17: 302; "República Argentina: Tucumán, C.S. Reed (Mus. de La Plata); number of syntypes not mentioned. Penny 1977: 21 [species list]; Brooks & Barnard 1990: 280 [species list, as *incertae sedis*]. **Type Material:** Lectotype by **present designation** [male, MACN, examined, but not imaged except for labels, CAT (Fig. 27D); abdomen cleared, in vial with glycerine; gonarcus missing]. Although Navás (1916) stated that the type was in the Museum at La Plata, Argentina, we and Freitas *et al.* (2009) found it in the MACN. We (CAT) deposited in the collection a nontype male specimen reared from a female collected at the type locality.

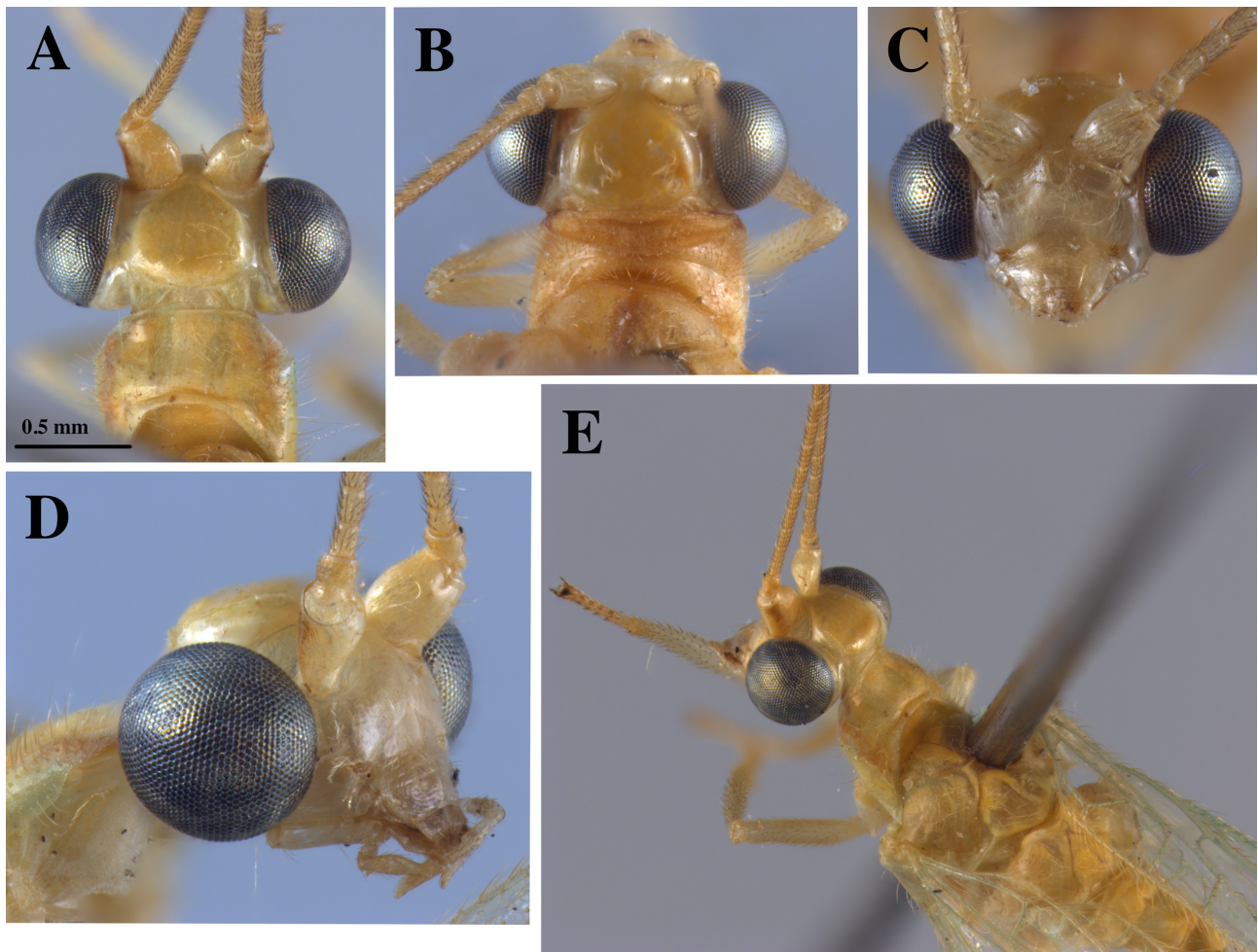
*Ceraeochrysa tucumana* (Navás, 1919). Freitas & Penny 2001: 265 [first use of combination, redescription]; Freitas *et al.* 2009: 586 [revision of genus]; Oswald 2020 [catalog listing].

### Support for Synonymy

The identity of *Ce. silvano* has long been a mystery. Navás' original description (Navás 1916: 21) is brief, and it includes two small drawings of the male abdomen. In their revision of the genus, Freitas *et al.* (2009: 578, fig. 48) included a redescription of the species and a copy of Navás' drawings, and they also included an image of a forewing (fig. 48A) that they attributed to *Ce. silvano*. However, they did not identify the source of that image; it was not in the original description. It is noteworthy that the number of gradate veins on the wing in the image (5, 5) do not coincide with those given in the original description (4, 6), and we question whether inclusion of this image in their fig. 48 was an error.



**FIGURE 27.** *Chrysopa silvano* Navás and *Ceraeochrysa tucumana* (Navás). A. Navás' drawings of the *C. silvano* terminalia from the original description. B, C. *Ce. tucumana* terminal segments of two specimens, for comparison (B. São Paulo, Brazil, with gonapophyses extended distally; C. Minas Gerais, Brazil, with gonapophyses withdrawn). D. Images of labels from *Chrysopa tucumana* type specimen in MACN. Scale applies only to Fig. 25C. Abbreviations: **S8+9** fused eighth and ninth abdominal sternites; **T9+e** fused ninth abdominal tergite and ectoproct.



**FIGURE 28.** *Ceraeochrysa silvanoii* (Navás), Tucumán, Argentina, male (MCT). A, B. Head, dorsal. C. Head, frontal. D. Head, frontolateral. E. Head, thorax, dorsolateral. Specimen A appears slightly teneral; its color is partially preserved. Specimen B is probably well developed and sclerotized, but it is discolored or faded.

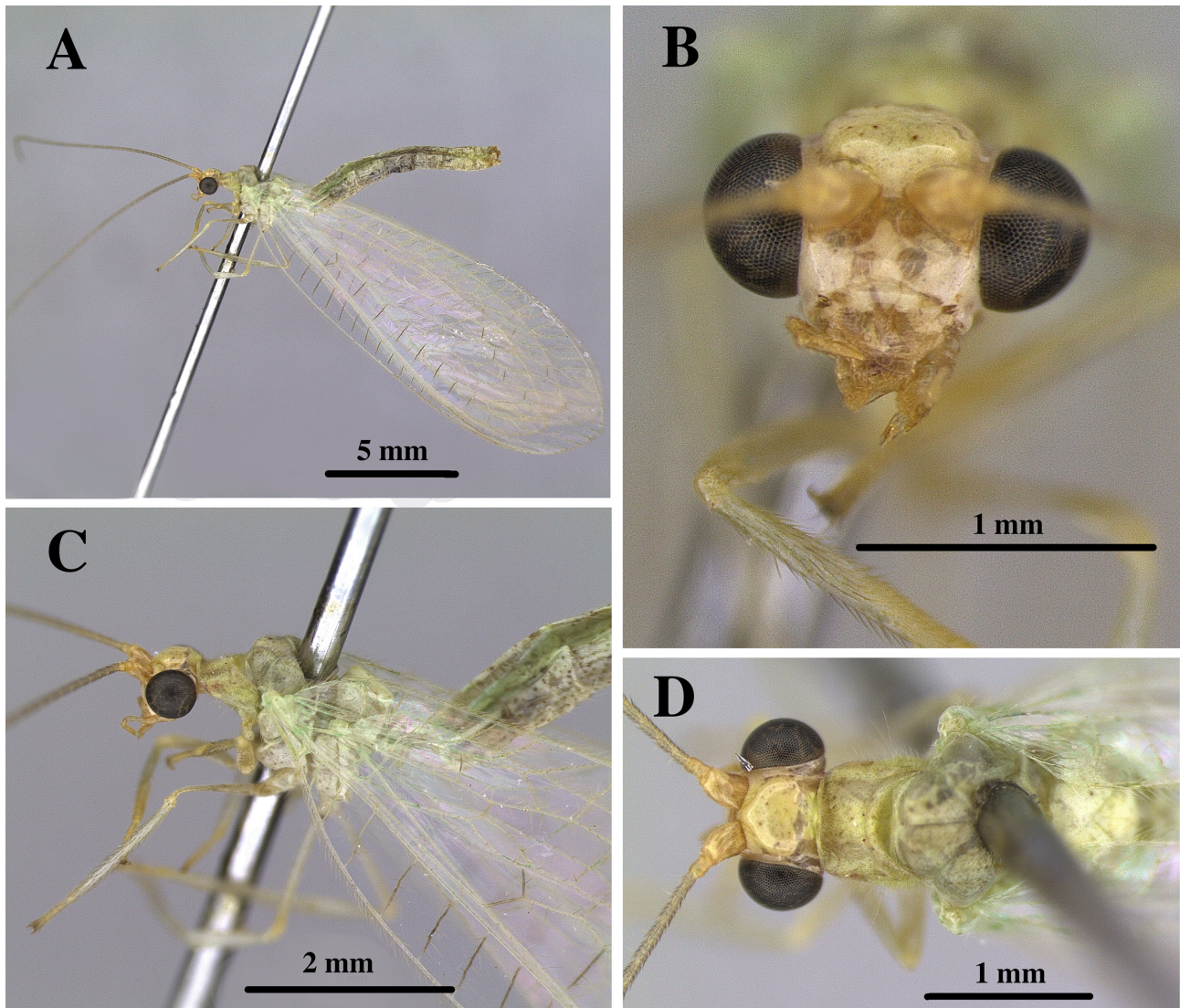
The lectotype of *C. silvanoii*, originally in Navás' collection, is now in the MNHN (Legrand *et al.* 2008); the abdomen and three wings are missing; we (CAT) have seen it but have not studied it. Moreover, no other specimens identified as this species are known. During the course of this study, we (FS) noted the similarities between the external terminalia in Navás' drawings and those of *Ce. tucumana*. Both species had been reported from Brazil — the *Ce. silvanoii* type from São Paulo state and *Ce. tucumana* from the Distrito Federal and the states of Rio de Janeiro, Rio Grande do Sul, Minas Gerais, and Bahia. The wing size of both species is the same; we know of no other species that fits the drawing as does *Ce. tucumana* (see Fig. 27). Specifically, as depicted by Navás, it has large terminal lobes on the T9+ectoproct, large, circular callus cerci, and an extended, acute terminus on S8+9. We acknowledge that Navás did not mention the lateral stripes that usually are found on the scapes of *Ce. tucumana* specimens; however, from Navás' statement concerning the eye color of the *C. silvanoii* type dried in the air, we suspect that his specimen may have faded after exposure to alcohol. We also noted that among the *Ce. tucumana* specimens that we studied, the markings on the scape vary from dark red, almost black, to very pale, and in some cases are absent. Therefore, we suggest tentatively (unless the remaining wing of the *Ce. silvanoii* type contradicts) that these two names are synonymous, with *Ce. silvanoii* (Navás, 1916) being the senior synonym and valid name.

**Redescription.** Based on specimens identified as *Ce. tucumana*; also see Freitas & Penny 2001: 265, fig. 19; Freitas *et al.* 2009: 586, fig. 54.

**Head** (n=2; Figs 28, 29). Width (frontal and dorsal, including eyes) 1.1–1.2 mm; ratio head width: eye width = 2.1–2.2:1. Vertex raised, relatively flat throughout, with very small upward fold posteriorly; surface, smooth, without setae. Frontal: distance (straight-line) between tentorial pits 0.34–0.37 mm, distance between antennae ~0.07–0.09 mm; length from mid-antenna to midway between tentorial pits 0.34–0.37 mm; length midantenna to

tip of clypeus  $\sim 0.51\text{--}0.53$ . Frons smooth, shiny throughout, with convex transverse fold along frontoclypeal margin; clypeal surface mostly smooth, with some transverse striation distally. Labrum with proximal margin straight, distal margin slightly cleft. *Coloration*. Cream-colored frontally, green dorsally, unmarked. Antenna with scape sometimes bearing reddish-brown longitudinal lateral stripe; pedicel unmarked; flagellomeres pale, with four transverse rows of dark setae. Maxillary, labial palpi entirely cream-colored. Venter cream-colored, unmarked.

**Thorax** (Figs 28A, B, 28E, 29C, D). *Coloration*. Dorsum with pronotum entirely green, bearing short red stripe on anterolateral margin; mesothorax, metathorax green with diffuse, cream mesal stripe. Pleural regions, legs white to cream, without markings; tarsal claws dark brown, slender, with deep, narrow cleft, quadrate base.



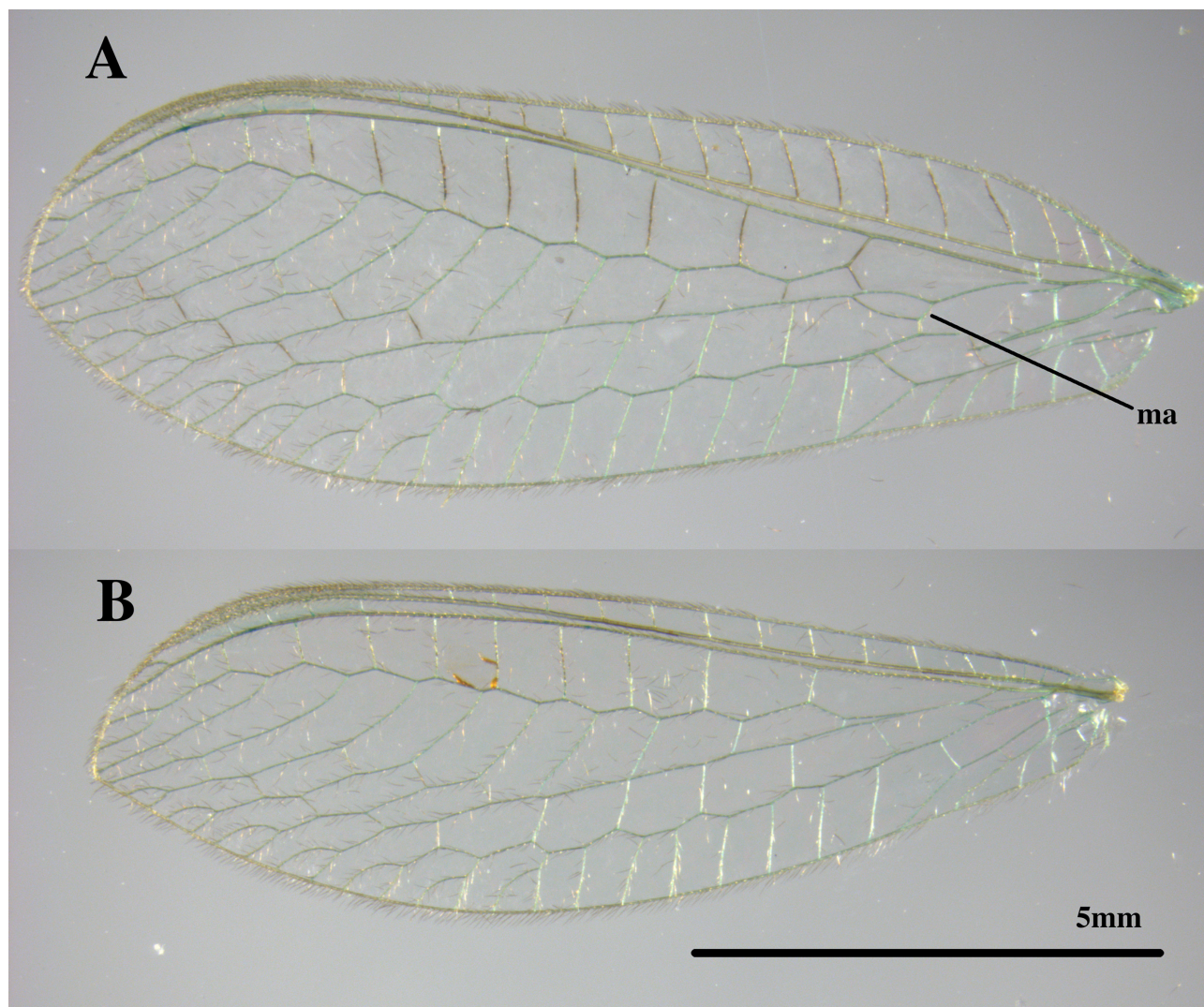
**FIGURE 29.** *Ceraeochrysa silvanoii* (Navás), Minas Gerais, Brazil, male (LRRP). A. Habitus, lateral. B. Head, frontal. C. Head, thorax, and base of abdomen, lateral. D. Head, thorax, dorsal.

**Wings** ( $n=3$ ; Fig. 30). Forewing length 10.5–12.5 mm, maximum height 3.5–4.2 mm; height gradually increasing from base well beyond midpoint; maximum height within distal quart; anterior margin sloping upward basally, relatively straight beyond basal quadrant; apex rounded. Costal area slightly expanded only over basal quarter of wing, narrowing thereafter; tallest costal cell (#5–6)  $\sim 0.18\text{--}0.22x$  maximum height of wing. Subcosta, Radius almost straight basally, curving in distal quadrant; most subcostal veinlets, radial crossveins straight to slightly curved. Nine to ten closed radial cells, height of tallest radial cell (#5–6 from base) 1.1–1.4x breadth. First intramedian cell ovate, elongate, with length of basal vein (*ma*) very variable (0.04–0.45 mm); breadth of *im1* 3.2–19.5x height (at *ma*),  $\sim 0.56\text{--}0.58x$  breadth of *m3*; two rows of gradate veins  $\sim$ regularly stepped, roughly parallel to each other, with three to four inner veins, six outer; four *b* cells, four *b'* cells; three intracubital cells, distal one open, *icul* slightly shorter than either *icu2* or *icu3*. Vein A1 forked. *Coloration*. Forewing membrane clear, slightly hyaline,

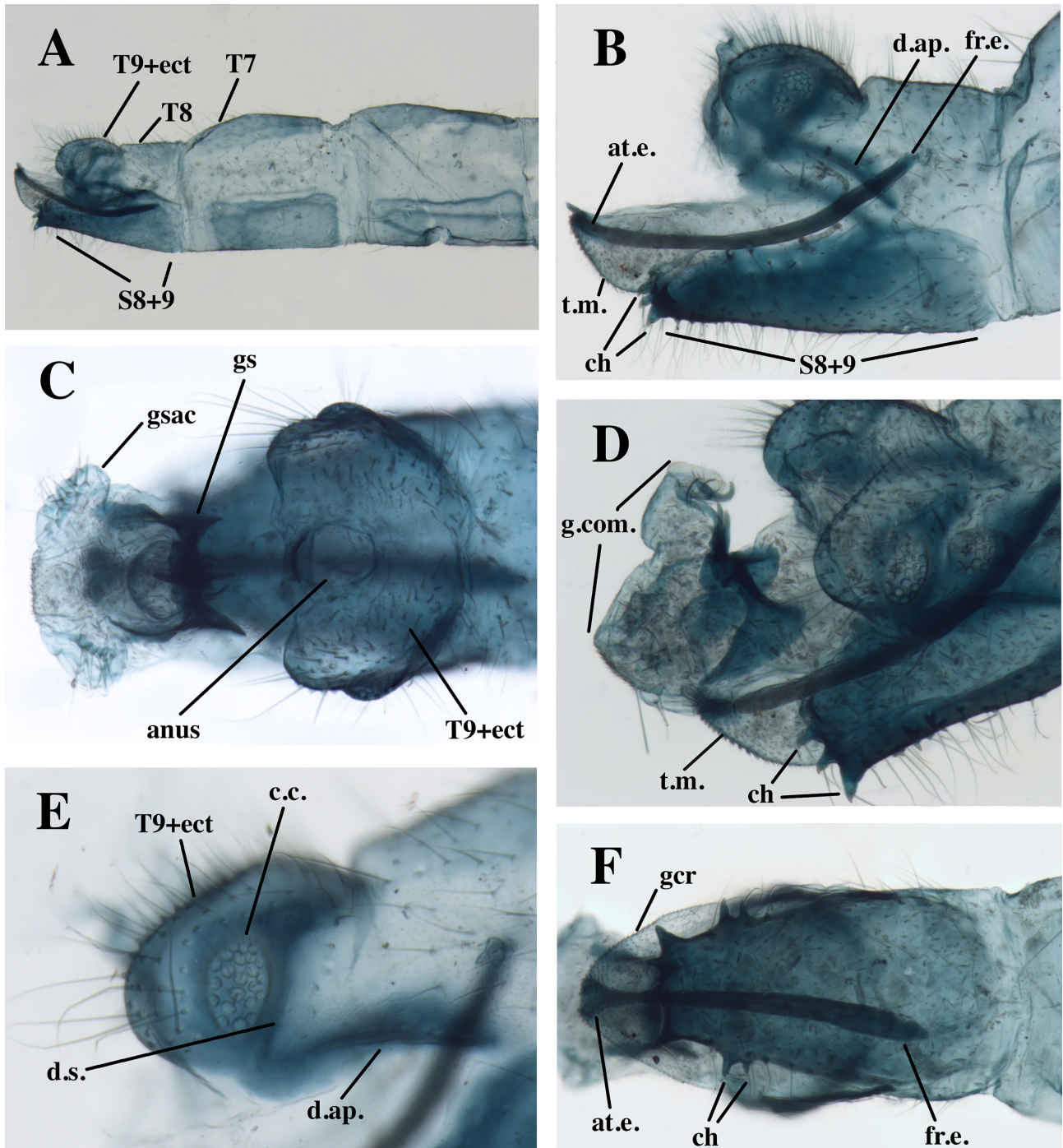
without suffusion around crossveins; stigma transparent to very slightly opaque. Venation green (pale when faded), except basal region of subcostal veinlets, radial crossveins, most gradate veins light brown or with midsection light brown.

Hindwing narrow, with apex acute; length 9.2–10.9 mm, height 2.8–3.5 mm. Ten to twelve closed radial cells; base of M merged with R, two rows gradate veins with three inner, four to five outer; three *b* cells, four *b'* cells, *t* cell present. *Coloration*. Stigma transparent or very slightly opaque; venation green throughout.

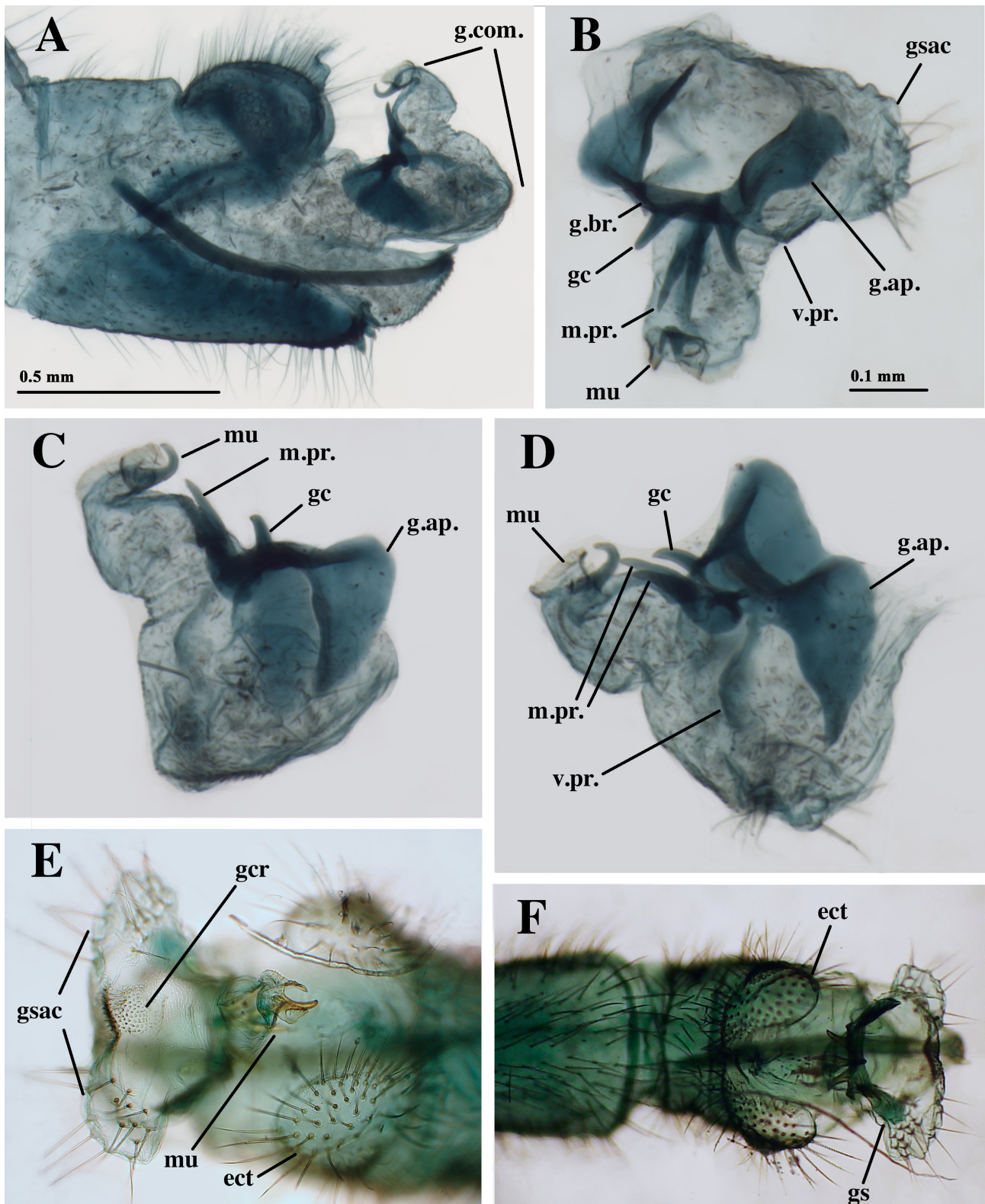
**Abdomen.** *Coloration*. Green, with cream middorsal stipe at least on anterior segments. **Male** (n=2; Figs 27, 29A, 31, 32). Tergites roughly quadrate in dorsal view, longer than tall. Ninth tergite+ectoproct large, rounded into two apical lobes on dorsal terminus; lobes widely separated, not fused dorsally, bearing dense, elongate, slender setae; ventral margin with dorsal apodeme having slight downward curve, extending along lower margin of ectoproct below distal one-third of T8, with dorsal spur extending along basal margin of callus cerci. Callus cerci oblong (height, 0.13–0.15 mm; width, ~0.09–0.10 mm), with ~25 trichobothria. Sternites longer than tall, with long, straight, setae, no microtholi; ratio length to height (lateral view): S6 = 2.8–3.0:1, S7 = 2.9:1. Fused S8+9, with slight darkening, dorsal indentation at suture; anterior margin almost as tall as adjoining distal margin of S7; dorsal margin sloping slightly through midregion of sternite, descending abruptly near terminus; ventral apodeme along dorsal margin of S8+9. Distolateral margin of S9 with setae arising from enlarged setal bases appearing as conical spurs, distal four to six setal bases particularly large, others tapering in size anteriorly; heavy gonocristae-covered membranous pouch surrounding distal end of gonapsis attached above terminus. Gonapsis extremely long, extending from near base of A8 well beyond terminus of S9; slender, curved throughout, with free (anterior) end rounded. Spiracular openings small, height 0.15 mm, width 0.10 mm; atria not enlarged.



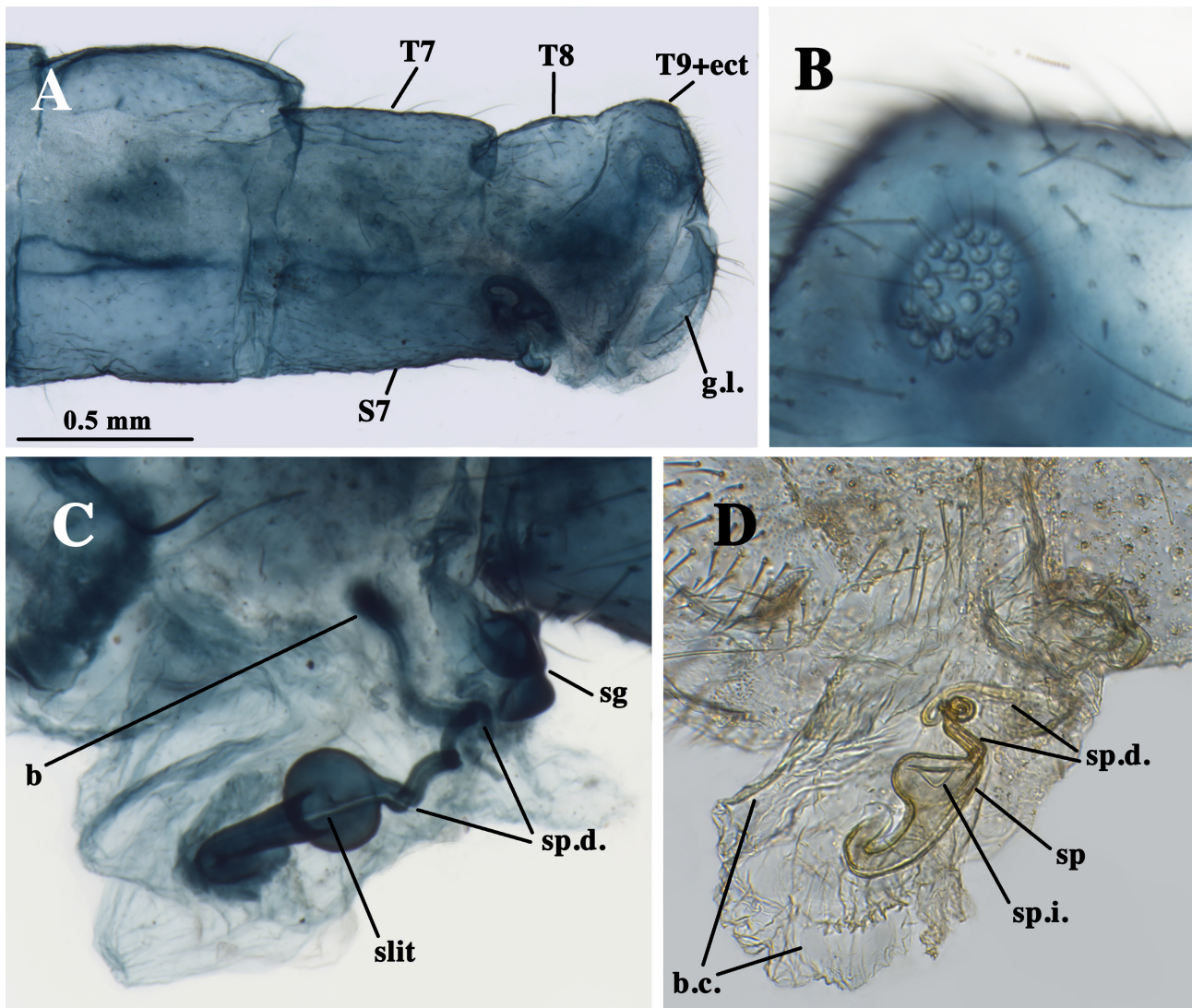
**FIGURE 30.** *Chrysopa silvanoii* (Navás). Wings, Tucumán, Arg., male (MCT). A. Forewing. B. Hindwing. Scale applies to both A and B. Abbreviation: **ma** basal section of the MP in the first intramedial cell.



**FIGURE 31.** *Ceraeochrysa silvanoii* (Navás), male abdomen, Tucumán, Argentina (MCT). A. Abdomen, lateral. B. Terminal abdominal segment, with genitalia removed, gonapsis present, lateral. C. Tip of abdomen with everted gonarcal complex, dorsal. D. Tip of abdomen with everted gonarcal complex, lateral. E. Ninth tergite + ectoproct, lateral. F. Fused eighth and ninth sternites, ventral. Abbreviations: **at.e.** attached end of gonapsis; **ch** enlarged spur-like chalazae; **c.c.** callus cerci; **d.ap.** dorsal apodeme; **d.s.** dorsal spur of dorsal apodeme; **fr.e.** free end of gonapsis; **gcr** gonocristae; **gs** gonarcus; **gsac** gonosaccus; **g.com.** gonarcal complex; **S8+9** fused eighth and ninth sternites; **t.m.** terminal membrane, in this case, pouch-like and with gonocristae; **T7**, **T8** seventh and eighth abdominal tergites; **T9+ect** fused ninth abdominal tergite and ectoproct.



**FIGURE 32.** *Chrysopa silvanoi* (Navás), male genitalia, Tucumán, Arg. (MCT). A. Terminus with genitalia everted, lateral. B. Gonarc complex, dorsal. C. Gonarc complex, lateral. D. Gonarc complex, frontolateral. E. Gonarcus, everted, distodorsal. F. Gonarcus, everted, dorsal. Scale on B applies to B, C, and D. Abbreviations: **ect** ectoproct; **gc** gonocornu; **gs** gonarcus; **gcr** gonocristae; **gsac** gonosaccus; **g.ap.** gonarc apodeme; **g.br.** gonarc bridge; **g.com.** gonarc complex; **mu** mediuncus; **m.pr.** mediuncal process; **v.pr.** ventral process of gonarcus.



**FIGURE 33.** *Chrysopa silvanoi* (Navás), female abdomen, Tucumán, Arg. (MCT). A. Abdomen, lateral. B. Callus cerci, lateral. C. Spermathecal and bursal complex, dorsal. D. Spermathecal and bursal complex, lateral. Abbreviations: **b** brushy tip of spermathecal duct; **b.c.** bursa copulatrix; **g.l.** gonapophysis lateralis; **S7** seventh abdominal sternite; **sg** subgenitale; **sp** spermatheca; **slit** opening along dorsum of spermatheca; **sp.d.** spermathecal duct; **sp.i.** spermathecal invagination; **T7**, **T8** seventh and eighth abdominal tergites; **T9+ect** fused ninth abdominal tergite and ectoproct.

Gonarc complex elaborate. Gonarc bridge fairly straight, robust, bearing pair of gonarc apodemes distolaterally, pair of gonocornua mesolaterally, pair of ventral processes distal to gonocornua. Gonocornua heavily sclerotized, slender, rounded, extending from heavy triangular base, bending outward, curving downward. Gonarc processes elongate, narrow, extending downward from anterodistal corner of gonarc bridge at junction of gonarc apodemes, not articulated with gonarc bridge or apodemes. Gonarc apodemes large, rounded, with lateral margins wavy, lower margin angular (lateral view). Mediuncus with sclerotized base and pair of elongate, tapered processes, extending outward from below gonarc bridge, bearing large, membranous pouch below; pouch extending from below tips of gonarc projections, with upper margin of pouch forming sclerotized belt that articulates distally with terminal structure having pair of lightly sclerotized lateral flanges and well sclerotized mesal hook. Pouch below mediuncus large, confluent with gonosaccus. Gonosaccus large, eversible, with field of gonocristae mesally, pair of lateral lobes each covered with dense field of well sclerotized chalazae bearing robust, elongate, tapered gonosetae. Hypandrium internum not found.

**Female** (n=2; Fig. 33). Tergites, sternites quadrate, with relatively straight margins (lateral view), angular corners. S6 length ~2.0–2.5x height. Spiracles small, round (diameter, 0.02–0.03 mm), atria not enlarged. Tergites, sternites, pleural regions (A6–A8), gonapophysis lateralis, with relatively long, slender setae throughout. Ninth



tergite+ectoproct (lateral view) with proximal margin tapered, extending well below T8; distal margin well below level of gonapophysis lateralis. Seventh sternite (lateral view) roughly rectangular, length ~2.5x height, dorsal margin not sloping except over distal quadrant, terminus steeply sloped. Callus cerci slightly taller than broad (height 0.15–0.16 mm; width 0.11–0.13 mm), with 27–28 trichobothria. Gonapophysis lateralis oblong, tall, narrow (height ~0.4 mm; width ~0.1 mm). Subgenitale small, consisting of relatively narrow, somewhat sclerotized base and short extension with narrow bilobed terminus; base with curved U-shaped bend of spermathecal duct within. Bursa copulatrix relatively large, covering entire spermathecal complex, consisting of light, clear membrane with transverse folds, connected directly to spermatheca and spermathecal duct. Bursal glands not discerned. Spermatheca funnel-shaped, with sharp U-shaped curve at tip; diameter at mouth 0.11–0.12 mm; length (mouth to end of sclerotized section beyond U-shaped curve) 0.28–0.29 mm; spermathecal invagination moderately large, diameter ~0.07 mm, depth ~0.07 mm; entire dorsal margin with elongate narrow slit opening directly to bursal copulatrix, slit continuing from dorsal margin of spermathecal mouth onto spermathecal duct. Spermathecal duct length ~0.27 mm, relatively slender at base (0.01 mm wide), with coil before subgenitale, then two right-angle bends within subgenitale, returning to abdominal cavity attached to bursa; basal ~one-third smooth, well sclerotized, without setae; middle third narrower; distal section expanded, with heavy setation. Colleterial complex, transverse sclerification not discerned.

**Specimens examined** (in addition to types listed above). **ARGENTINA.** *Corrientes*: Santa Ana, 8-V-1971, C. Porter & L. Stange (1♂, MCT); *Jujuy*: Ledesma/F. Yapeyu, 24–27/IV/01, E. G. Olazo y etrous (1♂, MCT); *Tucumán*: Villa Nougues, 2651'00"S, 6523'00"W, M. J. Tauber, C. A. Tauber (15 lab reared, Tauber Lot 2011:007, MCT); Horco Molle, Parque Sierra San Javier, el. 700 m 28-III-1975, Lionel A. Stange (2♂, MCT). **BOLIVIA.** *Santa Cruz*: Rio Piray -cerca de Santa Cruz de la Sierra, 7-VII-1972, C. Porter & L. Stange (1♂, MCT). **BRAZIL:** *Bahia*: Camacan, Reserva Serra Bonita, 800m, X-3 to 7-2005, G. S. Albuquerque, M. J. Tauber, C. A. Tauber Expedition, October 2005 (1♀, 1♂, MCT). *Distrito Federal*: CENARGEN Farm nr. Núcleo Bandeirante, X-22-96, M. J. Tauber, C. A. Tauber (1♂, MCT); Planaltina, EMBRAPA-CAPC, VI-24-96, M. J. Tauber, C. A. Tauber (1♀, MCT). *Minas Gerais*: Mata do Baú, Barroso, 12-VI-2010, M. Silva (1♂ LRRP); *idem.*, 04-XI-2010, M. Silva (1♀ LRRP); *idem.*, 17-II-2011, M. Silva (1♀ LRRP); Lavras, UFLA, small forest fragment, X-13-05, G. S. Albuquerque, M. J. Tauber, C. A. Tauber Expedition, October 2005 (4♀, 6♂, 9 lab reared, Tauber Lot 2005:027, MCT); *idem.*, UFLA, coffee, X.12-2005, G. S. Albuquerque, M. J. Tauber, C. A. Tauber Expedition, October 2005 (1♀, 1♂, 8 lab reared, Tauber Lot 2005:027, MCT); Parque Ecológico Cachoeiras do Rio Bonito, X-14-2005, G. S. Albuquerque, M. J. Tauber, C. A. Tauber Expedition, October 2005 (3♀, 2♂, MCT). *Rio de Janeiro*: Ilha Grande, V/01/02, Albuquerque (1♂, MCT); Santa Maria Madalana, Parque Est. Desengano, Terras Frias, 15-V-2002, M. J. & C. A. Tauber, A. J. & P. J. Tauber, G. S. Albuquerque, E.S. Silva (2M, MCT); *idem.*, X-28-2003, G. S. Albuquerque, M. J. Tauber, C. A. Tauber Expedition (1♀, 10♂, 3 lab reared, MCT); *Rio Grande do Sul*: Cachoeira do Sul, São Nicolau, I-16-07, G. S. Albuquerque, M. J. Tauber, C. A. Tauber (9♀, 10♂, 11 lab reared, Tauber Lot 2007:011, MCT); Maquin, Sítio de Amizade, I-9-07, 2932'16S, 5014'50"W, G. S. Albuquerque, M. J. Tauber, C. A. Tauber (1♂, 1♀, MCT).

**Known distribution.** **Argentina:** *Corrientes*, *Tucumán*; **Bolivia:** *Cochabamba*, *Santa Cruz*; **Brazil:** *Bahia*, *Distrito Federal*, *Minas Gerais*, *Rio de Janeiro*, *Rio Grande do Sul*; **Colombia:** *Cundinamarca*.

## Part 6. *Ceraeochrysa paraensis* Sosa, New Species

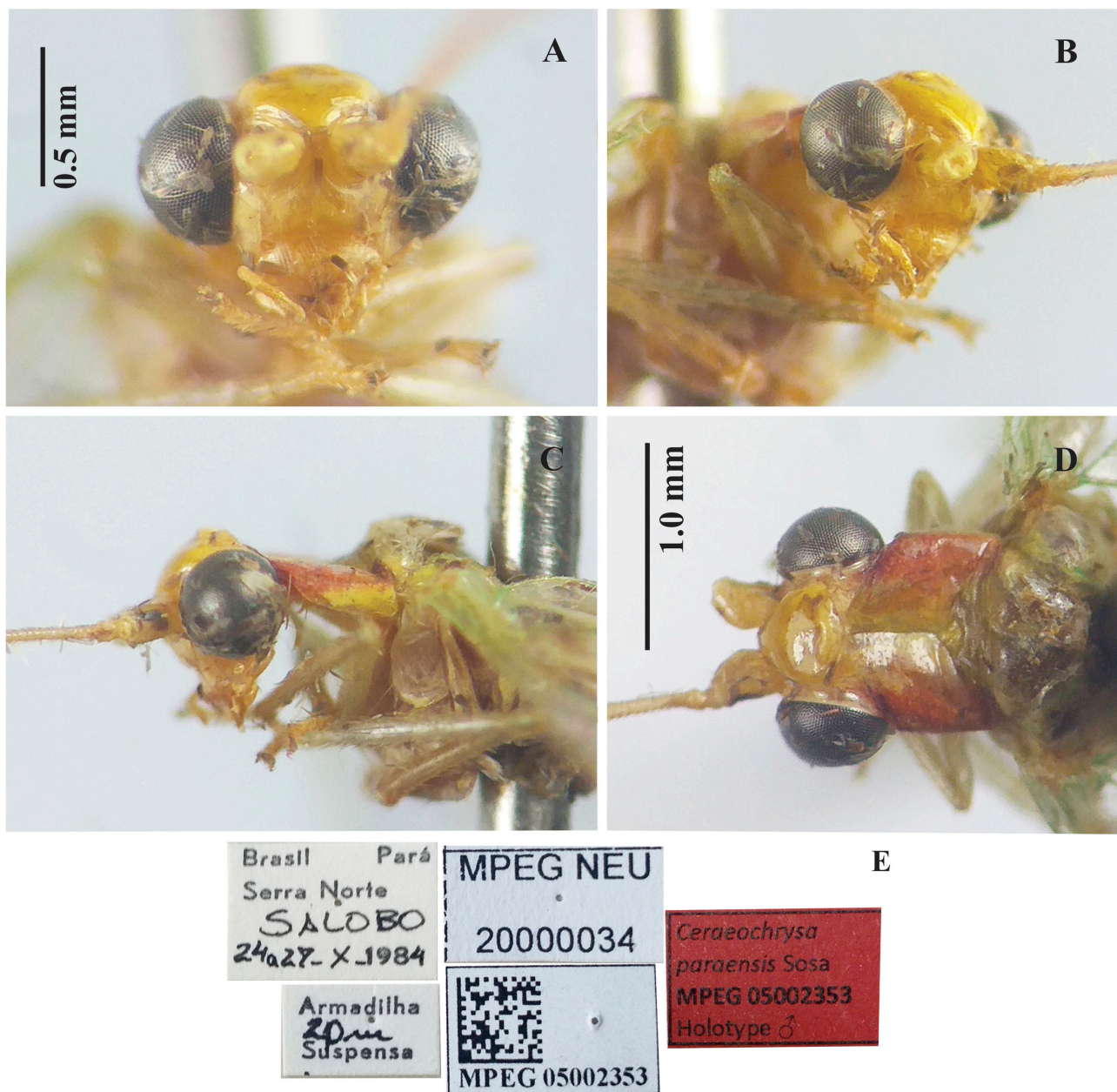
Figs 34–37

**Type material.** Holotype, MPEG, male (Figs 34–36), abdomen cleared, in vial with glycerine; collection data: Brazil, Pará, Serra Norte (Serra dos Carajás) Parauapebas, Salobo Ribers [~605'21.64 S-5010'34.97 W, 575m], with suspended trap 20 m high. Paratype, MPEG, female (Fig. 35), abdomen cleared, in vial with glycerine; collection data: Brazil, Pará, Belém, Ananindeua, Área de Pesquisas Ecológicas do Rio Guamá (APEG) [~126'11 S—4823'30 W, 32m], with suspended trap 1.6 m high. See Gomes *et al.* (2007) and Rafael & Gorayeb (1982) for information on the area (APEG) and the trapping method, respectively.

**Etymology.** The species is named to acknowledge the citizens of the Amazonian state of Pará, who warmly welcomed me (FS) as a brother and who strive to preserve the region's enormous diversity of cultures, ecosystems, flora, and fauna.

**Diagnosis.** This species is characterized by an unmarked head with pale palpi; wide lateral stripes on the pronotum; large, triangular gonocornua almost completely covering the mediuncus (dorsal view); small gonapsis with pair of lateral wings and a flagellar-like process near the apex; and a gonosaccus heavily covered with

gonocristae. This set of features is unique within *Ceraeochrysa*. Some specimens, especially faded ones, can be confused with other species if only external features are examined. For accurate identification, specimens (male and female) require examination of the genitalia. It should be noted that the triangular gonocornua that almost cover the mediuncus of *Ce. paraensis* are distinct from the dorsal hood that originates from the gonarcus, not the gonocornua, of the *Ce. everes*-species group; in this group the dorsal hood covers both the inflated gonocornua and the mediuncus.



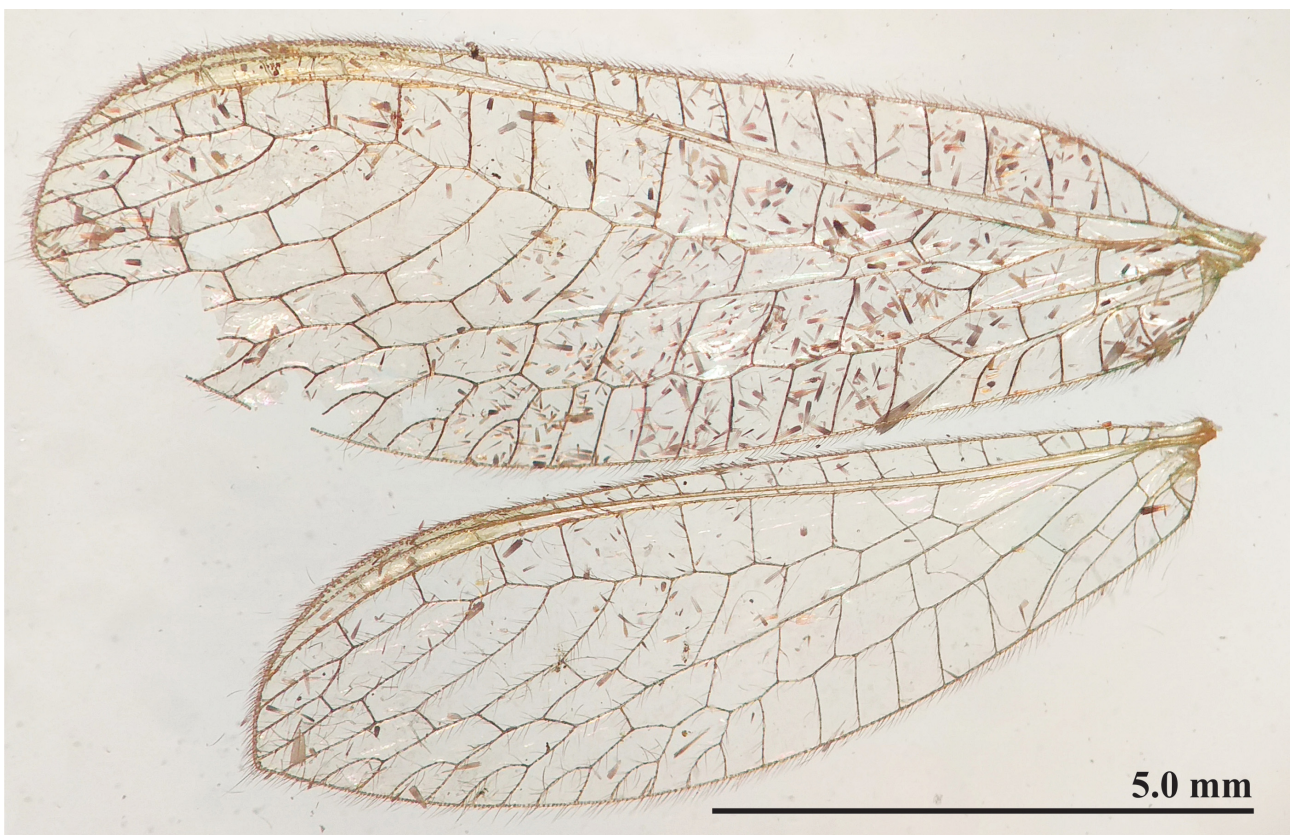
**FIGURE 34.** *Ceraeochrysa paraensis* sp. nov., holotype, male (MPEG). A. Head, frontal. B. Head, frontolateral. C. Head, thorax, lateral. D. Head, prothorax, dorsal. E. Labels.

**Head** (n=2; Fig. 34). Width (dorsal, including eyes) 1.22–1.30 mm; ratio head width: eye width = 2.4:1; head width (frontal, including eyes) 1.24–1.30 mm. Vertex raised, rounded throughout, with small upward fold posteriorly; surface smooth, without setae. Frontal: distance (straight-line) between tentorial pits 0.30–0.33 mm; length of frons (mid-antenna—midway between tentorial pits) ~0.31–0.33 mm; clypeus ~0.18–0.20 mm long (midway between tentorial pits—tip of clypeus). Frons smooth, shiny throughout, with convex transverse fold along frontoclypeal margin. Clypeal surface lightly striated transversely. Labrum with proximal margin slightly convex mesally; distal margin with cleft. Antennal length unknown. **Coloration** (specimen faded). Head entirely pale, unmarked. Antenna pale, with dark setae. Maxillary and labial palp pale. Venter cream, unmarked.

**Thorax** (n=2). Pronotum length 0.6–0.8 mm, width 0.9–1.0 mm, pale green with broad red stripe laterally. Meso-, metanota olive green. Pleural areas pale without markings. Legs pale without markings; tarsi amber tinged; tarsal claws dark amber.

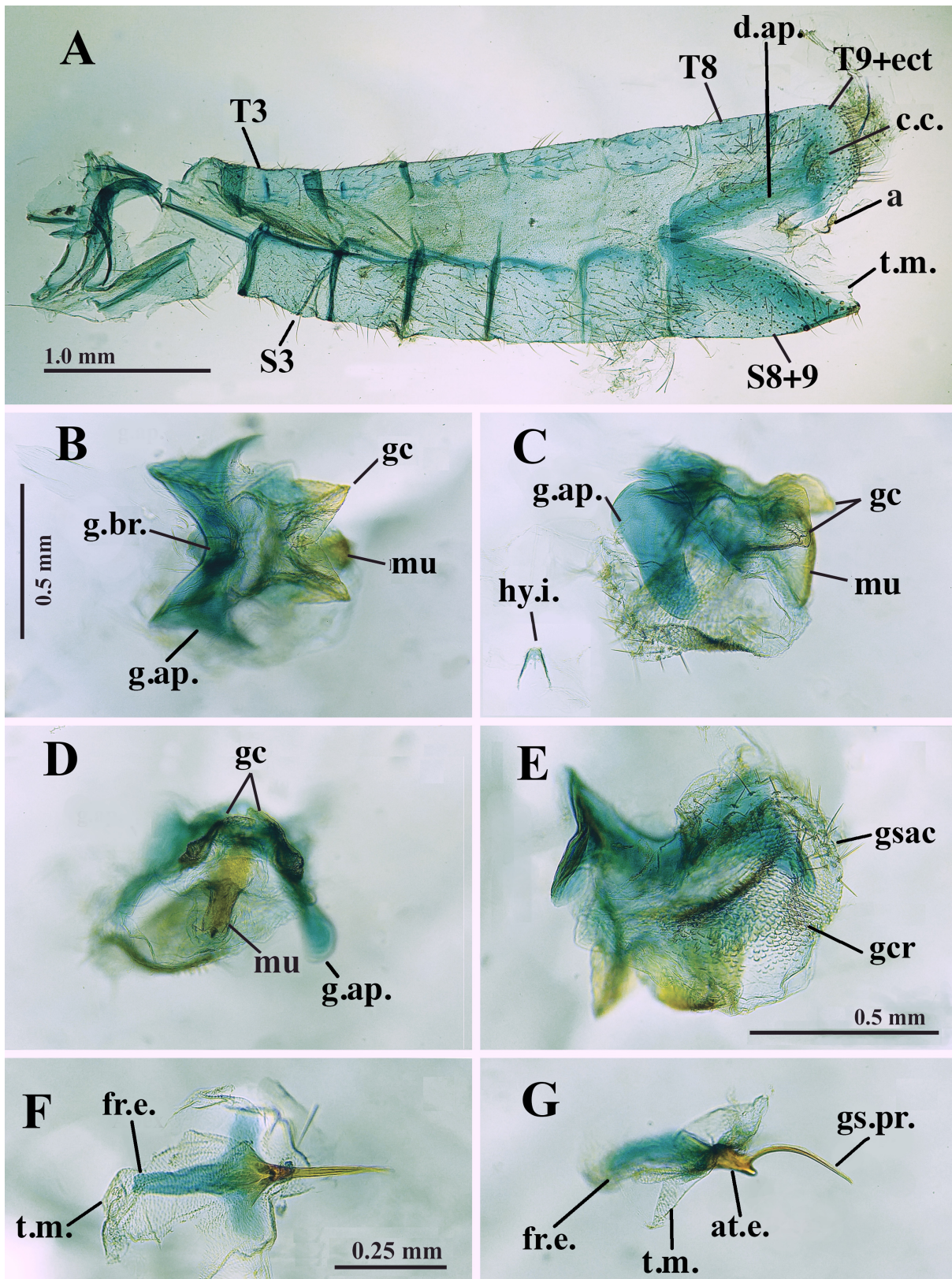
**Wings** (n=2; Fig. 35). Forewing length 10.9–11.4 mm, maximum height 3.5–3.9 mm, with wing heights at basal, mid, and distal points 2.6–2.8, 3.2–3.6, and 3.4–3.7 mm respectively; anterior margin rising over basal 1/4th of costal margin, relatively straight thereafter; apex broad, rounded. Costal area broad over basal one-half of wing, tapering thereafter; tallest costal cell (#4–5) height  $\sim 0.18$ – $0.20$ x maximum height of wing. Subcosta, Radius fairly straight; most costal veinlets straight or very slightly curved, slanted; radial crossveins mostly straight. Ten closed radial cells, height of tallest radial cell (#4) 0.84–0.98 mm. First intramedian cell ovate, breadth  $\sim 0.56$ – $0.60$ x breadth of third medial cell; two rows of gradate veins regular, roughly parallel, with four inner, six outer veins. Four *b* cells, four *b'* cells. Three intracubital cells, distal one open, *icu1* shorter than either *icu2* or *icu3*; 1A forked. **Coloration.** Membrane clear; stigma transparent. All longitudinal veins green except base of RP dark brown; all crossveins green or pale except gradates, m-cu2, and bifurcation of *icu3* dark; alar setae brown.

Hindwing narrow, with apex acute; length 9.6–9.8 mm, height 2.8–3.0 mm; nine to ten radial crossveins; base of M merged with R; *t* cell present; two rows gradate veins, with two inner, five to six outer; four to five *b* cells; three to four *b'* cells. **Coloration.** All veins green except outer gradate series black.

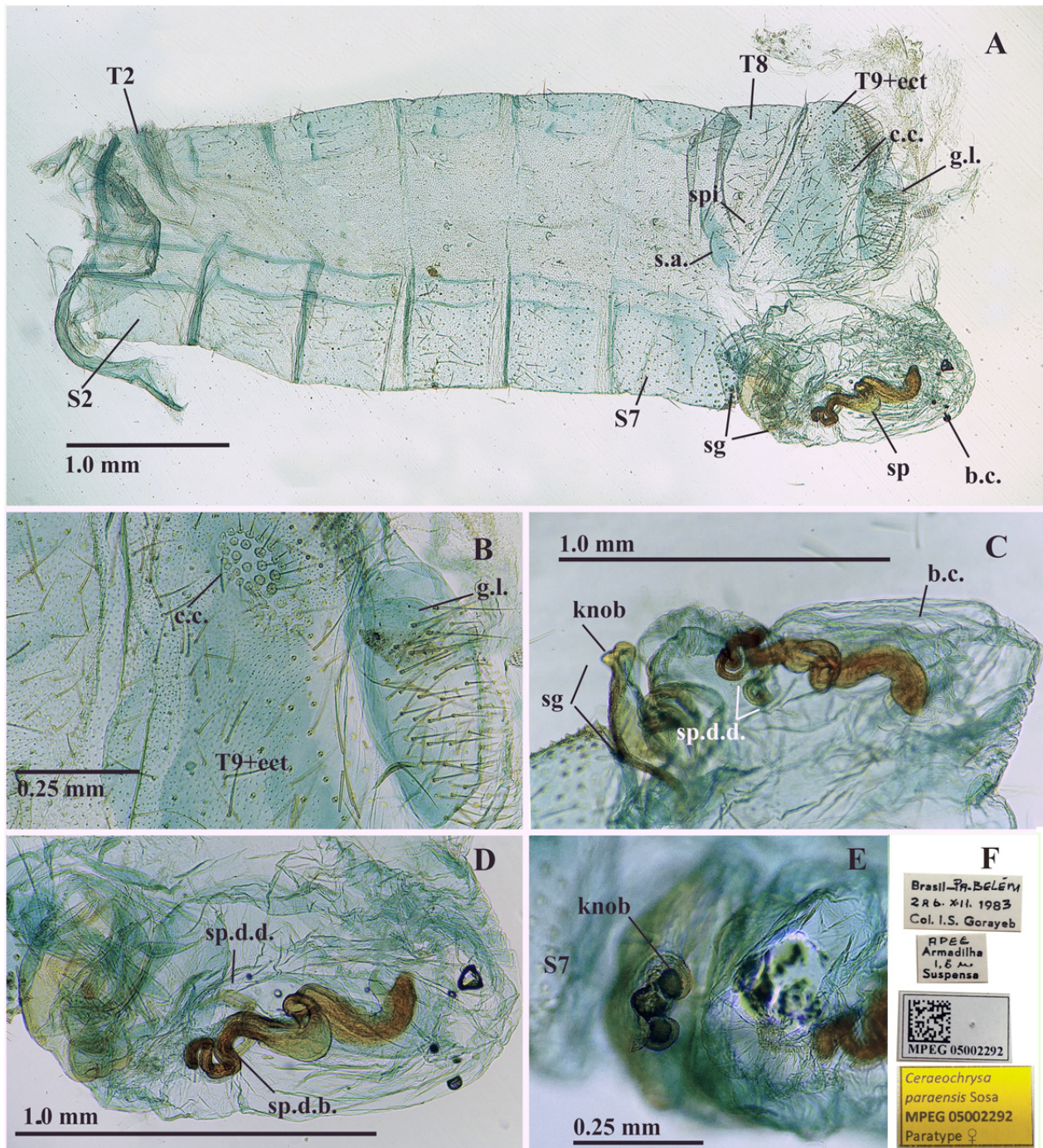


**FIGURE 35.** *Ceraeochrysa paraensis* sp. nov., holotype, male (MPEG), wings.

**Abdomen—Male** (Fig. 36). Tergites, sternites with long, straight setae; ectoproct with dense setae posteriorly. Tergites longer than tall; S3–S6 almost as tall as long, ratio length to height  $\sim 1:1$ ; S7 slightly longer, ratio length to height 1.3:1. Spiracular atria not enlarged; diameter of spiracle on A8  $\sim 1.7$ x larger than diameters of spiracles on A3–A7; T9+ectoproct with dorsal apodeme straight, lightly sclerotized, extending along lateral edge of elongate ectoproct, from proximal side of callus cerci well into seventh segment. Callus cerci small, oblong, 0.16 mm tall,  $\sim 0.10$  mm wide, with  $\sim 28$  robust, elongate trichobothria. Area between T9+ectoproct and S8+9 with atrium and conspicuous field of gonocristae. Fused S8+9 without suture; ratio length to height (lateral view) 0.6:1; dorsal margin very slightly sinuous, tapering throughout to acute apex; ventral apodeme diffusely sclerotized throughout, deeper than one-half depth of sternite. Terminus of S9 bearing field of long setae arising from large bases.



**FIGURE 36.** *Ceraeochrysa paraensis* sp. nov., holotype, male (MPEG). A. Abdomen, lateral. B–E. Gonarcal complex dorsal, lateral, frontal and ventral, respectively. F, G. Gonapsis dorsal, lateral. Abbreviations: **a** atrium below ventral spur of dorsal apodeme; **c.c.** callus cerci; **d.ap.** dorsal apodeme; **gc** gonocornu; **gsac** gonosaccus; **g.ap.** gonarcal apodeme; **g.br.** gonarcal bridge; **gs.pr.** rigid process of gonapsis, in this case flagellum-shaped; **hy.i.** hypandrium internum; **mu** mediuncus; **S3** third abdominal sternite; **S8+9** fused eighth and ninth sternites; **t.m.** terminal membrane; **T3**, **T8** third and eighth tergites; **T9+ect** fused ninth abdominal tergite and ectoproct. Scale in B applies to B, C, and D; Scale in F applies to F and G.



**FIGURE 37.** *Ceraeochrysa paraensis* sp. nov., paratype, female (MPEG). A. Abdomen; B. Callus cerci and gonapophysis lateralis. C, D. Spermatheca, ventral and dorsal respectively. E. Subgenitale, distal. F. Labels. Abbreviations: **b.c.** bursa copulatrix; **c.c.** callus cerci; **g.l.** gonapophysis lateralis; **knob** bilobed distal process of subgenitale; **S2**, **S7** second and seventh sternites; **s.a.** small, smooth sclerotized area; **sg** subgenitale; **sp** spermatheca; **spi** spiracle; **sp.d.b.** basal section of spermathecal duct; **sp.d.d.** setose distal section of spermathecal duct; **T2**, **T8** second and eighth tergites; **T9+ect** fused ninth abdominal tergite and ectoproct.

Gonarcus V-shaped, with apodemes oblong (lateral view), attached perpendicularly to ends of bridge. Gonocornua triangular with acute, lamellate tips almost completely covering mediuncus (dorsal view). Mediuncus heavily sclerotized, long, narrow, curved distally into beak-like tip, bearing small lateral lobes. Gonosaccus large, with dense field of long setae extending from robust setal bases adjacent to large posterolateral field of conspicuous scale-like gonocristae. Gonapsis ~ length of S8+9, entirely covered with spinulate membrane, with pair of flat

lateral wings near attached end, with long, thin, flagellar-like process extending from dorsal surface immediately before apex. Hypandrium internum small, triangular; comes short, thin, straight (dorsal view).

**Female** (Fig. 37). Tergites longer than tall; sternites slightly taller than long, with dorsal margins slightly convex (lateral view). Tergites, sternites (except A8, tip of S7) covered with sparse, scattered setae, with pleural regions densely covered by microtrichiae, short thin setae. A8 densely covered with thin setae; pleuron bearing smooth sclerite, posterior to spiracle. S7 with distal ventral margin densely covered by short setae arising from conspicuous setal bases. T9+ectoproct and gonapophysis lateralis densely covered with relatively short, thick setae throughout. S7 (lateral view) ~1.3x longer than tall, with dorsal margin sloping slightly. Callus cerci slightly taller than broad (0.16 mm tall, 0.11 mm wide), with approximately 26 trichobothria. Gonapophysis lateralis tall (height ~0.6 mm). Subgenitale of moderate size, consisting of relatively narrow, somewhat sclerotized base and distal bilobed, cordiform extension, with round knob at tip; base with wavy, folded texture ventrally, merging with bursa copulatrix dorsally, U-shaped spermathecal duct attached within. Bursa copulatrix long, saccular with multiple folds, completely covering spermatheca. Bursal glands not found. Spermatheca long, cylindrical (~0.5 mm long), with midsection tightly curved; entire dorsal margin with elongate, well sclerotized slit opening to bursal copulatrix. Spermathecal invagination not obvious. Spermathecal duct with wide base, tapering distally, having multiple U-shaped curves.

**Specimens examined** (in addition to types listed above). None.

**Known distribution.** Brazil: *Pará*.

## Part 7. Updated key to *Ceraeochrysa* species.

The last and only key that attempted comprehensive coverage of the *Ceraeochrysa* species was published by Freitas *et al.* (2009). During the eleven years since then, new species have been described, species have been moved into or out of *Ceraeochrysa*, males and females of species previously known from only one sex have been associated, and errors have been corrected. Here, to help improve efficiency and accuracy in the identification of *Ceraeochrysa* species, we provide an updated version of the original key to *Ceraeochrysa*. This key includes all species described since 2009, and it incorporates all taxonomic changes relevant to the genus since that time. For most species, descriptions of females are either lacking or without sufficient detail. Thus, the key relies heavily on male terminalic characters, almost to the exclusion of female terminalia because comparative data are not available. Such a male-biased key yields two major detriments. First, identification of females, even those that are described, can be difficult unless they are associated with a male. Second, the key omits several species known only from females, namely *Ce. castilloi* (Navás), *Ce. conformis* (Rambur), *Ce. dolichosvela* Freitas & Penny, *Ce. indicata* (Navás); *Ce. friebrigi* (Navás), *Ce. lateralis* (Guérin-Méneville), and *Ce. reducta* (Banks). Several other species currently in synonymy or designated as *nomina dubia* [*Ce. josephina* (Navás) and *Ce. adornata* (Lacroix)] are also in need of taxonomic investigation. We hope that this key helps provide an impetus for including female characters in systematic studies of the genus.

\*For names marked with an asterisk, see footnotes below the key.

1.	Pronotum with one or more pairs of lateral spots . . . . .	2
1'	Pronotum with pair of red or brown lateral stripes or no stripe . . . . .	11
2 (1).	Pronotum with single pair of lateral spots . . . . .	3
2'.	Pronotum with two pairs of lateral spots . . . . .	6
3 (2).	Forewing with inner and outer gradates, crossveins 1cua-cup and 2cua-cup, and 3A darkly margined; pronotum with lateral spots on caudal margin; male with mediuncus elongate, tapered acutely . . . . .	4
3'.	Forewing with gradates and other crossveins not margined; pronotum with lateral spots at midlength; male with mediuncus short and bifid or trifid . . . . .	5
4 (3).	Gonocornu straight-sided, tapered . . . . .	<i>Ce. tauberæ</i> Penny
4'.	Gonocornu twisted, contorted . . . . .	<i>Ce. angusta</i> Freitas & Penny
5 (3').	Scape with dorsum entirely brown; T9+ectoproct with dorsal apodeme having short, straight ventral spur that tapers ventrally; gonarcus bearing hood above mediuncus . . . . .	<i>Ce. costaricensis</i> Penny
5'.	Scape pale, with small, discrete spot on dorsum; T9+ectoproct with dorsal apodeme having long ventral spur that recurves distally; gonarcus without hood above mediuncus . . . . .	<i>Ce. discolor</i> (Navás)
6 (2').	Scape pale, with dorsoapical black mark; flagellum black . . . . .	<i>Ce. adynatos</i> (Freitas & Penny), <i>comb. nov.</i>
6'.	Scape may be colored, but without black marks; flagellum pale. . . . .	7
7 (6').	Forewing with base of distal intracubital cell (1cu3) darkly shaded and sometimes swollen with small, heavily marked, triangle at base . . . . .	8

7'	Forewing with base of 1cu3 lacking the above shading, markings, and swelling	9
8 (7)	Mesoscutum with pair of dark spots; mediuncus undivided, extending outward from gonarcus or with at most a slight angle; lateral apodemes of gonarcus with long, slender basal projections	
	..... <i>Ce. elegans</i> Penny, <i>Ce. nigripedis</i> Penny and <i>Ce. tacanensis</i> Cancino-López & Contreras-Ramos*	
8'	Mesoscutum without dark spots; mediuncus bifid apically, curved well below gonarcus; lateral apodemes not as above	
	..... <i>Ce. angulata</i> (Navás)	
9 (7')	Pronotal spots with discrete borders; S8+9 with bifurcate apex, with two spiny apical knobs between base of gonapsis and tip of S8+9	<i>Ce. paraguaria</i> (Navás)
9'	Pronotal spots with diffuse borders; S8+9 with apex undivided, without spiny knobs below base of gonapsis	10
10 (9')	Scape with red dorsal stripe; gonapsis lacking lateral lobes	<i>Ce. inbio</i> Penny
10'	Scape without dorsal stripe; gonapsis with lateral lobes	<i>Ce. defreitasi</i> Penny
11 (1')	Scape and toruli red marked throughout	<i>Ce. smithi</i> (Navás)
11'	Scape and toruli not as above	12
12 (11')	Dorsum of scape with two red stripes	47
12'	Dorsum of scape with a single stripe or no stripes	13
13 (12')	Basal flagellar segments pale	14
13'	Basal flagellar segments dark	26
14 (13)	Maxillary palpi dark brown or black	15
14'	Maxillary palpi pale, or at most amber yellow	16
15 (14)	Gena pale	<i>Ce. cubana</i> (Hagen)
15'	Gena with dark spot	<i>Ce. panamensis</i> Freitas & Penny
16 (14')	Scape with stripe	17
16'	Scape without stripe	20
17 (16)	Scape with dorsolateral stripe	18
17'	Scape with middorsal stripe	19
18 (17)	T9+ectoproct undivided distally, terminating in single rounded projection; S8+9 with ventral apodeme having subapical dorsal and ventral spurs, apex rounded, without projections	<i>Ce. valida</i> (Banks)
18'	T9+ectoproct deeply bifurcate, forming two large lateral lobes bearing robust setae terminally; S8+9 with ventral apodeme lacking spurs, apex deeply bilobed, with conical projections	<i>Ce. silvanoii</i> (Navás)
19 (17')	Dorsal apodeme of T9+ectoproct with ventral spur recurved, acutely tipped	
	..... <i>Ce. cincta</i> (Schneider) (Brazilian and Argentinean populations)*	
19'	Dorsal apodeme of T9+ectoproct with ventral spur straight and blunt-tipped	<i>Ce. cornuta</i> (Navás)
20 (16')	Mesoscutum with pair of dark marks on anterolateral margin; gonapsis having pair of rounded, spiny lobes basally	
	..... <i>Ce. michaelmuris</i> Adams & Penny	
20'	Mesoscutum unmarked; gonapsis without pair of spiny lobes basally	21
21 (20')	Head with dark spot along dorsal surface of gena from eyes to anterior tentorial pits	22
21'	Head without dark marks on dorsal surface of gena	23
22 (21)	Gonocornua elongate, slender	<i>Ce. tenuicornis</i> Adams & Penny
22'	Gonocornua short, stubby	<i>Ce. ariasi</i> Freitas & Penny
23 (21')	Forewing with all crossveins dark	<i>Ce. reddyi</i> Freitas & Penny
23'	Forewing with most crossveins green	24
24 (23')	Ectoproct expanded distolaterally into large, curved, setose lobe	<i>Ce. poujadei</i> (Navás)
24'	Ectoproct not as above	25
25 (24')	S8+9 with dorsal margin tapering abruptly through basal half, curving and extending distally thereafter, terminus blunt; gonapsis without wings or projection, base bifurcate	<i>Ce. fairchildi</i> (Banks)
25'	S8+9 with dorsal surface tapering gradually throughout, terminus acute; gonapsis with broad subapical wings laterally, flagelliform projection distally, base undivided	<i>Ce. paraensis</i> Sosa, sp.nov.
26 (13')	Legs dark brown	<i>Ce. nigripes</i> Adams & Penny
26'	Legs pale	27
27 (26')	Scape unmarked	28
27'	Scape with dark dorsal or dorsolateral stripe	30
28 (27)	Terminus of S8+9 truncate apically (lateral view); gonarcus bridge without dorsal hood; gonapsis with recurved, basal scythe-shaped projection near tip on left side	<i>Ce. fulcifera</i> Adams & Penny
28'	Terminus of S8+9 rounded apically (lateral view); gonarcus bridge with dorsal hood; gonapsis not as above	29
29 (28')	Dorsal hood of gonarcus bilobed apically; base of gonapsis with elongate process, curved in almost a full circle	
	..... <i>Ce. squalidens</i> Adams & Penny	
29'	Dorsal hood of gonarcus lacking apical lobes; apex of gonapsis with short, straight, mesal projection	
	..... <i>Ce. torresi</i> Sosa & Freitas	
30 (27')	Scape with entire dorsal surface darkly shaded; base of gonapsis with short curved digitiform process	
	..... <i>Ce. bitacornua</i> Freitas & Penny	
30'	Scape with discrete dorsal or dorsolateral stripes; gonapsis without digitiform process at base	31
31 (30')	Scape with thin, mid-dorsal stripe reaching the external margin of torulus; gonapsis heavily bifurcate basally	
	..... <i>Ce. claveri</i> (Navás)	
31'	Scape with broad, dorsolateral stripe; base of gonapsis not strongly bifurcate	32

32 (31').	Gena with dark markings	33
32'.	Gena entirely pale	37
33 (32).	Apex of S8+9 bearing large, conspicuous chazate setae	<i>Ce. effusa</i> (Navás)
33'.	Apex of S8+9 without conspicuous chazate setae	34
34 (33').	Dorsal apodeme of T9+ectoproct with no external terminal spur	<i>Ce. derospogon</i> Freitas & Penny
34'.	Dorsal apodeme of T9+ectoproct with external terminal spur extending beyond posterior margin of segment	35
35 (34').	Dorsal apodeme of T9+ectoproct with external terminal spur strongly curved upward; gonocornua long, tapered, strongly curved, extending outward above the mediuncus and away from the gonarcus	<i>Ce. curvabilis</i> Freitas & Penny
35'.	Dorsal apodeme of T9+ectoproct with external terminal spur straight; gonocornua short, not tapered, at most only slightly curved away from the gonarcus	36
36 (35').	Dorsal apodeme of T9+ectoproct with prominent external terminal spur; ventral spur gently curving posteroventrally, with distal end terminating only slightly below lower margin of T9+ectoproct; gonocornua not tapered or expanded distally, bending slightly distally; gonarcus with elongate, narrow, lateral projection	<i>Ce. digitata</i> Freitas & Penny*
36'.	Dorsal apodeme of T9+ectoproct with short external terminal spur; ventral spur terminating well below ventral margin of T9+ectoproct; gonocornua obtuse, slightly expanded distally, extending slightly mesally; gonarcus with short, stubby, bifurcate, lateral projection	<i>Ce. achillea</i> Freitas & Penny*
37 (32').	S8+9 strongly upturned distally, with distolateral lobes that receive the ventral spurs of the dorsal apodeme	<i>C. sanchezi</i> (Navás)
37'.	S8+9 without distinct upturn distally, without distolateral lobes	38
38 (37').	Dorsal apodeme of T9+ectoproct with ventral spur projected below margin of ectoproct	39
38'.	Dorsal apodeme of T9+ectoproct without ventral spur or with ventral spur not projected below margin of ectoproct	40
39 (38).	Dorsal apodeme of T9+ectoproct with ventral spur broad, anvil-shaped	<i>Ce. acmon</i> Penny
39'.	Dorsal apodeme of T9+ectoproct with ventral spur curved, hooked	<i>Ce. infausta</i> (Banks)
40 (38').	Gonarcus with dorsomedial hood above mediuncus	41
40'.	Gonarcus without dorsomedial hood	44
41 (40).	Gonarcus hood indented medially; surface between T9+ectoproct and S8+9 without scales	<i>Ce. dislepis</i> Freitas & Penny
41'.	Gonarcus hood evenly rounded distally; surface between T9+ectoproct and S8+9 with a conspicuous field of scales	42
42 (41').	T9+ectoproct rounded posteroventrally, with dorsal apodeme having very small or no ventral spur; gonapsis as long as S8+9, with apex flattened, margin spinose	<i>Ce. everes</i> (Banks)*
42'.	T9+ectoproct not rounded posteroventrally, with dorsal apodeme having a distinct ventral spur; gonapsis not as above	43
43 (42').	Dorsal apodeme of T9+ectoproct with ventral spur somewhat hook-shaped; gonapsis about length of S8+9, with lateral arms basally	<i>Ce. squama</i> Freitas & Penny
43'.	Dorsal apodeme of T9+ectoproct with ventral spur straight basally, bent at ~90 distally; gonapsis about length of S8+9, with rounded base bearing two acute projections	<i>Ce. melanopareia</i> Sosa & Freitas
44 (40').	Mesoscutum with pair of dark spots at suture with prescutum; S8+9 apically bifurcate; membrane below gonapsis with large gonocristae	<i>Ce. scapularis</i> (Navás)
44'.	Mesoscutum entirely pale; S8+9 undivided apically; membrane below gonapsis without gonocristae	45
45 (44').	Gonarcus with lateral apodemes long, three times as long as wide	<i>Ce. divaricata</i> Freitas & Penny
45'.	Gonarcus with lateral apodemes short, not longer than wide	46
46 (45').	Gonarcus lateral projection longer than gonocornua; gonocornua widely separated at base	<i>Ce. belizensis</i> Freitas & Penny
46'.	Gonarcus lateral projection shorter than gonocornua; gonocornua divergent from narrow base	<i>Ce. lineaticornis</i> (Fitch)
47 (12).	Basal segments of flagellum dark brown to black; gonapsis heavily bifurcate basally	<i>Ce. montoyana</i> (Navás)
47'.	Flagellum pale throughout; gonapsis with short digitiform processes basally	48
48 (47').	Pronotum with lateral stripes interrupted; mediuncus triangular, lacking lateral lobes apically	<i>Ce. pittieri</i> Sosa & Freitas
48'.	Pronotum with lateral stripes uninterrupted; mediuncus square-shaped, bearing lateral lobes apically	49
49 (48').	Tip of S8+9 deeply cleft, strongly recurved	<i>Ce. arioles</i> (Banks)
49'.	Tip of S8+9 not cleft nor recurved	50
50 (49').	Head yellow, scape with red stripes not reaching the toruli; S8+9 with dorsal margin sinuous, lightly tapering apically	<i>Ce. cincta</i> (Schneider) (Venezuelan population)*
50'.	Head whitish, scape with red stripes reaching the toruli; S8+9 with dorsal margin bearing a subapical protuberance	<i>Ce. cincta</i> (Schneider) (Florida population)*

### Footnotes to the Key

\***Couplet 8** (*Ce. elegans*, *Ce. nigripedis*, and *Ce. tacanensis*). We regret having to key three “species together in Couplet 8. In brief, we could not identify any consistent distinguishing characteristics, and the information that is available left us unable to verify their status as separate species within a complex of cryptic species, or as simply misidentified. By way of background, few specimens of these species are available for study. Indeed, all three are mostly known only from their type specimens. *Ce. elegans* has been reported from Tamaulipas, Mexico, as well as Puntarenas and Cartago, Costa Rica (Penny 1998, Freitas *et al.* 2009); *Ce. nigripedis* is known from Puntarenas, Costa Rica (Penny 1997); and *Ce. tacanensis* was recently described from Chiapas, Mexico (Cancino-López & Contreras-Ramos 2019), with a fairly large number of specimens from a relatively small



geographic area. In addition, we (CAT) examined three additional male specimens [all faded or discolored; two from Panama (USNM, TAMU); one from Nicaragua (USNM); all previously identified as *Ce. elegans*].

We observed the following: First, specimens identified under these three species names exhibit similar but variable darkening of the cubital veins of the forewing, as well as in their overall thoracic color patterns. Second, all three species were described as having yellow legs with one or two apical tarsomeres dark brown; our three specimens were similar. Third, the gross features of the male genitalia of the three species are very similar. However, the finer features of the male genitalia were described and illustrated in sufficient detail for only one of the species (*Ce. tacanensis*) (Cancino-López & Contreras-Ramos 2019). Fourth, images of the *Ce. tacanensis* spermatheca and subgenitale (by Cancino-López & Contreras-Ramos 2019: figs 3F, 3G) appear quite similar to the drawings of *Ce. elegans* by Penny (1998: 61, figs 16, 17). However, the female genitalia have not been described in detail for any of the species. Finally, the only other feature proposed to distinguish one of the species (*Ce. tacanensis*) is its discontinuous prothoracic stripe, in contrast to discrete prothoracic spots reported from the other two species. Such markings tend to fade or change as specimens age or with exposure to alcohol (e.g., Tauber *et al.* 2000), and most of the specimens of the other two species are either old or appear to have been exposed to alcohol. In addition, because specimens are so few, there is no obvious pattern of color variation among the three purported species. Cancino-López & Contreras-Ramos (2019: 99) beautifully documented a significant amount of variation in prothoracic markings among specimens collected during seasonal sampling along an extensive altitudinal transect of a Bioserve in Chiapas, Mexico. These findings indicate that significant variation can occur within a regional population. Thus, the suggestion of interspecific differences in color variation remains intriguing but undocumented. Because of this dilemma, we had no choice but to key all three species at Couplet 8\*. However, given the lack of detailed comparisons among the purported species, we do not synonymize them here.

**\*Couplet 19, 50 (*Ce. cincta*, geographic populations).** *Ceraeochrysa cincta* is one of the species in this genus that is frequently discussed for use or evaluation in biological control settings. Adults have frequently been encountered in orchards, and larvae have been reported to feed on homopteran pests of citrus and other horticultural crops (Morais *et al.* 2006; Ramírez-Delgado *et al.* 2007). Some populations have also been shown to have biological features that are amenable for mass production (López-Arroyo *et al.*, 1999a, b). However, this species exhibits distinct geographic variation in both adult and larval characters, including body color, head markings, and some morphological features (Tauber *et al.* 2000; Tauber & de Leon 2001; Sosa, unpublished or personal observations; Tauber, López-Arroyo, & Albuquerque, unpublished). We (FS) have also found significant variation in the size and shape of male abdominal characters; these are currently under study.

The large amount of variation expressed by the limited populations that have been studied is suggestive of a species complex. As a result, it is very important that the systematics of this group be studied in conjunction with studies aimed at using the species in classical or augmentative biological control programs. Such studies will bring immediate benefit to both types of projects and will enhance the long-term reliability and repeatability of the findings. This warning is especially important because *Ce. cincta* females have been shown to require intermittent mating and remating to sustain oviposition (López-Arroyo *et al.* 1999a, b). It is possible that attempts to augment the effectiveness of a local *Ce. cincta* population by the release of an unusual or exotic *Ce. cincta* population could lead to a decline in the effectiveness of a local natural enemy.

**\*Couplet 36 (*Ce. achillea*, *Ce. digitata*).** We refer readers to figs 56 and 63 in Freitas (2009) for use with this couplet. However, we must point out some errors on those figures that, without correction, could lead to confusion.

(i) In fig. 56D (*Ce. achillea*), the label “dapo [= “dorsal apodeme of Freitas *et al.* 2009: 506] indicates the ventral spur of the dorsal apodeme, not the dorsal apodeme itself; the main body of the dorsal apodeme extends apically below the callus cerci.

(ii) In fig. 63E (*Ce. digitata*), the label “dapo identifies the bifurcation of the ventral spur from the dorsal apodeme; the dorsal apodeme itself continues distally.

(iii) In fig. 56F (*Ce. achillea*), the short, bifurcate structure below the gonarcus is labeled “gvp [= “gonocornua ventral projection of Freitas *et al.* 2009: 506]. On fig. 63H (*Ce. digitata*), a similarly placed but more elongate and slender structure is labeled “ent (= entoprocessus of Freitas *et al.* 2009: 506). Neither of these structures appear to be articulated and thus are not entoprocesses; neither are they gonocornua, all of which extend upward or outward from the top of the gonarcal bridge. We use the term “ventral gonarcal processes (v.p.) for such unarticulated structures that extend ventrally from the gonarcus.

**\*Couplet 42 (*Ce. everes*, males and females).** The lectotype of *Ce. everes* (MCZ) is a female from French Guiana. Adams & Penny (1985: 452) based their redescription of the species in part on this type specimen but also on additional female and male specimens from Cuba and Brazil. Freitas *et al.* (2009) in their treatment of the species refer to specimens from a wide range of localities in Cuba, French Guiana, Brazil, and Paraguay. However, subsequent to these publications, we (FS) have noted that the

males of at least three “species can be matched with Adams & Penny’s redescription of the female *Ce. everes*. Thus, at this point we caution readers (especially those considering this species for biological control projects) that specimens (males and females) keying to *Ce. everes* may be part of a larger species complex, the members of which may differ in their biological traits. This variation is in need of study, and it is critical that all studies using this “species deposit voucher specimens in a reliable museum or collection for future verification.

## Acknowledgements

FS thanks Dr. Marcio de Oliveira, Msc. Thiago Mahlmann, and Biologist Francisco F. Xavier Filho (INPA); Dr. Inocência Gorayeb and Mr. Augusto Quaresma (*in memoriam*) (MPEG); Dra. Rogéria I. R. Lara and Dr. Nelson Wanderley Perioto (LRRP); Dr. Jürg Demarmels (MIZA) for allowing access to the specimens under their care and also for providing technical assistance during his study of the material. He also thanks Msc. Marise Silva, former student of the Universidade Federal de Lavras for sending specimens from Minas Gerais for this study.

CAT thanks the following colleagues for their help gaining access to specimens in their care: N. D. Penny (CAS, deceased), G. C. Grinter (CAS); J. E. Rawlins (CMNH); C. Kondratieff (CSUFC); C. B. Barr, P. T. Oboyski (EMEC); E. González Olazo, C. Reguilón (IFML); A. Roig Alsina (MACN); P. Perkins, S. Cover, B. Farrell, C. A. Maier (MCZ); J. Legrand (MNHN); D. Goodger, S. Brooks, B. W. Price (MNHUK); O. S. Flint (USNM, deceased). She also acknowledges G. S. Albuquerque (UENF) for his cooperation in the field and A. J. Tauber for her careful editing. Finally, she remains appreciative of earlier support from the National Science Foundation, the NRI-USDA Competitive Grants Program, the National Geographic Society, Cornell University, and Regional Project W-4185 that continues to facilitate her work.

Both authors thank Caleb C. Martins, an anonymous reviewer, and the editor for their thoughtful comments and review of the manuscript.

## References

- Adams, P.A. (1982) *Ceraeochrysa*, a new genus of Chrysopinae (Neuroptera) (Studies in New World Chrysopidae, Part II). *Neuroptera International*, 2, 69–75.
- Adams, P.A. & Penny, N.D. (1985) [1987] Neuroptera of the Amazon Basin. Part 11a. Introduction and Chrysopini. *Acta Amazonica*, 15, 413–479.  
<https://doi.org/10.1590/1809-43921985153479>
- Banks, N. (1914) New American Chrysopidae. *Canadian Entomologist*, 46, 24–27.  
<https://doi.org/10.4039/Ent4624-1>
- Banks, N. (1944) Neuroptera of Northern South America. Part III. Chrysopidae. *Boletín de Entomología Venezolana*, 3, 1–34.
- Banks, N. (1945) A review of the Chrysopidae (Nothochrysidae) of Central America. *Psyche*, 52, 139–174.  
<https://doi.org/10.1155/1945/39092>
- Banks, N. (1948) Chrysopidae (Nothochrysidae) collected in Mexico by Dr. A. Dampf (Neuroptera). *Psyche*, 55, 151–177.  
<https://doi.org/10.1155/1948/36576>
- Breitkreuz, L.C.V., Winterton, S.L. & Engel, M.S. (2017) Wing tracheation in Chrysopidae and other Neuropterida (Insecta): a resolution of the confusion about vein fusion. *American Museum Novitates*, 3890, 1–4.  
<https://doi.org/10.1206/3890.1>
- Brooks, S.J. & Barnard, P.C. (1990) The green lacewings of the world: a generic review (Neuroptera: Chrysopidae). *Bulletin of the British Museum of Natural History, Entomology*, 59, 117–286.
- Cancino-López, R.J. & Contreras-Ramos, A. (2019) A new species of *Ceraeochrysa* Adams (Neuroptera, Chrysopidae), with a key to the species from Mexico. *ZooKeys*, 888, 95–104.  
<https://doi.org/10.3897/zookeys.888.39064>
- Eisner, T., Attygalle, A.B., Conner, W.E., Eisner, M., Macleod, E. & Meinwald, J. (1996) Chemical egg defense in a green lacewing (*Ceraeochrysa smithi*). *Proceedings of the National Academy of Sciences*, 93, 3280–3283.  
<https://doi.org/10.1073/pnas.93.8.3280>
- Eisner, T., Carrel, J.E., Van Tassel, E., Hoebeke E.R. & Eisner, M. (2002) Construction of a defensive trash packet from sycamore leaf trichomes by a chrysopid larva (Neuroptera: Chrysopidae). *Proceeding of Entomological Society of Washington*, 104, 437–446.
- Freitas, S. & Penny, N.D. (2001) The green lacewings (Neuroptera: Chrysopidae) of Brazilian agro-ecosystems. *Proceedings of the California Academy of Sciences*, 52, 245–395.
- Freitas, S., Penny, N.D. & Adams, P.A. (2009) A revision of the New World genus *Ceraeochrysa* (Neuroptera: Chrysopidae).

- Proceedings of the California Academy of Sciences*, 60, 503–610.
- Gomes, J.I., Martins, M.B., Silva, R.C.V.M. & Almeida, S.S. (2007) *Mocambo—Diversidade e dinâmica biológica da Área de Pesquisa Ecológica do Guam (APEG)*. EMBRAPA, Brasília, D.F., 554 pp.
- Legrand, J., Tauber, C.A., Albuquerque, G.S. & Tauber, M.J. (2008) Navás' type and non-type specimens of Chrysopidae in the MNHN, Paris [Neuroptera]. *Revue Française d'Entomologie*, New Series, 30, 103–183.
- López-Arroyo, J.I., Tauber, C.A. & Tauber, M.J. (1999a) Comparative life histories of the predators *Ceraeochrysa cincta*, *C. cubana*, and *C. smithi* (Neuroptera: Chrysopidae). *Annals of the Entomological Society of America*, 92, 587–593.  
<https://doi.org/10.1093/aesa/92.4.587>
- López-Arroyo, J.I., Tauber, C.A. & Tauber, M.J. (1999b) Intermittent oviposition and remating in *Ceraeochrysa cincta* (Neuroptera: Chrysopidae). *Annals of the Entomological Society of America*, 92, 587–593.  
<https://doi.org/10.1093/aesa/92.4.587>
- Morais, R.M., Barcellos, A. & Redaelli, L.R. (2006) Insetos predadores em copas de *Citrus deliciosa* (Rutaceae) sob manejo orgânico no sul do Brasil. *Iheringia, Série Zoológica*, 96, 419–424.  
<https://doi.org/10.1590/S0073-47212006000400005>
- Navás, L. (1910) Crisópidos nuevos ó poco conocidos [I?]. *Revista de la Real Academia de Ciencias Exactas Físicas y Naturales de Madrid*, 9, 473–480.
- Navás, L. (1913) Crisópidos sudamericanos. *Brotéria (Zoológica)*, 11, 73–104 + 149–168
- Navás, L. (1914) Les Chrysopides (Ins. Névr.) du Musée de Londres [Ib]. *Annales de la Société scientifique de Bruxelles*, 38, 73–114.
- Navás, L. (1916) Neurópteros Sudamericanos. Tercera [III] serie. Neurópteros del Brasil recogidos por el R. P. Joaquín da Silva Tavares S. J. *Brotéria, Zoológica*, 14, 14–35.
- Navás, L. (1919) Algunos insectos Neurópteros de la República Argentina. Serie tercera [III]. *Revista de la Real Academia de Ciencias Exactas Físicas y Naturales de Madrid*, 17, 287–305.
- Navás, L. (1923) [1924] Crisópidos (Ins. Neur.) neotrópicos [I]. *Revista Chilena de Historia Natural*, 27, 110–116.
- Oswald, J.D. Bibliography of the Neuropterida. Available from: <https://lacewing.tamu.edu/Biblio/Main>. (accessed 30 September 2020)
- Penny, N.D. (1977) Lista de Megaloptera, Neuroptera e Raphidioptera do México, América Central, ilhas Caraíbas e América do Sul. *Acta Amazonica*, 7, (Suplemento), 1–61.  
<https://doi.org/10.1590/1809-43921977074s005>
- Penny, N.D. (1997) Four new species of Costa Rican *Ceraeochrysa* (Neuroptera: Chrysopidae). *Pan-Pacific Entomologist*, 73, 61–69.
- Penny, N.D. (1998) New Chrysopinae from Costa Rica (Neuroptera: Chrysopidae). *Journal of Neuropterology*, 1, 55–78.
- Penny, N.D. (2002) Family Chrysopidae. In: A guide to the lacewings (Neuroptera) of Costa Rica. *Proceedings of the California Academy of Sciences*, 53, 187–227 + 301–373.
- Rafael, J.A. & Gorayeb, I.S. (1982) Tabanidae (Diptera) da Amazônia, I. Uma nova armadilha suspensa e primeiros registros de mutucas de copas de árvores. *Acta Amazonica*, 12, 332–336.  
<https://doi.org/10.1590/1809-43921982121232>
- Ramírez-Delgado, M., López-Arroyo, J.I., González-Hernández, A., & Badii-Zabeh, M.H. (2007) Rasgos biológicos y poblacionales del depredador *Ceraeochrysa* sp. nr. *cincta* (México) (Neuroptera: Chrysopidae). *Acta Zoológica Mexicana*, 23, 79–95.  
<https://doi.org/10.21829/azm.2007.233587>
- Silva, P.S., Tauber, C.A., Albuquerque, G.S., & Tauber, M.J. (2013) Larvae of five horticulturally important species of *Chrysopodes* (Neuroptera, Chrysopidae): shared generic features, descriptions and keys. *ZooKeys*, 262, 39–92.  
<https://doi.org/10.3897/zookeys.262.4119>
- Sosa, F. & Freitas, S. (2010) New Neotropical species of *Ceraeochrysa* Adams (Neuroptera: Chrysopidae). *Zootaxa*, 2562 (1), 57–65.  
<https://doi.org/10.11646/zootaxa.2562.1.4>
- Sosa, F. & Freitas, S. (2011) A new synonym, a new male description and new geographical records for three *Ceraeochrysa* species (Neuroptera: Chrysopidae). *Zootaxa*, 2913 (1), 47–58.  
<https://doi.org/10.11646/zootaxa.2913.1.5>
- Sosa, F. & Freitas, S. (2012) A new genus of Neotropical Chrysopini (Neuroptera: Chrysopidae). *Zootaxa*, 3351 (1), 1–14.  
<https://doi.org/10.11646/zootaxa.3351.1.1>
- Tauber, C.A. (2010) Revision of *Neosuarius*, a subgenus of *Chrysopodes* (Neuroptera, Chrysopidae). *ZooKeys*, 44, 1–104.  
<https://doi.org/10.3897/zookeys.44.387>
- Tauber, C.A. (2017) Notes on two green lacewing (Neuroptera: Chrysopidae) types in the Hope Collections, Oxford University Museum of Natural History. *Entomologist's Monthly Magazine*, 153, 81–88.
- Tauber, C.A. (2019) South American Nothochrysinæ: I. Description of *Nothochrysa ehrenbergi* n. sp. (Neuroptera: Chrysopidae). *ZooKeys*, 866, 1–18. [<https://zookeys.pensoft.net/article/35394/>]  
<https://doi.org/10.3897/zookeys.866.35394>
- Tauber, C.A. & Flint, O. (2010) Resolution of some taxonomic and nomenclatural issues in a recent revision of *Ceraeochrysa* (Neuroptera: Chrysopidae). *Zootaxa*, 2565 (1), 55–67.

- <https://doi.org/10.11646/zootaxa.2565.1.4>
- Tauber, C.A. & Garland, A. (2014) *Kymachrysa*, a new genus of Nearctic green lacewings (Neuroptera, Chrysopidae, Chrysopini). *ZooKeys*, 437, 87–108.  
<https://doi.org/10.3897/zookeys.437.7984>
- Tauber, C.A. & de Leon T. (2001) Systematics of green lacewings (Neuroptera: Chrysopidae): Larvae of *Ceraeochrysa* from Mexico. *Entomological Society of America*, 94, 197–209.  
[https://doi.org/10.1603/0013-8746\(2001\)094\[0197:SOGLNC\]2.0.CO;2](https://doi.org/10.1603/0013-8746(2001)094[0197:SOGLNC]2.0.CO;2)
- Tauber, C.A. & Pantaleoni, R.A. (2018) Type specimens of Neotropical Chrysopidae (Neuroptera) in Italian museums, *Tropical Zoology*, 31 (4), 177–199.  
<https://doi.org/10.1080/03946975.2018.1493169>
- Tauber, C.A., de Leon, T., Penny, N.D. & Tauber, M.J. (2000) The Genus *Ceraeochrysa* (Neuroptera: Chrysopidae) of America North of Mexico: larvae, adults, and comparative biology. *Annals of the Entomological Society of America*, 93, 1195–1221.  
[https://doi.org/10.1603/0013-8746\(2000\)093\[1195:TGCNCO\]2.0.CO;2](https://doi.org/10.1603/0013-8746(2000)093[1195:TGCNCO]2.0.CO;2)
- Tauber, C.A., Albuquerque, G.S. & Tauber, M.J. (2012) Three new Brazilian species of *Chrysopodes* (Neuroptera: Chrysopidae). *Entomological Society of America*, 105, 638–663.  
<https://doi.org/10.1603/AN12028>
- Tauber, C.A., Tauber, M.J. & Albuquerque, G.S. (2014) Forum: Debris-carrying in larval Chrysopidae: unraveling its evolutionary history. *Entomological Society of America*, 107, 295–314.  
<https://doi.org/10.1603/AN13163>
- Tauber, C.A., Legrand, J., Tauber, A. & Tauber, M.J. (2017) An annotated catalog of the Lacroix types of Neuropterida, with emphasis on Chrysopidae. *Entomologica Americana*, 123, 9–28.  
<https://doi.org/10.1664/1947-5144-123.1-4.9>
- Tauber, C.A., Simmons, Z. & Tauber, A.J. (2019) Type specimens of Neuropterida in the Hope Entomological Collection, Oxford University Museum of Natural History, *ZooKeys*, 823, 1–126.  
<https://doi.org/10.3897/zookeys.823.30231>
- Tillyard, R.J. (1916) Studies in Australian Neuroptera. No. 3. The wing-venation of the Chrysopidae. *Proceedings of the Linnean Society of New South Wales*, 41, 221–248.  
<https://doi.org/10.5962/bhl.part.15306>
- Tjeder, B. (1954) Genital structures and terminology in the order Neuroptera. *Entomologiske Meddelelser*, 27, 23–40.
- Tjeder, B. (1966) Neuroptera-Planipennia. The Lace-wings of Southern Africa. 5. Family Chrysopidae. In: Hanström, B., Brinck, P. & Rudebec, G. (Eds.), *South African Animal Life. Vol. 12*. Swedish Natural Science Research Council, Stockholm, pp. 228–534.
- Viana, G. & Albuquerque, G.S. (2009) Polimorfismo no padrão de manchas tegumentares de larvas e adultos de *Ceraeochrysa caligata* (Neuroptera: Chrysopidae) e redescricao dos instares larvais. *Zoologia*, 26, 166–174.  
<https://doi.org/10.1590/S1984-46702009000100023>
- Wheeler, A.G. & Stocks, I.C. (2019) *Ceraeochrysa lineaticornis* (Fitch) (Neuroptera: Chrysopidae): Larval plant associations and construction of debris packets from wax of planthoppers (Hemiptera: Flatidae). *Proceedings of the Entomological Society of Washington*, 121, 299–310.  
<https://doi.org/10.4289/0013-8797.121.2.299>